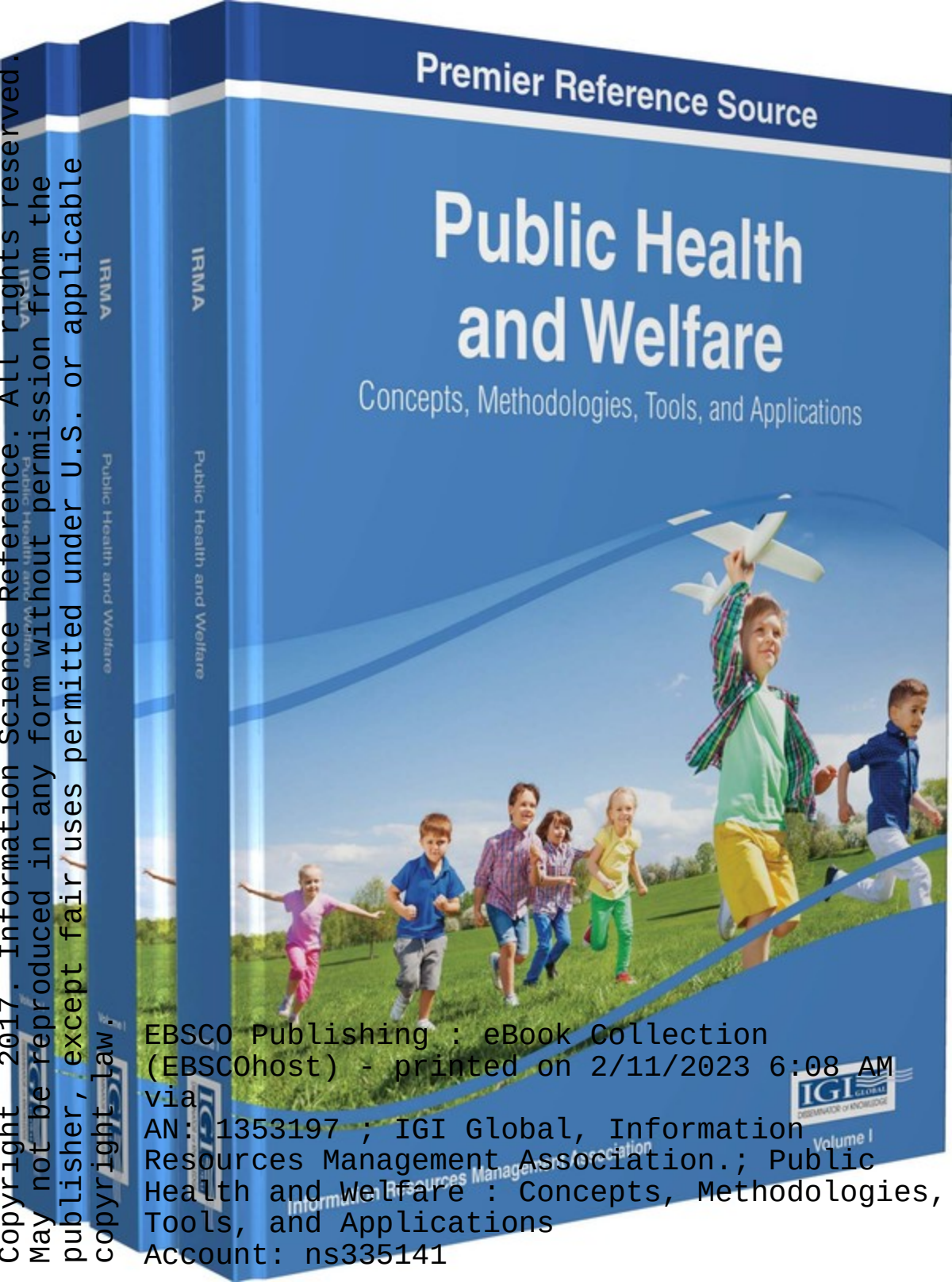

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Fundamental Concepts and Theories

This section serves as a foundation for this exhaustive reference tool by addressing underlying principles and provides in-depth coverage of conceptual architecture frameworks essential to the understanding of Public Health and Welfare. Chapters found within these pages provide an excellent framework in which to position Public Health and Welfare within the field of information science and technology. Insight regarding the critical incorporation of global measures into Public Health and Welfare is addressed, and examinations to specific discussions on methodology. With 13 chapters comprising this foundational section, the reader can learn and chose from a compendium of expert research on the elemental theories underscoring the Public Health and Welfare discipline.

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Tools and Technologies

This section presents an extensive coverage of various tools and technologies available in the field of Public Health and Welfare that practitioners and academicians alike can utilize to develop different techniques. These chapters enlighten readers about fundamental research on the many tools facilitating the burgeoning field of Public Health and Welfare. It is through these rigorously researched chapters that the reader is provided with countless examples of the up-and-coming tools and technologies emerging from the field of Public Health and Welfare. With 13 chapters, this section offers a broad treatment of some of the many tools and technologies within the Public Health and Welfare field.

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This section discusses a variety of applications and opportunities available that can be considered by practitioners in developing viable and effective Public Health and Welfare programs and processes. This section includes 12 chapters that review topics from case studies to best practices and ongoing research. Further chapters discuss Public Health and Welfare in a variety of settings. Contributions included in this section provide excellent coverage of today's IT community and how research into Public Health and Welfare is impacting the social fabric of our present-day global village.

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Preface

The constantly changing landscape of Public Health and Welfare makes it challenging for experts and practitioners to stay informed of the field's most up-to-date research. That is why Information Science Reference is pleased to offer this three-volume reference collection that will empower students, researchers, and academicians with a strong understanding of critical issues within Public Health and Welfare by providing both broad and detailed perspectives on cutting-edge theories and developments. This reference is designed to act as a single reference source on conceptual, methodological, technical, and managerial issues, as well as provide insight into emerging trends and future opportunities within the discipline.

Public Health and Welfare: Concepts, Methodologies, Tools and Applications is organized into six distinct sections that provide comprehensive coverage of important topics. The sections are:

1. Fundamental Concepts and Theories;
2. Tools and Technologies;
3. Utilization and Applications;
4. Organizational and Social Implications;
5. Critical Issues and Challenges; and
6. Emerging Trends.

The following paragraphs provide a summary of what to expect from this invaluable reference tool.

Section 1, "Fundamental Concepts and Theories," serves as a foundation for this extensive reference tool by addressing crucial theories essential to the understanding of Public Health and Welfare. Introducing the book is *The Fundamentals of Health Literacy* by Kijpokin Kasemsap; a great foundation laying the groundwork for the basic concepts and theories that will be discussed throughout the rest of the book. The section also presents in-depth coverage of the conceptual design and architecture of Public Health and Welfare. Section 1 concludes, and leads into the following portion of the book with a nice segue chapter, *Accountability and Public Reporting: Publication of Performance to Improve Quality* by Maria Tanzariello, Sabina Bucci, Walter Ricciardi, and Antonio Giulio de Belvis.

Section 2, "Tools and Technologies," presents extensive coverage of the various tools and technologies used in the implementation of Public Health and Welfare. Section 3 begins where Section 2 left off, though this section describes more concrete tools at place in the modeling, planning, and applications of Public Health and Welfare. The first chapter, *The Role of Management Accounting Systems in Public Hospitals and the Construction of Budgets: A Literature Review* by Carla Marina Pereira de Campos, Lúcia Lima Rodrigues, and Susana Margarida Faustino Jorge, lays a framework for the types of works that

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can be found in this section. The section concludes with *Identification of Associations between Clinical Signs and Hosts to Monitor the Web for Detection of Animal Disease Outbreaks* by Elena Arsevska *et al*. Where Section 2 described specific tools and technologies at the disposal of practitioners, Section 3 describes the use and applications of the tools and frameworks discussed in previous sections.

Section 3, "Utilization and Applications," describes how the broad range of Public Health and Welfare efforts has been utilized and offers insight on and important lessons for their applications and impact. The first chapter in the section is titled *An Investigation of the Application of New Media and Its Impact on Taiwan Health Communication* written by Rose Hung, Pi-Fang Hsu, and Chia-Wen Tsai. This section includes the widest range of topics because it describes case studies, research, methodologies, frameworks, architectures, theory, analysis, and guides for implementation. The breadth of topics covered in the chapter is also reflected in the diversity of its authors, from countries all over the globe. The section concludes with *A Study on Adoption of Employee Welfare Schemes in Industrial and Service Organisations: In Contrast with Public and Private Sectors* by Chandra Sekhar Patro, a great transition chapter into the next section.

Section 4, "Organizational and Social Implications," includes chapters discussing the organizational and social impact of Public Health and Welfare. The section opens with *Fostering Global Citizenship in Higher Education: Development of an International Course in Global Health* by Lee Stoner *et al*. This section focuses exclusively on how these technologies affect human lives, either through the way they interact with each other, or through how they affect behavioral/workplace situations. It also presents focused coverage of Public Health and Welfare in a managerial perspective. This section serves as a vital resource for developers who want to utilize the latest research to bolster the capabilities and functionalities of their processes. The section concludes with *When the System Fails: Challenges of Child Trauma on Adoptive Families' Social and Emotional System* by Jacqueline Y. Ford.

Section 5, "Critical Issues and Challenges," presents coverage of academic and research perspectives on Public Health and Welfare tools and applications. The section begins with *The Crisis of Public Health as a Media Event: Between Media Frames and Public Assessments* by Valentina Marinescu. Chapters in this section will look into theoretical approaches and offer alternatives to crucial questions on the subject of Public Health and Welfare. The section concludes with *Toward an Informed-Patient Approach to E-Health Services* by Keren Mazuz, Seema Biswas, and Rui Amaral Mendes.

Section 6, "Emerging Trends," highlights areas for future research within the field of Public Health and Welfare, opening with *Health Policy Implementation: Moving Beyond Its Barriers in United States* by Khadijeh Rouzbehani. This section contains chapters that look at what might happen in the coming years that can extend the already staggering amount of applications for Public Health and Welfare. The final chapter of the book looks at an emerging field within Public Health and Welfare, in the excellent contribution, *The Future of Healthcare: Political Participation of Nursing and Public Health Students* by Christine Vandenhouten *et al*.

Although the primary organization of the contents in this multi-volume work is based on its six sections, offering a progression of coverage of the important concepts, methodologies, technologies, applications, social issues, and emerging trends, the reader can also identify specific contents by utilizing the extensive indexing system listed at the end of each volume. As a comprehensive collection of research on the latest findings related to using technology to providing various services, *Public Health and Welfare: Concepts, Methodologies, Tools and Applications*, provides researchers, administrators

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and all audiences with a complete understanding of the development of applications and concepts in Public Health and Welfare. Given the vast number of issues concerning usage, failure, success, policies, strategies, and applications of Public Health and Welfare in countries around the world, *Public Health and Welfare: Concepts, Methodologies, Tools and Applications* addresses the demand for a resource that encompasses the most pertinent research in technologies being employed to globally bolster the knowledge and applications of Public Health and Welfare.

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Section 1

Fundamental Concepts and Theories

This section serves as a foundation for this exhaustive reference tool by addressing underlying principles and provides in-depth coverage of conceptual architecture frameworks essential to the understanding of Public Health and Welfare. Chapters found within these pages provide an excellent framework in which to position Public Health and Welfare within the field of information science and technology. Insight regarding the critical incorporation of global measures into Public Health and Welfare is addressed, and examinations to specific discussions on methodology. With 13 chapters comprising this foundational section, the reader can learn and chose from a compendium of expert research on the elemental theories underscoring the Public Health and Welfare discipline.

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Chapter 1
The Fundamentals of Health Literacy

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ABSTRACT

This chapter describes the overview of health literacy; the characteristics of functional health literacy, interactive health literacy, and critical health literacy; and the significance of health literacy in global health care. Health literacy is about how patients understand health information about health and health care, and how they apply that health information to their daily lives, utilize it to make health-related decisions, and act on it. Being able to understand health information and make decisions from that information is vital to patients' well-being. Health literacy can help patients prevent their health problems and protect their health, as well as better manage those problems and unexpected situations that happen. Patients with good health literacy make effective health decisions because they can find, understand, and evaluate the health information in global health care.

INTRODUCTION

Health literacy is established as a central concept in health communication and education (Dubowicz & Schulz, 2013). The concept of health literacy includes not only the ability of individuals to read and understand health care information, but also the ability to function within the health care system (Torres & Nichols, 2014). Health literacy is the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make health decisions (Berkman, Davis, & McCormack, 2010). Health literacy comprises skills in obtaining, understanding, and acting on information about health issues in ways that promote and maintain health (Mårtensson & Hensing, 2012).

Health literacy is the mechanism by which individuals obtain and utilize health information to make health decisions about individual treatments in the home, access care in the community, promote patient-health care provider interactions, structure self-care, and navigate health care programs both locally and nationally (Westlake, Sethares, & Davidson, 2013). Distributed health literacy is a potential resource for managing individual's health, thus communicating with health professionals and making health deci-

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sions (Edwards, Wood, Davies, & Edwards, 2015). Low health literacy is a burden to individuals and to health care-related society (Carollo, 2015).

Health information is created, updated, and exchanged by people, and electronic communication networks can distribute the health information to provide easy access to users (Yim, Khuntia, & Argyris, 2015). Health literacy provides the skills to effectively utilize the health information (Londono & Schulz, 2015). The effectiveness of health information largely depends on people's ability to understand and utilize information (Meppelink & Bol, 2015). Providing explicit health information to people with limited health literacy is necessary to reduce these health-related difficulties (Meppelink & Bol, 2015).

This chapter aims to bridge the gap in the literature on the thorough literature consolidation of health literacy. The extensive literature of health literacy provides a contribution to practitioners and researchers by describing theory and applications of health literacy in order to promote the health care literacy in global health care.

BACKGROUND

The term literacy is globally used and it is often used to separate a technical understanding of reading and writing on one hand, and a wider understanding of communication on the other hand (Lundvall, 2015). Health literacy has been prioritized in public health and rigorously studied since the 1990s (Leung, Cheung, & Chi, 2015). Public health is concerned with protecting the health of populations which can be as small as a local neighborhood or as large as an entire country (Raghupathi & Raghupathi, 2013). Early research on health literacy focused on health outcomes among individuals with low health literacy (Leung et al., 2015). As health care moves toward greater choice, with shared responsibility and decision making between doctors and patients, a wide variety of resources and skills are needed by individuals if they are to be active participants in their health (Manning & Dickens, 2006).

Early definitions focused on the ability to apply reading, writing, and numeracy skills to the health-related materials, such as prescriptions, appointment cards, and medicine labels (Parker, Baker, Williams, & Nurss, 1995), while later conceptualizations encompassed a range of skills, including social and communication skills that enable people to obtain, understand, and use the health information in ways that enhance health, well-being, and engagement in the medical decision making (Nutbeam, 2000). Health literacy has been conceptualized in various ways (Nielsen-Bohlman, Panzer, & Kindig, 2004), and its scope have been widened during the last decade (Estacio, 2013). Health literacy has become a topic of significant interest among health and medical researchers during the past two decades, particularly in regard to its explanatory role in health disparities (Reeve & Basalik, 2014).

Health illiteracy is a societal issue that, if successfully addressed, may help reduce health disparities (Brown, Teufel, & Birch, 2007). Health literacy, or the degree to which individuals have the capacity to obtain, communicate, process, and understand basic health information and services needed to make suitable health decisions, is an important predictor of health outcomes (Kaphingst, Goodman, MacMillan, Carpenter, & Griffey, 2014). Inadequate health literacy has been linked to increased health disparities, unsuccessful self-care, poor health outcomes, poor use of health care services, and among elderly persons, poor overall health status, and high mortality rates (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011).

Health literacy is recognized as an essential factor in optimizing health (Carollo, 2015). Malloy-Weir et al. (2015) indicated that ethical arguments for enabling people to participate in decision making

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about their treatment are widely accepted. More recent definitions of health literacy include the ability to apply these skills in various settings and across the life span (Rootman & Gordon-El-Bihbety, 2008). Lower educational attainment is associated with suboptimal health literacy (Sentell, Braun, Davis, & Davis, 2013); however, those who have higher educational attainment may still have low health literacy (Institute of Medicine, 2004). Limited health literacy has been linked with higher incidence of chronic illness, poorer self-reported health, lower utilization of preventive health services, higher rates of hospitalization, and higher health care costs (Weiss & Palmer, 2004).

PERSPECTIVES ON HEALTH LITERACY IN GLOBAL HEALTH CARE

This section explains the overview of health literacy; the characteristics of functional health literacy, interactive health literacy, and critical health literacy; and the significance of health literacy in global health care.

Overview of Health Literacy

Health care is experiencing an exponential growth in the scientific understanding of diagnostic, diseases, and care pathways (Akaichi & Mhadhbi, 2016). Over the last decades, health care policies in many countries have shifted from a supply to a demand or consumer driven organization of health care services (Rademakers, Nijman, Brabers, de Jong, & Hendriks, 2014). Health care sector is a growing field and health conscience has been a major concern for everyone (Sankaranarayanan & Ganesan, 2016). Advances in medical technologies and medical services require adequate health literacy from patients in order to improve quality of life (Tung et al., 2014). Health information should be accessible everywhere and at any time to help with clinical decision and be available for clinical studies (Peixoto, Domingues, & Fernandes, 2016).

Health literacy has been conceptualized to explain how health information facilitates the maintenance of health (Freeman, 2015) regarding medical and public health contexts (Nutbeam, 2000). Knowledge-intensive industries regularly seek to improve positive relationships between forms of human capital and modes of competency (Kasemsap, 2016a). Health literacy is the range of skills and competencies that people develop to seek out, comprehend, evaluate, and utilize health information and concepts to make informed choices, reduce health risks, and increase quality of life (Nielsen-Bohlman et al., 2004). Both providing patients with health information and involving them in health decisions are the major components of patient-centered health care (Coulter, 2002). Active involvement in modern health care is unlikely to be achieved if patients have suboptimal health literacy (Jordan et al., 2013). Research linking health literacy to health knowledge, health behaviors, health outcomes, health disparity, and health status is prevalent across the globe (Mancuso, 2009).

Appropriate health information provision regarding diagnosis, treatment, long-term effects, and health care services can result in informed decision making, improved treatment adherence, lower levels of distress, and higher satisfaction with care (Mallinger, Griggs, & Shields, 2005). There is a growing recognition that inadequate health literacy contributes to health inequalities as it is more prevalent among lower socioeconomic groups, ethnic minorities, the elderly and those with long-term conditions or disabilities (Sihota & Lennard, 2004). Health literacy researches among adolescents are the developing fields and have established the independent associations among lower health literacy levels, poorer

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understanding of preventive care information, among limited access to preventive care services (Shone, King, Doane, Wilson, & Wolf, 2011).

To become health literate, individuals need to mobilize their family, school, social, cultural, and professional assets, gathered over time through contact with knowledge, attitudes, and health behaviors (Zanchetta, Perreault, Kaszap, & Viens, 2007). Therefore, individuals need to be skilled in interpreting the health-related world, accessing knowledge (Barton & Hamilton, 1999), and communicating health messages (Institute of Medicine of the National Academies, 2004). It has a strong influence on communication in medical settings and consequences for the patients' health outcomes (Andrus & Roth, 2002). The necessity of the concept of health literacy as a link between communication and better health outcomes is demonstrated in the fact that low health literacy levels are a better predictor of an individual's health than the classical socio-demographic variables of age, income education, employment status, and race.

Many studies about health literacy measures (Ishikawa, Takeuchi, & Yano, 2008) focus on evaluating health information-related reading, comprehension, and numeracy skills (Jordan, Osborne, & Buchbinder, 2011). There is a growing consensus that health literacy encompasses a broader range of attributes other than only literacy skills, such as abilities to interact within broader social and environmental contexts (Lee, Arozullah, & Cho, 2004). Results from the available health literacy measures have shown that people with suboptimal health literacy have difficulty understanding health information (Schillinger, Bindman, Wang, Stewart, & Piette, 2004), poorer knowledge of their condition (Gazmararian, Williams, Peel, & Baker, 2003), and lower utilization of preventive health services (Guerra, Krumholz, & Shea, 2005).

Measuring health literacy is likely to be a particular challenge as it is an emerging and evolving construct (Nutbeam, 2008). Assessment of health literacy has yet to become the clearly established aspect of clinical practice or population-level health needs assessment (Chinn & McCarthy, 2013). A comprehensive model of health literacy was proposed by Schulz and Nakamoto (Rubinelli, Schulz, & Nakamoto, 2009). To emphasize the patient centeredness and component of health literacy concept, Schulz and Nakamoto added judgment skills to the concept, retaining the other components of functional health literacy, declarative knowledge, and procedural knowledge (Schulz & Nakamoto, 2013). Attention to judgment skills is driven by the idea that a patient, in new situations regarding the disease, needs to make autonomous decisions based on knowledge, personal competence, and practical intelligence in general (Dubowicz & Schulz, 2013).

Training in clear health communication improves resident knowledge, attitudes, and skills regarding health literacy (Green, Gonzaga, Cohen, & Spagnoletti, 2014). Researchers investigated how health literacy related to the individual's knowledge and motivation (Paasche-Orlow & Wolf, 2007) and whether health literacy is viewed as a set of health care skills as proposed by the Institute of Medicine (Nielsen-Bohlman et al., 2004). Tsai et al. (2014) indicated that health-related programs that are literacy sensitive and culturally appropriate are needed to teach and encourage individual's health-promoting behaviors. Knowledge and motivation are recognized as the important factors contributing to the development of health literacy (Leung et al., 2015).

The widespread low health literacy affects health and health service delivery (Canadian Council on Learning, 2008). For these reasons, health literacy needs to be extensively introduced and further developed in nursing education curricula (Zanchetta et al., 2013). Regarding nursing education, analyzing students' performance and self-criticism of their roles in promoting health literacy can inform nursing education in a social environment that expects new graduates to be health promoters (Zanchetta et al., 2013). Nurses play a key role in providing health care information to individuals in a wide variety of

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health care settings; therefore, it is crucial that nurses are prepared to experience the challenges of working with patients who may have the limited literacy skills (Torres & Nichols, 2014).

The concept of health literacy is widely utilized for measuring the patients' abilities to obtain, process, and communicate information about their health condition, and lately major work in defining and theory-building has been done (Speros, 2005). Patient teaching and engagement are core nursing responsibilities (Sofaer & Schumann, 2013). However, if patients do not understand what nurses have taught them, effective communication has not taken place (Parker & Gazmararian, 2003). The socio-epidemiological relevance of health literacy as a social determinant of health (Raphael, 2009) requires nurses to update their professional knowledge, innovate within their scope of practice and generate new knowledge in the area of promotion of health literacy (Rootman, 2004). Nurses are in the privileged position of being able follow up clients' learning related to health literacy (Zanchetta et al., 2007).

The average American adult reads at the 8th grade level while most written health information materials, including medication guides, are written at the 12th grade level (Chen, Noureldin, & Plake, 2013). To assist students with health literacy-sensitive communication, pharmacy schools should incorporate educational activities addressing health literacy competencies (Chen et al., 2013). Despite the opportunity for pharmacists to reduce the health literacy demands placed on patients, there are many obstacles to making such improvements in retail pharmacies, such as the hectic pace of pharmacies, high prescription volumes, low profit margins limiting pharmacy resources for the improvement activities, a workflow designed to dispense medications, and physical layouts limiting communication between pharmacists and patients (Shoemaker, Staub-DeLong, Wasserman, & Spranca, 2013).

Limited health literacy is associated with increased use of emergency care services, elevated risks for several chronic diseases and overall mortality, and poorer utilization of preventive health services, such as cancer screening (Bennett, Chen, Soroui, & White, 2009). Factors contributing to the decrease in cancer mortality rates include increases in cancer screening rates, appropriate abnormal screening test follow-up, and treatment advances (Oldach & Katz, 2014). Regarding health literacy, the provision of appropriate information is one of the most important aspects of the support for cancer survivors (Verkissen et al., 2014). Limited health literacy skills may explain the overall low uptake of screening and social inequalities in screening, and they may inhibit the individuals' capacity to understand, and subsequently engage with the written screening information (von Wagner, Semmler, Good, & Wardle, 2009).

Characteristics of Functional Health Literacy, Interactive Health Literacy, and Critical Health Literacy

Nutbeam (2000) emphasized the significance of obtaining health literacy at the functional, interactive, and critical levels. Functional health literacy is concerned with the use of general literacy skills (e.g., reading and writing) to clearly understand the basic health messages (Velardo, 2015). Toci et al. (2014) indicate that functional health literacy is related to individual characteristics, ill health, and disease knowledge. Functional health literacy has been shown to be linked with the demographic and socioeconomic characteristics of individuals (von Wagner, Knight, Steptoe, & Wardle, 2007).

Many studies have reported the significant associations of functional health literacy with age (Jovic-Vranes, Bjegovic-Mikanovic, & Marinkovic, 2009), education (Artinian, Lange, Templin, Stallwood, & Hermann, 2003), and income (von Wagner et al., 2007). The limited or marginal functional health literacy has been linked with worse or less favorable health outcomes or disease knowledge (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Nakagami et al. (2014) stated that both inadequate and

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marginal functional health literacy are associated with older age, lower income, lower educational attainment, and poor health knowledge. People with limited functional health literacy are significantly less likely to perceive the lifestyle factors as cancer risks (Adams et al., 2013).

Interactive health literacy focuses on the ability to understand and utilize the information for prevention and self-management. The terms interactive health literacy and communicative health literacy have both been used in literature to refer to the skills that can be used to actively participate in everyday situations, extract health information, and derive meaning from the different patterns of health communication, and apply this perspective to the changing health care circumstances (Chinn, 2011). The increasing amounts of attention are being paid to the interactive and critical health literacy (Sykes, Wills, Rowlands, & Popple, 2013). van der Heide et al. (2015) indicated that interactive health literacy is associated with patients' perceived ability to organize care, interact with the health care providers and perform self-care, whereas only functional health literacy is associated with a number of general practitioner visits.

Most studies on health literacy have focused on functional health literacy, which reflects the basic skills in reading and writing (Chinn, 2011). Age has been found to be a significant inverse predictor of health literacy, both in general populations (Paasche-Orlow, Parker, Gazmararian, Nielsen-Bohlman, & Rudd, 2005) and among older individuals (Benson & Forman, 2002). Regarding cognitive ability perspectives, individuals with inadequate health literacy have lower verbal ability for oral expression and verbal communication; lower mental processing ability for speed and efficiency of thought, comprehension of text and numerical information; poorer memory ability for recalling spoken instructions; lower perceptual speed ability for performance of electronic health searches; and poorer executive function ability for critical thinking, weighing options, and making decisions and inferences (Wilson & Wolf, 2009).

Reading and numeracy are recognized as the fundamental cognitive abilities necessary for navigating and understanding the health care system (Wolf et al., 2009). Because poor cognitive function may undermine health literacy, efforts to target older adults on improving health literacy should consider cognitive function as a risk factor (Nguyen et al., 2013). Overall cognitive ability and education are positively related to health literacy (Yost, DeWalt, Lindquist, & Hahn, 2013). Cognitive status has been shown to be a significant predictor of health literacy among older adults (Federman, Sano, Wolf, Siu, & Halm, 2009).

Critical literacy refers to more advanced cognitive skills that allow individuals to extract information, derive meaning from the different patterns of communication, and utilize this information (Nutbeam, 2000). Critical health literacy is the cognitive and social skills needed to critically assess the applicability of health information to personal situations or its reliability, such as information about the performance of health care providers (Chinn, 2011). Heijmans et al. (2015) indicated that communicative and critical health literacy play a role in successful self-management of chronic disease but the impact differs by the health-related context.

Significance of Health Literacy in Global Health Care

Addressing health literacy as a theory of behavior change can generate the positive gains in individual, health care community, and global health care (Pleasant, 2011). Rehabilitating a debilitated health care system is essential to public, social, and economic health (Ridpath, Larson, & Greene, 2012). Health literacy is a multidimensional construct that bridges basic literacy skills and various health and illness contexts (Yamashita & Kart, 2011). Studies of adults have shown an association between low health

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literacy and worse health outcomes, decreased use of preventive services, and poor self-reported health status (Bennett et al., 2009).

Low literacy is an unrecognized barrier to the effective self-health management (Reyes, 2010). Fransen et al. (2014) stated that inadequate health literacy is regarded as a common barrier in patient and public health education. Inadequate health literacy is associated with the inadequate understanding of written information and the poor communication with health care professionals (Davis & Wolf, 2004). Recent studies in health literacy among adolescents, link literacy rates with health behaviors and outcomes including online health information seeking, over-the-counter (OTC) medication use, and obesity (Sharif & Blank, 2010).

In comparison with individuals with adequate health literacy, those with inadequate health literacy have less knowledge of diseases and treatments, often lack the skills to negotiate health care system, exhibit suboptimal self-management, and have worse health outcomes (Gazmararian et al., 2003). Differences in health literacy levels by race and education are broadly hypothesized to contribute to health disparities (Howard, Sentell, & Gazmararian, 2006). The observed relations between health literacy and important indicators of health status have led investigators to develop the effective health interventions to improve health literacy (Sheridan et al., 2011) in the anticipation that they may be effective in improving patient health and address ethnicity-related health disparities (Waldrop-Valverde et al., 2010). Health disparities on the basis of geographic location, social economic factors, and education levels are well documented (Murimi & Harpel, 2010). Limited health literacy may also partially explain racial disparities in outcomes (Saha, 2006).

Low health literacy is recognized as a burden to the individual, thus influencing the access to health services, limiting the understanding of health information, and impacting the quality of health-related decisions (Baker et al., 2007). Low health literacy has been associated with inappropriate use of emergency services, higher rates of hospitalization, and increased health care costs (Koskan, Friedman, & Messias, 2010). Individuals with limited health literacy have overall poorer physical function, less knowledge about managing their chronic health conditions, and participate less in the health care decision-making process (DeWalt, Boone, & Pignone, 2007).

Patients with limited health literacy are reported to have less interest in shared health decision making (Levinson, Kao, Kuby, & Thisted, 2005) which has implications for treatment adherence and health outcomes (Eckman et al., 2012). Health care providers have difficulty detecting patients with limited health literacy (Wittich, Mangan, Grad, Wang, & Gerald, 2007). Patients with limited health literacy are less likely to ask questions (Katz, Jacobson, Veledar, & Kripalani, 2007), seek information from print resources (Koo, Krass, & Aslani, 2006), remember the verbally communicated medication instructions (McCarthy et al., 2012), toward contributing to patients' inabilities to effectively utilize information. Speaking and listening skills are considered more important than reading and numeracy in patient self-advocacy within the health care system (Martin et al., 2011). Verbal exchange skills are key to patient understanding and use of health information that impact health outcomes (Finan, 2002). Swavely et al. (2014) indicated that low health literacy is more prevalent in persons with limited education, members of ethnic minorities, and those who speak English as a second language, and is associated with multiple adverse diabetes-related health outcomes.

Beyond having poorer health outcomes than their adequate health literacy counterpart (Bostock & Steptoe, 2012), patients with suboptimal health literacy show poorer ability to understand medical instructions and medication labels, and to properly take their medications (Berkman et al., 2011). Patients with low health literacy contribute to the increase in health care expenditure through the less frequent

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use of preventive health services, the poorly managed chronic illness, and the greater use of emergency department services (Larsen & Lubkin, 2009).

Patients with limited health literacy may have difficulty locating providers and services, understanding written medical information, communicating with health care providers, and implementing self-care instructions (Green et al., 2014) and tend to ask the fewer questions of clinicians because of fear and embarrassment associated with this condition (Aboumatar, Carson, Beach, Roter, & Cooper, 2013). This translates into an array of adverse outcomes, including increased hospitalizations (Baker, Parker, Williams, & Clark, 1998), decreased preventive health care (White, Chen, & Atchison, 2008), poorer overall health status (Cho, Lee, Arozullah, & Crittenden, 2008), and higher mortality rates (Baker, Wolf, Feinglass, & Thompson, 2008).

Health literacy has established the links between literacy skills and health outcomes and is considered as an important strategy for improving the health of disadvantaged populations and addressing social inequality (Flecha, García, & Rudd, 2011). Low health literacy negatively affects a woman's health knowledge, preventive behavior, ability to navigate the health care system, and ability to care for her children (Shieh & Halstead, 2009). In pregnancy, woman's health status and her understanding of health information may directly affect the maternal-fetal health (Lupattelli, Picinardi, Einarson, & Nordeng, 2014). Previous research among pregnant subjects with pregestational diabetes has shown that low health literacy is positively associated with unplanned pregnancies, no use of folic acid prior or during pregnancy, and later presentation for prenatal care (Endres, Sharp, Haney, & Dooley, 2004).

FUTURE RESEARCH DIRECTIONS

The classification of the extensive literature in the domains of health literacy will provide the potential opportunities for future research. Patient safety issues are the avoidable errors in health care that can cause harm to patients. Harm in this context means injury, suffering, disability or death. The effective communities of practice (CoPs) facilitate the social interactions and encourage the members' willingness to share knowledge and ideas in the workplace (Kasemsap, 2016b). Social media tools are open to anyone, whereas reaching the traditional media often requires a lot of money and a good network of media industry contacts (Kasemsap, 2016c). Total quality management (TQM) practices in quality performance has the potential to improve organizational performance (Kasemsap, 2015). Encouraging both health literacy and patient safety improvement through CoPs, social media, and TQM practices in modern health care will be the essential issue for future research direction.

CONCLUSION

This chapter highlighted the overview of health literacy; the characteristics of functional health literacy, interactive health literacy, and critical health literacy; and the significance of health literacy in global health care. Health literacy is about how patients understand health information about health and health care, and how they apply that health information to their daily lives, utilize it to make health-related decisions, and act on it. Health literacy is important because it affects an individual's ability to manage personal health: to navigate the health care system, share health history with health care providers, engage in self-care and manage chronic disease, and understand concepts, such as probability and risk.

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Being able to understand health information and make sound health decisions from that information is vital to patients' well-being in health care settings.

Health literacy can help patients prevent their health problems and protect their health, as well as better manage those problems and unexpected situations that happen. Patients with good health literacy make effective health decisions because they can find, understand, and evaluate the health information in global health care. Low health literacy is linked to higher rates of hospitalization and use of emergency services, and less frequent use of preventive services in health care settings, and is linked to health disparities regarding population-specific differences in the presence of disease, health outcomes, or access to health care.

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KEY TERMS AND DEFINITIONS

Communication: The two-way process of reaching mutual understanding, in which participant not only exchange information, news, ideas, and feelings, but also create and share meaning.

Health Care: The act of taking the preventative or necessary medical procedures to improve a person's well-being.

Information: The data that is organized for a specific purpose and presented within a context that gives it meaning and relevance.

Knowledge: The understanding of a circumstance gained through experience.

Literacy: The ability to read and write.

Patient: A person who is receiving medical care, or who is cared for by a particular doctor or dentist when necessary.

Skill: The ability acquired through the deliberate, systematic, and sustained effort to smoothly and adaptively execute the complex activities.

Understanding: The knowledge about a situation or about how something works.

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Chapter 2
The Information Paradox: Researching Health Service Information Systems Development

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ABSTRACT

This paper is based on a 2008 chapter (Shahtahmasebi, 2008) exploring the availability of information for public health policy purposes which argued its ineffectiveness to add insight and inform the process of policy development. Processes are dynamic by nature which politicians and professionals often neglect in addressing public health issues. The Chapter argued that whilst information is a major currency within health systems a lack of understanding of what constitutes information has disguised available data as small change. Since 2008, against a backdrop of reorganisations, restructuring, buzzwords, and coupled with the rapid advancement in technology the issues remain the same but are somewhat more complicated due to the feedback effect of dynamic processes. For example, a curious persistence of various governments with electronic health records has done nothing to address the gap in "information" or incompatibility in the information systems developed and managed by various care agencies. Furthermore, changing information to "intelligence" (e.g. Public Health Intelligence Units) or "observatories" to carry out similar tasks of reporting health outcomes using the same routine data will not solve the problem. This paper proposes a re-evaluation of the author's focus on informatics and suggests a move away from a technological "solution" based approach to a human behaviour-led approach that utilises the full potential of technologies to address important issues. To this end, this paper proposes a conceptual model to improve access, over and above clinical data, to health data.

INTRODUCTION

Data is the main currency within any organisation, especially within health services around the world. However, currency gains value when it informs the process of policy and service development that is appropriate, efficient, effective, and value for money.

For the purpose of administration, health services routinely collect monitoring and clinical data. Such data helps to forecast and plan population-based interventions, e.g. secondary care services that may be

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required such as the number of hospital beds, number of operations, number of health professionals, for the following financial year. In other words, this data refers to morbidity and mortality after the event, to add insight into the process of morbidity or disease development decision makers often rely on funded projects and research studies.

Until recently data collection was paper-based and as such the method was designed to suit the medium on which data were recorded. Rapid advancement in technology substantially improved the collection and access to digitised data with a much increased capacity for data storage. Information technology (IT) opened up whole new horizons to be creative with data and enhance its value as a currency.

However, practice suggests that creativity may only be limited to the technology. For example, Pagliari (Pagliari *et al.*, 2007) explains that "HealthSpace (www.healthspace.nhs.uk/) is a secure online personal health organiser available to all patients in England. The system was initially launched in 2003 to store health notes generated by patients." The system collects and stores administrative and clinical data selection and booking of hospital appointments; storage and charting of health indicators such as blood pressure, peak flow, or weight; a calendar with the option to generate email reminders; a database of NHS contacts; and links to online health information (Pagliari et al., 2007). The system provides patients with access to their NHS Summary Care Record—a snapshot of the general practice record documenting allergies, adverse reactions, and drug treatment (Pagliari et al., 2007). "Although HealthSpace will not provide access to detailed care records, clinicians can add data to the summary record with the patient's agreement. Other features under consideration include allowing patients to enter their needs or preferences, such as for wheelchair access or translators; greater use of text and email alerting; and enhanced tools for patients with chronic disease. The link with NHSDirect Online (www.nhsdirect.nhs.uk) also offers possibilities for integrating electronic consulting and education in the future. Although HealthSpace promises a national solution to electronic personal health records, it will be some time before its full potential is realised." (Pagliari et al., 2007).

It seems that despite the level of advancement in IT and database technology and after allocating billions of dollars, creativity has been limited mainly to digitising the paper format. The heavy emphasis on intervention and clinical data has removed all concerns for converting data into valuable information to gain insight into the process of disease development (Shahtahmasebi, 2008). For example, the creation of electronic health records is testimony to the narrow and unwise focus of governments and health services decision makers; why spend billions of dollars to recreate what is already available? Furthermore, given the emphasis of the strategy on access to clinical/administrative data (Boonstra *et al.*, 2014; Garrety *et al.*, 2014; Soumerai & Avery, 2010; Waterson, 2014) for governments to go ahead with e-records is like reinventing the wheel!

It is claimed that the technology will lead to enhanced health maintenance and self-care, participation in decision making, better health and quality of life, improved quality of care including patients' safety, and lower costs (Pagliari et al., 2007). The main problem is that such statements are often made without any supportive evidence. It is plausible that the high level of technology integration is based on presumed benefits. It is not surprising that a technology solution based approach will be of limited application (Boonstra et al., 2014; Buntin *et al.*, 2011; Coiera, 2011; Garrety et al., 2014; Trisha Greenhalgh *et al.*, 2010a; Kellermann & Jones, 2013; Kidd, 2008; Waterson, 2014).

Even without access to millions of dollars, the questions of design should have considered other issues besides reproducing clinical data that is already available on a different platform. The design should have included the role of other actors such as the public, researchers, other disciplines, information and

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communication technology (see (Shahtahmasebi & Liddell, 2011; Shahtahmasebi & Millar, 2013)). For example, an appropriate question may be "what database design can assist to enhance the value of data, i.e. convert it into useful information?" Such a question would have opened up the scope of the discussion and widened the focus to understand health before designing a limited database for clinical use. Ironically, a complex and expensive medium for an informatics system does not necessarily equate to a commensurate improved quality in information – information is as good as the data input into the system, e.g. the onus is on the health practitioners to record patients' data (Garrety et al., 2014; Walsh, 2004). Most health informatics systems collect minimum clinical/administrative patients' data, yet, governments around the world e.g. USA, Australia, New Zealand are pumping billions of dollars into the medium for storage rather than the needed information.

The motivation for a narrow focus may have been due to lack of a unified health information strategy and various governments submitting to the market forces giving rise to many different information systems which are incompatible with each other. Indeed, this question was raised in the meeting of the steering group on the 'Health of the Nation's targets on Mental Health' and was adopted as one of the main guidelines on data collection ((Yorkshire Regional Health Authority, 1993), pp12). The guideline prescribed that the health service commissioners should develop a *unified* database by 1994 with particular reference to suicide. Despite the advancement in technology since 1994, two decades on, no such thinking has been developed into an information strategy (Shahtahmasebi, 2008; Shahtahmasebi & Liddell, 2011; Shahtahmasebi & Millar, 2013).

As with any decision making process, a major problem with IT in the health services is a lack of evidence. Improvement in health and administrative outcomes are often presumed and projected improvements are based on a misinterpretation of the capability of technology. In other words, technology can improve health care delivery because technology can offer tera bytes of storage in the form of a small computer disc and provide access to them within a fraction of a second from anywhere in the world, and perform millions of calculations per second. However, some studies suggest that there is a large gap between the perceived and empirically demonstrated benefits of e-health technologies e.g. see (Black *et al.*, 2011; Kellermann & Jones, 2013). Statements such as "if problems are addressed effectively then electronic records may improve…" (Pagliari et al., 2007) suggests major issues with the perceived application of technology to deliver appropriate and relevant information to stakeholders.

On the other hand, addressing the issues of designing a database will involve consideration of the dynamics of knowledge. As health care systems have become more complex in order to respond to all the health needs of the population, cracks in the system were identified and were attributed to resources distribution with rising demand, which in turn attributed to inequalities in health. The fable of the physician on the river bank may describe the problem more clearly, retold by (McKinlay, 1975), though attributed by him to Irving Zola:

"you know", he said, "sometimes it feels like this. There I am standing by the shore of a swiftly flowing river and I hear the cry of a drowning man. So I jump into the river, put my arms around him, pull him to the shore and apply artificial respiration. Just when he begins to breathe, there is another cry for help. So I jump into the river, reach him, pull him to shore, apply artificial respiration, and then just as he begins to breathe, another cry for help. So back in the river again, reaching, pulling, applying, breathing and then another yell. Again and again, without end, goes the sequence. You know, I am so busy jumping in, pulling them to shore, applying artificial respiration, that I have no time to see who the hell is upstream pushing them all in."

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Thunhurst ((Thunhurst, 1982)) argued that we have spent too long measuring the flow of the river, the size of the fishing nets and the rate at which people are brought to shore. Health statisticians and health professionals need to refocus, Thunhurst further argues investigating the largely unmapped terrain upstream, particularly in solving the problem of differential class experiences of health.

In an earlier paper, Shahtahmasebi ((Shahtahmasebi, 2006)) argued that health services still rely heavily on downstream activities, thus health informatics are based on an illness having occurred. In other words, health informatics systems do not provide access to information prior to illness. The information is often gathered from ad hoc cross-sectional sample surveys which are then unwisely generalised about the population.

The principle of collecting information on morbidity and mortality as and when they present themselves in order to cater for the health needs of the population will lead to a reactive health care system. In other words, the health care system is reacting to cries of help from people in need of being saved but only reaches some of them and not all.

There is no doubt that mortality and morbidity data are essential to help with the planning and distribution of resources to deliver health care. However, without interrogating the data and asking the question "why", health care systems remains ignorant of disease development and in particular how they could be more effective in preventing an outcome.

Today's health care systems are far too big and complex, and governments around the world spend huge sums of money maintaining these systems. In the short term, maintaining is often all that can be done. Research and Development (R&D) funding and evidence-based decision making is often restricted to RCTs of specific treatments or to bring about a change in providing/withdrawing care. In other words, limitations and pitfalls of evidence-based medicine (Friedman & Richter, 2004; Kelly *et al.*, 2015; Timmermans & Mauck, 2005) is really a method of limiting services in the face of maintaining complex health care systems with limited resources and no knowledge of the upstream.

To illustrate this, consider the leading causes of death and mortality over the last few decades, such as heart disease, cancers, and suicide. Despite decades of rapid advancements in medical technology and investing billions of dollars to prevent them, these same diseases are still the leading reasons for mortality and morbidity. For example, transplant technology may add years to the life of a patient, but it doesn't provide insight as to why and how disease was developed in the first place, and more importantly, someone else has to die in order for another patient to live longer.

Government agencies' funding of poor research leading to ambiguities is, in part, responsible for focusing on the downstream in order to maintain a reactive health care system. Suicide prevention is a good example of a reactive system. Despite a growing body of work criticising lack of insight into suicide (Cutcliffe, 2003; De Leo, 2002; Institute of Medicine, 2002; Shahtahmasebi, 2003; Shahtahmasebi, 2005a; Shahtahmasebi, 2013), and discrediting psychological autopsies (Hjelmeland *et al.*, 2012; Shahtahmasebi, 2005a; Shahtahmasebi, 2013), and the fact that between two-thirds and three-quarters of all suicide cases do not come into contact with psychiatric services, decision makers insist on a policy of intervention in order to prevent suicide.

The suicide (or the information) paradox is that instead of finding a way of utilising the available data (e.g. from health services, education, social, justice) to explore suicide prevention, vast amount of money and resources are instead allocated to support poor research and information systems.

In the absence of information arising from relevant data a culture of short-termism has developed in which health services thrive on buzz words and phrases (Shahtahmasebi, 2008). Each buzz word symbolises a new strategy in the hope that it will last longer than the preceding ones. Of note are buzz words

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such as "restructuring", "streamlining", "evidence-based" decision making, "intelligence" units, "public health observatories", "targeting care", "needs assessment", and so on. If any one of these strategies worked well then the buzz words will no longer be needed. All these strategies have accomplished is to perform the same tasks as before but under a new name (Shahtahmasebi, 2008).

INNOVATIVE APPROACH

Informatics is essentially the collection and management of data in order to inform. There are two main aspects to informatics: information, and technology. An informatics system is effective only when it informs and adds insight about a process. Technology merely expedites the process and will have little impact on the quality and appropriateness of data. Information depends on the relevance and quality of data, appropriateness of analytical methodology, and interpretation. However, rapid advancements in ICT has led to sophisticated informatics systems, but such complexities have not led to commensurate progress in gaining insight from them – ICT is employed ineffectively to reproduce and report the same data, namely, routine morbidity and mortality data. To remedy the situation we must refocus our emphasis from what technology can do for our current data administration to how technology can be utilised to inform our processes.

The link between various processes and health is well documented and acknowledged, e.g. health outcomes have been linked to other social, educational and economic outcomes (Butterworth *et al.*, 2009; Holstein *et al.*, 2009; Shahtahmasebi, 2004, 2006; Shahtahmasebi *et al.*, 1992; Wagstaff, 2002). These relationships are often acknowledged but in the context of government policy the approach is disjointed and lacks continuity in developing government strategies for health and social care services. For example, the UK government acknowledged the link between socio-economic factors, e.g. employment status, and health outcomes in the UK's mental health strategy (Department of Health, 2011), yet, there is no promise of a coherent information action policy. The main issue is how the policy statement of a causal relationship between poverty and mental health outcomes will be translated into relevant and appropriate policy actions? The public, social and political sectors responsible for policy development, implementation and monitoring social, educational and economic outcomes have their own information systems that are likely to be incompatible with each other. Unfortunately, when a tragedy occurs, the first outcome of a review is often for the various agencies to share information (e.g. see (ComputerWorldUK, 2010; NZHerald, 2015)). An effective informatics system should make the information readily accessible to all health professionals and decision makers. In other words, for health informatics to effectively inform health care planning and delivery, it should be able to communicate with the other sectors over and above multi-disciplinary research activities.

Although technology is sufficiently advanced to create a unified database most of the effort in translating access to information have concentrated on access to clinical information. For example, the recommendation and development of e-records by various governments such as the UK, Australia, USA, New Zealand and Canada will ultimately lead to e-health (Whetton, 2005), which may encourage a move towards self-treatment ((Stevenson *et al.*, 2003), also see http://computerworld.co.nz/news.nsf/management/health-it-board-drafts-e-health-plan; or, http://www.who.int/goe/ehir/2010/24-august-2010/en/index.html).

The main issue here is that, in terms of information, we may have improved access to numbers, rates and ratios of morbidity, mortality and possibly other events such as administration of a treatment e.g.

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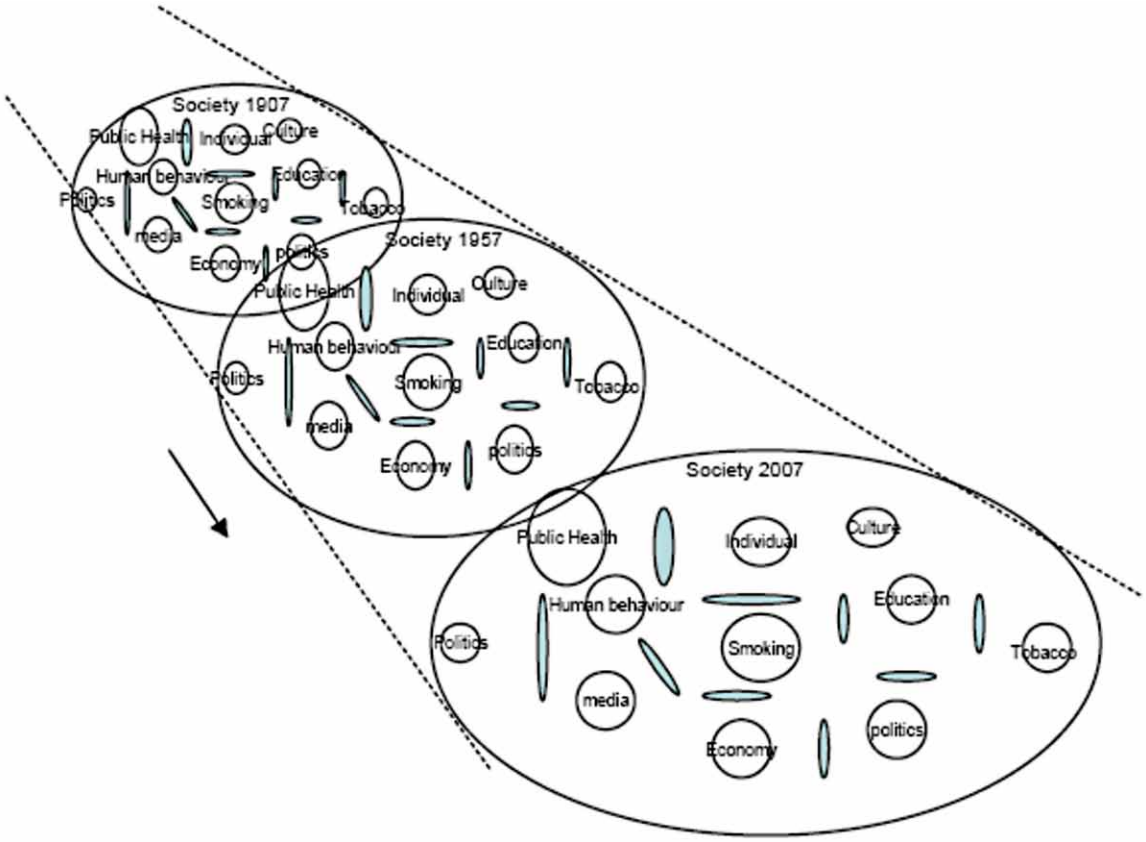
type of medication, surgery, but we do not have any ideas or information about the competing forces in society (as shown in Figure 1) on health-related behaviour. As an example, consider smoking behaviour and suicide. Smoking is considered a major cause of morbidity and mortality yet, despite the restriction placed on the sale (including advertising) of tobacco, taxation regime and prohibition of smoking in public places, people continue to smoke. It seems that the single message of "smoking kills" on its own is not sufficient, which may be a feedback effect of an advancing medical technology e.g. the expectation that the cure for heart disease and cancers, in particular lung cancer, is not too far away. Other competing forces include the tobacco industry and the media's portrayal of smoking constantly exposing the public to smoking often disguised as "a fact of life", "art", "entertainment", and public interest (for a discussion of such issues see (Shahtahmasebi, 2007)).

As mentioned above, technological advancements to improve data access has not led to commensurate improvements in data. For example, data held in health informatics system on suicide does not contain additional information over and above number of deaths and hospitalisation which can make health care planning a hit and miss process (Shahtahmasebi, 2013; Shahtahmasebi, 2014). Any "hits" may be the temporary feedback effect coinciding with the effects of other competing forces. To illustrate, consider the suicide report issued by Doncaster PHIU on their web page (Doncaster PHUI, 2003). Once again the same data (i.e. rates and ratios by sex, age and groups) are presented graphically and a description of

Figure 1. An example of a conceptual model of smoking (Shahtahmasebi, 2006)



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the graphs (highs and lows) is given. This report, however, takes an extra step of looking into the claim that a pain killer (co-proxamol) had been a common method of committing suicide. Therefore, in 1998 attempts were made by the Doncaster Health Authority to reduce access to this drug. The report presents a graph of superimposing the rate of prescriptions of co-proxomal on the number of suicides using co-proxomal and makes a tantalizing projection that such a policy may have had a significant effect on reducing suicide ((Doncaster PHUI, 2003), page 8). The report does not take into account the fact that there were the same number of suicides in 1995, 1996 and 1997, when the prescription of co-proxomal was at its highest, as that in 1999 and 2001 after the reduction in prescribing co-proxomal. By the same token, a policy of removing access to a method of suicide may have had an effect on suicides using that method but there is evidence to suggest that suicide victims do switch to more violent methods to ensure successful completion (e.g see (Shahtahmasebi, 2005a, 2005b)). To conceptualise suicide prevention, in Figure 1 smoking is replaced by suicide.

Neither health and social outcomes nor resources are static. Health informatics that is too focused on clinical outcomes will, on average, only serve a particular group, namely, some of those who happen to fall ill. This approach has prevented us exploring 'upstream' and has made sure the progress remains 'downstream'. For example, as a result of clinical successes in making organ transplantation fairly routine, social expectations have changed accordingly; the public are expected to automatically become donors. On the other hand, those in need of a transplant may be praying for a donor which is ironic as it means someone else must die for a transplant organ to become available. The feedback effect leads to a perpetual cycle of more intervention e.g. cloning designer organs for transplantation.

Clearly, it is not possible for one service provider to design and collect information on a massive scale as conceptualised in Figure 1. Certainly, I am not proposing that health services around the world develop complex IT systems. What I am proposing is that the authorities go beyond their buzzwords invented to gloss over the reinvention of the wheel such as "intelligence" units, observatories, neighbourhood building block, 'Health of the Nation Targets' and so on. In other words, if we do not put meanings into each buzzword the buzzword is a lost opportunity. For example, in the early '90s when the UK Government announced targets on mortality and morbidity rates in its 'Health of the Nation Targets' strategy (Department of Health, 1992), health authorities and districts in England and Wales translated the strategy as a target setting exercise and converted national targets into local targets! Thus an opportunity was lost to explore 'upstream' and develop prevention plans that reduce the need for intervention and thus holistically achieve national or local targets. As it was, most of the discussion around achieving targets was focused on administration and possible interventions.

We need to understand that we need information *not* only to calculate targets on mortality/morbidity rates, budgets and costing of services for intervention, but in order to develop sustainable and effective services we need to gain an insight into disease development. We need information from other processes. Theoretically, given the advancement in ICT, this is not impossible or difficult to achieve.

In order to refocus on what constitutes appropriate data we need to re-evaluate our view of routine data. In the UK the NHS and other agencies routinely collect information in various formats e.g. from qualitative and textual reports such as health visitors' records to minimum data sets and hospital records. From these records it should be possible to gain factual and objective information on the population from birth to death. Apart from the quantitative hospital records and mortality data, almost no other NHS records have been utilised (see (Shahtahmasebi, 1997)). It is plausible that until recently there were technical issues with utilising such records. However, the technology is now available, e.g. powerful palmtops with cell phone technology and networking capability.

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It must be first recognized and acknowledged that appropriate information is necessary for any sustainable policy development. One of the features of the conceptualisation in Figure 1 is an understanding that data from various processes is essential. It can then be conceptualised that in order for the model to work data must be allowed to flow between processes. This means the depoliticising and sharing of data. Most countries now have IT systems for the monitoring of health, social, education and economic outcomes. A unified database could be in the form of a *virtual* warehouse, acting as a buffer or filter, providing access to *more* data collected at various stages of life.

Assuming that the technology can be utilised to accommodate privacy and confidentiality requirements, there are two immediate benefits for clinical practice and research. The virtual warehousing can be used to generate aggregate and anonymous multi-level population based data for research, be it a pilot or feasibility study, in order to explore and assess a broad issue or test developed hypotheses using appropriate modelling methodologies.

The second advantage is that individuals can be given an access key (such as National Insurance Number) to access all information held on them. This facility can be extended to provide further information in the form of responding to online voluntary update forms. Perhaps the greatest gain will be in the clinical practice where health care professionals are able to access primary care records (GPs, public health nurses, health visitors, etc) as well as hospitals, and socio-economic and education parameters. However, access to all records may not be appropriate for every health/social professional, and access to all information may be provided by the individual. On the other hand, an ability to have an objective life events history complemented by the patient's own recounting will be an important tool in predicting and preventing or modifying health-related behaviour, e.g. suicide and self-harm, obesity and smoking.

CONCEPTUALISING A UNIFIED DATABASE

Table 1 provides an example of routinely collected data that, when complete, can provide upstream data. Together, the data collection systems have the potential to provide life event histories for any individual. The major issue here is that these data collection systems are not linked and do not communicate with each other. It is possible that data collection systems are often purpose-built and designed independently. Nevertheless, most data systems will have a common unique individual identifier(s) that can be used to link data systems together. In an ideal world databases would have been part of the same design and by default would have been linked so that upstream data may inform the planning of downstream activities (clinical interventions). Whilst, we do not live in an ideal world, given the vast advancement in hardware and software technology, we can conceptualise a unified database that is populated with data from different sources.

As shown in Figure 2, a virtual mega database could be conceptualised to provide access to life history events including health, morbidity (hospital records) and mortality records for professional practice, and, anonymised and aggregated life histories for research. We do not propose to re-invent the wheel by insisting on another physical database such as e-records. The unified database could be a set of communication software protocols acting as secure gateways to other databases, or, it can be a virtual database which is populated from other databases via communications software protocol. As suggested earlier, health and social outcome data and life event histories are already available from different sources and in different formats. The technical issues in this scenario will relate to the architectural design of the database (or interface) and thus populating it with anonymised life history records.

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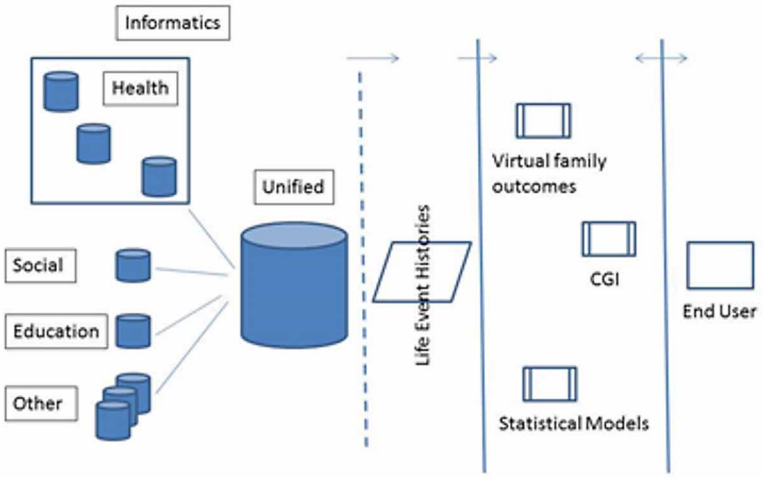
Table 1. An example of available data systems and routinely collected data

Data exist because of incidents of ill health		Data exists because of reporting checks and monitoring	
Ill-health data systems	**Data Items**	**"Qualitative" Health data systems**	**Data Items**
Patients records	e.g. unique identifier, personal details, diagnosis, treatment, referrals, …	Midwifery records	e.g. unique identifier, personal details, baby's nutrition, weight, height, problems and issues,…
Hospital records	e.g. unique identifier, personal details, diagnosis, treatment, hospital identifier, specialists, referrals, …	Nursing records	e.g. unique identifier, personal details, nutrition, weight, prenatal and postnatal monitors, problems and issues,…
GP records	e.g. unique identifier, personal details, diagnosis, treatment, referrals, …	Monitoring records	e.g. Screening records (e.g. breast and cervical), routine check-ups (e.g. heart),…
Mortality records	e.g. unique identifier, personal details, cause(s) of death,…	Other records	e.g. Education records, Justice/police records, social and employment records,...

Figure 2. A conceptual model of a unified (health) informatics



Of course the records will have to be linked perhaps via a unique identifier code such as a National Insurance number or social security number. It is possible to conceptualise a unified database in terms of access to anonymised life histories which are linked by a unique identifier. The basic structure of a unified database will be a 'hub' that is enabled to communicate with other available databases and run queries on them. The hub will be software interfaced to perform basic as well as complex time series

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statistical modelling. In both scenarios, the ability to communicate in real time will need to be considered in order to help health care professionals make informed decisions.

In addition, the ability to communicate in real time will address the criticism of various health, social and justice agencies for repeatedly failing to share information, which will be a major benefit of a unified database. For example, often a lack of communication and sharing of information between different agencies is blamed for failing to prevent a tragedy such as death due to suicide or child abuse. Because, operationalising an appropriately designed unified database, any concerns raised by a care service provider (e.g. hospital) will be immediately flagged and seen by another (e.g. social services, police).

Obviously, there are many issues that are relevant for the design and architecture of a database, such as ethics (privacy and confidentiality), resources, stakeholders and access, will need to be identified and resolved. Clearly, issues necessary for creating a unified database such as design, ethics and so on are large scale research projects in their own right.

POLITICS OF INFORMATION

Although, society responds well to technological gadgets and is enthusiastic about technology, its application in public administration is resource intensive, politicised and is challenged with legal and ethical issues including privacy and confidentiality. In the UK, during 1993-4, a proposal for the analysis of hospital records to utilise the added data item 'social class' did not proceed because the data item 'social class' had not been populated with relevant values. The high missing values is not surprising as an exploratory analysis of such records suggested that professionals, on average, reported statutory minimum clinical data requirement. In an evaluation study of the English e-records system (T. Greenhalgh *et al.*, 2010b) a lack of compliance with reporting on all the data items, ethical considerations, skills gap, experience and knowledge of the systems in use, shortage of resources, immediate and free access to an informatics station, are some of the issues raised as barriers for the full utilisation of the e-records.

The shift towards a technology-based culture may reinforce barriers to the utilisation of new informatics systems. For example, at the Health Informatics New Zealand (HINZ) Conference in 2010, speakers and delegates commonly described the available technologies such as smart pens, smart pads, e-health and mobile technology as solutions. In other words, we can now define, or, perhaps create a problem/market for which there exists a 'solution' in the form of a device. By the same token, the fact that we have lots of 'solutions' suggests that, as mentioned earlier, the technology is no longer an issue but its applications are.

However, most 'solutions' appear to address clinical administration e.g. improved and fast access to patients' records, reduction in human error, and accounting. Given the extent of the technological advancement in hardware and software we ought to have, at some point, asked ourselves why stop with 'solutions' for administrative aspects of health care while there are questions that can be investigated? In other words, technological solutions must be human behaviour-led (evidence-based) and not the other way round. This approach can also assist to overcome some of the barriers in the full utilisation of technology.

On the other hand, under a human behaviour-led approach barriers can be conceptualised as opportunities in developing more socially acceptable 'solutions', see Figure 2. In other words, the inclusion of human and social parameters in the process of developing technology and informatics systems at the concept stage will enhance the decision making process and its outcomes, see Figure 3. Indeed,

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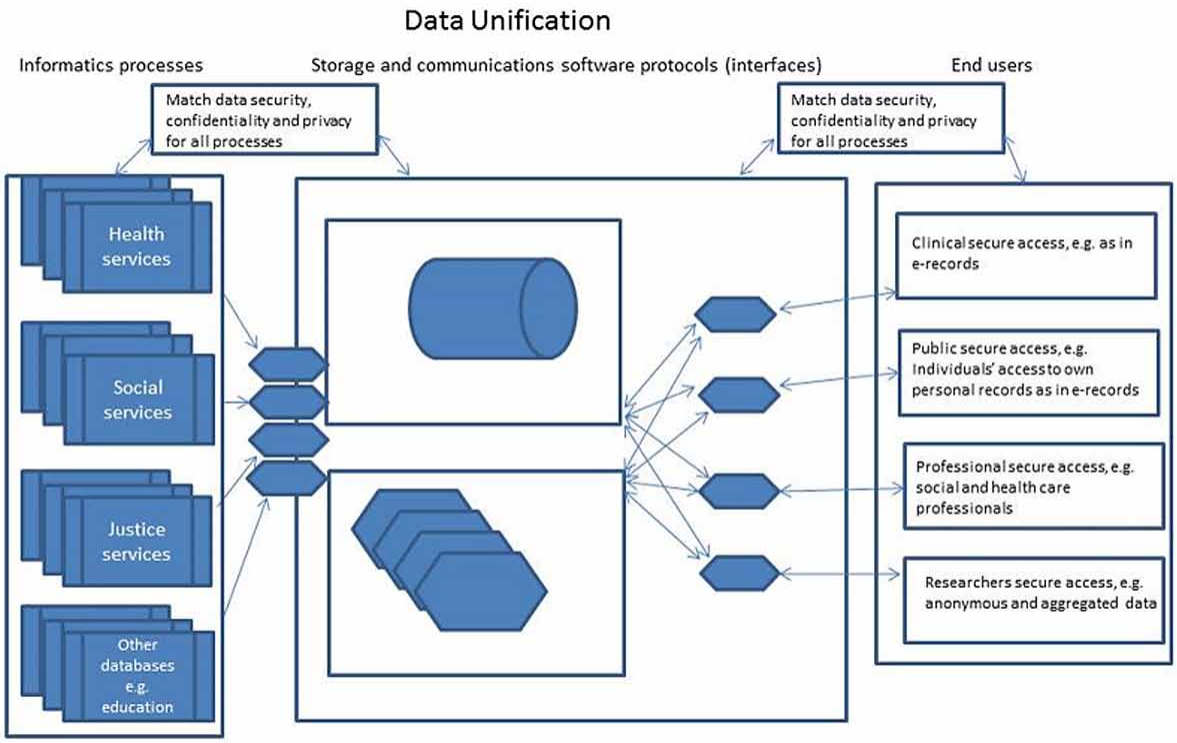
conceptualisation considers barriers as part of the solution by assuming they are processes in their own right, and, processes are dynamic by nature. Thus barriers become multi-disciplinary research projects to inform the process of defining a unified database and its functions.

CONCLUSION

Ironically, the problems and issues discussed in this paper, including failing to prevent tragedies because different care agencies fail to communicate, were supposed to be resolved through major IT strategies both at government and agency level. The various strategies may have actually contributed to more complexities while addressing the digitisation of data. Due to market forces health care providers may have opted for the IT systems that met their IT strategy for their budget, e.g. value for money. A unified IT strategy approach would have been far better so that all care agencies are invited to subscribe to the same purpose-built and designed data collection system. This approach would have reduced variability and facilitated communication between systems.

However, as part of an IT strategy, some care agencies attempt to improve access to information. For example, with some systems mortality or morbidity (hospital records) data and appropriate population files can be queried through the organisation's network. This solution can only provide a snapshot of past mortality and morbidity in the context of a population. There is still no sign of a unified database,

Figure 3. Conceptualising the informatics processes



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despite health outcomes being linked to variations in social, economic and environmental circumstance (Butterworth et al., 2009; Holstein et al., 2009; Shahtahmasebi, 2004, 2006; Shahtahmasebi et al., 1992; Wagstaff, 2002), and the cumbersome methods of combining hospital data with data from other sources.

Although meeting the challenges of utilising different datasets can be exciting and satisfying, the question arises yet again: why is health data from the same organisation administered and stored in different sources, some of which are incompatible with each other? Indeed, this was raised in the meeting of the steering group on the 'Health of the Nation's targets on Mental Health', former Yorkshire Regional Health Authority (UK), and was adopted as one of the main guidelines on data collection ((Yorkshire Regional Health Authority, 1993), pp12). The guideline prescribed that health service commissioners develop a unified database by 1994 with particular reference to suicide prevention.

Although it is apparent that routinely collected data such as mortality and hospital records may be readily accessible, it is more difficult to access primary care data such as GPs and nursing and social care records. Nevertheless, data is routinely collected by the various care organisations and their internal departments but the various data or information systems do not communicate with each other in terms of the flow and sharing of data. Whether the blocking issues are political so that each department is viewed as a separate entity to perform a certain task, or incompatible technologies, or a combination of processes, it is, nevertheless, possible using the current information technology to create a multidimensional flow of information. An important implication is access to additional data/information from publicly funded projects (e.g. medical and health research councils, government departments, research and development). These projects may be linked to the virtual warehouse in a multi-way flow of information, to some extent, to fill the current and future gaps in data and research. The concept of a holistic approach to inform the process of policy formation is the subject of a proposal currently being developed by the author. Therefore, it is difficult to prejudge the outcomes in terms of strength and weaknesses. However, the idea of a holistic approach is to create a flexible policy that can respond to the short-term needs and is sustainable to respond to future needs. The limitation or weaknesses associated with such an ideal 'framework' are the complexities associated with human behaviour (e.g Politics, conflict and politics e.g see (Irestig & Timpka, 2007)), methodology (e.g see (Pilemalm & Timpka, 2007)) and costs. On the other hand, assessments of a flexible policy, at least theoretically, could lead to the projection that sustainable policies may be more economical over time as the need for short-term expenditure will be greatly reduced.

The intention of this paper is to highlight the shift away from evidence that has coincided with technological advancements in the light of a heavy emphasis on "evidence-based" decision making. Of course, it is good to know that one can find data at a touch of a button and through fast access to the internet, but this feeling would soon change to frustration when data is insufficient, irrelevant and inappropriate. On the other hand there are a number of specialty longitudinal databases such as the longitudinal census and FACS (the Department of Work and Pension's Families and Children Study). As discussed in this chapter, analytical methodologies are equally as important as the research methodology to translate data into information (e.g see (Emerson *et al.*, 2008)). Although, the creation of longitudinal databases is a step in the right direction, given the technological advances to date, the political will towards a unified database is still well out of sight.

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Chapter 3
Health in MENA:
Policies for Inclusive Development

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ABSTRACT

This chapter argues that health is an essential pillar of growth, and that ensuring Universal Health Coverage is a key pre-requisite for equitable and inclusive development. MENA health systems are far from meeting this challenge, because of clear developmental failures and lack of political will, not to mention wars. At present, MENA health systems are fragmented, inefficient, and deficient, delivering often mediocre, urban centered, tertiary care. They exclude large swathes of the population, particularly the poor, resulting in persistent disparities and inequities. Because of privatization, the neglect of public health, and defective social protection, MENA citizens shoulder some of the highest financial burdens amongst developing regions, which worsen and deepen poverty. To meet its health challenges and achieve inclusive development, governments need to revamp their public health sectors, and play a more central role in protecting the poor and vulnerable. MENA must invest in health, equity and development.

BACKGROUND AND INTRODUCTION

Mainstream macroeconomic views of Middle East and North Africa (MENA)[1] continue to depict the region as benefitting from significant historical improvements in health and education delivered by its old social contract, though concerns may be voiced about inequalities of outcomes or about the quality of public goods and services.[2] However welcome, achievements in health outcomes (e.g. life expectancy) are not exclusive to MENA: they are displayed by most middle income countries. Since the 2001 report on *Macroeconomics and Health*, it has been shown that national health indicators in these countries cannot be used to draw any firm conclusions about health or of health systems.

In MENA's case, such limited macro-level analysis focused on a few "visible" outcomes is incompatible with three bodies of evidence. Firstly, the upheavals associated with the Arab Spring exposed with widespread dissatisfaction with the status quo and many structural problems, including pervasive inequalities and deficient social protection mechanisms. In this context, Alami and Karshenas (2012)

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argue that: the region suffers serious deficiencies in health; public resources allocated to the sector were typically below international norms; and many people were being left behind because of waning government commitments. Earlier, Salehi-Isfahani (2010) and El-Laithy (2011) noted an increasing shift from the principle of universality to the ability to pay. Secondly, since the late 2000s, a spate of sectoral studies, typically based on household surveys, noted deficiencies and inequities in access to and delivery of healthcare. Thirdly, World Health Organisation (WHO) country and regional reports[3] point to systemic problems if not widespread crises.

Arguably, the question is not whether health outcomes improved historically, but why there are still so many failings, and why do improvements continue to elude many people. The aforementioned macro-approach recognises there has been non-inclusive growth in the region, but is unable to relate it to these problems, and has little to say about unmet needs or relevant public policy. That would require looking at health in a more meaningful way that would, *inter-alia*, reflect its centrality to both development and social justice. Using this perspective, this chapter proposes a more relevant diagnosis whose policy recommendations are compatible with sectoral evidence. It shows that MENA health systems face a double whammy of not coping with current needs or with the looming epidemiological transition to Non-Communicable Diseases (NCDs). It echoes the sectoral call for action, arguing that MENA countries need to reverse the neglect of public health sectors, address the structural deficiencies that underpin the observed inequities, and work towards Universal Health Coverage (UHC). The latter also means addressing other aspects of public policy, particularly extending social protection to the poor and vulnerable.

To demonstrate its case, the chapter proceeds as follows. Firstly, in the next section, it traces the rising importance of health equity and of UHC. UHC aims to provide to key promotive, preventive, curative, and rehabilitative health interventions for all, at an affordable price (OECD, 2013; Stuckler *et al.*, 2010). It then demonstrates the considerable convergence between UHC and an inclusive growth (IG) strategy, the former becoming a barometer for success in health policies. The third section applies these approaches to MENA. It shows the deficiencies in health outcomes and systems, and traces the retreat of public health spending in the region. The fourth section outlines the financial burden of healthcare and consequences of ill health in MENA. A key result here is that Out of Pocket spending (OOP) on heath in MENA is perhaps the worst amongst middle income countries. The fifth section categorises these deficiencies and placing them in an international context, while section six outlines the political economy that led to this neglect, and derives policy suggestions. The last section concludes, stressing the need to go beyond health targets, and the need to put back development, equity, and inclusiveness into political priorities.

HEALTH, EQUITY, AND DEVELOPMENT

All Roads Lead To Universal Health Coverage

Until recently, mainstream economics tended to view health and health improvements as a by-product or natural consequence of income growth. This approach to health was strengthened by the dominance in the 1980s and 1990s of the Washington Consensus (WC), which tended to belittle the importance of public health interventions and of the public sector in healthcare. In that framework, health was at best an item of public expenditure that merits ring-fencing. Improving the financing of healthcare systems

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and catering for unmet needs were to be done by championing the private sector, and by improving efficiency and cost recovery.

This narrow treatment of health was not uncontested. Amartya Sen's work, rooted in his capabilities approach, had a seminal influence in restoring the importance of health for both individual and national development, and in highlighting its direct relation to poverty.[4] Furthermore, Anand and Ravallion (1993) show that far from being a by-product of growth, two thirds of the achievements in well-being (life expectancy) could be distinctly attributed to public spending on health, whereas the rest came from poverty-reducing income growth. Sen (2004) went on to add that health achievements need to be related to: resource allocation; fairness in process and access; the way social arrangements undermine or support health equity and the health of the deprived.

At the same time, a large body of literature was arguing that the importance of health and health investments for growth were grossly underestimated, this being captured by the 2001 report on *Macroeconomics and Health*. The Report further noted that despite life expectancy in middle income countries reaching over 70 years, these still faced significant health challenges. The key issue for them was to build well-structured systems that reached the poor, and UHC is the best strategy to do so. A UHC strategy is centred around three policy axes:[5] to cater for unmet healthcare needs and manage disease burdens by relying on good quality public healthcare, including primary; to work on pooled schemes to deal with the associated financial burdens.

Conversely, compelling evidence was emerging about the presence of "medical poverty traps",[6] whereby health spending, particularly in emergencies, pushes people to fall into or stay in poverty. This helped to raise the alarm about the burden of healthcare costs, and spearheaded a large body of WHO-led investigations into OOP.[7] At the same time, the WC was beginning to acknowledge the importance of equity in economic growth.[8] As argued by Elgazzar *et al.* (2010), both streams contributed to the proliferation of research into health inequity.

All these arguments pushed the policy pendulum in favour of equity-oriented health sector reforms and of strengthening public health. The WC-inspired budgetary cuts and retreat of public health sectors began to be reversed with the launch of the Millennium Development Goals (MDGs) in 2000. With four main goals dedicated to health,[9] the MDG process did much to commit national and international resources for health. Together with the Sachs report, they helped to establish an international consensus on UHC, leading to the adoption of a UN resolution in December 2012.[10] The World Bank has now added its institutional weight behind this campaign "…to achieve universal health coverage, with the aim of providing quality, affordable health care to everyone—ultimately improving health outcomes, reducing financial risks associated with ill health, and increasing equity".[11]

Health, Inclusive Growth and Development

Just as our understanding of health has evolved towards integrating the consequences of ill health and the determinants for health inequities, Inclusive Growth (IG) has also grown in response to persistent developmental failures and/or socio-economic exclusion in spite of income growth. IG shares the same intellectual drivers as those in the debate on equity and health, and is now a vast field that covers a multitude of conceptual approaches. These differ in their emphasis on: achieving income growth while reducing inequality, improving social opportunities, ensuring equality of access, and protecting the vulnerable. A fairly representative definition of IG is: it is growth that grants equal access to income growth, reduces disparities, and involves "disadvantaged-reducing improvements in non-income dimen-

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sions of well-being" (Klasen, 2010, p. 3). IG frameworks also typically require the poor to be the main, but not the only, beneficiaries of growth, and that growth improves income poverty (OECD, 2013). In both senses, IG is about inclusive development.

The IG literature is also clear about the importance of public policy. It places particular emphasis on investments in public services to support human capabilities, and on the mitigation of risks via social protection. However, there are substantive differences in the literature about the role assigned to actors (state vs. market forces), and in policy recommendations. Thus, protecting the vulnerable means targeting and social safety *nets* in Post Washington Consensus (WC) analysis, but means universality and social protection *floor* for UN agencies.

As health is crucial aspect of equity, development, and growth, health enters IG frameworks in three major ways:

- In its own right;
- As a pillar of equitable growth (both at the micro and macro levels); and
- As key to the ability to participate in the economy.

Health also matters for IG because it matters for poverty reduction, since poor health can compromise the acquisition of both human capital and income, thereby perpetuating poverty. In that sense, IG is echoing Sen's work, re-emphasising the need to improve income and well-being simultaneously. Arguably, IG is converging towards the aforementioned consensus on an equity-oriented view of health.

These considerations suggest that there are three key policy components to an IG strategy: improving health outcomes for all, reducing inequities in the use of and access to health services, and reducing the financial barriers to and financial consequences of healthcare. Therefore, success in and attention to these policy areas become important barometers of inclusive developmental strategies. The most direct expression of health dimension of IG is that of the OECD (2013): growth is inclusive to the extent that it leads to better health statuses *and* declining inequities in access to health services. In OECD (2011), monitoring the inclusiveness of health involves a wide range of indicators, such as cancer screening, waiting time for elective operations, etc.

The fact that health and health equity remain important for participatory growth and social justice in rich industrial countries, suggests even more pressing importance for developing countries (DCs). Applying this approach here implies going beyond national indicators, and tests the inclusiveness of growth by asking the following questions:

A. Has growth led to better health outcomes for all?
B. Have the provision, delivery, and access to healthcare improved?
C. What has been the impact on the poor and on poverty reduction?

Despite strong conceptual foundations, in practice, the success of IG in incorporating health has been mixed. Monitoring outcomes, access, and provision, is weakened by an often mechanical use of key indicators. Despite facilitating cross-country comparison, these indicators, like MDGs, are plagued by problems of relevance (e.g., monitoring malaria where diabetes is more important) and by their inability to pick up problems of quality and equity. Hence, it is not just the number of doctors that matters, but also their distribution and quality of their training and of the treatment they offer. All these are considerations that are being actively discussed, including by MENA, in the context of Post-2015 Development Agenda.

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For example, a recent study of MENA (FEMISE 2014), builds on the methodology of the Human Development Index and on the Asian Development Bank's work on IG. It presents an IG index, which is the geometric mean of standardised values of different indicators grouped into seven pillars, one of which being health. The health index is based on indicators of: public health expenditure in GDP, life expectancy, child mortality, tuberculosis (TB) rates. This analysis picked up low levels of funding for public health in Morocco and Egypt, and the poor performance of Yemen. However, most countries have similar levels of life expectancy, and have overcome TB and other communicable diseases, resulting in similar scores. Similarly, the IG index includes indicators for water and sanitation, both crucial for health and human development. But these indicators have severe limitations, ignore problems of cost and quality.[12] Therefore, these indicators and the IG index paint an overoptimistic picture of health and of the inclusiveness of growth in MENA.

More successful results have been obtained by research using disaggregated and survey data, or indicators of spatial distribution of health services, or of the use of services by income quintiles. Such information is more useful for gauging the inclusiveness of an IG process, potentially leading to more relevant policy directions. For example, a stylized fact in DCs is that maternal and infant mortality rates can be 3-10 times higher for poorer women, especially in remote areas. Policies to reduce these rates are different from the ones based on an average figure influenced by the outcomes of the rich quintiles. An example is the study by Tandon and Zhuang (2006). It uses spatial data from both Chinese micro surveys and data from WHO surveys to highlight inequalities in health outcomes across China, arguing that while large income gains have resulted in significant improvements in health outcomes, inequalities undermine the inclusiveness of China's growth, and therefore need to be addressed directly.[13]

Finally, though many IG frameworks analyse social protection, they rarely consider health protection. Likewise, the literature has typically overlooked the financial burden of healthcare and its impact on poverty. However, this dimension can be easily incorporated by looking at OOP, and the proportion of households who fall into poverty, or for whom health outlays have "catastrophic" consequences. Healthcare payments are considered "catastrophic" for households if they take up on average 10% or more of their total expenditure (the international range being between 5-25%) (Elgazzar *et al.,* 2010). Examining OOP and the nature of catastrophic health expenditure (CHE) allows us to detect the impoverishing and disequalising effects of health spending, as well as any deterrent effect on utilisation (Abu-Zaineh *et al.,* 2013).

Implications for Analysis

So far, this chapter argued that an IG strategy is relevant for MENA because it can help to address key problems MENA faces, namely the needs to: improve health outcomes for all; reduce reduce inequities in the use of and access to health services; and reduce financial barriers to and consequences of healthcare spending, particularly for the poor. Therefore, it extends existing studies in a number of ways.

Firstly, it goes beyond health outcomes, and uses a disaggregated level of analysis and more relevant set of diagnostics. Secondly, it does so in the context of the WHO framework whereby *outcomes* (health statuses, equity, public satisfaction) are the results of systems of *delivery* (proxied by access and quality indicators), these themselves reflecting the underlying *structural aspects* (financing and infrastructure) (Stuckler *et al.,* 2010). Thirdly, it complements the sectorial assessment with a look at the financial burden of healthcare and the availability of social protection. Lastly, it adopts a thematic emphasis on equity in health, which also means putting overall policy direction in the context of progress towards UHC.

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HEALTHCARE IN MENA: STRUCTURE AND FINANCING

Statuses and Outcomes

From the standpoint of the 1960s or even later, there have been improvements in national health outcomes in MENA. The region has eliminated many major communicable "Type I" diseases and epidemics, except perhaps in Yemen, Iraq and now Syria, where some major diseases have reappeared.[14] In most MENA, life expectancy has been over 70 years since mid-2000s. These indicators place most of these countries in the UNDP's category of medium human development. However, closer scrutiny reveals serious and persistent problems

Firstly, progress has tended to stall or slowdown in recent years. The region's average maternal mortality rate may be better than Africa, but is only at par with Latin America, and most countries are behind Turkey, China, or Sri Lanka (see Table 1). Secondly, there continues to be clear differentiation of outcomes by income levels: indicators are twice to four times worse for poorer income quintiles than for richer ones. This trend is also confirmed by surveys and occasional studies,[15] which also document the widespread persistence of regional disparities. In most countries, poorer and rural women and children display health outcomes that were reached by top income quintiles ten years ago, *clearly not an inclusive process*.

Table 1. Arab countries: Basic health indicators, 1990-2013

	Life expectancy (years)			**Maternal Mortality Ratio**			**Mortality rate, under-5 (per 1,000 live births)**		
	1990	**2000**	**2012**	**1990**	**2000**	**2013**	**1990**	**2000**	**2012**
Algeria	59.6	70.0	70.9	220	120	89	67.6	34.7	20
Egypt	56.2	69.1	70.9	230	75	45	93.5	45.1	21
Iraq	57.3	70.7	69.2	89	71	67	46.1	44.8	34.4
Jordan	67.0	72.1	73.7	110	65	50	38.3	27.7	19.1
Lebanon	66.6	70.6	79.8	52	37	16	38.3	19.9	9.3
Libya	60.0	72.5	75.2	99	21	16	44.5	27.1	16.2
Morocco	57.6	68.7	70.6	300	200	120	85.9	50.3	31.1
Syria	66.2	74.0	74.7	240	75	49	38.2	23.6	15.1
Tunisia	62.1	72.6	75.1	130	65	46	49.3	29.7	16.1
West Bank & Gaza		70.9	73.0		59	47	44.7	29.9	22.6
Yemen	48.8	59.7	62.9	610	370	220	128	96.8	60
Average	***60.1***	***70.1***	***72.4***	***208.0***	***105.3***	***69.5***	***61.3***	***39.1***	***24.1***
Iran	52.3	69.7	73.8	120	44	23	64.8	34.5	17.6
Turkey	56.6	69.4	74.9	67	33	20	79.8	37.4	14.2
Upper Middle Income	65.8	70.4	74.2	120	93	57	48.9	37.9	20.2
Middle Income	61.5	67.7	70.1	280	270	170	84.7	70.7	44.9

Source: *World Bank Development Indicators* (April 2012, May 2014)
DOI: http://dx.doi.org/10.5257/wb/wdi/2014-05-09

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In particular, Algeria boasts that its maternal mortality ratio (MMR) of 97-100 per 10,000 in 2010 is above African averages.[16] Yet it is only at par with poorer Morocco and worse than Syria's. This ratio is also high given that most births in Algeria are said to be attended by skilled staff, raising serious questions about the quality of care. As clear from any field visits, the under-provision and poor quality of maternal health care is a major deficiency of the Algerian health sector. According to IPEMED (2012) and the latest WHO report, this situation has been going on despite a major inquiry into the problem in 1999.

Similarly, improvements in Tunisia's maternal health outcomes are unevenly distributed. In 2002-2006, the rates for unassisted deliveries stood at 5.4 nationally, 11 in rural areas, and a high of 22-29 in the underdeveloped areas. The corresponding levels in 1994 were respectively at 15.8, 30.6, and 34 (Boutayeb & Helmert, 2011). Similarly, in Morocco, in 2010, the national, urban, and rural MMRs stood at 112, 73 and 148 respectively, while medically assisted deliveri*es in urban and rural areas stood at 94% and 57% (Haut Commissariat du Plan, 2013)*. Yet the latter had seen an improvement from 18.75 to 45% in five years thanks to the provision of lodging and infrastructure to personnel in disadvantaged regions (Elgazzar *et a*l., 2010).

Survey data confirm a similar pattern of uneven and unequal outcomes in child health (see Table 2). The proportions of underweight children are relatively low in MENA, but child stunting remains a significant problem in Egypt, Morocco, Syria, and Yemen. Furthermore, outcomes are mostly worse amongst poor quintiles: children in poorest quintiles in North Africa are 3 to 5 times more likely to die (Boutayeb & Helmert, 2011, pp.7-9). Similarly, Assaad *et al.* (2012) highlight inequalities in outcomes and opportunities in child health in Egypt, Jordan, Tunisian and Turkey. They find that total inequality and inequality in opportunities only clearly improved in Turkey, the country with the lowest health differentials amongst children.

Table 2. Health indicators by income groups in Arab countries

		Births attended by skilled health personnel (%)		**Urban Under-five mortality rate (%)**			**Underweight prevalence in children under 5 (%)**	
		Poorest 20%	**Richest 20%**	**Poorest 20%**	**Richest 20%**	**National**	**Poorest 20%**	**Richest 20%**
Algeria	2006	88	98				5	2
Egypt	2005	73.6	99.2	54.3	26	31.9	8	5
	1995	39.1	93.8					
Jordan	2007	98	99.9	28	22	25.2	3	0
	1990	80.7	95.3					
Morocco	2003	73.2	95.7	50.5	17.6	44.2	15	3
	1992	44.1	82.2					
Syria	2006						10	7
Yemen	1997	7	50	58	35			
	2007/8	17	74	163	73			
Developing countries							40	15

Sources: WHO, MDG database; UNICEF, State of the World Children 2012.

Yemen: Arab Human Development Report 2009 and World Development Indicators 2011

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Clearly then, MENA has *not* continued to improve basic health interventions, nor has it been improving their quality or extending them to all the population. Further, the lingering focus on vaccinations and indicators of Type I diseases means that MENA systems are not responding to the epidemiological transition to NCDs (cardio-vascular and mental diseases, etc.).

Provisions and Structures

Human and Physical Infrastructures

MENA health infrastructures can be described as biased towards tertiary care and large hospitals (Femise, 2009; El-Laithy, 2011; Kronfol, 2012a, 2012b), with services and workforces concentrated in urban areas and amongst richer income quintiles. As shown in Table 3, in terms of hospital beds, except for Yemen and Iraq, the number of beds in most countries is in the range of 1.4-2.4 beds per 1,000 displayed by middle income countries, but below the rates for China, Sri Lanka, or Brazil. The national bed/population of 3.6 in Lebanon has a highly skewed distribution: bed capacity is concentrated around Beirut, where the ratio is 7 (Salti *et al.*, 2010). In Morocco in 2005, the ratios of private practice per population

Table 3. Key health infrastructure indicators per population

	Bed/1000 people (1)	**Physicians (2)**	**Primary Health Care units or centres (3)**
	(2005-2010)	**2010**	**2010**
Algeria	2.1	12.1	..
Egypt	2.2	28.3	2.2
Jordan	1.8	26.5	2.4
Iraq	1.3	6.1	0.7
Libya	3.7	19.0	2.6
Lebanon	3.6	30.7	2.3
Morocco	1.1	6.2	2.9
Syria	1.5	15.1	0.7
Tunisia	2.1	12.3	2.0
Yemen	0.7	3.0	2.0
Average	**2.0**	**15.9**	**2.0**
Middle income	2.4		..
Upper middle income	3.2		..
Iran	1.7	8.9	3.2
Turkey	2.3	15.4	
Notes:			

(1) World Development Indicators (WDI) 2013; Algeria: 1994 data; Libya: WHO report (2011)
(2) Per 10,000 people. Source: WHO, except for Algeria and Turkey (WDI 2013)
Rates for Sri Lanka, Brazil and China: 4.92, 14.6, 17.6
Countries with least improvement since 2000: Yemen and Syria
(3) Per 10,000 people. Source: WHO, except for Algeria and Turkey (WDI 2013)
Egypt (2005); Libya (2011)

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were 1 per 3,057, and 1 per 59,561 in urban and rural areas respectively (IPEMED, 2012). Access to facilities is further fragmented according to status. For example, in Lebanon, most beds are available only to private or insured users. In Jordan, *19 percent of bed capacity is reserved for the military and their families* (Ajlouni, 2011).[17]

The regional literature and country reports leave little doubt about another feature of health systems in MENA:[18] the private sector has become a key provider of health infrastructures and services, even in public-led systems like Jordan or Tunisia. In Tunisia, in 20 years only 3,000 public beds were added, allowing the private sector to expand its share to 12.5% in 2008. Further, modern diagnostic equipment are concentrated or only available in private facilities (IPEMED, 2012; Abu-Zaineh *et al.,* 2013). In Jordan, private hospitals account for about a third of bed capacity, but the occupancy rate is low (below 50%). Similarly, WHO data show that except in Iran, the availability of generic medicine is distinctly higher in the private sector at 70%-98%, *vs* 28%-64% in the public sector.[19]

In terms of health workforce, Table 3 shows that only three countries have more than 20 physicians per 10,000 people. Yemen only had 2 physicians and 7 nurses/10,000. Yemen, Morocco and Iraq are among 57 countries indicated by the WHO as facing a critical shortage of workforce.[20] In Algeria, the 2008 ratio of the health workforce of 2.4 per 1000 is a cut over the 1999 level of 3.4, with shortages noted in specialists, surgeons, and pharmacists (IPEMED, 2012). Jordan also had a low ratio of nurses in the private sector, mainly due to the poor salaries (Ajlouni, 2011). Similarly, country studies show health staff are concentrated around urban centres and richer regions, in line with the concentration in the infrastructure. Hence, most Jordanian Ministry of Health personnel were in hospitals (6% in primary health centres), and physicians were mostly urban based (90%) and in the private sector (28%) (Ajlouni, 2011).

Most countries have a basic, though typically thin, network of primary health care centres, with a typical ratio of 1-2 per 10,000 people. Turkey, Jordan and Egypt did better than the rest, but substantive physical barriers remain in most countries. This is particularly true of Yemen, Morocco, and Syria, where most people have to travel more than 5 km to reach basic health care (El-Laithy, 2011). These centres also suffer from a number of problems affecting their role in health provision, such as insufficient resources, dilapidated facilities, or short opening hours. In Tunisia, 45% of primary care centres opened 1 day a week (WHO Country Brief 2006). In Lebanon, only 120 of the 800 primary health care centres are public (WHO Country Brief, 2010). *An important consequence of the weakness of primary care is that users are forced onto the more expensive secondary and tertiary sectors.*

Systemic Problems

Regional and country studies also document of a host of systemic challenges that undermine the operation and performance of health systems, with negative effects on accessibility and ability to satisfy needs. The first category of issues are: the *quality* and *safety* of the facilities, medication and treatment; ways of monitoring them; ensuring continuous improvements, etc.[21] It also seems there is a lack of effective regulation or of strong regulatory authorities, which would monitor or control quality and safety standards.[22] Under-resourcing have been a key reason for the poor quality of public systems, which are now synonymous with bad quality and long queues (Salehi-Isfahani, 2010).

A second category of problems highlighted by the literature are pervasive inefficiencies in the use of available resources (be it unused private bed capacity in Jordan, high nursing staff levels in Libya, idle high-tech equipment in Lebanon) and in procurement systems. The third and related problem is that of the lack of coordination between providers and between various levels of health care, *and between*

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financing schemes.[23] Furthermore, poor governance and poor administrative capacities hamper the interface between private and public.

A fourth set of problem is: poor data collection, underdeveloped information systems, and poor management of these, with little ability to track patients, patient needs, or utilization. Examples are: the lack of systematic or coherent recording of deaths in Jordan; the reliance of Tunisia's FMAP system on *manual* recording and different data systems that do not monitor quality or cost; the need for digitization in Libya. Another common recommendation has been the desperate need for more: evidence based research; systematic and comprehensive data collection; actuarial and feasibility studies; and performance assessments and utilisation analyses.[24] Evidence-based research is also crucial for improving sectoral performance, guiding policy, and moving towards UHC. Indeed, cases of successful progress towards UHC were supported by accurate actuarial information, and by developing appropriate administrative capacity.[25]

The Demise of Public Health Spending in MENA

The levels and allocations of government spending on health around the world vary significantly, requiring caution in interpretation (WHO, 2011). There are large and small "allocators": Thailand managed to extend UHC at relatively low per capita levels, while Korea provides good healthcare with 4% of GDP. Nonetheless, in so far as extending and improving medical services in DCs require investments, government allocations to health are expected to rise, with a similar trend noted in developed countries albeit for different reasons. Conversely, the general tendency of health spending in DCs to fall in the 1990s, was seen as setback that undermined progress, with a reversal required to support the MDGs in the 2000s.

With this caveat in mind, this section argues that trends in MENA health spending, be it in terms of the size of the economies or government allocations, point towards a neglect of health, or at best a recovery from low levels. Salehi-Isfahani (2010), El-Laithy (2011), Karshenas and Alami (2012) all agree that public health systems have had to cater for larger populations and expanding health needs on the back of limited, if not shrinking, resources. Additionally, the latter show that, with a few exceptions, public and total health spending as share of 2005-2010 GDP in MENA were *below* international norms, often below the 2.7% for Sub-Saharan Africa. In FEMISE (2014), the average share of health spending in GDP for the Arab World[26] was *the lowest of all regions between 2000 and 2010*.

Table 4 below confirms these trends. Firstly, government health expenditure (GHE) accounted for less than half of Total Health Expenditure (THE) in: Egypt, Iran, Lebanon, Syria, Yemen, and Morocco. Secondly, rises in all three indicators are only registered in Iraq and Morocco; levels fell in at least five countries, stagnating in Algeria and Tunisia. The expansion in the share of government health spending in Jordan is countered by a fall from 4.1 to 3.2 of GDP between 2006 and 2010 (ESCWA 2012).

Similar trends are found on a per capita basis. On a global level, there has been a tendency for health spending to fall in the 1990s due to fiscal retrenchment, and to recover as of the early 2000s. As illustrated in Figure 1 below, in constant US$ terms, MENA levels recovered later, and mainly in Algeria, Iraq and Libya. WHO data for 2011 show that the East Mediterranean region had the *lowest regional levels* of CGHE in GE and in THE in GDP. Similarly, on a PPP basis, Table 5 shows that the average per capita health spending in the East Mediterranean was close to low income countries, and about half of the average for middle income countries. The regional median of US$114-115 was below the $146 in Sub-Saharan Africa. The region also had the slowest growth. Likewise, in constant 2005 US$ terms,

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Table 4. Out-of-pocket health expenditure (% of total expenditure on health)

	1995	2000	2005	2012
Algeria	23.9	25.8	22.9	15.0
Egypt	48.0	58.0	58.4	59.6
Iraq	..	69.9	26.6	*46.4*
Jordan	24.4	38.7	39.8	28.5
Lebanon	55.3	55.7	41.9	44.8
Libya	50.4	42.8	38.2	22.7
Morocco	52.7	54.1	59.5	58.7
Syria	60.3	59.6	49.5	53.9
Tunisia	37.9	36.2	40.9	35.5
Yemen	65.5	43.7	64.8	71.7
AVERAGE	***46.5***	***48.4***	***44.2***	***42.4***
Median	***50.4***	***48.9***	***41.4***	***45.6***
Iran	*53.6*	*56.2*	*53.2*	52.5
Turkey	*30.0*	*28.0*	*23.0*	*16.8*
Sub-Saharan Africa	29.6	31.5	34.5	31.8
Middle income	39.4	43.8	42.4	35.8
Low income	53.1	51.9	51.6	47.9
Upper middle income	35.7	40.9	39.2	33.3
Source: *World Development Indicators* (May 2013, May 2014)				

Figure 1. Average per capita expenditure on health in MENA, 1995-2010

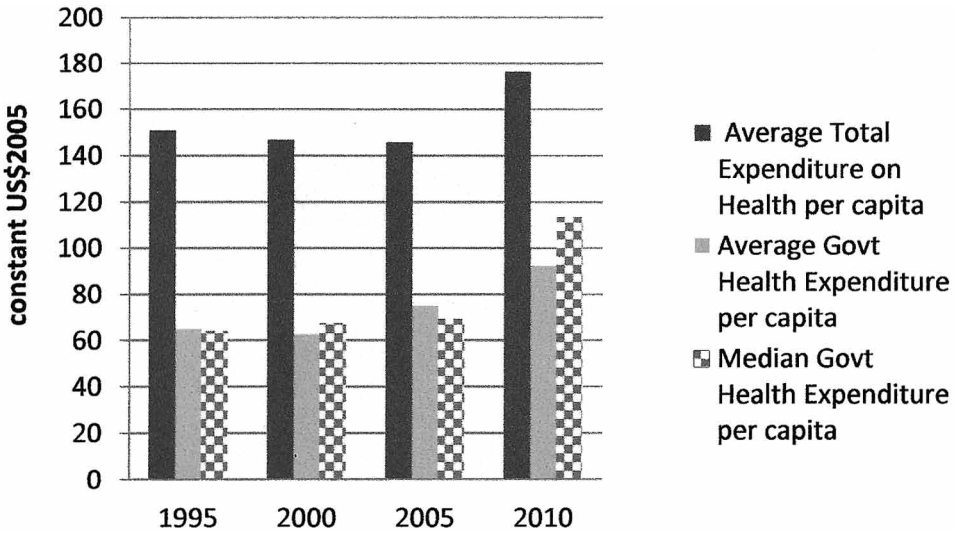

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Table 5. Government spending on health in MENA, 2000-2010

	Govt Spending on Heath in Total Health Spending		Govt Spending on Health in Total Govt Spending			Per capita government expenditure on health (PPP int.$)		
	2000	2010	2000	2005	2010	2000	2005	2010
Algeria	73.3	79.9	8.8	7.9	9	138	160	291
Egypt	40.5	39.2	7.3	6.4	6.1	81	91	115
Iraq	1.1	81.2	0.1	3.3	10.2	<1	82	281
Jordan	48	67.6	10.9	11.6	19.2	147	202	333
Lebanon	32.6	27	7.9	11.9	5.8	246	353	235
Libya	50.8	70	6	5.5	4	214	245	401
Morocco	29.4	35.3	4	4.7	6.9	32	51	98
Syria	40.4	46	6.5	6.8	5.6	65	86	80
Tunisia	54.9	54.3	8.1	9.2	10.8	161	208	295
Yemen	53.8	21	8.3	4.8	4.3	47	39	33
AVERAGE	***42.5***	***52.2***	***6.8***	***7.2***	***8.2***	***125.7***	***151.7***	***216.2***
MEDIAN	***44.3***	***50.2***	***7.6***	***6.6***	***6.5***	***138.0***	***125.5***	***258.0***
Iran	41.6	40.2	8.4	8.8	10.1	127	228	320
Turkey	62.9	74.8	9.8	11.3	12.8	286	421	777
Brazil	40.3	47	4.1	4.7	10.7	203	279	474
India	26	28.2	7.4	6.8	6.8	17	21	36
Thailand	56.1	75	11	12.4	14.3	93	153	248

Source: Health expenditure series, World Health Organization, Geneva, http://apps.who.int/nha/database/DataExplorerRegime.aspx_

in 2011, per capita GHE in Egypt, Syria, Morocco, and Yemen were below the US$62 needed to reach MDGs (WHO 2010).

Finally, Figure 2 puts the regional average in an international context. Clearly, it lags behind Latin America and Turkey. It was ahead of India, but progress has been slower than Thailand, where levels in constant terms almost tripled. In other words, aggregates for government health spending are below levels displayed by reforming countries embracing UHC, which witnessed expanding government outlays on health, improving outcomes, and falling OOP. *In MENA, only Turkey has managed to achieve this result;* Yemen, on the other hand, recorded the largest drop in GHE and largest rise in OOP.

FINANCIAL BARRIERS TO HEALTH CARE

Deficient Provision of Health Protection

Health protection in MENA is characterized by the restriction of public health insurance to public sector or government employees, and the dearth of both private and social health insurance. In 2011, at 6% and 4% of total health financing, social health insurance and private plans in the Arab world were

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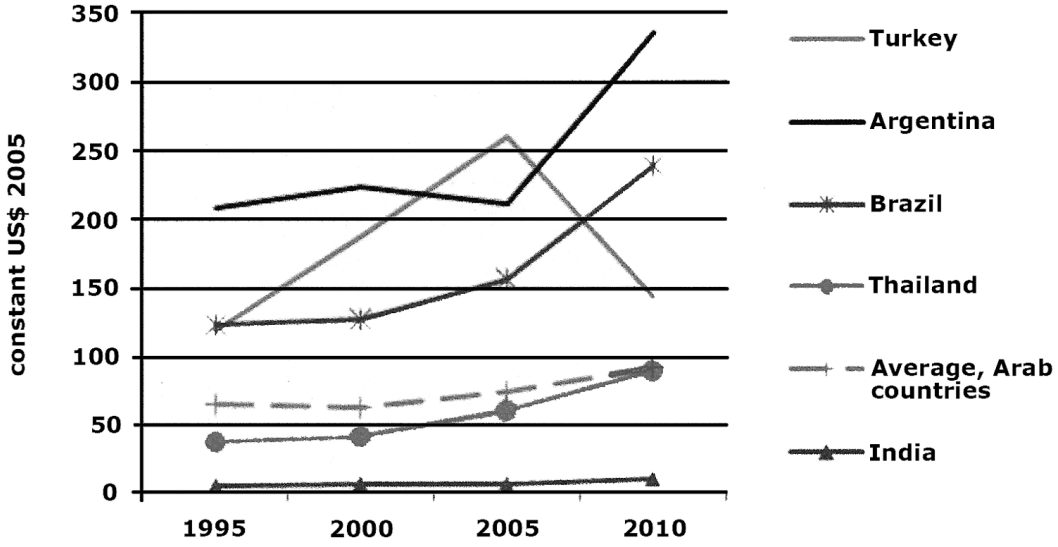
Figure 2. Government Health Expenditure per capita: Arab countries vs others, 1995-2010



amongst the lowest in all developing regions, and compared with 38% and 18% in the Non-Arab world. OOP for the two regions stood at 32% and 18% respectively,[27] with OOP only worse in South Asia. Consequently, the region faces a substantive challenge of extending and revamping existing financial protection or risk-pooling mechanisms.

Though many countries claim to provide healthcare to all citizens, this remains a distant promise in practice. Indeed, public health insurance is *only* available on *a contributory basis*, and tends to be restricted to civil servants and the military. This means that *de facto*, only 30%-40% of the population are covered by public health insurance. The proportion of uninsured population ranges from a *de jure* rate of 15% in Algeria and Tunisia, to 80% in Yemen. Private health insurance is restricted to the rich, urban based population, and is only significant in Lebanon and Jordan. In Lebanon, the insurance coverage is 48%, ranging from 18% to 70% between the bottom and top income quintiles (Salti *et al.*, 2010).

Furthermore, public healthcare and the insurance that come with it are not one unit: they tend to be delivered by a multitude of public funds and agencies, many of which are dedicated to particular categories or segments of public sector and government employees.[28] Such fragmentation leads to considerable inefficiencies and distortions, such as the existence of parallel forms of covers, or bureaucratic limitations on access and on refunds.

The region has witnessed recent initiatives to extend coverage to the uninsured, and/or overcome the fragmentation. Perhaps the most comprehensive initiative has been that launched by Tunisia in 2007-2008, when Tunisia merged its two formal medical insurance systems, unified its mandatory schemes, and started defining the basket of services covered (ISSA, 17/12/2008). This provided progress on *de jure* basis: *de facto* population coverage remained at some 31% with little access to the uninsured (Elgazzar *et al*., 2010). Arfa and Elgazzar (2013) show the FMAP program targeting the poor (now believed to be 15 percent of the population) only reached 40%, while health cards for the needy had are severe limitations, because of the prevalence of co-payments and the reluctance of providers to provide free care. Consequently, at 68%, OOP amongst poor Tunisians is higher than for the richer, not to mention the significant dissatisfaction at "worsening" delivery.

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A more patchy record exists elsewhere. In Syria where only 20.5% of the population have social protection, Sen and El-Faisal (2011) report that the social health insurance pilot scheme introduced in 2008 suffered from poor administration and poor data, and required contribution. Similarly, the Lebanese government has attempted to offer free hospitalisation to the poor uninsured, but this is hardly known or believed in practice (Kronfol, 2012a), particularly that there are so few public hospitals. Egypt and Morocco began piloting health card systems in the last few years. While the Egyptian scheme remained limited to Suez, Morocco made health insurance mandatory as of 2005, and over 2012-2014, it rolled out the RAMED health cards system, aiming to reach 8 million needy Moroccans. No evaluations or monitoring reports are publicly available.

Review of OOP

As previously mentioned, OOP is a good indicator of the financial burden of healthcare, with high levels pointing to inequities in the provision and accessibility of healthcare. By definition, it is high wherever government spending and pre-paid health insurance plans are low: even amongst OECD countries, higher shares of public spending on health are associated with lower OOP (OECD, 2011). By the same token, OOP is lower (under 20% of THE) where there is UHC, which entails good public health provision and significant use of social health insurance. Furthermore, countries with 2 percent or less poverty tend to have OOP levels of less than 15 percent (*World Social Security Report, 2010/11).* Therefore high OOP contributes significantly to poverty.

Figures 3 and 4 depict the situation for MENA. Figure 3 shows that OOPs tend to be 30% or less where government health spending is above 3% of GDP. Figure 4 indicates that households paid for about a quarter of THE where GHE reached at least two thirds of total health spending. Clearly, MENA households shouldered most of the burden of healthcare, with Egypt, Morocco, Syria, Yemen and Iran displaying ratios of 50% or more for quite some time. Moreover, most countries saw stagnating or worsening OOPs. Only Libya and Turkey almost halved of their OOP by doubling their GHE.

Figure 3. OOP vs Government Health Expenditure in GDP, 1995

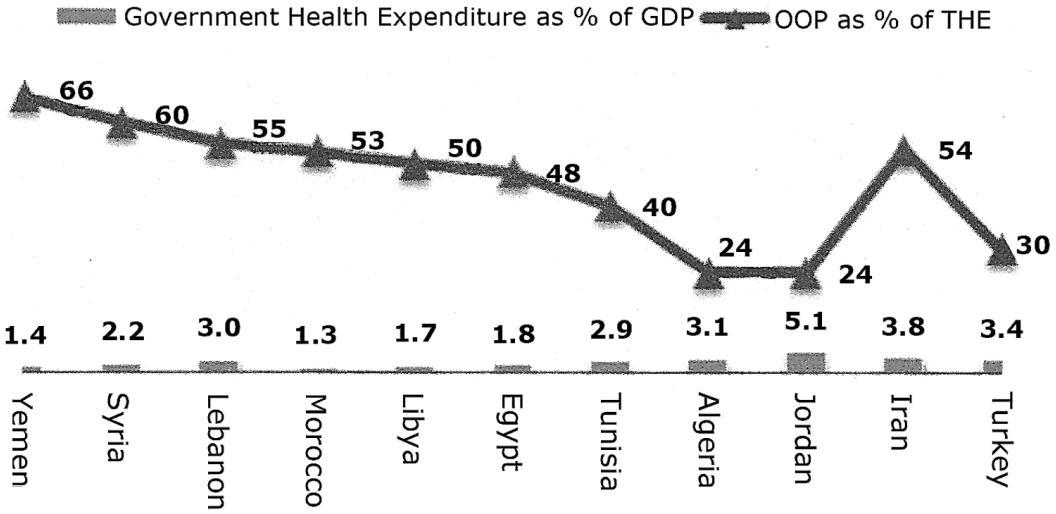

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Figure 4. OOP and Government Health Expenditure, 2011

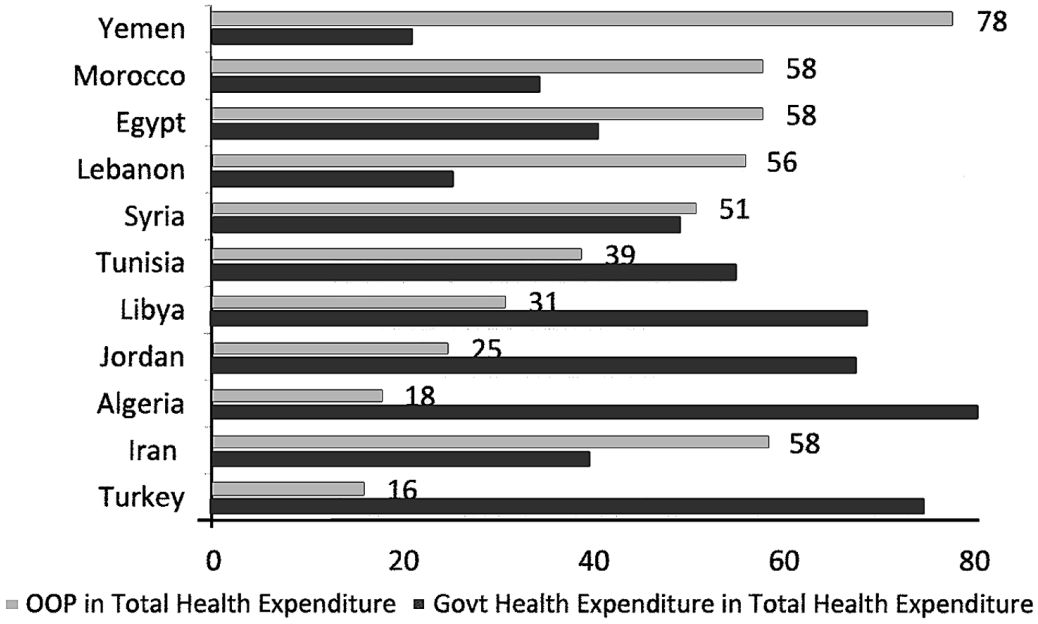

Table 5 not only shows a lack of progress over time, but document a remarkable fact: *MENA countries display some of the highest OOP levels in the world,* a point previously noted by Karshenas and Alami (2012) and ESCWA (2012). The 2010 regional average of 42.4% was higher than the 31.8% displayed by Sub-Saharan Africa. It also clearly exceeded the 33.3% and 36.4% displayed by upper middle and middle income countries respectively. MENA had also maintained this ranking for the last decade. While levels in middle income countries clearly fell from the 2000-2002 levels of 41-45%, MENA did not progress.

There are only a handful of studies on OOP in MENA, two of which (Elgazzar *et al.*, 2010; Abu Zaineh *et al.,* 2013), are of seminal importance. The former covers six MENA countries, and the latter looks at Tunisia. Elgazzar find that CHE in MENA affect between 7-13% of households, and that 10-35% of households *forgo* healthcare because of these costs. Abu-Zaineh finds that 12% of Tunisian households were exposed to CHE at the threshold of 10% of total expenditure, this proportion rising to 49% of households at the threshold of 10% of total non-food expenditure. Furthermore, *poorer quintiles* are *four times more likely* to suffer CHE, with the overshoot over the threshold being higher amongst them. Zouari and Ayadi (2014) find a mild improvement in the proportion of households suffering CHE in Tunisia between 2005 and 2010 (from 19.5% to 17.1% at the 10% threshold). Rashad (2014) finds that 20% of the population in Egypt is vulnerable to CHE at the 10% threshold, but reports a mild impact in Jordan and Palestine. Abu Zaineh finds that the percentage of Tunisian households exposed to CHE is triple the levels in Malaysia or Thailand, but slightly lower than those in India or Bangladesh.

All studies document serious worsening of poverty levels and headcounts as a result. In Elgazzar *et al.* (2010), *headcount poverty increased by 5-14% post-healthcare payments, with 23% more people pushed below the poverty line when accounting for healthcare.*[29] In Yemen, the poorest households display lower OOP because they forgo healthcare altogether. In Tunisia, poverty rises between 13%-17%, from 3.69% to 4.35% using the World Bank poverty line of $1.08, and 12.3% to 13.8% using the WHO approach (Abu-Zaineh *et al.,* 2013; Zaouri & Ayadi, 2014). Rashad reports that an additional 4%

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of the Egyptian population is pushed below the $2 poverty line due to CHE. The increase in poverty headcounts in MENA are slightly above the rises in poverty headcounts in Asia when the US$2 poverty line is used, but comparable to the 14% increase at the $1.08 poverty line (van Doorslater *et al.,* 2006).

Clearly then, poverty in MENA is much higher (typically 10% or more) and deeper than is believed if healthcare spending is taken into account. However, although CHE may deepen poverty, what is also clear particularly in Tunisia and Lebanon, is that paying for healthcare have significant impoverishing effects for the non-poor, with OOP making significant impacts on the discretionary non-food budgets of large proportions of non-poor households. In other words, OOPs are a cause of both poverty and vulnerability.

Three studies (Salti *et al.,* 2010; Elgazzar *et al.,* 2010; Abu-Zaineh *et al.,* 2013) also find that the worst impacts of OOP and CHE tend be found amongst uninsured households. However, OOP or even CHE may be observed where there is social protection because of: extensive use of co-payment; the poor provision or availability of public services or medication, typically restricted benefit package (e.g. cover for hospitalisation but not medication, or for cancer diagnostics but not treatment).

Though limited, information on the main components of OOP that can be extracted from the literature indicates the following. In Iran, the largest component is inpatient care. In Yemen and Tunisia, the three largest categories are medication and pharmaceuticals, exceptional medical care, visits to physicians. Zaouri and Ayadi (2014) and Abu-Zaineh *et al.* (2013) show that co-payments, caps on expenditure, exemptions, all contribute to high OOP, despite the Tunisia system being publicly led and offering free services to the poor.

In light of the previous sections, which showed deficiencies in the quality, quantity, and coverage of the health infrastructure, in light of the limited social protection, and in light of the regional literature presented thus far, OOP is a burden for most MENA citizens, not just the poor. They are symptomatic of systemic problems due to the way MENA health systems have evolved, i.e. below what they could be for the middle income status. Therefore, OOP in MENA is arguably exceptionally high in MENA because of the following factors:

1. The deterioration in the quality and availability of public health, with GHE falling, stagnating or failing to respond to needs in most countries.
2. The creeping explicit and implicit privatisation of services and infrastructure, with the private sector becoming a dominant supplier in many countries.
3. The neglect of primary health care, forcing people to use specialists, secondary or tertiary care.
4. The shift to cost-sharing and fee recovery, resulting in forgone healthcare for the poor, and high OOP for those who can buy it.
5. The inability of MENA health systems to respond to the epidemiological transition to NCDs,[30] resulting in big gaps in both services and social protection available.

MENA SYSTEMS IN A COMPARATIVE CONTEXT

To sum up, in terms of outcomes, MENA has not done badly, though progress has stalled recently and is less impressive when compared to many of its peers. Furthermore these outcomes are characterised by serious inequities in terms of gender, location, or income. Inequities are also found in the provision and delivery of healthcare, be it in terms of quality, access, or financial burden. As captured by OOP, the financial burden of healthcare in MENA is high for its income category, and is made worse by limited

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social protection. Using the WHO's three dimensions of UHC (who, what and how much is covered in terms of healthcare)[31], MENA insures or covers less than half of its population, only for basic health issues, and with important exclusions.

As argued throughout this paper, UHC is particularly relevant for Arab health sectors, because it seeks both to improve health outcomes for all, and to reduce inequities in access and use of healthcare. Furthermore, a number of policy directions have been developed from international experiences of achieving UHC, and these provide benchmarks against which regional performance can be assessed. The exercise results in the following policy suggestions.

Firstly, more government resources need to be mobilised. Countries need to spend at least US$65 per capita by 2015, and it is difficult to achieve UHC by spending less than 4-5% of GDP on health. This is particularly relevant for Egypt, Syria, Morocco, and Yemen. Similarly, the share of CGHE needs to increase, or at least be preserved. After all, the WHO Africa region has suggested a voluntary target of 15% of government spending. Secondly, OOP levels need to be halved in most countries, particularly amongst vulnerable groups. This means improving on who is covered, and on the proportion of costs included. Thirdly, financial and physical barriers must be reduced by a combination of supply and demand interventions (Elgazzar *et al.,* 2010).

The feasibility of these strategies has already been demonstrated worldwide and in Turkey, which followed a UHC-oriented strategy to eliminate the same challenges now facing MENA. According to Atun *et al.* (2013), Turkish health reforms, which spanned over a decade, adopted UHC and the right to healthcare as an integral part of citizenship, and gradually filled the gaps in provisions and outreach. For example, the tenfold increase in the number of beds (including the use of spare capacity in the private sector), allowed Turkey to offer free emergency healthcare as of 2008. It improved the access of the poorest deciles through both contributory and non-contributory schemes. Likewise, the number of poor people covered rose from 2.4 to 10.2 million, and maternal health indicators improved dramatically. This expansion was built on a rise of CGHE/THE from under 10% in 2000 to 13.8% in 2011, with THE/GDP rising from 2.7% to 6.1% between 1990 and 2008.

The UHC framework is also at the root of the classification used by the *World Social Security Report 2010/2011* to classify the levels of vulnerability of populations in DCs. Most middle income countries, particularly those which made significant progress towards UHC, have a low level of vulnerability. On average this means less than 17% of the population with no coverage, and only a 14.7% deficit in health staff.[32] In terms of financial burden, countries with low vulnerability tend to have OOP of 38.5% or less, with financial barriers affecting 19.3% or less of the population.[33] In countries with medium levels of vulnerability, these ratios are 30.8%, 27.3%, 41.7%, and 39.7% respectively. Significantly, low levels of vulnerability are characteristic of countries where public resources GHE account for at least 60% of THE.

The MENA regional profile places *most countries in the medium to high levels of vulnerability*. It also seems there are two regional sub-grouping. The first group consists of Turkey, Algeria, Jordan, and Tunisia, which have less severe problems. Turkey is the best performer, displaying indicators associated with low vulnerability. The second group, to which Iraq and Libya can probably be added, can be classified as displaying high vulnerability, due low health coverage, high OOP, and major deficiencies in provision.

In terms of social protection, the regional average is almost 49%. On the one hand, we have Tunisia, Algeria, and Jordan, where the *de jure* gap in coverage is 20% or less. On the other hand, in Yemen and Morocco, the majority of the population are not covered, to which crippling deficit in health personnel can be added. Financial barriers are significant and above 20% in all but Jordan, Iran, Tunisia and Lebanon.

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However, the scores reveal a number of problems and suffer from inconsistencies. For example, Algeria is said to have an OOP of 21% but financial barriers affect nearly 30% of the population. Conversely, Tunisia has high OOP levels that do not gel with the estimated *de jure* level of coverage. Indicators report no deficit in personnel in Lebanon or Egypt, though these suffer significant bottlenecks and uneven geographical distribution.

Furthermore, even among the star performers in MENA, the dominance of government spending provision in healthcare is yet to be translated into low vulnerability and low OOP, a result only achieved by Turkey. For the rest of MENA, huge barriers remain in terms of protection, finance, staffing, and physical resource. These countries are unlikely to be able to close the deficits without scaling up government health spending.

POLICY IMPLICATIONS

Sectoral evidence presented thus far leaves little doubt that MENA countries face massive policy challenges in moving towards good quality, accessible and affordable healthcare for all, these being key policy goals in IG and UHC frameworks. While the large gaps in provisions in Morocco and Yemen are not unusual amongst poorer countries, many such countries have done better, and even embarked on major reforms. MENA is also similar to other developing regions in that public health provisions clearly suffered from budgetary pressures and economic crises in the 1990s. However, whilst there was a clear reversal of this trend elsewhere, MENA has yet to see a reversal of fortunes, with many health sectors stagnating despite strong economic growth in 2004-2009.

As documented by the literature on the MDGs and UHC, health sectors in DCs were also undermined by the political economy of neo-liberal frameworks of the WC, which prioritised cost recovery and financial goals over clinical soundness and equity.[34] The regional literature[35] establishes a similar situation in MENA. For example, Sen and Al Faisal (2011) show that EU's privatisation-driven modernisation program had negative effects the Syrian public health sector, and was designed with little consideration for equity. In Tunisia, the shortages of medications and public services and creeping privatisation have been hidden behind stable shares of health spending in the economy.

But the crises in MENA sectors are not just about insufficient resources. The demise of public health in MENA is also reflected in a deterioration of performance and status. According to Jabbour (2013), who summarises the findings of the regional public health alliance, public health in the region is weak "in institutional capacity and human resources, undermining its leadership potential". This is a very serious situation, since public health sectors are the very vehicle that is required to deliver equitable health for all. In their current state, MENA health sectors have continued to deliver inequities in access, delivery, and outcomes, as a clearly documented in the first section of this chapter. Governments have been happy to roll on health policies that were not just out of synch with their population needs, but also led to substantive financial burdens, despite protests from sectoral specialists who have been championing UHC for some time.

As Kronfol (2012b) and Jabbour (2013) argued, it seems that what has made the situation worse in MENA has been the lack of political commitment, which have amplified the negative effects of insufficient resources. This political neglect has arguably been two-pronged: a lack of "political visibility"

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or "political clout" for health ministries and agencies (Arfa and Elgazzar, 2013); a neglect of equity dimensions of economic policies and lack of serious anti-poverty policies. Most analysts now agree that poverty and equity would not have made it to the policy agenda where it not for the protests of the Arab Spring. Likewise, the fact that some many rural areas in MENA continue to be deprived of good health services is indicative of failing rural development and poverty reduction strategies.

The lack of political commitment is more glaring when MENA's piecemeal initiatives are compared to the multi-year, cross-party, national political commitment and holistic reforms elsewhere. Brazil initially committed to UHC in 1990, and went on to scale up and improve its Family Health Care primary health system since 1996. Its Bolsa Familia program emerged from reforming, in 2003, four assistance programs; a key element in this was the construction by a common information and registry system. Thailand committed to address domestic social problems and extend healthcare to all the population in 2001. South Korea constructed its public health system over a period of 12 years as of the 1980s (van Ginneken 2003). Similarly, political factors (such as democratic transitions or commitment of major parties or trade unions), were found to be statistically significant determinants in cases of UHC adoption (Stuckler *et al.,* 2010).

While in MENA, economists are still trying to demonstrate the feasibility of extending basic healthcare to all[36] (i.e. really paying for basic services for the poor), Latin America has been earmarking significant resources to health transfers in kind, which come on top of other transfers. According to Lustig *et al.* (2013), these transfers ranged between 2.6% and 4.7% of GDP and were almost equally split between a contributory and non-contributory basis. The study showed that these transfers had a tangible redistributive role in those countries, with social spending achieved significant reduction in GINI coefficients and poverty levels. In this sense too, MENA is far from mobilising tax revenues and far from being having fiscal policies with a redistributive potential.

CONCLUSION: TIME FOR ACTION

Since the MDG process, there has been a push towards a holistic approach to dealing with development failures, i.e. towards an inclusive development process that prioritizes equity and gives attention to non-income aspects of well-being. This set the scene for the current global consensus on UHC, which has helped restore the centrality of health and of health equity to growth, development, and social justice. In working towards affordable healthcare for all, UHC established the need to go beyond national health outcomes to look at the building blocks of health systems, which determine fairness in access and delivery, and shape the financial risks associated with ill-health. Ensuring good health for all is in turn a pillar of an IG process, and crucial for achieving poverty reduction.

These frameworks imply particular benchmarks for success, and their applications in developing regions have produced a number of policy directions that need to be followed to achieve UHC within an IG process. The former include the elimination of inequities in provision, utilisation, and outcomes, while the latter typically require well-supported public health systems that receive a minimum of public resources.

In the MENA region, sectoral specialists have enthusiastically embraced UHC as a framework that could deliver solutions to the problems besieging regional health systems. MENA systems are far from

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ensuring good health for all, and are characterised by a focus on often mediocre tertiary care centred on large urban centres. They are still described as mismanaged, inefficient, and fragmented (between levels of care, civilian/military, insured/uninsured). Severe disparities and inequities remain, and large swathes of the population, particularly poor mothers, are barely achieving what rich quintiles achieved ten years ago: they are unlikely to do so if current policies continue.

Underpinning this situation has been a policy of tangible neglect of public sectors, be it in terms of financing, equipment, or staff. MENA public health systems suffer from systemic problems in terms of management, institutional capacity, and regulatory abilities. Even amongst star performers, there are major deficiencies in the organisation, collection, and use of information, data and evidence. Considerable efforts are also needed throughout the region in terms of improving the standards, quality, and safety of care, medication, and facilities.

In most MENA, public health spending and budgetary allocations have been below the norm of middle income countries, and certainly below the reported needs of their population. There has been a pervasive, though often implicit, privatisation, with a clear shift to the ability to pay. The poor state of public facilities and services, *de facto* privatisation, and deficiencies in social protection, have all contributed to the fact that OOP in MENA is the highest amongst their middle income peers. Far from being eased by a golden social contract, poverty and vulnerability in the region are considerably worsened by the financial burden of healthcare.

Politicians and macro-economists have largely ignored this reality, the former largely because of their focus on the preservation of power and use of force, and the latter largely because of a narrow focus on income growth, and because of the false reassurance of few health indicators. In doing so, they have contributed to policies that have undermined the vehicle that can deliver good healthcare for all, namely the public health sector. This vehicle has to be revamped just to cope with current needs, and would have to be scaled up in order to respond to the epidemiological transition to NCDs.

However, revamping health sectors is not just about financing requirements, but rather it is about having a developmental strategy and a political will. At the heart of the health challenges facing MENA are clear developmental failures in terms of rural development, poverty reduction, and social protection, all of which require serious departures from current practices. Thus, it is easy to recommend an increase in health personnel, but deploying and retaining them in rural areas is more complex. Furthermore, improving health outcomes for the poor also means improving living conditions, access to water, etc. Likewise, it is easy to issue free medical cards to the poor. But as the Tunisian case shows, public provision is often neither free nor available. Finally, improving social protection is a complex institutional and fiscal challenge, but without it, shortages in coverage will not take care of themselves, and vulnerability levels will remain high.

Lastly, regional political systems have continuously provided short-termist, piecemeal policy suggestions, and only paid lip service to the UHC agenda. What it needed is the political will to tackle the political exclusions that led to regional, income, and health inequities in the first place. Such political will come from a commitment to prioritising development and social justice in the political agenda, paving the way to dealing with them within a holistic road map. Alas, the Arab Spring may have created a political opportunity for social justice, but at present, such needs are being pushed aside by more instability, emergencies, sectarianism, and tribalism.

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KEY TERMS AND DEFINITIONS

Catastrophic Health Payments: Health payments are said to be "catastrophic" when they exceed a certain threshold. This can be calculated either out of the total budget, or net of food spending, which some see as a closer reflection of the ability to pay.

Inclusive Growth: Growth is inclusive to the extent that it that grants equal access to income growth, reduces disparities and inequities, and improves non-income dimensions of well- being for all. Inclusive development can be thought of as the same process but in a developmental context, where major challenges such as poverty or depravation prevail.

Millennium Development Goals: These are eight international developmental goals endorsed at the 2000 Millennium Summit with a target date of 2015. These goals are: eradicating extreme poverty and hunger; achieving universal primary education; empowering women and improving gender equality;

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improving maternal health; combating major killer diseases (e.g. HIV/AIDS); ensuring environmental sustainability; working in a genuine global partnership for development.

Non-Communicable Diseases: These are chronic diseases and/or diseases that are not passed on from person to person, but which are important causes of morbidity and ill health. The main categories are cardio-vascular diseases, cancer, diabetes, mental illnesses.

Out of Pocket Expenditure: Any health related expenditure paid by individuals or households that are not covered by insurance, government, or other sources.

Social Protection Floor: Refers to the minimum set of interventions provided by a social protection system. Ideally it guarantees access to healthcare and basic income to children, older persons, and others who are unable to earn that income.

Universal Health Coverage: UHC is about providing key promotive, preventive, curative, and rehabilitative health interventions for all, at an affordable price.

ENDNOTES

1 In this chapter, Arab Countries and Arab World refer to: Lebanon, Syria, Jordan, Iraq, Yemen, Egypt, Libya, Tunisia, Algeria, and Morocco. MENA refers to these countries plus Turkey and Iran. The latter two are mainly used as comparators, with Turkey having made the most progress.

2 See respectively Galal and Selim (2012), and Arezki and Nabli (2012).

3 See references for WHO reports used in this chapter. For example, a 2007 WHO Libya brief suggested "redesigning the health system".

4 See Sen's interview with the WHO, http://www.who.int/infwha52/to_our_health/amartya.html

5 See Stuckler *et al.* 2010, WHO (2010); OECD (2013).

6 See Whitehead *et al.* (2001).

7 See van Doorslaer *et al.* (2006), Xu *et a*l (2003), Leive and Xu (2008).

8 See *The World Bank Development Report 2006.*

9 These are MDG 3, 4, 5 and 8E (reducing child mortality, improving maternal health, combating HIV/AIDs/other diseases, providing affordable drugs on a sustainable basis).

10 Sponsors of the resolution include Jordan and Egypt.

11 See http://www.worldbank.org/en/topic/health/publication/universal-health-coverage-study-series.

12 Dağdeviren and Robertson (2011) show that indicators of access to water fail to capture whether: access is delivered through a fully functioning network; the supply of water is available continuously (not rationed); and it is connected to a functioning sewage system. Similarly, despite good water access indicators, Lebanon relies on bottled drinking water, while Gaza's fresh water is unfit for human consumption.

13 A large body of literature has also assessed health provision by looking at social opportunity functions, or by constructing curves and indexes for access to services by income deciles at different points of time (Ali and Son (2007), Ali and Zhuang (2007), Zhuang and Ali (2009)). These studies have a sectoral focus and are not easily integrated with other aspects of IG.

14 Polio has re-appeared with epidemics being reported in Syria and amongst Syrian refugees.

15 See Assaad *et al* (2012), Salti *et al* (2010), Boutayeb and Helmert (2011).

16 Algeria is classified in the Africa region of the WHO. In *Health Statistics Profile 2010*, women receiving 4 or more antenatal visits stood at 41% in Algeria and 44% in Africa.

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[17] Unfortunately, no comparable data exist for countries with substantive military establishments (Algeria, Egypt, Syria).

[18] See El-Laithy (2011); Kronfol (2012b and 2012c); Sen and Al Faisal (2011); IPEMED (2012)

[19] See MDG 8, http://apps.who.int/gho/data/view.main.660, accessed 22 August 2014.

[20] See WHO (2006), "List of 57 Countries facing Human Resources for Health Crisis", http://www.who.int/workforcealliance/countries/57crisiscountries.pdf

[21] See El-Laithy (2011); Kronfol (2012b, 2012c); Jabbour (2013).

[22] Ibid, and Ajlouni (2011) and IPEMED (2012).

[23] See Arfa and Elgazzar (2013)

[24] See Kronfol (2012 b), IPEMED (2012,) WHO (2010), Ajlouni (2011).

[25] van Ginneken (2003) ; Stuckler *et al* (2010).

[26] Including GCC countries.

[27] See WHO data, http://apps.who.int/nha/database/Comparison_Report/Index/en, accessed 31 July 2014

[28] See Femise (2009), El-Laithy (2011). The latter mentions that 29 agencies are involved in Egypt. In Tunisia, 10 public agencies collect data but there is no centralised system to deal with poor beneficiaries (Arfa and Elgazzar, 2013).

[29] In West Bank and Gaza, OOP imply a rise of 80% from 14% to 25% of households.

[30] This trend is stated in almost every WHO report of countries studied, but also in IPEMED (2012) and others.

[31] Stuckler *et al* (2010).

[32] Health staff deficit is the ratio of health personnel minus the ILO benchmark (40/10,000) in percent of that benchmark.

[33] Financial barrier is defined as: per capita THE minus OOP, expressed as in percent of the benchmark for countries with low level of vulnerability ($350 per capita on a PPP basis),

[34] See Whitehead *et al* (2001), Van Doorslaer (2006), Xu *et al* (2008).

[35] Salti *et al* (2010), Kronfol (2012 b), Jabbour (2013); Sen and Al Faisal (2011); Saleh *et al* (2014)

[36] Using the social protection floor framework, ESCWA (2012) calculated that, in 2015, between 0.4% and 6.3% of GDP would have to be spent to extend basic healthcare to all, the scale corresponding to Tunisia and Yemen. If these percentages were added to current rates, this would bring most MENA countries to in line with international norms.

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APPENDIX

WHO Publications

Algeria: Statistical Factsheet 2010
Algeria: Statistical Profile 2010
Egypt: Health Profile 2013
Egypt: Country Co-operation Strategy *at a glance*, 2009
Iraq: Country Co-operation Strategy *at a glance*, 2011
Lebanon: Country Co-operation Strategy *at a glance*, 2008
Libya: Health Profile 2013, *Country Cooperation Strategy for the WHO and the Libyan Arabian Jamahiriyya*, EM/ARD/039/E/E03.11
Morocco: Health Profile 2013
Tunisia: Health System Profile, 2006
Yemen: Health Profile 2011

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Chapter 4
Innovation in the Health System:
Evidences from Brazilian Local Production and Innovation Systems

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ABSTRACT

This chapter discusses the main findings of five empirical studies focusing on local health innovation systems in Brazil. It focuses on the articulation of service and manufacturing segments within the Health complex and the other organizations that constitute a Local Innovation and Production System (LIPS) and discusses the learning, capacity building and innovation processes and their effective and potential impact on the local territory. The findings suggest that the types and intensity of interactions are closely related to the characteristics of what can be called a local cognitive territory. The directions of capacity building and scientific and technological evolution are directly influenced by conflicts among individuals and groups. The influence of these power relations, which are often associated with diverging private and public (collective) interests, highlights the importance of the institutional and policy dimensions for mediation and for promoting an evolution of the system that favors social inclusion and efficiency.

INTRODUCTION

Health and, specifically, the service and manufacturing segments of the health complex are of central importance for development at the national, regional and local level. This importance is related to two general vectors of development: on one side health figure as a structuring factor of the Welfare State (life quality and citizenship), and on the other side it is a major driver of economic growth, given the mass consumption characteristic of health products and services, as well as its potential for job creation, investment and innovation.

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This is especially relevant in the case of Brazil were the 1988 constitution guaranteed universal and integral access to health treatment for the entire population. Given its almost 200 million inhabitants, it constitutes the biggest universal and integral public health system in the world. Thus, the analysis of health from a development perspective cannot be exclusively subordinated to the logic of industry competitiveness. Both from an analytical point of view and from a normative one, the health system must be understood from a dual perspective that encompasses economic competitiveness and its dimensions as a public and social essential service. This involves criteria of availability, access and quality. The state plays a fundamental role, not only for introducing active policies aimed at strengthening the technological production base, as well as for ensuring the convergence with social objectives.

Reducing interregional and intraregional inequalities figure as one of the main goals of the Brazilian development policy. The trend towards concentration of the manufacturing activities within the health industry that occurs on the international sphere is reproduced within the country. Thus, recognizing and mobilizing the productive, scientific and technological potential related to health in different states, counties and micro-regions of the country is a key goal.

A territorial approach to the health production and innovation system allows using the capillarity health services have to stimulate the territorial diffusion of productive and innovative activities and to articulate the economic and social dimensions of development. If, on the one hand, health services are relatively evenly spread across the territory, the same is not true for the manufacturing segments, nor to the process of generation and dissemination of knowledge and innovation. Recognizing the territorially and socially rooted dimension of learning process and the generation of innovations, health offers a potential to make transformations that are relevant and related to the needs and opportunities of each local territory.

Thus, the focus of this chapter is to discuss the empirical evidences related to the processes of learning and innovation in healthcare production/service provision activities in a local territorial dimension. The empirical findings come from the research project "Health and Innovation: Territorialization of the Health Economic-Industrial Complex" were five different cases were analyzed.

These studies were based on the analytical and methodological framework of Local Innovation and Production Systems (LIPSs), which emphasizes a systemic perspective for the analysis of social processes in a specific territory. The cases cover five different states of the country, offering a broad and diversified set. The findings from these studies converge to form a complex mosaic of issues that are of central relevance for the territorialization of the health system. Therefore, we focus on those aspects that represent general implications that may help to advance on federal and state policies for health system on a territorial sphere.

The text is structured in five sections. The first one discusses the conceptual framework for the analysis of health production and innovation systems. The second section offers a concise overview of the five cases. The next section discusses the findings related to the learning and innovation processes. The fourth section focuses on the institutional dimension that influences the development of these local cases. Finally, the conclusion addresses some policy implications.

HEALTH INNOVATION SYSTEMS

The Brazilian industrial policy directed to the health industry has been carried out in the last decade under the header of the Health Economic-Industrial Complex – HEIC. It encompasses both manufactur-

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ing industries (the chemical and biotechnology industry and the mechanics, electronics and materials industry) as well as service providers (hospitals, clinics, diagnostic and treatment) that are consumers of the products manufactured in the first group and at the same time articulate the consumption of these industrial products by the population. Figure 1 shows the structure of the HEIC and the three production subsystems that compose it.

From the Systems of Innovation perspective we consider that the HEIC comprises a central part of the National Health Innovation System (Gadelha, 2010). Thus, beyond the production and innovation subsystem, the health innovation system also includes the subsystem of organizations dedicated to education, science and technology, the subsystem of demand (users/beneficiaries), the subsystem of promotion, regulation and support, as well as the broader social, cultural and institutional environment (Cassiolato & Lastres 2008). For analyzing this systemic dimension of health on a concrete territorial dimension we use the analytical and methodological framework of Local Innovation and Production Systems (LIPSs), developed by the Brazilian research network RedeSist for analyzing production, learning and innovation and their impact on competitiveness and sustained development (Cassiolato et al. 2003). This framework is based on the broader framework of innovation systems (Freeman 1987; Lundvall 1992; Nelson 1993), focusing on the local sphere of production and innovation, but also considering its insertion within the broader national and international contexts. (Lastres et al, 2003).

In the case of the health sector, the service segment within the production and innovation subsystem is primarily responsible for the mobilization and coordination of the manufacturing segments of the HEIC, given its strong impact on the demand for products. In addition, the services subsystem not only uses the innovations generated in the manufacturing sectors, but also has the capacity to endogenously innovate and drive innovative efforts in others segments. Thus, we find intense (nonlinear) interactive relations of the services subsystem with suppliers and customers (Gadelha, 2010). In addition to these dynamic elements, from a social perspective, we find that the service segments generate the most relevant impacts in terms of jobs and income generation. Thus, it conforms a strategic locus for systemic innovation processes, becoming the core of the health LIPS.

Figure 1. The Health Economic Industrial Complex – HEIC
Source: Gadelha, 2010

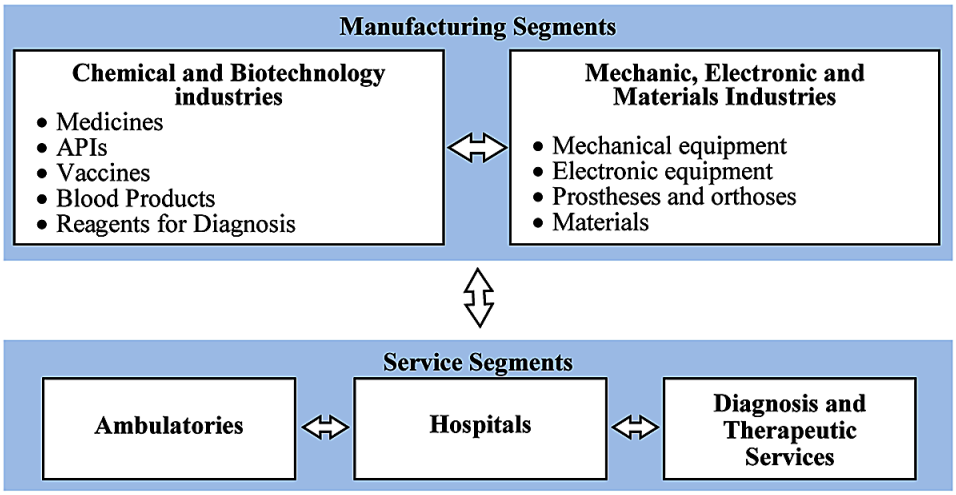

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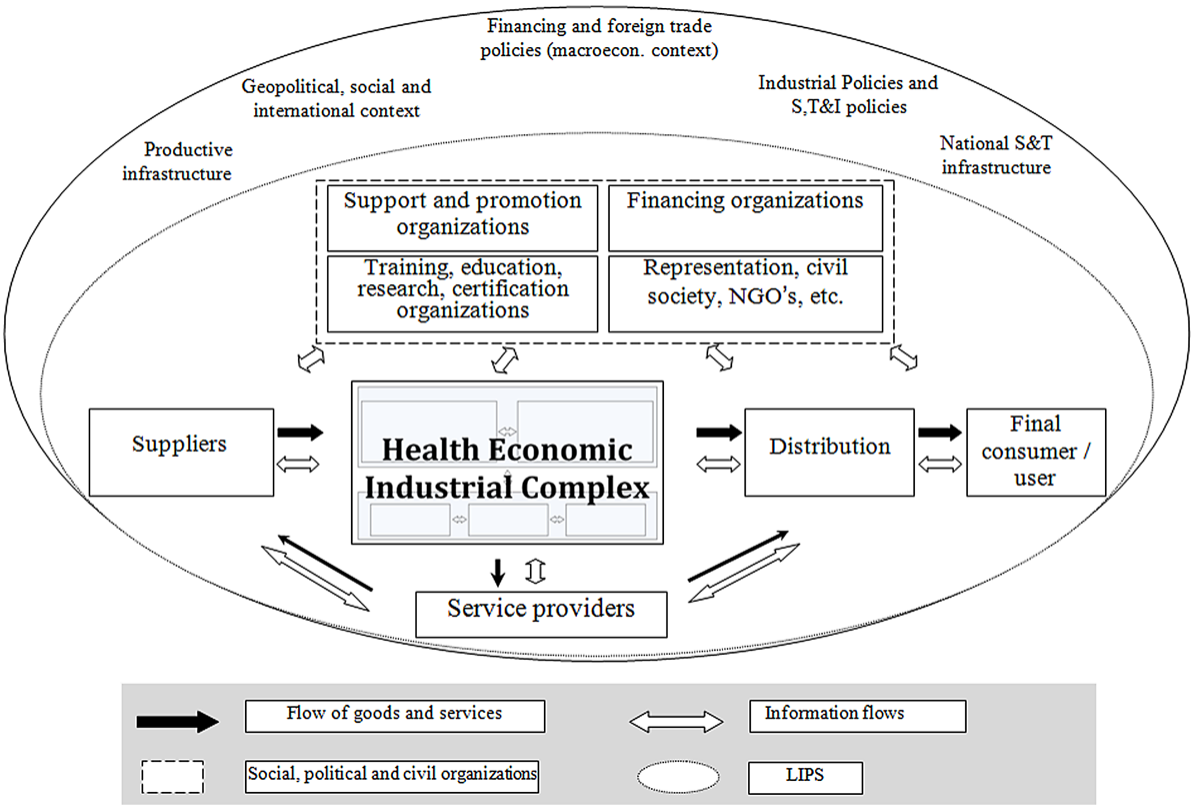
Figure 2 shows the schematic structure of a LIPS, which has in its centre the production activities of the different manufacturing segments and services related to health.

As we know, this systemic perspective of health is relatively new, since most studies have focused on specific sectors (such as biotechnology and pharmaceutical industries, for example). Thus, it is a challenge to consider innovation, production and health services within a systemic perspective. The challenge is even bigger if we consider this within a specific local dimension, which indeed is fundamental for closing the "gap" between social policies and industrial and innovation policies.

The analytical and methodological framework of LIPSs has also been recently used in research efforts in the scope of a Globelics network project entitled "RISSI-Research on Innovation Systems and Social Inclusion". This framework involves empirical studies, using specific questionnaires and interview guides that explore issues related to the structure and dynamics of firms, the processes of interactive learning, cooperation and innovation in the territory and the articulation with the training, scientific and technological subsystem, the social dimension and the broader institutional set-up. It also encompasses analytical guidelines for answering the main issues related to the LIPS research agenda. For the study of the health system many adaptations and modifications had to be made both in relation to the field research tools and to the guidelines for analysis. This derives from the specific characteristics of the health system and its different segments. Especially, when considering the service segments as central drivers and coordinators of production, knowledge generation and innovation activities, the recent literature on

Figure 2. A local innovation and production system with the HEIC in its centre
Source: Own elaboration, based on Matos et al. (2012)



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'service innovation' (Sundbo & Gallouj 2000; Hipp & Grupp 2005; Miles 2008) and on innovation in health segments (Barbosa 2009; Engel 2008; Cunningham 2005; Consoli et al. 2005) offered important insights. Since the study takes inclusive development as a main normative reference, the recent literature on inclusion/exclusion, empowerment and capabilities (Sen 1999; Joseph et al. 2010, Sutz 2010, Soares & Cassiolato 2008, Soares et al. 2014) also constituted a central reference[1].

Since the health system constitutes a very ample and diversified field, each empirical study opted for focusing on specific subsets of this system. This led, for example, to the choice to focus on the different actors and processes that relate to a specific field of illness. Furthermore, the studies focused on a specific urban area or a broader territorial dimension, on specific core institutions or adopting a more horizontal approach. But in all cases the same key aspects of interactive learning and innovation, the articulation with the broader production base and the social-cultural dimension of the territory were analyzed. In this paper we discuss the main findings from a qualitative and appreciative perspective.

RESEARCH METHODOLOGY

The research methodology of LIPS is based on field research with specific questionnaires and interview guides and qualitative and semi-quantitative analysis of the results.

The LIPS methodology emphasizes the importance of gathering original primary data for understanding local processes of systemic innovation, learning and capacity building. Secondary information, available from data gathering official agencies do not suffice. So there is a need to collect information directly from local actors, combining the secondary information that may be available with this primary information.

The questionnaire is directed to the productive actors/agents who are at the core of the local system. These actors can be formal enterprises, informal ones or individuals. The set of productive agents and other organizations to which this questionnaire and the interview guides would be applied should be defined in advance, based on the previous characterization of the LIPS and the identification of the relevant segments and actors.

The questionnaire is structured in five blocks of questions. The first aims to characterize the productive organization, with questions about segments, products, origin and structure of the capital, and characteristics of the employees. The second block poses questions about the economic performance of the enterprise/organization, such as turnover, sales and markets attended, as well as factors considered to be important for the competitive capacity of the enterprise. The third block poses the central questions for the analysis, investigating the innovative efforts and the social and economic performance of the enterprise, the activities of learning and cooperation with diverse agents and the impact of these interactive processes on the capabilities of the enterprise. The forth block investigates aspects related to the competitive advantages associates to the local environment, the articulation to the local productive structure, and the patterns of governance. The fifth block evaluates the existing and potential support and promotion policies.

The field research tools also encompass three different interview guides. The first is directed to organizations with functions of education, training and research such as technical schools, universities, technological centers and social organizations. The main questions include not only issues about the research lines and the characteristics of the courses that are offered, but also matters such as the interaction between scientific and traditional/local knowledge, information and knowledge flows, and the main agents with which those organizations interact. The second interview guide is directed to organizations

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with representation functions such as associations and unions, as well as relevant social organizations. It evaluates their action in relation to the productive agents, other organizations and the public sphere, considering their role in the intermediation and coordination of the diverse policy actions. We highlight the questions related to the efforts of the organizations for the technological capacity building of the associated productive organizations, to the main potentialities and difficulties of the productive sphere including working conditions and the circumstances for participation and social inclusion, and the possible implications for future policy actions. The third interview guide is directed to public and private organizations (including international cooperation) with promotion and policy functions. It includes questions related to their action in relation to professional training, technical consultancy, credit lines, fiscal incentives, scholarships, as well as for the strengthening of social organization and management, provision of basic infrastructure and other forms of social improvement. It also includes their perception on the contribution of the LIPS to the improvement of the social conditions in the territory. These questions help to identify the main policy actions, their objectives and targets, the organizations that are involved and their function, the tools and the methodology for evaluation, the origin of resources and the lessons that can be extracted from the present stage of those programs.

Many questions of the interview guides are complementary to questions of the questionnaire, focusing on the same issues on to different perspectives. The combination of these different perspectives allows identifying with more detail the positive and negative points of actions, projects and policies. This helps to propose targeted policy actions that may have a greater chance of being successful and contribute to the development of the LIPS and territory in which it is inserted.

THE FIVE HEALTH LIPSs

The following five empirical studies of health Local Innovation and Production Systems were carried out during the year of 2012 in different parts of Brazil[2]:

The study of Bahia focused on health activities related to cancer treatment in this northeastern state. On the one hand, the tumors are responsible for a significant proportion of deaths in the state (nearly 14% in 2010) and, with the aging of population an increase of this percentage can be expected. On the other hand, treatment of neoplasm is intensive in high-cost technologies, involving high-level spending of the state, which becomes even more relevant when considering the growing incidence of the disease. Specifically, the study focuses on breast cancer and the institutional setup related to the access of the population to treatment in the public health system (Ferreira Júnior 2012).

The study in the State of Espírito Santo focused on the institutional setup for public health provision in the metropolitan area of Vitoria. The study chose as focal point the Evangelical Hospital in the municipality of Vila Velha. This hospital is especially relevant since it provides reference services in various specialties (cardiac surgery, bariatric surgery, neurosurgery, vascular surgery, ophthalmology, renal transplantation, transplant corneas, bone transplantation and oncology) and has been granted certifications for its high level of service and patient safety. This hospital was also the first charity hospital in the state to receive a high level of accreditation by the National Accreditation Organization (ONA), a title given only to health institutions that stand out with a high level of quality of care and patient safety. Thus, the interest is on how such an outstanding institution deals with complex problems of health service provision in varied fields within a big metropolitan area (Villaschi 2012).

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In the case of the State of Minas Gerais, the study focused on the treatment of cardiovascular diseases in the Triângulo Mineiro region. Cardiovascular diseases are the leading cause of mortality in the region. The focus of research was on high-complexity care carried out within the public health system, since treatments in this area are situated on the frontier of scientific and technological knowledge. The field research took as a reference the participation of university hospitals in the health system in the region, especially the Clinical Hospital of the Federal University of Uberlândia and the Clinical Hospital of the Federal University of Triângulo Mineiro (Uberaba), because both have broad regional coverage, offer services of high complexity and its functions go beyond the typical university hospitals. At the same time, they encompass high level treatment together with education and research tasks, and constitute almost the only access point for public health services in ambulatory and emergency in the region (Botelho 2012).

In the case of the state of Paraiba, the analysis focused on the LIPS of João Pessoa. This study articulated the systems of innovation framework with theoretical and methodological propositions of Cavalcanti Filho (2011), which focused on 12 dimensions that characterize the existence of a Production System. Those can be grouped into three subsystems: Cultural (Population, History and Territory), Political (Power, Property and Labour) and Economic (Investment, Consumption, Production, Marketing, Finance and Innovation), trying to analyze the LIPSs from the dimensions described. From this analysis, the study investigated the 'economic functions' that characterize the system and its bonds with other LIPSs and the broader productive system (formed mostly by pharmaceutical companies and firms specialized in the production of electronic equipment for hospitals, clinics and laboratories). Cardiovascular diseases were taken as reference for the development of research, given the large percentage of deaths caused by this disease in the city of João Pessoa (Cavalcanti Filho 2012).

Finally, the study in the state of Rio Grande do Sul focused on the health LIPS in the metropolitan region of Porto Alegre linked to cardiovascular and oncological treatments. This metropolitan area encompasses a large share of the state health care services, as well as relevant number of manufacturing activities within the HEIC in the fields of chemistry and biotechnology, mechanics, electronics and materials. The same is true for the structure of education and research in the state. The focus on cardiovascular and oncological treatment was due to the prevalence of these diseases in the epidemiological profile of the region. The choice was to focus on teaching and research hospitals of Porto Alegre, which are those that offer services of high complexity and allow examining the interplay between education, knowledge generation and their impact on the services provided (Tatsch 2012).

LEARNING, CAPACITY BUILDING AND INNOVATION IN HEALTH LIPSs

Empirical evidences highlight the varied processes of knowledge generation, diffusion and socialization on the part of companies, organizations and individuals in Local Innovation and Production Systems. This is particularly relevant in the case of tacit knowledge, which is implicit and embedded in individuals, organizations and even regions. Learning is fundamental for the transmission of knowledge and the expansion of productive and innovative capacities of companies and other organizations. Training activities are essential for enabling the introduction of new products, processes, methods and organizational formats (Lundvall & Johnson, 1994). In the sphere of private firm, these processes are crucial for ensuring their sustained competitiveness. In the sphere of public essential services there is an additional dimension related to ensuring universal access and quality to health services and products.

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Our focus on the research of health related activities with emphasis on its public service dimension aims to contribute to innovation system research in issues that are still little explored even though they are key for knowledge generation and innovation. Recent research on innovation in services explain the importance of considering the characteristics of each segment to understand: (i) the ways of articulation among actors (ii) the channels and processes through which information is transmitted, (iii) how the logic of the services provided and the types of critical knowledge (and technical base) influence the features and direction of learning and innovation. These factors are even more specific in the case of innovation systems rooted in local territorial bases. In the following section we explore the qualitative results of the five empirical studies which might help us to advance in the understanding of these issues.

The Cognitive Territory within the Health LIPSs

A key concept for understanding the interactive processes of knowledge generation, dissemination and use in a LIPS is that of the 'Cognitive Territory'. This consists of the set of actors that are part of a LIPS, their knowledge, the interaction channels and the ways in which information circulates. Therefore, identifying the actors and their modes of interaction contributes to understand the characteristics of a specific cognitive territory. Each of the five LIPSs has a specific structure with regard to the agents that constitute the institutional framework and the socio-cultural dimension. This translates into specific patterns of learning, generation and diffusion of innovations and building of capacities.

In all studies we found what can be characterized as different levels of fragmentation of these cognitive territories. Be it because of the absence of agents that constitute specific links of a complex system or because of the way processes are organized. Such logics are conditioned by the institutional framework, by economic conditions and power relations that are established between different actors.

Although each case is very specific, some of the features that conform the cognitive territories and the processes of capabilities generation and innovations stand out in all studies as important aspects for discussing the potential for promoting health systems in a territorial dimension.

The Subsystem of Education, Science and Technology

According to the categorization proposed by Cassiolato and Lastres (2008) we can characterize the subsystem of Education, Science and Technology as the set of organizations that are connected to the production sphere and are centered on research, education, certification, metrology etc. These organizations play an important role in the processes of generation and dissemination of knowledge, because they are the locus where new people are trained and where the bulk of research efforts are developed, especially basic and applied research, but also the search for practical solution for specific problems/ challenges. Although situated in quite disparate contexts, in all five LIPSs there is a diverse and relevant training, education and research base.

In the case of Minas Gerais, we find that this state has a strong knowledge base in S&T in the field of health, with internationally recognized academic research. Especially important are the Federal University of Minas Gerais - UFMG, Fiocruz Minas - Research Center René Rachou and Ezequiel Dias Foundation (FUNED). However, these organizations are located in the state capital, while the empirical study focused on the LIPS in the region of the Triângulo Mineiro. In this region there are two federal universities, university hospitals and research institutions linked to the areas of health. One challenge highlighted in the study is precisely to promote greater interaction between the local base of S&T and that

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in a broader dimension, particularly in relation to the participation in major research programs, training and use of the infrastructure. Further, linked to Higher Education Institutions (HEIs), we find a multitude of research groups, which develop research in different areas related to medicine and biosciences.

The case of Rio Grande do Sul is outstanding for its ample and prestigious S&T infrastructure. In this state 58 higher education institutions (HEIs) offer courses in healthcare area. Particularly important is the Federal University of Rio Grande do Sul (UFRGS). Other institutions situated in the LIPS territory are the Federal University of Health Sciences of Porto Alegre (FUFCSPA), the Pontifical Catholic University of Rio Grande do Sul (PUCRS), the Cardiology Institute of RS - University Foundation of Cardiology (IC-FUC) and the State Foundation for the Production and Health Research (FEPPS).

The research conducted by these organizations is largely linked to the testing of new drugs, i.e., participation in international protocols for testing. On one hand, such involvement leads to many benefits - related to new scientific knowledge and the possibility of treating people who are in need - on the other hand, the primary focus in this type of research leaves little space for specific research that is closer related to the characteristics of the specific territory, such as its epidemiological profile.

Both studies mentioned above highlight the importance of research activities carried out by research groups linked to HEIs. Specifically in the fields of cardiology and oncology there are 43 groups. In both studies we find their important contribution for advancing in areas of basic and applied research and for enabling the creation of technology-based companies. On the other hand, the studies also highlight the obstacles for a greater coordination of these groups with the various organizations of the local health system. Noteworthy is the fact that the areas of research are very specific, so that it is very rare to find other organizations and research groups developing related research activities. In the main, there is a great but rather unexplored potential for articulating the research efforts with the specific challenges/demands of public health in those territories. Although mostly supported by public funds, through research grants and use of the infrastructure of public institutions, research efforts show to be linked rather to the outside (national and international scientific community) than to the territory. This constitutes a first dimension of fragmentation of local cognitive territory were changes in incentive structures may be necessary.

In the case of Paraiba there are 85 university courses related to health, of which 49.4% are located in the capital João Pessoa. The largest university hospital in the state is also linked to a public university (UFPB). In terms of research efforts, there are some laboratories and several research lines related to the College of Santa Emilia Rodat (FASER) and the Colleges of Nursing and Medicine Nova Esperança. The FASER also establishes partnerships with clinical laboratories of João Pessoa, the Federal University of Paraíba, the Federal University of Pernambuco and the Integrated Faculty of Patos. However, the authors of the study stressed the low innovativeness within the LIPSs and found this to be directly related to the low density in terms of research and development that is undertaken. In the case of Espírito Santo, higher education is mainly related to the Federal University of Espírito Santo (12 courses) although there are other important higher education institutions, which are spread throughout the state. Private Institutions of Higher Education offer 48 courses related to health.

In these two cases we find a relatively smaller contribution of these organizations in the field of research. But even in these cases, as in all studies, educational institutions play a key role for the formation of human resources. Training is the most important link of this subsystem to the production and service activities. All studies highlight education and training at a technical level, undergraduate and graduate level as a decisive factor for the functioning of the health systems of those states and localities. The great demand for professionals is supplied by continuous training of professionals in these institutions.

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On the other hand, several studies point to challenges related to this education structure. Firstly, they highlight the mismatch between the type of education privileged and the needs arising from the public health system. There is a great demand (and consequently greater number of vacancies) in areas related to the formation of specialists at the expense of training of general practitioners. Specialists comparatively earn higher salaries besides finding higher profitability when working as liberal professionals in private offices or clinics. But considering the health system as a whole, it has a relatively greater demand for general practitioners, especially in relation to preventive health care and low and medium complexity activities.

Secondly, some of the studies highlight the lagging quality of training offered by some organizations, which may impact directly on the quality of health services provided. This aspect is particularly emphasized in the study of Espírito Santo. The formation of professionals (middle and upper levels) is quite heterogeneous. There are, for example, frequent complaints about the nursing staff. The quality of higher education presents also various levels (both between areas and intra-areas). In medical training, for example, there are important differences in training offered by the more traditional schools and those that were created in the last ten years (mostly private).

Thirdly, the results of the case studies point to a broader discussion related to the structure of education in the area of health. This issue is especially prominent in the study on the LIPS in Paraiba. This study draws attention to external forces which act on the local activities. This influence is exerted mostly by manufacturers of drugs and medical equipment, both from other parts of the country and from abroad. Noteworthy is the inductive role that these organizations have in shaping the 'business model' of health service. Specifically with regard to training, this translates into a specific formative profile of the physicians, since these organizations are major funders of research in medical areas. In many cases, more attention is directed to areas that offer higher profitability and others are neglected despite their potential impact on a greater share of the population, but with a low income profile.

Finally, the study in Paraiba also highlights the influence of power relations, related to the dominance of a local elite on the training facilities and the provision of health services. This translates, for example, into a low inclination to expand the number of vacancies in higher education in the medical field, although there is wide demand for qualified personnel in the region. The relative scarcity of these professionals favors a 'business model' in which the established medical body "divides" its attention between the public health system and the private practice, the later being responsible for a higher share of their income.

In all this cases we find a fundamental conflict between the public (socially inclusive) and private (profit and notoriety oriented) logic. All the aspects discussed are significant challenges for the consolidation of educational projects focused on a public logic for the offering of universal free health services. This translates into a training profile that does not favor the convergence between the supply of health services (in terms of training, availability of health professionals and access and quality) and demand (in terms of the needs of the population which dependents on the public health system). Such issues deserve special attention in the section that discusses the policy implications.

The Hospital – University Relation

We now focus on those actors that constitute the core of the LIPS according to this conceptual framework: the organizations providing health services. The studies focused especially on the major hospitals as reference centers for medium and high complexity treatment. The methodological choice of placing

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such organizations as central actors proved to be correct, since all studies stressed their important role as a place of convergence, mobilization and transformation of capacities.

Especially rich is the articulation of these organizations with the subsystem composed by training, education and research organizations. This relationship is particularly nurtured in the case of LIPSs were university hospitals are key actors. As mentioned before, the LIPS in Minas Gerais has two university hospitals as central health service providers. Especially with regard to high complexity treatment related to cardiovascular diseases, these organizations are core references. The association between the activities of medical practice, teaching and research sets these hospitals as privileged loci for the generation and expansion of scientific and technological capabilities and training of personnel.

However, the studies also highlight issues that prevent such privileged spaces for capacity building to materialize all their potential. A central aspect is the fact that most services provided by the university hospitals are characterized as emergency procedures. This implies enormous limitations to schedule appointments and planning activities related to research and training.

The study of the LIPS in Rio Grande do Sul also sets the teaching hospitals as key actors. Especially important are the residency programs for more than thousand students each year, as well as undergraduate and postgraduate formation and scientific and technological research. The Santa Casa de Misericordia de Porto Alegre for example has an agreement with more than 13 higher education institutions (HEIs), developing several residency programs. In the case of the LIPS in Paraiba, the most complex example of cooperation for innovative learning involves the federal university UFPB and the Lauro Wanderley University Hospital, which operates exclusively for the public health system. This organization provides an ample residency program and makes available equipments used for medical research undertaken by the university.

Both studies give special attention to a central figure of great importance: the professionals who work both in practice and in medical research and teaching. These professionals are important bridges between the structure of health services provision (notably hospitals), on one side, and universities and other scientific and technological organizations, on the other side. Thus, they play a special role in relation to the following aspects: (i) the application of scientific knowledge (and eventually the knowledge related to new technologies) to medical practice, incorporating it into medical procedures and allowing therapeutic application; (ii) the application of knowledge generated in practice in teaching and research activity; (iii) structuring of residency programs, and (iv) the conduct of research that depends both on laboratory infrastructure and testing activities with patients.

The study of the LIPS in Bahia highlights the importance of different internal and external knowledge sources for healthcare organizations. With regard to internal sources, the body of professionals is key, since the bulk of learning is linked to the interaction of qualified staff in everyday procedures (learning-by-doing and learning-by-using). This learning is even more relevant in the case of doctors and nurses who besides working in oncology units are also teachers in local universities. With regard to external sources of learning, health service organizations highlight the importance of universities within the LIPS, as well as professional training organizations and partnerships with research institutes. Universities, especially public ones that offer courses in health areas, are important pillars for learning. Research institutes, in turn, serve as a benchmark for healthcare facilities, providing new protocols and space for the evaluation of treating techniques.

However, the studies also stress factors that limited the potential benefits related to this interaction between the service provision and the knowledge base. The most common picture is that of teacher-researcher which exert a limited role as a doctor in the hospital and develop research that is rather un-

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related to assistance activities. All studies find that there is, with varying intensity, a low commitment of these professionals to practice in hospitals. In many cases doctors use their activity in the public hospital and the university as showcases to promote their activities in private practice, the latter being the most important source of income. The absence of regimes of exclusive dedication favors this type of allocation of time, so that the contribution of these professionals for the generation and dissemination of knowledge in the public health system tends to be relatively less significant.

Manufacturing Segments of the Health System

Manufacturing segments of the Health Economic-Industrial Complex are other important potential links in the cognitive territory of the LIPS. These companies play an important role in the generation and dissemination of knowledge, especially in relation to the development and market introduction of new drugs, equipment, techniques and prostheses. The interaction of companies with potential users of innovations – organizations of the health service segment or final consumers – spurs their continued learning, improving and creating new products.

But this dimension is where we find the greatest heterogeneity among the five cases which were analyzed. While the structure of the national public health system favors the relatively widespread presence of organizations from service segments in the territory (given the need for direct interaction with the user / beneficiary), the same does not apply to manufacturing segments. In this case, economic factors are those that almost exclusively influence the existence and location of firms. In many cases, the actual requirements of scale and agglomeration economies favor the existence of few companies in a particular segment and their concentration in few regions. Factors related to the sphere of the National Innovation System help to explain the existence or not and the importance of different industries in the country.

In the case of the LIPSs in the Triângulo Mineiro in Minas Gerais we find some companies from different manufacturing segments of the HEIC. Five companies operate in the area of human health, three of which are startups that are still at the stage of prototyping and testing of its products. These companies were spinoffs linked to research centers at the Federal University of Uberlândia and Incubation Center for Entrepreneurial Activities of Uberlândia (CIAEM). This incubator offers technical consulting service and strategic planning, in addition to physical infrastructure for the construction of laboratories. Although this is a small set of firms we find very relevant interactive relations with other actors. An agreement with the Federal University of Uberlândia enables the utilization of the Laboratory of Biochemistry and Molecular Biology to develop methods, consulting and diagnosis activities related to molecular biomarkers in the areas of human / animal health, athletic performance and oral health. Many equipments required for the development of research on the part of these companies were incorporated into the laboratory occupied by researchers in universities. Companies have access to the university's databases of genetic material and offer access to their databases for university research.

As detailed beneath, these companies have a significant innovative performance with the introduction of products which are new even for the world market. Thus, these companies highlight the university and its laboratories as their primary cooperation partner. Cooperative relations occur both through formal channels such as covenants and doctoral programs and informal channels offered by the academic environment. Not surprisingly, the companies cite as main driver and facilitator for their innovative efforts the articulation with the Federal University of Uberlândia and Research Institutes.

The LIPS in the Metropolitan Region of Porto Alegre, Rio Grande do Sul, has a far wider industrial base. Companies operate in different segments of mechanics, electronics and materials and chemistry

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and biotechnology. The products manufactured are diverse: food supplements; the homeopathic, herbal and, less frequently, allopathic medicines; radiopharmaceuticals; vaccines and antibodies; equipment for cardiovascular and general surgery; laboratory equipment; orthopedic devices; dental and optical products and general hospital consumables. However, unlike what happens in the case of Minas Gerais, in this case there is not a close articulation with universities and research institutes. Among the information sources for learning companies highlight the institutions for testing and certifications and public agencies, including regulation agencies. Customers (especially health service organizations that use the products) and companies related to distribution and sale activities are also relatively important. This structure of interaction is directly related to the profile of these companies – well established and operating in a broad market. Thus, instances that relate to quality, compliance and certification of their products are more relevant. Likewise, this study confirms the central importance of organizations providing health services as users of the products developed by companies, providing important information about their use, potential for improvement and demand for new solutions. On the other hand, this study demonstrates the low articulation and limited information flow between different industrial segments of the HEIC and between these and other directly or indirectly related segments. This constitutes a major dimension in which the cognitive territory could be better articulated, promoting more systemic relations and expanding the potential of knowledge generation.

The other three studies emphasize the other side of the coin, related to an almost absolute absence of companies in the manufacturing segments of the HEIC. As noted above, many of the economic factors help to explain why one cannot expect to build up "complete" system in all localities, even in the case of state capitals. However, the case of Minas Gerais discussed above, exemplifies how, departing from research activities in higher education institutions and counting with incentive funds, an initial industrial structure may be viable, which can cooperate with the search for solutions related to the specific challenges of public health in a given territory. To the extent that there is no presence of these kinds of firms in the three LIPSs, many opportunities are lost to generate and disseminate knowledge endogenously. At the same time, these studies stress that this enhances the power of big enterprises from outside to influence productive and scientific and technological choices. These firms end up directly influencing the direction of technological change via incorporation of equipment, medications, procedures, etc. This is discussed in more detail below. If, in the future, new public policies are to succeed in internalizing some of the industrial production segments in the LIPS, especially those that do not rely on very large economies of scale, local actors of the service segments would be able to influence the innovation and production process of their suppliers. As vastly shown in the literature 'user-producer' interactions are essential for innovation and for determining the direction of technological change (Lundvall 1985). When it comes to the needs of health systems in specific territories, many solutions may have to emerge locally.

Summing Up

Even with different characteristics and with greater or lesser relevance (and presence) of different actors that compose the nodes of the cognitive territory, all studies highlight the positive impacts derived from interactive learning processes.

From the point of view of manufacturing enterprises, the studies of Rio Grande do Sul and Minas Gerais stress: (i) an improved capacity to develop new products and processes, (ii) an improvement on the quality of products and services (iii) new business opportunities, (iv) greater ability to comply with

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the requirements of regulatory agencies, and (v) implementation of improvements in infrastructure, equipment and materials.

From the point of view of health services organizations (notably hospitals), the studies points to a significant impact of these interactive processes related to: (i) training and improvements in service provision; (ii) partnership with research institutes and advances in the quality of products and services; (iii) the ability to introduce organizational innovations. As will be discussed in the next section, the impact of learning and cooperation processes related to organizational innovations is particularly relevant for the local sphere of health innovation systems.

Innovation in the Health LIPSs

The bulk of innovation literature stresses the ability to innovate as a fundamental aspect for the competitiveness of organizations, regions and countries. Competitiveness is defined as the ability to formulate and implement competitive strategies that allow an organization or set of organizations to expand or maintain a sustainable position in the market. The strategic objective of seeking competitive advantages, which provide greater market power, induces economic agents to make efforts for the introduction of new products and processes as well as organizational innovations (Nelson and Winter 1982; Freeman 1987; Dosi 1988; Nelson 1993). Such formulations are closer related to the reality of private companies. Considering innovation in the areas of public services and especially highlighting its social development dimension necessarily implies the need to broaden the understanding of the role of innovation, driving forces and mechanisms through which these are enabled and put into practice. The five empirical studies present a range of evidences for innovation on this broader perspective and discuss the obstacles and limitations for these processes.

Innovations in the Manufacturing Segments

In those two LIPS were we find some firms of the manufacturing segments, there are also relevant innovations being undertaken. In the case of Rio Grande do Sul, 25 out of 29 companies that were interviewed introduced product innovation (86.2%), 9 introduced process innovations (31.0%) and 6 organizational innovations (20.7%). Both in the case of product innovation and in the case of process, the firms adopt a strategic stance as a close follower, observing the leaders (Freeman and Soete 1997). Thus, most product innovations (75.9%) and process innovations (27, 6%) were new only for the company, but already existing in the market.

In the case of Minas Gerais the close articulation of companies with the university environment contributes to a high rate of innovation. Only one of the companies did not introduce relevant innovations. On the other hand, all other cite innovations that can be considered new not only for the company but for the market. These involve: kits for diagnosis of allergies through blood test; software for diagnostic in audiology; molecular test for the detection of HPV; molecular test for the detection of prostate cancer; molecular test for the detection of predisposition to hypertension; kit for determination of Salivary total protein concentration; kit for the diagnosis of salivary alpha amylase; process for assessment of salivary alpha-amylase, and process for evaluating the total salivary protein. As noted above, although the innovative activity of these companies is significant, impacts specifically related to health issues in the region are very limited. These are very specific innovations mostly derived from the specialized

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competences and research interests of the companies' owners. Taking up the perspective of a LIPS as a privileged sphere for the generation and use of innovative solutions, the main challenge is how to induce the existing innovative capacity of these companies to products and processes related to the pressing needs of the public health system.

Innovations in the Service Segments

Secondly, we highlight the diverse array of innovations that are developed and implemented by hospitals and other organizations providing health services.

In all five studies the innovations were mainly related to processes and organizational methods. An interesting organizational model is related to private policlinics, were the concentration of specialists and diagnostic services cheapens the consultation and testing. This model constitutes an alternative especially for those who do not have private Health Insurance Plans and want or need to find faster solutions for their complaints. The longer the waiting is in the hall of public health organizations, the more this alternative business model prospers. In many cases, people use this cheap private option for acquiring the diagnostic which is a precondition for the subsequent treatment, which is costly and will be done in the public system. The main inducing factors for innovations are: (i) the improvement and efficiency of care and increased quality control over services; (ii) the high demand for treatment and tests; and (iii) the very technological advancement.

The case of Rio Grande do Sul also highlights the importance of organizational innovations in the public organizations. Changes in ways services are provided, organizing processes of care, diagnosis, hospitalization, etc., are critical to the efficient functioning of the hospitals. Regardless whether in the public or philanthropic organizations we can observe, over the last few years, a clear process of professionalization of management. Major impacts are related to the quality of services and efficiency, in terms, for example, of the occupancy rate, treatment time, etc. These efficiency gains related to management can generate positive outcomes for patients and also for the public health system with potential cost reductions. The Hospital das Clinicas de Porto Alegre, for example, is a reference in terms of management, being the benchmark for the National Recovery Program of University Hospitals (REHUF) of the Ministry of Education. The Hospital takes part of this program since 2009, helping to transfer its management model to other University Hospitals.

In Espírito Santo, the study found innovative activities in all levels and nodes of the health system. But they are rather incremental and limited to the adoption of organizational procedures and embodied technologies. In most cases they are focused on enabling the access of larger portions of the population to health services, in all levels of treatment complexity. The same situation occurs in the LIPS of Bahia. Despite the presence of a relatively well established system for the treatment of cancer, the service units, although in partnership with universities and research institutes in the region, do not innovate much internally, limiting themselves to the incorporation of embodied technologies.

The cases of Espírito Santo and Bahia highlight that most innovations in health service organizations occur through the adoption of 'closed packages'. This characteristic is directly related to the subordination of innovation to an economic logic. Big companies from outside the LIPS exert strong influence on the service organizations, inducing the adoption of drugs and medical equipment. This is perceived as a good substitute for own innovation efforts, since it apparently doesn't involve any considerable risk. Examples are:

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- The acquisition of machinery, equipment drugs etc. without any closer interaction between innovative vendors and local users, thus without any adaptation. Technological standard is exogenously determined and meets the requirements of the broader production system but not necessarily the local needs;
- The incorporation of new products to meet the changes in the consumption pattern that are determined external to the LIPS, without considering local consumers/users as a main source of information and without any connection with local research and development initiatives, i.e., the local knowledge base;
- New operational procedures and analysis techniques, diagnosis and treatments, that are not flexible to be adapted to the organizational particularities of the hospital.

Thus, these big players affect the technological and innovative pattern, influencing the profile of health care provision. In this case the 'direction' of the innovation process is exogenously determined. This pattern is strengthened in so far as local physicians receive considerable incentives for prescribing medicaments and treatments that fit into this model. This approach often implies the demand for technologies that have not yet been fully tested in the country and cannot guaranty safety and ensure effectiveness of treatments. In this perspective, the strengthening of the regulatory framework, as discussed beneath, is paramount.

As said before, the health service providers, especially big hospitals, may exert a central role within a health innovation system, mobilizing competences and directing innovative efforts. In part, the empirical findings suggest they do. But we also find this potential to be limited by different aspects. First of all, it is important to recognize a hospital as one of the most complex types of organizations. This translates into two characteristics. First, in order to efficiently manage this complex structure, most innovative efforts are directed to organizational efficiency. Decisions concerning organizational modes are restricted to a rather small group of agents. An interesting element related to organizational innovations in all cases is that they are mostly directed to grant access, given that the potential and effective demand is much bigger than the service provision capacity[3]. Thus, efforts are directed in this sphere instead of taking as focal points the quality of services and preventive accompaniment after treatments.

Second, in the case of innovations related to products and processes, two main elements of complexity arise: the need to coordinate diversified teams, which do not have innovation as their main objective and the organizational rigidities for enabling articulations with external actors, such as firms in specific niches of manufacturing segments. On the one side, this may favor the adoption of "closed packages", as discussed above. On the other side this may limit the potential for mobilizing and boosting local processes. Organizational and institutional barriers are even greater in the case of public organizations which are subject to a complex set of regulations and bureaucratic procedures. These elements will be discussed in more detail beneath.

THE INSTITUTIONAL DIMENSION IN THE HEALTH SYSTEM

Through explicit and implicit policies, the state has an influence in the case of health hardly found in other production systems. This influence is related to (i) the purchase of goods and services, (ii) the allocation of funds to the service provision infrastructure, (iii) investments and incentives directed to

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industry and health care networks, as well as (iv) a wide range of regulatory activities that delimit the strategies of economic agents.

The compliance of policies from the federal government level in the territory is strongly mediated by state and municipal institutions, since the public health system is organized in a tripartite structure. According to legislation there are specific responsibilities for each of the three government spheres. Thus, the institutional arrangement of the public health system is based on a number of instances of agreement, involving different institutions and various segments of society.

Social, territorial and political divergent interests are involved that may lead to conflicts, such as disputes concerning priorities for the allocation of the public budget. Thus it is not possible to understand the learning, competence building and innovation processes in the local sphere without understanding the institutional environment that conditions these processes.

Power Structures and the Institutional Framework

The study on the LIPS in the State of Paraiba centers its discussion on some aspects which are relevant in all five cases. This study discusses the influence of the local political structure on the dynamics of the LIPS. The local elite is directly related to the origin and evolution of the health service system in the state. Owning most hospitals, clinics and laboratories, besides belonging to the staff of public hospitals and universities, the local elite consolidates a specific health services 'business model'. As mentioned before, this model, influenced by large multinational corporations in the fileds of drugs and equipment, set the technological standard, the profile of services and the organization of the LIPS in the territory. Besides the economic sphere, this elite exerts strong influence on the political dimension at the state level, capturing regulators, influencing the profile of education and training (favoring a relative scarcity of skilled personnel), among others. This has the effect of selective mechanism within the LIPS, restricting or enabling forms of articulation between finance, innovation, marketing and production. Thus, the case of Paraiba clearly shows how the evolution of the health LIPS in a direction that favors a public service logic, is inextricably hinged by local political and institutional structures.

It is important to underline that national strategic policies can reinforce or counteract local political-institutional dynamics that are less virtuous. Funding policies by federal agencies, such as BNDES, federal programs aimed at democratizing access to higher education, such as REUNE, among others, may contribute to the progressive disruption of the links that favor a 'feedback circuit of power' of the local elite. This shows that S&T policy, innovation policy and industrial policies are not neutral even if horizontally shaped. They favor specific technological trajectories and specific business models. Thus, the challenge is not only to expand investments in the health system but to orient those investments in a direction that is consistent with the constitutional assignment of a universal and integral health system. Some changes are in place, as discussed in the next section.

Regulation and Public Procurement

The state possesses important means for influencing the dynamics within the health system at the local sphere, favoring specific patterns of learning and innovative efforts and fomenting the local productive structure. These can help to diminish the influence and dependence on external actors and provide a more efficient use of public resources.

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First, we emphasize that, to a large extent, the introduction of technological innovations is conditioned by national regulatory instances. The regulation of the incorporation of new technologies is a central element in modern systems of health care. It is decisive for the reduction of possible negative effects, for maintaining some control over their impact on costs, and for evaluating ethical and social aspects that may be involved.

In Brazil, the Ministry of Health has the incumbency for deciding about the adoption of technologies in the health system. Only recently a more coherent institutional setup has been created for dealing with this delicate issue. In 2011 the National Commission for the Incorporation of Technologies in the public health system (CONITEC) and the Department of Management and Incorporation of Technology in Health – DEGITS have been created.

CONITEC advises the Ministry of Health in issues related to the incorporation, exclusion or modification of new drugs, and procedures, as well as the alteration of clinical protocols or therapy guidelines. This technical advice takes into account issues such as efficiency, accuracy, effectiveness and safety of the technology, in addition to considering cost-benefit aspects in comparison to existing technologies.

The study of the LIPS in Bahia highlights the importance of therapeutic guidelines, clinical protocols and technologies to be incorporated into cancer care under CONITEC. The high costs for cancer treatment reflect the fact that this is one of the services that incorporate most technologies, both from the pharmaceutical/biotech industry and from the equipment industry. Such technologies are produced by large multinationals whose main competitive strategy is product differentiation.

A second important dimension that directly influences the dynamic processes in the health LIPSs is public procurement at the federal, state and local administrative level. Procurement linked to the supply of goods and services for the Health System represent a broad, dynamic and constantly growing market. In 2007 public spending on health reached 3.7% of GDP. This is a rather small number if compared with other countries with universal and integral health systems. Thus the growing tendency of this spending stresses the potential for setting a powerful policy instrument aimed at the development of productive and innovative capacity in the country.

Linking the industrial development to government procurement is, in this sense, strategic for the dynamics of the productive structure related to health in the territory. Only with the purchase of medicines, the federal government, state and municipalities spend more than US$ 6 billion in 2012, according to data from the Ministry of Health. Data for spending with other medical products are less accurate but the Ministry of Health estimates that in 2007 spending totaled more than US$ 2 billion. Nevertheless, and especially in view of the restrictions brought about by the legislation governing public procurement, this instrument has been used in an extremely limited way in the country.

The legislation governing the acquisitions of public hospitals (bidding system) implies that the supply of certain items may be undertaken by companies located outside of the LIPS, even in situations where firms with similar capabilities are present in the local sphere. This type of mechanism favors only price, regardless of product quality, customer follow up, or strengthening of local production ties. In some situations, purchases are realized via federal auctions, as in the case of the Central Hospital of Porto Alegre, in other cases auctions are conducted by the hospital itself, both having price as the only relevant attribute.

However, in 2010, the government approved the Law 12,349, amending the Law from 1993, establishing preference margins for products manufactured in the country in government procurement. The application of the new Law depends on complementary regulations. In July 2012, for example, a decree established the use of preference margins for medical products, according to the level of technological

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complexity of the product. A next necessary step, still not envisaged by legislators, would be to set some kind of preference margin for local suppliers of specialized and general goods.

In fact, positive changes in this direction can already be observed in the studies. The regional public development bank Banco do Nordeste (BNB) started to apply some preference margin criteria for granting loans for the acquisition of medical equipment. Besides the BNB, the National Development Bank (BNDES) also created a financing program (BNDES Finame) for the acquisition of machinery and equipment. According to the decision of the Federal Government, funding for the purchase of machinery and equipment for the health system requires a minimum of 60% of the product value to be of domestic content. Preference margins for domestic products of 8% to 25% are part of the actions to stimulate domestic production within the national development policy (*Plano Brasil Maior*).

Innovation at the Institutional Level

Two of the studies highlighted successful experiences related to innovations that derived from different institutional arrangements at the state level. These converge with the challenges posed by the occupational structure of the territory and the need to provide universal health services vis-à-vis the concentration of the infrastructure of health services in the capital cities and large urban centers. The institutional/organizational innovations focused on bringing services and solutions to the countryside. Although simple, these can have a significant impact, helping to speed up the health service provision, avoiding unnecessary travels, and reducing costs for the national public health system.

The first case comes from Minas Gerais and was initially called Minas Telecardio. This was a pilot project of telemedicine in cardiology, started in 2006, which implemented the telecardiology service in 82 small municipalities. The project was designed by the public university hospitals of Minas Gerais, under the leadership of UFMG and the participation of the universities of the LIPS that was analyzed. Medical procedures did not suffer any modification. The main innovation brought to the health system was to rely on diagnostics from experts in a short period of time, given the transmission of clinical examination (electrocardiogram) via Internet. Moreover, this initiative also mobilized a set of incremental innovations in information technology. Based on its positive impact the program was gradually expanded, covering activities related to various other areas of medicine, constituting the current program Tele Minas Health.

Another important experience comes from the state of Bahia. The initiative was based on the recognition that getting the diagnosis constitutes one of the main challenges and barriers for patients to get access to treatments in oncology in the public system. The initiative was based on itinerant mammography equipment transported on a bus. This bus along with specialized technicians traveled through the regions of the state in which this kind of equipment is not available. As the study points out, this initiative contributed to a significant increase in the number of women aged between 50 and 69 who performed mammography.

Both experiences are relevant not only from the perspective of the beneficiaries, but also from the perspective of efficiency and cost saving within the public health system. All five cases show that hurdles for getting access to diagnostics and proper treatment in early stages of infirmities end up putting pressure on the public health system, since the patients' complications tend to evolve and require more complex and expensive procedures in the future.

If, on the one hand, these initiatives, especially telemedicine, reveal themselves especially promising to deal with the challenges of health care in a country with continental dimensions, some considerations should be made. As the study in Minas Gerais emphasizes, telemedicine is growing in importance because

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of certain socio-economic aspects, such as the persistence of high levels of poverty, lack of access to qualified health services, shortage of human and material resources, the high costs of the health system and the importance of chronic disease in the epidemiological profile. In this sense, telemedicine does not act to solve these problems, just to alleviate its consequences. In addition, considering the importance of the strengthening of a cognitive territory, it is important to emphasize telemedicine tools as a complementary but not substitute for the development of capacities present and rooted in the territory. The opportunities and challenges for strengthening the local learning and capacity building process directed to the needs of the public health system constitute the focus of the concluding section.

CONCLUSION AND FUTURE RESEARCH

A look at the health production and innovation system from a territorial perspective helps to guide policy initiatives that may help to transform the great mobilization potential of this area into local development. Development in this sense encompasses both an economic and a social dimension. Learning and innovation dynamics that are connected to the needs of the territory, which mobilize local capabilities and build upon them, play a special role in this process. The five studies clearly show that technological development (and innovation in general) is not a neutral process. It is subject to characteristics and priorities of specific societies, groups within it and individual actors. When it comes to a system that is mostly financed by public resources and should serve collective goals there is a clear priority for the agenda: the building of a complex system envisaging an effectively universal and integral public health system. Along with it, there are many opportunities for nurturing local development and many challenges. As discussed in the paper, market forces and individual interests, if left on their own, may not (in most cases they do not) favor the achievement of the Constitutional principles of a universal and integral health system.

The research project and the five related empirical studies seek to offer some contributions to this debate.

The results show that the territorial embedding of the Health Economic-Industrial Complex and the broader innovation system related to it still involves great challenges. Due to space limitation, some of these were not properly discussed in this paper. We chose to focus on the learning, capacity building and innovation processes and the factor that influence this processes.

Even if not discussed in detail the set of challenges that were identified deserve to be cited:

- Definition of strategic systemic policies that link the national and the local sphere.
- Raise public spending in health, improve its efficiency and guide them strategically.
- Use the state purchasing power to stimulate the revitalization of the productive and innovative structure in the country and establish specific instruments for promoting these at the local level.
- Better articulation of the institutional network that conforms the public health system.
- Favoring a public health logic in detriment of business models directed by private agents.
- Strengthen the learning and capacity building processes, especially taking advantage of local specificities.
- Promote the productive and innovative structure within the local territory.

Based on the focus of this paper we take a deeper look at the last three aspects.

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In many examples, we identified the conflict between the public and private logic in the health system[4]. Both from an analytical point of view and from a normative one it is important to consider the two sides of the health system as a vector of development. On the one side, it is an important dimension of industrial and S&T development and economic competitiveness. On the other side, it has an essential public and social service dimensions. The main challenge is for the state and society to balance the forces generating asymmetries and inequalities that are associated with the operation of business strategies and markets. This calls for a perspective focused on the political and institutional dimension and the mode these influence the way production, service provision and other activities are organized in each local territory. Conducive changes have to rely on the collaboration of public institutions in all administrative levels. As discussed in the text, funding and procurement policies on the part of public development banks and public programs for amplifying access to higher education, among other policies, may contribute to provide an increased supply of public and private services that are closer articulated to local social needs. Other important policy initiatives may involve:

- Modification of the pedagogical projects to be followed by higher education institutions, notably medicine, so as to strengthen the public logic of universal free health care and favoring the formation of professionals dedicated to preventive and communitarian health care;
- Prioritize international interaction of the HEIs with institutions from countries that opted for public and universal health care systems;
- Increasing the funding resources for medical research articulated to the local epidemiological profile and to local potentialities (e.g. in phytotherapics) and traditional knowledge.
- Creation of exclusive dedication regimes and proper incentive regimes to direct scientific and medical capabilities to the challenges of public health.

Another main challenge is to strengthen the learning and capacity building processes. The low innovative potential in most LIPSs is related to the fragmentation of the local cognitive territory and its limited articulation to the national health innovation system. In many cases, the service providing organizations limit their innovative activities to organizational changes and the incorporation of "closed packages", although there are some important partnerships with universities and research institutes.

Thus, a suggestion given by the research of Bahia to reduce the problem of poor and peripheral regions is to direct efforts to technological upgrades and improvements that allow to rapidly opening new access points into the health system. This of course involves the interconnection of different types of innovations and a close institutional mobilization to allow these changes to take effect

On the other hand, an improvement in financing conditions for research and innovation is core to promote greater coordination between local, regional and national innovation system. The expansion and improvement of programs in support of innovation tend to have positive results in the medium and long term, also helping to overcome the distance between science and technology policies. However, as mentioned, this is not a neutral process. S&T and innovation promotion in the field of health reflects the broader pattern of innovation promotion in the country, which still overemphasizes the supply side and without a strategic guidance. Even if it is an open debate to what extend the state should 'direct' innovation efforts in certain directions, we can expect to find more consensus when it comes up to a public essential service financed by public resources. Thus, the main argument is that health (together with other essential public services) constitutes a special case were explicit influence should be exerted by the state.

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At the level of industrial, S&T and innovation policy, subsidies and procurement connected to specific goals should be the norm instead of tax incentives. This means research funding should be directed to reduce problems related to the mismatch between scientific and technological development identified in the case studies. An example would be to support researchers to develop subsequent phases toward the introduction of product and process innovations. Support to costly phases of testing with patients should be very selective in terms the potential impact on the public health system.

At the institutional level, the recently created Commission for the Incorporation of Technologies in the public health system (CONITEC) should set explicit requirements that converge with an efficient and cheap treatment of larger fractions of the population. Specifically with regard to the incorporation of new drugs and procedures, as well as the establishment of clinical protocols, it would be important to strengthen and expand the role these institutions. There is a large potential to articulate the role of this institutional apparatus, on the one hand, with innovation and industrial policies and, on the other hand, with regional and local development policies. This institutional apparatus, established at the national level, could eventually be partially extended to the regional/local dimension, stimulating (via existing or potential capabilities) local developments that have direct relation to the needs of these territories. Local specific needs may be related to the natural environment, ethnic composition, socio-demographic and epidemiological profile, urban structures, productive structures, etc.

Further, one cannot expect efforts on the part of researchers (and learning processes in general) to serve a national/local public logic if the incentive structure is based on different meritocracy standards. On the one side, we find the research agendas to be strongly influenced by institutions and enterprises from developed countries. On the other side, the 'parnassian' 'publish or perish' productivity requirements directed to academics in the country make far less sense in the case of health. The objective quantitative measurements that exist for evaluating academic production should be more permeated by qualitative standards that set the public health system in the front stage.

Another main finding of the studies was the control local elites and other power structures exert over scientific and technological knowledge. As stated, it directly influences the profile of formation of future physicians and other professionals and therefore the way they offer medical, hospital and laboratorial services. Thus, the expansion of courses in medicine and other areas of health with a focus on socio-sanitary priorities is mandatory. In this context, the formation of general practitioners should be further stimulated, rather than the training of specialists, especially in relation to activities of preventive health care for low and medium complexity, and family medicine. This would contribute to a qualitative expansion of the required number of physicians and other specialists working in the public health system and could help to reduce the influence of the so-called private 'business model' as referred before.

Another suggestion made in the study of the LIPS in Paraiba is to favor the internationalization of HEIs, stimulating education and research activities in countries with public and universal health systems, in order to strengthen the training and policy guidance in this direction.

Regarding the mismatch between research conducted by faculty researchers and their assistance activities, with consequent low involvement of these professionals with practice in hospitals, an alternative would be the set of schemes of exclusive dedication.

The issue of power structures is also evident in relation to external forces exerted by the manufacturers of drugs and medical equipment, which contribute to shaping the business model of health service activity. A challenge to overcome this dependency is to promote a closer articulation with the S&T infrastructure that exists in the country, i.e. a better articulation of the local and national spheres of the health innovation system. This articulation, in line with increased resources for research, could help to

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reduce the influence of these organizations in the training profile of physicians, direct research to issues concerning broader fractions of the population, but that are neglected due to its lower profitability (e.g. research related to epidemiological profile of each region).

Another dimension in which there is a need to overcome policies mismatches is related to the relationship between science policy and technology policy. This disconnection is related to poor coordination and limited information flow between different industrial segments of the Health Economic-Industrial Complex. Thus incentives schemes should be directed to building of more systemic ties within the LIPS's cognitive territories favoring cooperative initiatives at the regional and local level that involve firms from different segments and S&T organizations.. The research efforts should be able to mobilize the firms to develop specific solutions in a given territory. This may also contribute to reduce the "dependency" on multinational corporations that profoundly influence the direction of technological change in health care. Public policies directed to greater articulations within the LIPS can enhance the innovative capacity of firms and provide competitive advantages for local actors with positive impacts on the territory.

In this context, the creation of technology parks could be encouraged. A special incentive can be given to the relationship between information and communication technologies (ICTs) and health, given the scientific and technological capacities already achieved in the country in these areas. Several case studies proposed an expansion and improvement of the use of information technology (IT) to streamline access and treatment in health, especially in the poorest municipalities of the LIPSs. In this sense, telemedicine is growing in importance but its role, in spite of extremely relevant, should be envisaged as a complementary tool in public health policies, not substituting the efforts to improve local capabilities.

In sum, the research efforts focusing on five different localities in Brazil showed that there is a potential for promoting systemic structures and relations on the local sphere, although the bulk of scientific knowledge and technological evolution is very concentrated in the national and world level. However, taking advantage of this potential in a country such as Brazil, characterized by enormous heterogeneity and diversity, requires the advancement of the territorial approach in the discussion of health-innovation linkages. Learning and innovation dynamics that are connected to the needs of the territory, which mobilize local capabilities and build upon them, play a special role in this process. Therefore, advancing the research on health production and innovation systems from a territorial perspective is an important component of a research agenda aiming to guide policy initiatives focused on transforming the great mobilization potential of this area into the local development.

When it comes up to considering the drivers of capacity building processes and of innovation, institutional and power dimensions play a far greater role than in other industries. It was shown that there is a complex interplay between public and private interests that have to be mediated by an institutional setup, which is itself complex and structured in multiple levels. This is another component of a future research agenda, which constitutes one of the most interesting and important fields of enquiry based on a systemic and interdisciplinary approach within social sciences.

Finally, there is an increasing understanding that the interaction between health systems and innovation systems can generate extremely positive synergies in terms of growth, efficiency and equity, thus constituting a significant link in a proactive strategy for inclusive development (Arocena and Sutz, 2012). Problems of exclusion in health can be transformed into sustainable demand for research and innovation stimulating the use of existing capabilities in developing countries. Thereby enhancing the understanding on how to induce the interaction between health systems and innovation systems for social inclusion is another central element of a future research agenda in this field.

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KEY TERMS AND DEFINITIONS

Capacity Building: Refers to the accumulation of knowledge and abilities by individuals and organizations, based on formal and informal learning processes. The capability of firms enables them to develop and reproduce more advanced productive and innovative practices, leading to an increase of their endowment of tangible (equipment, infra-structure) and intangible resources (knowledge, abilities, competences) and, therefore, fostering their competitiveness.

Cooperation: The general meaning of cooperation is 'working together', involving relations of mutual confidence and coordination at different levels among the actors. In local productive systems, different types of cooperation can be identified, including productive cooperation for the attainment of economies of scale and scope; improvement of quality and productivity; and innovative cooperation, which leads to the reduction of risks, costs, time and, especially, to interactive learning, increasing the potential for the creation of productive and innovative capabilities.

Governance: The different patterns of coordination, intervention and participation in the processes of decision making of different actors (the State, in its various levels, companies, citizens, workers, non-governmental organizations, etc.); and to the diverse activities associated to the organization of production and commercialization, as well as to the process of generation, dissemination and use of knowledge.

Innovation: The process by which organizations incorporate knowledge in the production of goods and services that are new for them, not mattering if they are or not new for domestic of foreign competitors. In the innovation economy, the main focus of analysis falls upon technical changes and other associated changes, which are considered to be fundamental for the understanding of the factors that make organizations, sectors, regions and countries develop faster than others.

Learning: Cumulative process, by which the organizations (through their human resources) acquire and amplify their knowledge, refine their searching procedures and their abilities in developing, producing and commercializing goods and services.

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Local Innovative and Productive Systems – LIPSs: Groups of economic, political and social actors, situated in the same territory, developing correlated economic activities and that present expressive productive, interactive, cooperative and learning connections. LIPSs generally include companies (producers of final goods and services, suppliers of equipment and other inputs, industrial services, commerce, clients, etc.), cooperatives, associations, and representations and other organizations dedicated to the training of human resources, information, research, development and engineering, promotion and financing.

Territory and Territoriality: Generically, the idea of territory refers to the geographical portion appropriated by a group of humans or animals, or by an individual, seeking to secure their reproduction and the satisfaction of their vital necessities. There are several meanings for the word territory. All conserve the idea of a personal or collective dominium in different contexts and levels: the house, the office, the neighborhood, city, region, nation, and planet. Each territory is, therefore, shaped through the combination of internal and external conditions and forces and should be understood as part of a spatial totality. The territory cannot be reduced to its material or concrete dimension, presenting various dimensions such as (a) Physical – concerning its natural characteristics and resources (such as climate, soil, relief, vegetation and subsoil), as well as those resulting from the use and from the territorial practices of social groups; (b) Economic – through the physical organization of the economic production processes – what is produced, how it is produced and who produces; (c) Social and political – representing a mean through which social integration occurs and domination and power relations are established – how and who dominates or influences it; (d) Symbolic – including the affective and cultural bonds of identity of the individual or of a social group with its geographic space; (e) Cognitive – referring to the conditions for the generation, use and diffusion of knowledge.

ENDNOTES

1 Unfortunately space limitations do not allow us to explore this literature and its implications for research methodology. For a detailed discussion of the LIPS framework applied to studies focusing on inclusive development see Matos et al. (2012).

2 The complete research reports for the Five studies can be found in Portuguese in: http://www.redesist.ie.ufrj.br/p4/

3 The legislation, that implemented the universal and integral public health system, is little more than two decades old. In historical perspective this is a rather short period for building up an entire system for providing health for 200 million people in a country with continental size. Although there is a long way ahead for fully meeting the constitutional assignment, this system is in fact constantly improving. The set of studies presented in this paper seek to provide some input for this ongoing process.

4 The detailed discussion of all these aspects can be found in the complete research report in: http://www.redesist.ie.ufrj.br/p4/

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Chapter 5
Infectious Diseases and Climate Vulnerability in Morocco: Governance and Adaptation Options

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ABSTRACT

Climate change is expected to affect the distribution, prevalence and life cycle of several infectious diseases. This scenario is relevant to Morocco since the country is considered by many IPCC assessments reports as a climate change hotspot with a high vulnerability to many expected impacts. Given this existing vulnerability, this chapter aims to highlight relevant vector-borne diseases, the risks of their reemergence in many vulnerable regions and the pressing need to understand their dynamics within a context marked by knowledge gaps and limited scientific evidence; underline the problematic aspects of health adaptation to climate change and the current difficulties in terms of policy and governance to manage climate-health linkages; and finally undertake an assessment of Morocco's adaptive capacity from a health perspective and formulate recommendations for effective climate-health governance and policy.

INTRODUCTION

The current realization that human beings need to be concerned about the only 'life-support system' that the Earth and its environment provide stems perhaps in part from the fact that, until fairly recently, the evolution of humankind was largely dependent on the quality of the environment and the resources it provides in terms of water, food, and favorable health conditions. These are as vital as ever, despite

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current levels of technology and apparent resilience in the face of often degraded environments in many parts of the world. Today, the necessary conditions for maintaining human security – i.e. water quality and quantity, food security, and health – are under threat as a result of numerous human-induced factors; among these, climate change is certainly one of the more durable aspects of anthropogenic disruptions to natural resources (Beniston 2010). It is currently recognized that with the constant increase of the planet's temperature, there are, and will be, more frequent and severe floods, droughts, storms, and heat waves; these changes to Earth's biophysical system will exacerbate and extend the rates and ranges of many diseases and overall contribute to poor health among all populations (Friel et al. 2011).

Therefore, coupled with other environmental risks, climate change poses a serious threat to the progress made towards global health and development goals in recent decades. This challenge will make efforts to ensure the conditions in which people can be healthy more difficult in a myriad of ways (Wiley 2010). Moreover, not only does climate change carry a direct and indirect health warning, it is already contributing towards widening the gap in health inequalities between people living in the developing and developed world. In other words, climate change health impacts will – perversely, unjustly and inequitably – affect those in our society who are most disadvantaged and who arguably have contributed least to it – certainly in terms of their consumption of natural resources. Thus, and according to Friel et al. (2011), without a lessening of background rates of diseases, the multiplier effects of climate change on health outcomes will greatly exacerbate existing health inequities between and within countries, which poses a major additional challenge to international development.

For Wiley (2010), climate change acts primarily as an intensifier, and to some extent a redistributor of existing threats to health. More precisely, climate change is expected to directly affect many environmental determinants of health – mainly water, air, weather, oceans, and ecosystems (Portier et al. 2010) – which may exacerbate exposure to natural disasters and disease-carrying vectors, access to safe and potable drinking water, and food security. Similarly, Boxall et al. (2009) asserts that weather and climate factors are known to affect the transmission of water and vector-borne infectious diseases. Some linkages between climate and health are fairly obvious, such as the impact of weather-related natural disasters, whereas others are less obvious and may be neglected by policymakers, such as the indirect impacts of natural disasters, especially on mental health (Wiley 2010).

Addressing the health impacts of climate change is especially challenging because both the surrounding environment and the decisions that people make influence health. In real-life situations, a host of other factors come into play in determining vulnerability including biological susceptibility, socioeconomic status, cultural competence, and the built environment. In a world of myriad 'what if' scenarios surrounding climate change, it becomes very complicated to create wise health policies for the future because of the uncertainty of predicting environmental change and human decisions. The need for sound science on which to base such policies becomes more critical than ever (Portier et al. 2010).

Within a Moroccan perspective, the main health vulnerabilities to climate change include the following: risk of reactivation of certain diseases sensitive to climate change (such as malaria, bilharzia, typhoid, leishmaniasis, dengue and cholera); possibility of re-emergence of infectious diseases, vector-borne diseases as well as diseases and deaths related to extreme weather events, especially among the most vulnerable groups; increased water and food-borne diseases; increased incidence of respiratory infections and allergies due to air pollution and sudden weather events and rising temperatures which contribute to the increased volume of ozone at ground level and precipitate the start of the pollen season; natural disasters such as floods which cause damage (affecting agriculture, livestock and real estate), deaths and illnesses suffered by victims and their families; etc.

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Instead of covering all health impacts of climate change in Morocco, this chapter aims to focus on many infectious diseases that are expected to change their geographical or seasonal patterns and incidence due to climate change and variability. More specifically, climate change will likely affect the distribution, prevalence and lifecycle of several vector-borne diseases – such as Malaria and Leishmaniasis – and water-related disease – such as Schistosomiasis, and this scenario is relevant to the Moroccan context. These diseases still ravage lives in many developing and less developed countries and are likely to have a major human health burden in the coming years due to climate change and other factors. However, and despite this alarming fact, there is still limited specific scientific evidence to support policy-making processes in many countries.

In Morocco, infectious diseases are still a public health problem and the situation may be more complicated in light of climate change. Due to legal requirement to report notifiable diseases, the number of cases – both indigenous and imported – is continuously recorded for Malaria, Schistosomiasis and Leishmaniasis and showed an increase of the latter. This chapter aims to identify vector-borne diseases that are highly sensitive to climate change in Morocco, the risks of their reemergence in vulnerable regions; highlight the pressing need to understand the dynamics of these diseases, especially in a context marked by limited and uncertain scientific evidence regarding the health vulnerability to climate change; underline the problematic aspects of health adaptation to climate change and the current difficulties in terms of policy and governance action to manage climate-health linkages; and finally undertake an assessment of Morocco's adaptive capacity within a health perspective while formulating recommendations to effectively adapting the health sector to climate change and developing an effective climate-health governance and policy.

RELEVANT CLIMATE SENSITIVE INFECTIOUS DISEASES IN MOROCCO

Parasitic diseases still pose a public health challenge in Morocco. Their spread is very closely tied to risk factors – climatic, ecological, and socioeconomic – and other factors, such as urbanization, agricultural practices, beyond health authorities' traditional sphere of influence. Climate change is imposing a burden that is unevenly distributed across populations. The most vulnerable populations are in worse positions to effectively face these challenges because they have a limited ability to adapt to changing conditions. In particular, vulnerability in this context is linked to the emergence of vector-borne-diseases: Leishmaniasis, Malaria, and Schistosomiasis, which can be life-threatening. Therefore, there is an urgent need to understand their life cycle, habitats of reservoirs, micro niche of arthropod/insect vectors in the Moroccan context by using an eco-epidemiological approach.

Leishmaniasis

Leishmaniasis is a complex disease caused by *Leishmania* species and transmitted by a Phlebotomine sand fly (Diptera: Psychodidae) (Figure1). Two forms are known, cutaneous and visceral Leishmaniasis. The main reservoirs are dogs for Zoonotic Visceral Leishmaniasis (ZVL), rodents for Zoonotic Cutaneous Leishmaniasis (ZCL) and human for Anthroponotic Cutaneous Leishmaniasis (Figure 1) (ACL) (Rioux et al., 1982; Nejjar et al., 1998; Pratlong et al., 1991; Kahime et al., 2014).

Actually, three parasite species co-exist in Morocco:

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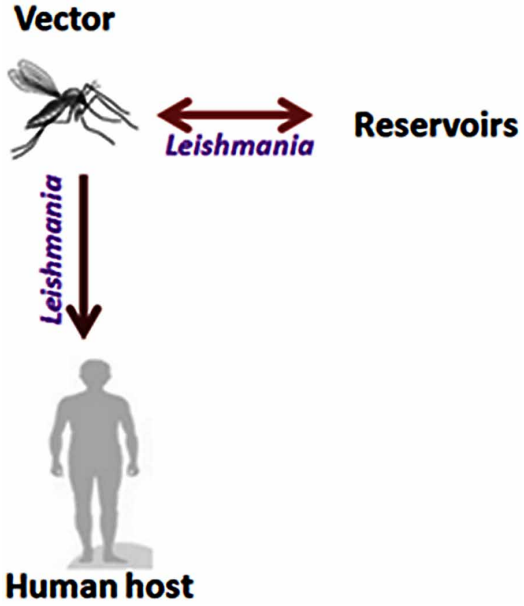
Figure 1. Simplified Life cycle of Leishmaniasis



- *Leishmania infantum*, causes mainly ZVL and transmitted by species of the subgenus *Larroussius.* It is widespread in the whole country and is more frequent in its northern part (Kahime et al., 2014, 2015a); L. *infantum* can cause Cutaneous leishmaniasis (CL) as well even if it is a rare condition with a few sporadic cases in the North of the country (especially in Sidi Kacem province) with little epidemiological data available (Kahime et al., 2015b).
- *L. major* causes ZCL with *Phlebotomus papatasi* as the vector in pre-Saharan area (Rioux et al., 1982, 1986; Kahime et al., 2014); and
- *L. tropica,* causative agent of ACL is widespread in northern and central areas, especially in semi-arid regions with *P. sergenti* as the vector (Guilvard et al., 1991; Pratlong et al., 1991; Kahime et al., 2014).

Malaria

Malaria is a mosquito-borne infectious disease caused by parasitic protozoans of the genus *Plasmodium* (*P. vivax, P. malariae, P. ovale* and *P. falciparum*) and is transmitted by female mosquito vectors of the Anopheles species. The cycle of *Plasmodium* is carried out in several stages which spread between mosquitoes and humans (Figure 2).

Malaria raged in Morocco for centuries and was an endemic disease in the majority of provinces. In 1960, a domestic program to fight the disease was launched. It allowed to control the situation after 40 years of bitter struggle. By 1999, malaria was occurring as sporadic cases of *Plasmodium vivax* in some residual foci in the north. The epidemiological assessment undertaken by the Moroccan Ministry of Health showed a shift towards the elimination of indigenous cases and the last indigenous case was reported in 2004. Morocco is now WHO certified Malaria free but imported cases are reported constantly.

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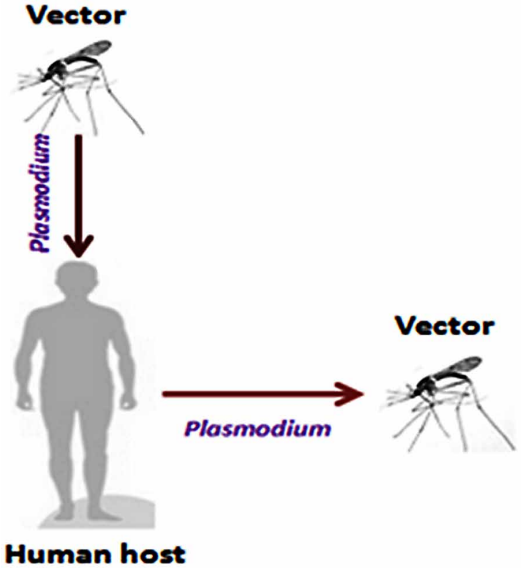
Figure 2. Simplified life cycle of Malaria



In Morocco, *Anopheles labranchiae* is the main vector of malaria. In common with leishmaniasis, it is the female (vector) that bites when it needs a blood meal before laying eggs. The vectorial capacity of *A. labranchiae* is considerably high during the summer which corresponds to the rice cultivation period in northern Morocco (Faraj et al., 2008).

There are two areas with high risk of transmission: The north foci (Al Hoceima, Taounate and Chefchaoune) and the center (Beni Mellal, Khouribga and El Kelaa) (MMH, 2004; Trari and Carnevale, 2011).

The risk of malaria resurgence in Morocco is higher because of the possible presence of parasite in human and invertebrate hosts in the last malaria foci, numerous imported cases and the presence of the main vector of Malaria in Morocco.

Schistosomiasis

Schistosomiasis is a disease caused by parasitic worms belonging to the class of trematodes and genus *Schistosoma* (S. *haematobium, S. mansoni, S. japonicum* and *S. intercalatum*). The parasite develops successively in two hosts: mollusk and human (Figure 3). This parasite is commonly found in ponds, streams and irrigation canals, housed in freshwater mollusks, and infests humans through the skin via contact with contaminated water (Figure 3).

In Morocco, the disease had spread in the oases in the south and along the southern side of the Atlas (MMH, 1980). The majority of cases have been filed in the Province of Tata, Chtouka, Taroudant, and Errachidia (WHO, 2012b). In recent years, many *S. haematobium* foci proved unstable and some even disappeared. However, creating large water supply for irrigation may lead to the onset of new foci.

Despite the existence of monitoring programs and adequate health services, cases of Malaria, Leishmaniasis and Schistosomiasis are still recorded in Morocco. As shown in Table 1, Leishmaniasis is the most reported diseaseand all cases are indigenous. In contrast, all Malaria cases are imported. For

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Figure 3. Simplified life cycle of Schistosomiasis

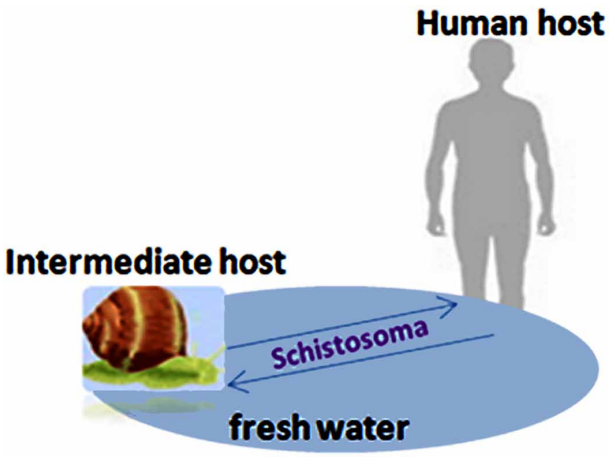

Table 1. Annual evolution of parasitic diseases in Morocco between 2005-2014

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Malaria (Imported cases)		100	83	100	142	145	218	312	364	314	308
Schistosomiasis		13	4	8	2*	2*	1 *	5 (3*)	0	3	1
Leishmaniasis	ZVL	114	170	160	163	134	139	107	113	111	85
	ACL	865	1197	1938	1697	1611	2263	2100	2137	2055	2081
	ZCL	2174	2164	1352	3431	4402	6444	2219	740	537	460

MMH, 2014.
*Imported cases.

Schistosomiasis, the number of indigenous cases is rarely associated with the risk of introduction of new species, which is linked to travelers or immigrants from countries where these species are endemic.

These diseases constitute a real social problem in Morocco because they disproportionately affect the poor, particularly those in vulnerable housing and environmental conditions. Loss of income and healthcare costs exacerbate the economic situation of already-disadvantaged households (Kahime et al., in press). Urban population growth, responsible for the spatial expansion of cities, creates enormous need for community facilities and equipment related to decent housing, access to clean water and sanitation and environmental preservation. The vulnerability of populations to these disease risks varies across spatial and temporal scales in response to environmental change, economic development dynamics, social capital, demographics and population structure. Understanding the interactions between human health and the environment is quite complex. In fact, the very term environment can be confusing because it is used in various acceptances. The ecosystem approach to human health is distinguished from traditional approaches by integrating all determinants of health, namely economic and environmental factors and community needs.

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CLIMATE CHANGE IMPACTS ON INFECTIOUS DISEASES: THE CASE OF MOROCCO

Anthropogenic climate change may directly affect the behavior and geographical distribution of mosquito vectors and the lifecycle of the parasite, and thus change the incidence of the disease. Indirectly, climate change could also have various effects by influencing environmental factors such as vegetation and the availability of breeding sites (Martens et al., 1995).

As the climate has an important influence on environmental and socio-economic components, the juxtaposition of many of socio-economic factors e.g., poverty, economic degradation over time may convincingly increase as result to climate change. This change could, depending on the region, have adverse impacts on water resources, agriculture, biodiversity, ecosystems, food and health security.

A wide range of infectious diseases may change their geographic range, seasonality and incidence due to climate change, but there is still limited and uncertain scientific evidence about the extent of health vulnerability to climate change. For example, over the past decade, the epidemiological situation of CL has changed significantly. It is acquiring an increasingly epidemic status with geographic expansion to previously free areas and the emergence of new foci in several provinces of Morocco. 24 804 cases of zoonotic *L. major* CL and 16 852 cases of *L. tropica* anthroponotic CL were recorded between 2004 and 2013 in Morocco (Kahime et al., 2015b). ZCL acquires an increasingly epidemic status with geographic expansion into previously free areas in several provinces of South-East Morocco (Kahime et al. in press). Whereas, ACL has an extensive geographical distribution (Kahime et al., 2015b).

The leishmaniasis lifecycle, parasite-reservoir-vector, evolves depending on geographic regions and is sensitive to environmental changes that can affect the parasite, the reservoir and the vector, as well as their dynamic interaction and territorial expansion (Bounoua et al., 2013). Seasonal patterns and the correlation between the vector density and the number of cases have been documented (Feliciangeli et al., 1998). Weather and climate variables also play an important role in leishmaniasis incidence as they can constrain or exacerbate favorable conditions for the disease, such as an acceleration of the development of the parasite or synergistic changes in reservoir and vector populations that cause an explosion in the vector population. For example, increase in precipitation may increase the vegetation foliage, and thus the number and quality of breeding sites for both rodents and sandflies (Yates et al., 2002; Bounoua et al., 2013).

Distribution and seasonal activity of malaria are also sensitive to climate factors and impact the local capacity to control the disease. Malaria is one of the few climate-sensitive diseases that has been modeled by many research groups, which facilitates a thorough assessment of possible climate change effects using a multi-model inter-comparison (Caminadae et al., 2014). The distribution and population dynamics of malaria are probably more governed by abiotic than biotic factors (Southwood, 1977). Of the possible abiotic influences on the transmission cycle of malaria, temperature and rainfall are the most important; therefore, the situation could be exacerbated by climate change. Although this linkage is still uncertain, an increase in the incidence of malaria has been identified as a potential impact of climate change in South America (Lieshoutet al., 2004) and Africa (Ebi et al., 2005). Climatic factors that feed into the phenomenon could have a direct bearing on the number of malaria cases. Actually, a number of studies have reported the association between malaria cases, rainfall and temperature (Bhattarai et al., 2007). For example, a study carried out in Ethiopia revealed an association of malaria with rainfall

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and minimum temperature, the strength of which varied with altitude (Teklehaimanot et al., 2004). In South Africa, variations in annual cases of malaria were shown to be related to rainfall and temperature patterns (Craig et al., 2004).

According to McCreesh and Booth (2013), climate change will inevitably influence both the distribution of *Schistosoma* sp. and incidence of schistosomiasis in areas where it is currently endemic. Global warming is expected to be accompanied by perturbations in the global hydrologic cycle (Allen and Ingram, 2002), precipitation levels and pronounced changes in water availability (Allen et al., 2005). However, only a few attempts have been made to predict changes in the spatial distribution of schistosomiasis due to global warming; and the results have been conflicting (Martens et al., 1995, 1997). Thus, the nature and extent of climate change on the transmission of schistosomiasis remains poorly understood (Morgan, 2001). The lack of research in this field probably explains why climate change implications for schistosomiasis control and elimination have been largely ignored (McCreesh et al., 2015).

Snails of the genus *Bulinus* serve as the intermediate hosts of *S. haematobium* in Africa and the Eastern Mediterranean (WHO, 1990). These aquatic snails breed in waters (barrages, irrigation canals...), contaminated with infected faeces or urine from infected person or by infected wastewater, used also for irrigation. Water resources development schemes in certain areas, particularly irrigation schemes, can contribute to the introduction and spread of schistosomiasis. Consequently, intermediate hosts can determine the geographical area of schistosomiasis risk. In Morocco, the disease foci, especially in Beni Mellal, El Kelaa and Nador Provinces were linked to hydrologic programs for irrigation (barrages and irrigation canals and wells) in the 1970s (WHO, 2012b).

Potential impact of climate change on the transmission of schistosomiasis and other diseases must be juxtaposed to profound ecological, demographic, and socioeconomic changes. Also, it should be mentioned that, in Morocco, there is no study that addresses the relationship between malaria or schistosomiasis and climate change.

ADAPTATION TO CLIMATE CHANGE FROM A HEALTH PERSPECTIVE: CHALLENGES AND OPPORTUNITIES

Supported by a rapidly growing body of evidence, the health implications of climate change are widely covered at international meetings and used to demand action on climate change. However, while the health sector is well involved in adaptation strategies, mitigation efforts are anticipated to largely take place outside of the sector according to Lovell (2011). Nerlander (2009) asserts that proactive health adaptation strategies are needed to protect vulnerable people from climate change impacts on their health and well-being. This is true because reducing vulnerabilities and increasing resilience in general will help populations cope with climate change health effects. For Wiley (2010), adaptation to climate change requires a set of law, policy and governance tools (such as a purpose-built legal and policy framework designed to specifically address climate risks, which may provide particular models of governance and management for adaptation to climate change (Godden et al., 2013) that are very different from what environmental policymakers have typically employed in their mitigation efforts[1]. However, to date, there has been limited research on how legal, institutional and regulatory frameworks can support and facilitate effective adaptation and responses to climate risks (Godden et al., 2013). While many factors influence resilience and the capacity to prepare for and respond to these risks, regulatory and policy frameworks remain significant drivers of collective and behavioral change.

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In addition, adaptation of the health sector to climate change requires a continuous access of decision makers to relevant scientific evidence and information. Nevertheless, forecasting the impacts of climate change on human health is still limited because populations have different vulnerabilities to change and susceptibility to disease. This depends – among other factors – on hygiene practices, clothing, housing, and medical and agricultural traditions. Adaptation to the spread of disease is also determined by the economic level of a given population, the quality and coverage of medical services, and the integrity of the environments. Thus, human biological and psychological factors are primary determinants, but ecological and global systems are also involved, as are economics and access to health care, which shape the vulnerability of societies to disease. Shifts in environmental conditions that interact with the biology of disease agents can also exert profound effects. Changes in land use affect the distribution of disease carriers, such as rodents or insects, while climate influences their range and affects the timing and intensity of outbreaks. Changing social conditions, such as the growth of multimillion-inhabitant cities in the developing world and widespread ecological change, are today contributing to the spread of infectious diseases (Beniston 2010).

Adaptation to climate change is equated with the well-established concept of public health preparedness (Frumkin et al., 2008) and necessitates that traditional public health initiatives are integrated with weather warning systems, climate forecasts, and disaster preparedness. In addition, reducing vulnerabilities and increasing resilience to climate change includes strengthening health systems (Nerlander, 2009) because inadequate healthcare infrastructure contributes to the increase of vulnerability to the effects of climate change and reduces the adaptive capacity of nations (Patz and Kovats, 2002).

There are different adaptation strategies to reduce the vulnerability of human health to climate change. These strategies include measures taken before the observation of impacts (preventive measures), as well as other measures taken after the appearance of such impacts (corrective measures). In addition, adaptation may be the result of political decisions (planned adaptation), or it can be spontaneous (independent measures). In addition, adaptation in unmanaged natural systems is carried out by independent and corrective measures while the managed natural systems can take advantage from preventive measures and planned adaptation strategies. Many adaptation options may produce benefits beyond those associated with climate change; the rehabilitation and maintenance of the public health infrastructure for example is often considered the most important coping strategy, most profitable and most immediately needed.

For adaptation purposes, the World Health Organization has called on the health care sector to prepare for climate change impacts through efforts to increase resilience (CCGHC and Nova Scotia Department of Environment and Health Canada, 2013). In addition to continually engage in broader community discussions and initiatives around climate-related issues, the health care sector should constantly mainstream climate change into risk assessments and consider it when developing plans and activities. Health care and public health professionals and staff should be prepared for climate change by assessing risks from extreme weather events, readiness to manage climate-related infectious disease outbreaks or atypical cases and increasing understanding of how gradual shifts in weather can affect risk profiles. Moreover, adaptation strategies to reduce the vulnerability of human health to climate change should include public health training, monitoring, viable prevention and control programs, and more effective response systems in case of emergencies, including the setting up of multi-disciplinary health care teams to address the various health effects and implications of climate change. Furthermore, health care facilities can reduce risks of climate change through proper management of critical resources (e.g. pharmaceuticals, food, transportation, medical supplies and equipment) based on climate change considerations. A resilient health care facility is also one that commits to sustainable practices, such as water and energy conserva-

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tion, promoting active transportation, and local food procurement. In investing in resilience activities in these areas, health care facilities can reduce operating costs and increase resilience in the community.

On another level, climate change will likely exacerbate already existing urban social inequities and health risks, thereby exacerbating existing urban health inequities. According to Neiderud (2015), urbanization leads to many challenges for global health and epidemiology of infectious diseases. In other terms, the rise of the new modern cities creates potential risks and challenges in the aspect of emerging infectious diseases. Risk factors in the urban environment could, for example, be the poor housing connected to inadequate water supplies, sanitation and waste management (these conditions contribute to a favorable setting for both rodents and insects which carry pathogens and soil-transmitted helminth infections[2]). Also, if buildings lack effective fuel and ventilation systems, respiratory tract infections can also be acquired. Contaminated water can spread disease, as can poor food storage and preparation, due to microbial toxins and zoonotic agents.

In addition, the new megacities can be incubators for new epidemics, and zoonotic diseases can spread in a more rapid manner and become worldwide threats. The density of inhabitants and the close contact between people in urban areas are often potential hot spots for rapid spread of infectious diseases such as severe acute respiratory syndrome (SARS) and the avian flu. Criteria for a worldwide pandemic could be met in urban centers, which could develop into a worldwide health crisis. Adequate city planning and surveillance can be powerful tools to improve global health and decrease the burden of communicable diseases, hence it must be in the mind of the governing bodies of these megacities.

Urbanization is both a cause of and potential solution to global climate change. Most population growth in the foreseeable future will occur in urban areas primarily in developing countries[3]. How this growth is managed has enormous implications for climate change given the increasing concentration and magnitude of economic production in urban localities, as well as the higher consumption practices of urbanites, especially the middle classes, compared to rural populations. There is still much to learn about the extent to which climate change affects urban health equity and what can be done effectively in different socio-political and socio-economic contexts to improve the health of urban dwelling humans and the environment. But it is clear that equity-oriented climate change adaptation means attention to the social conditions in which urban populations live – this is not just a climate change policy issue, it requires inter-sectoral action. Policies and programs in urban planning and design, workplace health and safety, and urban agriculture can help mitigate further climate change and adapt to existing impacts. If done well, these will also be good for urban health equity (Friel et al., 2011).

From a governance point of view, adaptation to climate change within a health perspective requires the consideration of many issues such as:

- Public health often depends on activities in other sectors. To ensure that climate change health effects are not overlooked, the health sector needs improved integration into strategic planning in sectors such as water, agriculture, and disaster management. This includes safeguarding the integration of health concerns into for example National Adaptation Programmes of Action (Nerlander, 2009). However, and despite emerging efforts to better integrate health and environmental objectives in international and domestic law and policy, scientists, policymakers, and advocates in these two fields remain regrettably cut off from each other (Wiley, 2010).
- Integration of health concerns into the law and governance of other related disciplines should be given high priority. Although scientific research has pointed to the interdependence of the global environment and human health, policymakers have been slow to integrate their approaches to

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environmental and health concerns. A robust response to climate change will require improved integration on two fronts: health concerns must be given higher priority in the response to climate change and threats associated with climate change and environmental degradation must be more adequately addressed by health law and governance (Wiley, 2010). The call for integration is being heard, but to properly heed it will require that we carefully consider our health and environmental priorities and set forth a mutually beneficial agenda for protecting both. On international level, the mitigation/adaptation response paradigm currently evolving both within and beyond the United Nations Framework Convention on Climate Change (UNFCCC) is a potentially powerful framework for thinking about the integration of health and environmental concerns more broadly[4]. It may even be a useful way of thinking about global health law and governance with respect to other upstream determinants of health (Wiley, 2010).

- Public health planning and decision making need to shift from only focusing on relatively short term risks to the projected long term impacts of climate change. It will be increasingly important to address the links between climate and health at different time- scales. Already today we need to be better at dealing with climate variability and its related health effects. Improving our capacity to prepare and respond, through using for example early warning systems and seasonal forecasts, will allow us to be better positioned to address the challenges that climate change will bring. Long-term climate projections will be increasingly important to ensure that we are prepared for risks changing over time when planning resource allocation, building infrastructure and ensuring that surveillance systems are able to detect changing patterns of disease (Nerlander, 2009).
- Research gaps to increase the understanding of climate change and health should be identified so that mitigation of and adaptation to the environmental effects of climate change in the healthiest and most efficient ways can be facilitated. Filling these gaps in many countries like Morocco also requires the strengthening of the connections between traditional researchers (clinicians, biologists, epidemiologists) and other important researchers (like meteorologists and climatologists). Additionally, expanding the understanding of the often indirect, long-term, and complex consequences of climate change for human health should be a high priority and challenging research task for both developed and developing countries.

MOROCCO'S ADAPTIVE CAPACITY AND OPTIONS NEEDED TO EFFECTIVELY MANAGE CLIMATE-HEALTH ISSUES

As shown above, it is increasingly recognized that climate change will directly and indirectly impact human health and alter the way countries should protect their vulnerable populations. Worse, the adaptive capacity varies widely from one country to another, and within countries from one region to another. Developing countries, in contrast to rich countries, lack not only expertise, but also adequate resources and effective health systems capable of managing climate-health risks.

This is also true for Morocco which is expected, in addition to current health challenges, to face many public health concerns in the future due to many factors and pressures. The data accumulated over the past decades show that the country is very concerned by climate risks and its potential effects on many sectors, including public health (MMH, 2004, 2012). These data also reveal that climate change will not affect all regions in the same way: while climate-related diseases would affect vulnerable populations in general, rural areas will suffer more due to the various effects of floods and droughts and resource

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depletion (the recent floods occurred in 2015 in the South of Morocco revealed the extent to which many regions are extremely vulnerable to climate-related disasters and the level of human and economic damage to be reached). This applies in particular to regions where livelihood is closely linked to natural resources (i.e. agriculture, forestry and fisheries). Malnutrition, largely as a result of poor access to food, either because of poverty or the declining agricultural productivity, can also cause various health impacts. Water supply conditions, already precarious in rural areas, could promote the development of water-borne diseases and this effect is likely to be exacerbated during periods of drought. However, changes in the distribution, extent, prevalence, incidence and seasonality of these diseases are to be expected in a context where the magnitude of change is difficult to determine with certainty.

With this prognosis, the state of the health system adds to the problem. It still suffers from many structural and organizational deficiencies which negatively affect its performance and governance. This includes: weak health infrastructure coverage; difficult access to care and health services; weak human and technical capacities with limited training and recruitment opportunities[5]; limited financing capacity of institutional actors (health costs 5.3% of GDP in Morocco, against 6.4% in Tunisia and 9% in OECD); inadequate prevention system; limited trust in the health system and professionals; low level of awareness, linked in part to a deficient educational level especially in rural remote areas, particularly about climate-sensitive diseases; difficulties related to health facilities' management methods; a drug policy relatively transparent when it comes to the determination of prices (which remain poorly harmonized with those applied in similar countries); insufficient partnership, especially between the public sector, private sector and civil society; strong centralization of decisions (which also refers to a kind of non-effective regionalization and the lack of autonomous management); and the persistence of certain health indicators below international standards (MMM, 2012).

Lemsioui (2012) highlights the insufficient consideration of natural risks in the national development plan, the lack of forecast-mapping studies of natural risks, the incomplete state of national legislation system and the absence of a framework-law on risk prevention. For the author, the cumbersome legislative system often prevents the advancement of risk management strategies of natural disasters. Meanwhile, the insufficient awareness of communities with respect to natural hazards and risk magnitude worsen the situation.

This situation may impede the implementation of effective measures to reduce the social vulnerability to climate change, especially in terms of health security. Therefore, the country, already facing many domestic problems with limited capacities to meet pressing social needs, may be more vulnerable face to climate change health impacts.

In order to foster health security in Morocco face to climate risks, adaptation options should aim to: strengthen the health system through upgrading of health facilities and the network of primary healthcare and the introduction of compulsory medical insurance; develop a robust epidemiological surveillance system; strengthen the programs against climate-sensitive diseases by promoting disease surveillance, screening and good patient management, the development of environments that promote health through sectoral programs; and strengthening intersectoral partnerships.

The universal health coverage, whose basic principle is the right to health, should also be a strategic priority. Morocco has recently engaged in this direction through the implementation of numerous initiatives – such as a medical assistance plan called RAMED[6] which aims to reduce the effects of unexpected expenses related to healthcare on the poor (ANAM, 2013) – in order to ensure adequate access to health services, while minimizing health expenses and saving the most vulnerable populations from falling into extreme poverty. Two fundamental components are given priority: access to required health services and

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financial protection to prevent the degradation of public health from leading vulnerable people to poverty. However, these initiatives are only a first step which must be strengthened through additional funding, outreach to all vulnerable social groups, and the implementation of appropriate governance measures.

In addition, populations need to be regularly sensitized and informed about climate-related health risks and its consequences. Training and awareness programs as well as capacity building for prevention and action against infectious diseases should be an integral part of adaptation options to be considered.

Insufficient or inadequate information on climate and health issues may prevent the adoption of a genuine strategic perspective. Thus, improving knowledge on climate-health issues (including studies analyzing and modeling the evolution of climate parameters and their impact on related notifiable infectious diseases) is needed to better understand the future and prioritize adaptation options. Also, allowing policymakers continuous access to viable and high quality information is crucial to good decision making. To do this, exchange between scientists, experts and decision makers should be institutionalized (via for instance setting up of a competence center for climate and health research, committees of experts, observatories, etc.). In addition, the government should encourage the development of a national expertise and strengthening the links between researchers, decision makers and professionals concerned by climate-health issues.

There is also the need to develop a strategic framework to manage climate change and health issues. Such a framework should enable a continuous exchange between research and policy spheres. The underlying approach consists of guiding all relevant actors during policy making and implementation and reciprocally help define research needs and priorities based on lessons learned from practices.

Given the diverse aspects of climate change-health issues and associated uncertainties, it is still difficult to analyze and investigate these issues. Therefore, caution is recommended in any work aiming to forecast and interpreting risks, especially that human health is in permanent interaction with ecosystems whose biotic and abiotic elements are affected by climate change (ONERC, 2007).

The establishment and improvement of early warning systems, including seasonal climate forecasting, have also become essential to support decision and policy-making processes. Similarly, it is useful to have a surveillance mechanism that can monitor extreme weather events and climate-related epidemics which may affect human health and safety.

Also, the adaptation strategy in the health sector should be guided by the equity imperative, which requires the involvement of all relevant stakeholders in engaged processes. Such involvement will ensure the inclusion of stakeholders' expectations in a spirit of solidarity and complementarity.

The management of climate-related health impacts requires the development of a 'multilevel governance' which offers a more flexible system and promotes the efficiency, consistency and economies of scale. In this governance framework, the health policy also includes action on socio-economic and environmental determinants of health (access to financial resources, nutrition, healthy environment, education, etc.). However, Morocco should gather many conditions to ensure the efficiency of this governance framework such as: Reforming its legal and policy framework related to health and environment; fostering the human rights approach within the health and environment areas; developing regional health and climate plans and strategies; mainstreaming health and climate change in social and human science research and teaching; bridging the gap between health/climate expertise and policy makers; promoting the full involvement of civil society actors in health and climate policy making and implementation processes, etc.

In addition to these, adaptation options to climate change in Morocco from a health perspective should focus on the following key priorities: The allocation of sufficient financial and human resources

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according to public health needs while ensuring that these resources are distributed fairly in a spirit of regionalization; the establishment of adequate, operational and sufficient health infrastructure, covering the whole territory and ensuring a balance between regions and urban and rural areas; the development of a good health governance by adopting effective management methods, reforming health institutions, strengthening the network of primary healthcare, strengthening the compulsory medical coverage and the development of health professionals' capacities. To support the implementation of such option, Morocco may develop health-focused projects to be submitted to the UNFCCC for funding.

CONCLUSION

This chapter has attempted to demonstrate how infectious diseases in Morocco – mainly Leishmaniasis, Malaria, and Schistosomiasis – are expected to change their geographical or seasonal patterns and incidence due to climate change and variability. Given the gravity of these vector-borne-diseases, the analysis highlights the pressing need to understand its dynamics, especially in a context marked by limited and uncertain scientific evidence regarding the health vulnerability to climate change in Morocco.

In addition to this, the analysis underlines the problematic aspects of adaptation to climate change from a health perspective and the current difficulties in terms of policy and governance action to manage climate-health linkages.

Finally, and by reference to the Moroccan context, an assessment of the national adaptive capacity within the health sector has been undertaken. Relevant recommendations to effectively adapt to climate change and develop effective climate-health governance and policy have been formulated.

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ENDNOTES

[1] Climate change mitigation strategies are also synonymous with health improvement, whether through improved housing, active transport, changes to patterns of food consumption or economic localization.

[2] Soil-transmitted helminth infections are among the most common infections worldwide and affect the poorest and most deprived communities. They are transmitted by eggs present in human faeces which in turn contaminate soil in areas where sanitation is poor. The main species that infect people are the roundworm (*Ascaris lumbricoides*), the whipworm (*Trichuris trichiura*) and hookworms (*Necator americanus* and *Ancylostoma duodenale*). For more information: http://www.who.int/mediacentre/factsheets/fs366/en/

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[3] About a century ago, only 20% of the world's population lived in cities, and in the least developed countries the percentage was only 5%. Approximately half of the world's population now live in these urban centers. The two inhabited continents, which currently are the least urbanized, are Asia and Africa, with respectively 48 and 40% of the population living in cities. These percentages are expected to rise dramatically by the year 2050 to 64 and 56% respectively (Neiderud, 2015).

[4] The Paris Agreement recently adopted by the COP21 recognizes the links between climate change and health concerns: It recognizes the social, economic and environmental value of voluntary mitigation actions and their co-benefits for adaptation, health and sustainable development; and acknowledges that Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health…(FCCC/CP/2015/L.9/Rev.1).

[5] The remote geography of many rural areas in Morocco also creates additional challenges such as the retention and training of medical staff, the collection of health system data, and the provision of infrastructure.

[6] RAMED: Régime d'Assistance Médicale.

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Chapter 6
Nurses, Healthcare, and Environmental Pollution and Solutions:
Breaking the Cycle of Harm

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ABSTRACT

Many nurses may not be aware of the role that healthcare plays in the cycle of harm. Healthcare participates in the cycle of harm by mismanaging waste, using fossil fuel energy and offering meat-based diets. Lack of knowledge, resources and empowerment potentiate this participation. Greenhouse gas emissions from fossil fuel use and meat-based diets, with resultant water pollution, contribute to climate change. Climate change and healthcare source pollution in water from mismanaged waste, contributes to illnesses of community members. Once sickened, individuals come to the healthcare center for treatment. This illness care then contributes to more environmental pollution. Specific human health consequences of resultant water pollution and climate change will be discussed. With healthcare professionals collaborating with others concerned, the connections potentiating this cycle of harm can be broken. Recommendations will be offered for healthcare's forward movement to help create the solutions to the pollution.

INTRODUCTION

Nursing professional scope does include evaluating and correcting environmental factors to improve human health. From the Nightingale foundational concepts in the eighteen hundreds (Nightingale, 1969) to the *American Nurses Association's (ANA) Principles of the Environmental Health for Nursing Practice with Implementation Strategies* (American Nurses Association [ANA], 2007) a helpful framework is set for healthcare's forward movement into the twenty-first century.

Florence Nightingale was not only the founder of the modern nursing profession, she was a pioneer in recognizing the environment as a key factor in determining if a patient would recover from his wounds

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or die. She reduced the death rate of those wounded in the Crimean War dramatically by providing a hygienic environment including clean water, clean air, clean linen and frequent wound cleansing followed by an application of clean bandages (Dossey, 1999).

According to the ANA (2007) there are ten principles of environmental health:

1. "Knowledge of environmental health concepts is essential to nursing practice.
2. The Precautionary Principle guides nurses in their practice to use products and practices that do not harm human health or the environment and to take preventive action in the face of uncertainty.
3. Nurses have a right to work in an environment that is safe and healthy.
4. Healthy environments are sustained through multidisciplinary collaboration.
5. Choices of materials, products, technology, and practices in the environment that impact nursing practice are based on the best evidence available.
6. Approaches to promoting a healthy environment respect the diverse values, beliefs, cultures, and circumstances of patient and their families.
7. Nurses participate in assessing the quality of the environment in which they practice and live.
8. Nurses, other health care workers, patients and communities have the right to know relevant and timely information about the potentially harmful products, chemicals, pollutants and hazards to which they are exposed.
9. Nurses participate in research of best practices that promote a safe and healthy environment.
10. Nurses must be supported in advocating for and implementing environmental health principles in nursing practice" (p.16).

The ANA's principles most applicable to the current discussion include one, two, four, six, seven and eight. The writing of this entire chapter is built on principle one. This foundation in environmentalism will be demonstrated throughout the chapter. Also referred to in this chapter is principle two, the precautionary principle. According to principle two, healthcare workers do not need to wait until environmental conditions have caused irreparable harm to human health before taking action to mediate circumstances that could lead to such harm. Principle four talks about the need for multidisciplinary collaboration. In order to create a cleaner, safer and more sustainable future for humankind, this chapter will call on far-reaching professional networks to strive together to accomplish such an end. Principle six affirms that approaches to promoting a healthy environment respect the diverse values, beliefs, cultures, and circumstances of the patient and their families (ANA, 2007). This chapter will show environmental concerns are multinational and all cultural contexts are in need of solutions suited to individual regions, resources available and associated circumstances. Principle seven is about assessing the quality of the environment. As the chapter emphasizes, this environmental assessment is a legitimate and important part of a nurse's scope of practice. Finally, principle eight emphases the right to know information about potentially harmful products and hazards. This right to know encompasses healthcare workers as well as the general community population. The current chapter will affirm that dissemination of this risk and hazard information can be an important part of a nurse's role along with health education on measures that families can undertake to minimize their polluting behaviors. Recommendations will include discussion of who could take on this educational role and some suggestions and examples of how this could be done will be included.

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BACKGROUND

This chapter will be discussing the part healthcare plays in adding to water pollution, environmental contamination and resultant climate change. Although much has been written on the existence of human-source climate change in other publications and the topic can be reviewed in chapter one of this book, a brief discussion is included here.

There is ever increasing evidence for human-caused climate change, according to McCarthy (2012) of the Union of Concerned Scientists. A critical piece of climate change is the shift in the parameters of the world's waters. The planetary water is being heated, melted and acidified. Convincing evidence includes deep sea warming, melting of millennium old ice shelves and lower Ph of ocean waters. All of this evidence is consistent with the rate at which heat-trapping gases, mainly carbon dioxide, is being released into and held in the lower atmosphere. Changes are now happening 100 to 1,000 times faster than at any time since humans have lived on Earth (McCarthy, 2012). Extreme weather events are increasing secondary to climate change. 2012 was the third most expensive year in recorded history for natural and man-made disasters with a price of $166 billion in repairs. Superstorm Sandy alone is estimated to have caused $70 billion in damages. Corn crop failures in the United States of America resulted in $11 billion in losses, which is the largest ever recorded (Guenther & Balbus, 2015). Much of the reason for this weather-related detriment is that economies and infrastructures were designed for the more stable climate of the past. With the rapidly changing climate of today and the future, many areas will have difficulty with adaptation (Federal National Climate Assessment and Development Advisory Committee [FAC], 2014).

In addition to causing climate changes, such as extreme weather events, higher carbon dioxide levels from burning fossil fuels has a direct effect on ocean water. Carbonic acid is created when carbon dioxide interacts with ocean water. The ocean and carbon dioxide interaction causes the waters to become more corrosive and acidic. This increased acidity makes it more difficult for some aquatic animals to survive and reproduce. Resultant dropping numbers of some marine life, will in turn, impact the aquatic food chain, of which humans are the apex consumer (FAC, 2014).

While scientists continue to formulate projections of the future climate, observations definitely show that climate change is occurring and that the warming of the past five decades is mainly due to human activities that cause emissions of heat-trapping gases. These greenhouse gas emissions come predominately from burning fossil fuels, with additions from forest clearing and some agricultural practices (FAC, 2014).

OBJECTIVES

1. Explain how and why the healthcare community takes part in the cycle of harm.
2. Discuss the health consequences of resultant water pollution and climate change.
3. Explore how the healthcare system can help to create solutions to the pollution.

Objective One

Explain How the Healthcare Community Takes Part in the Cycle of Harm.

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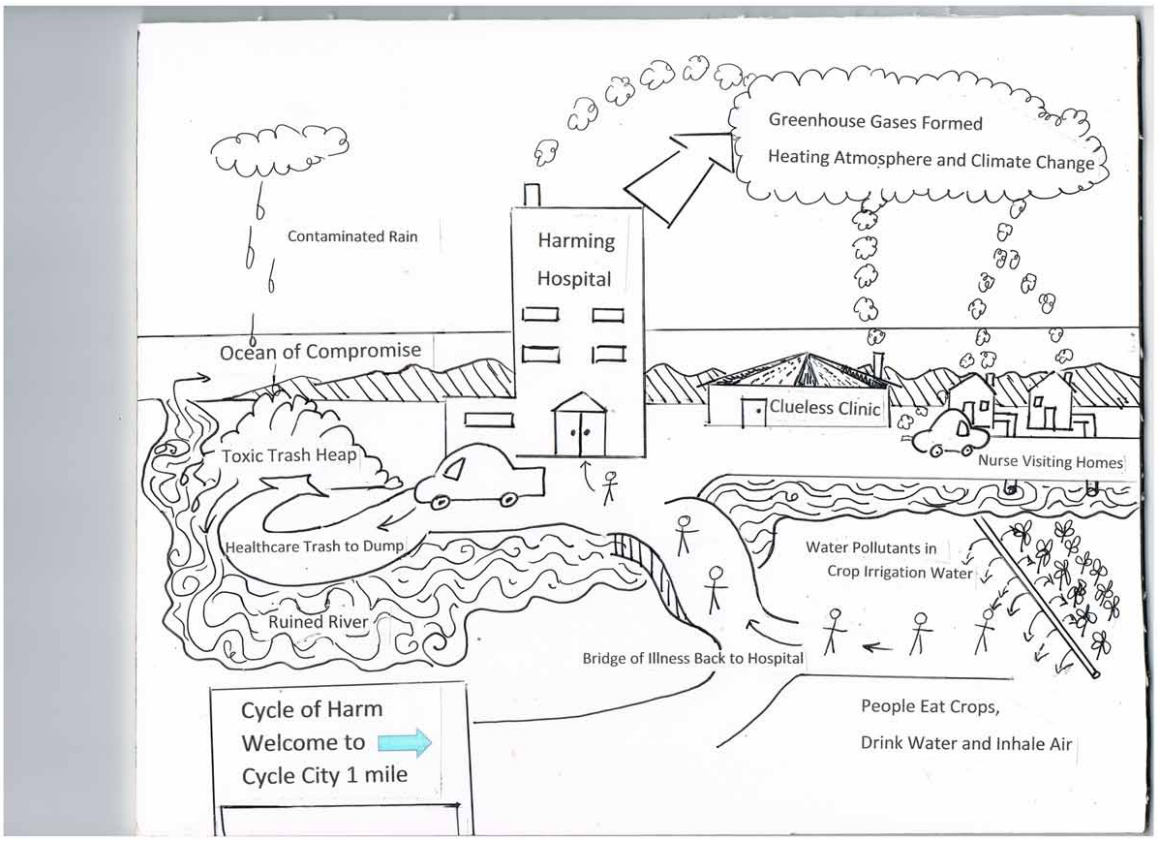
Figure 1. "Cycle City" by chapter author A.E. McKeown, 2015. The "Cycle of Harm" includes increased acidification and heating of ocean waters secondary to release of greenhouse gases. The cycle also includes chemical and biological contamination of fresh waters secondary to improper waste disposal. Humans suffer health consequences directly by consuming contaminated water and food or breathing contaminated air. Indirect human health consequences occur secondary to the weather extremes of climate change associated with greenhouse gases. People receiving treatment for resultant illnesses produces more pollution.



Mismanaging Healthcare Waste

Healthcare waste has several different distinct categories which include solid waste, biohazardous waste and chemical waste. The solid waste can be as much as ninety percent of hospital trash. It includes paper, cardboard, plastic, metal, glass, old tubing and intravenous lines. Larger items can also include used furniture, old medical equipment, packing materials, food service equipment and food debris Shaner-McRae, McRae, & Jas, 2007). Even noninfectious substances such as food scraps can attract flies and become a microbial breeding place if not disposed of promptly.

Biohazard or red bag waste is about ten to fifteen percent of hospital waste. Contaminated sharps, or needles, should go in a hard sided red box along with other sharp, contaminated waste. Soft, contaminated materials, such as disposable, blood-soaked gowns, or gloves should go in a red biohazard

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bag (Shaner-McRae et al., 2007). At times the waste is improperly sorted, leaving biohazard materials in with ordinary solid waste. This is a health hazard to staff disposing of infectious substances and an environmental hazard once in a land fill or other unprotected place of disposal. Dirty needles are the most serious and immediate threat to people, as they may transmit disease pathogens to individuals by an accidental puncture. World Health Organization (WHO) estimates that high income countries produce 0.5 Kg of hazardous waste daily per patient bed. Low income countries produce about 0.2 kg per bed per day (as cited in Hakim, Mohsen, & Bakr, 2014, p. 348). An example of healthcare trash not being sorted is related for illustration. In Egypt, Hakim et al. (2014) reports that health care related waste have recently become recognized as a major concern for healthcare facilities and for the environment. However in developing countries, it is noted that hazardous and non-hazardous waste is most often not separated, making the overall volume of contaminated waste much higher. This creates a health threat to municipal workers who handle garbage disposal as well as to the general public. Small scale incineration or autoclaving is what is most often used in countries where efforts are being made to deal with waste problems. Egypt is challenged to improve waste practices despite the Environmental Law Number Four of 1994 that was mean to deal with the issue. Some of the reasons for this ongoing waste management problem is weak enforcement and the healthcare worker's lack of knowledge of the legislation and lack of efficient waste segregation systems (Hakim et al., 2014).

Another category of waste, hazardous chemicals, are to be governed in the USA by the Resource Conservation and Recovery Act (RCRA) of 2007. RCRA regulations require a material safety data sheet (MSDS) to accompany each potentially hazardous chemical. This MSDS tells what is in the chemical, how to store it and what first aid measures to take if exposed. Individual instructions are to be followed for disposal of the substance as well (Shaner-McRae, et al., 2007). Any of these chemicals disposed of in a way unintended by the product-makers risks health consequences for exposed individuals. Toxic or hazardous chemicals may be used too liberally in hospital settings. Intensive care units may have the most toxic supplies due to a higher frequency of procedures performed. Huffling and Schenk (2014) call for the reduction or discontinuance of a number of substances. Among these is Triclosan, an anti-microbial used in soaps that is linked to thyroid disease. Furthermore, on the list of substances to avoid are phthalates and fragrances in personal care products that can alter fertility and hormone levels and cause headache and eye irritation respectively (Huffling, & Schenk, 2014). Any of the personal care products or soap mentioned could find their way into the water supply by being washed down the drain.

An example of freshwater contamination by hazardous chemicals is the case of the Great Lakes of North America. The Environmental Protection Agency (EPA) routinely monitors the Great Lakes for contaminates in fish and issues fish consumption advisories. Older, larger and fatter fish are considered the most toxic because they have had more time to absorb toxins from the lake water. The EPA monitors for a total of 39 chemicals, but the top concerns include mercury, and pesticides chlordane and dichlorodiphenyltrichloroethane (DDT). Pregnant women, nursing mothers and children are considered to be at greatest risk for adverse health outcomes secondary to fish consumption (Environmental Protection Agency [EPA], 2015).

A particularly problematic hazardous chemical waste comes from discarded pharmaceuticals. A notable category of environmental pollution from healthcare includes the contamination of the water supply by flushing wasted medications down the sewer. This policy of flushing wasted medications has been a healthcare standard of the past. However, this practice has now been shown to harm aquatic life and impose potential human health risks (McKeown & Pawloski, 2012).

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Using Fossil Fuel Energy

Huffling and Schenk (2014) state that healthcare takes part in what they call the harming circle by use of resource and energy intense processes. For example, it is noted that the USA healthcare system produces eight percent of annual greenhouse gases released in the USA (Huffling, & Schenk, 2014). The healthcare system has many and varied branches which includes acute care centers, usually referred to as medical centers or hospitals, the outpatient centers or clinics, doctor's offices, home health agencies, public health departments, medical research centers and institutions of higher learning for health professionals, to name several prominent sectors of healthcare . All sectors of the healthcare system have varying amounts of energy and resource use. However, intensive care units (ICUs) in an acute care center are some of the most energy consuming practice areas. ICUs house five to ten percent of hospital patients, while accounting for twenty to thirty-five percent of hospital costs. Fossil fuel based energy use in these settings has serious human health consequences. The pollution that is formed when fossil fuels are burned include mercury and acid gases. Airborne contaminates created in the fossil fuel burning process can be inhaled or may be consumed as part of contaminated water or food sources after pollutants have precipitated out of the air. Acid gases are causative agents for respiratory illness such as chronic obstructive lung disease, asthma and bronchitis. The release of mercury into the environment is also a threat to human health, because it is a potent neurotoxin as well as a risk factor for developing fetuses and young children. The discussion previously on EPA monitoring for mercury levels in Great Lakes fish should be remembered. Besides these direct influences on human health, there are the less direct impacts caused by the release of greenhouse gases, which contribute to climate change. Climate change is a looming risk factor in lung and heart disease, infectious disease, displacement and other weather related illnesses and injuries (Huffling, & Schenk, 2014).

Offering Meat Based Diets

Another way that healthcare takes part in the cycle of harm in some locations is by relying heavily on meat based dietary offerings for staff and patients. Allied health researchers have documented how dietary choices are linked to greenhouse gas emissions (GHGEs) with major consequences of food choices. The example noted here is in North America. Analysis of meat-based compared with plant-based diets are coming to the forefront in the interests shared by public health, environmentalism, and nutrition (Soret et al., 2014).

Soret et al. (2014) compared the GHGEs associated with diets eaten in a large North America population to mortality rates according to dietary patterns in the same population. Three dietary patterns were studied which included vegetarian, semi-vegetarian, and non-vegetarian Vegetarians were defined as individuals who ate meat less than one time a month. Semi-vegetarians were defined as individuals who ate meat more than one time a month, but less than one time a week. Non-vegetarians were defined as individuals who ate meat at least one time a week. The GHGE intensities of over two hundred foods were calculated through the individual food's life-cycle assessments. An established computer program, SimaPro software, was used for the analysis. This computer software is able to calculate the food's related output of global warming gases, including methane, carbon dioxide and nitrous oxide during the product's growth, care and processing into an edible form. Supplementary data was obtained, where needed, from previously published research on GHGEs and directly from food makers. The study participants were obtained from the data base of Adventist Health Study Two (AHS2) subjects. Study results showed,

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with the use of the meat-based diets as a baseline, the average reductions in greenhouse gas emissions for semi-vegetarian diets was twenty-two percent and vegetarian diets was twenty nine percent.

Soret et al. (2014) concluded that differences in the caloric intake of meat provided nontrivial reductions in GHGEs and also improved health outcomes (Soret et al., 2014). This study found mortality rates were sixteen to seventeen percent lower among semi-vegetarians and vegetarians as compared with non-vegetarians (Soret et al., 2014).

Besides benefits to the climate, lowering the use of animal products in an individual's diet is important for that person's health. Meat-based diets are linked to poor health while plant-based diets have positive influence on human morbidity and mortality.

Explain Why the Healthcare Community Takes Part in the Cycle of Harm

Lacking Knowledge

Environmental problems in modern healthcare can be very challenging. As Shaner-McRae et al. (2007) of the USA explains, hospital wastes are more complex, diverse and hazardous than other industries. Hospitals have some of the most difficult and diverse types of waste to manage. For example, Mathias (2012) points out, most health professionals agree that it is better to keep pharmaceuticals out of the water supply. However, it is very difficult to understand and comply with pharmaceutical waste management requirements and take part with best environmental practices. Developing a plan can be difficult partly because of the large number of items in a hospital pharmacy. There can be as many as four thousand different medications to consider and all are not subject to EPA's Resource and Conservation and Recovery Act (RCRA). The EPA is a branch of the USA government instituted to create policy, such as RCRA, and facilitate activities that will conserve natural resources. However, some medications are covered instead under hazardous waste rules. It can be challenging to determine in which category a drug is included. Also, there are other rules for management of wasted controlled substances, such as narcotics. Narcotics are under the separate rules of the Drug Enforcement Administration (DEA) (Mathias, 2012).

Another common problem in healthcare is that often there is not a clearly defined person at the facility to take charge of the hazardous chemicals, the MSDSs and be responsible for meeting regulations for safe handling and disposal. The most common violation of RCRA rules in hospitals is the failure to identify hazardous materials at all (Shaner-McRae et al, 2007).

An example of healthcare staff lacking adequate knowledge of environmental issues and resources to promote positive change is reported by Silva et al. (2014). Silva et al. (2014) of Santa Cruz, Brazil states that there is a growing concern over the preservation of natural resources and public health associated with management of solid waste in health services (SWHS). Some measures have been taken to address the problem, such as a classification system to help identify potentially hazardous waste. The National Health Surveillance Agency (NHSA) of Brazil classifies waste from health services as group A-potentially infectious, group B-chemical, group C-radioactive, group D-common residues and group E-sharps. The reason to group wastes is to better understand how to manage them. It can be seen that the mismanagement of waste can cause serious harm in higher rates of hospital-acquired infections and even in community wide epidemic secondary to contaminated ground water. In this study of 17 nursing professionals interviews were conducted and analyzed to identify how nursing professionals viewed waste management issues.

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Data analysis identified two main trends. The first trend was the concept that mismanaged SWHS contributed to environmental damage. It was noted by participants that final disposition outside the hospital was a contributing factor to the problem, but participants were unable to identify where SWHS was routed after leaving the hospital.

The second trend was the acknowledgement that SWHS can create a risk to the public health. It was acknowledged by participants that SWHS deposit locations favor the emergence of harmful microorganisms. Overall, the analysis showed that although nurses have identified the improper disposal of SWHS as a problem, it was unknown to them how to seek solutions.

Brazil's National Survey of Basic Sanitation shows that 63% of Brazilian cities collect SWHS, while 18% of these cities use some type of waste treatment, 36% burn the SWHS in the open and 35% do not follow any type of treatment. The authors conclude that solutions to proper SWHS disposal must be a joint venture, including the government as well as the health care facilities (Silva I., Bonfada, Silva R., & Souza, 2014). This is a good example of the application of ANA's principle four that states that healthy environments need to be sustained through multidisciplinary collaboration (ANA, 2007).

Lacking Resources

At times staff may have knowledge of what could improve waste disposal practice, but lack resources to implement the ideas. The cost for disposal of contaminated materials is ten to twenty times as high as for disposal of regular non-contaminated waste. The caution is not to waste time and resources putting uncontaminated materials in red biohazard boxes or bags. It can cost as much as one to five dollars a bag to properly dispose of contaminated waste (Shaner-McRae et al., 2007). Besides the concern of proper use of the red bag and box system, in some areas such a system may not even be available.

As an example, discussion was given on the Basel Action Network (BAN) website concerning the financial constraints of waste disposal efforts in India. According to the website authors, one should understand that most developing countries do not have the facilities to either monitor or regulate toxins, especially in the narrow regulatory limits as have been set in the west. Such facilities are also extremely expensive, and a financial strain on regulatory agencies. The clinical incinerators still found in some countries need to be retired and steps taken to adopt cleaner technologies and practices as well as waste minimization (McRae, G. & Agarwal, 1999).

Funding availability, however, in healthcare sectors in such countries is very limited. Solutions must be able to address key problems, such as the management of contaminated needles and basic waste segregation. Solutions are needed which require low cost approaches rather than expensive technology centric ones. They must reflect the solutions feasible in the developing countries. The solutions should be those which are good for the next decade or two since financial investments, once made, are not easy to replace in a low cash situation (Basel Action Network and Health Care Without Harm, 2015).

Lacking Empowerment/Nursing Diagnoses

In the following discussion on lack of empowerment of healthcare workers, the concept of nursing diagnoses is introduced. Nursing diagnoses will be discussed in this chapter as related to environmental pollution and climate change. However, below one will see how a nursing diagnosis can be used to apply to nurses themselves.

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Most readers are familiar with medical diagnoses that clearly state what problem the physician is to heal or correct. Besides the medical diagnoses, there are numerous nursing diagnoses that may have increased utilization in the future. In the realm of healthcare, the concept of nursing diagnoses embodies the idea that nurses can effectively and independently intervene on certain concerns, once the concern is clearly identified. The nursing interventions leading to the resolution of the concern can be more accurately identified and evaluated through this structured process. Nursing diagnoses are formalized and organized by NANDA International (NANDA-I) into 235 brief phrases that include defining characteristics, risks and related factors (NANDA International [NANDA-I], 2014). A drawback of nursing diagnoses is that they are not universally used and understood. Some nurses may find nursing diagnoses cumbersome to use or may find that it does not fit every health situation. Some nurses will not use any healthcare problem terminology system, or some may use a different system. One such alternate system is the Omaha system (The Omaha System, 2015). Using a terminology system is recommended to improve patient outcomes, however, whichever system is used, it is important to work within the prevailing system of one's own setting. One strong point of nursing diagnoses, which the chapter author will use, is that it gives nurses a framework to identify and thus effectively address a wide range of patient concerns. The more nurses are familiar with nursing diagnoses, the more that knowledge strengthens the profession and the individual nurses as well. Working knowledge of nursing diagnoses opens the door to more uniform and universal standards of nursing practice and more precise communication across practice groups and across geographical regions.

Many healthcare providers are concerned about environmental issues and yet find it difficult to do anything to improve practice or institute policies that have less negative environmental impact. Because of this growing phenomena, one author identifies this situation as suitable for labeling with the nursing diagnosis of Moral Distress in Nursing (Jameton, 2013). Moral Distress is a nursing diagnosis that is defined by NANDA-I as the response to the inability to carry out one's chosen ethical or moral decision. The defining symptoms or characteristics include fear, anxiety, and expressed anguish. The related factors described by NANDA-I that are most applicable to the current context include, conflict among decision-makers and conflicting information guiding ethical or moral decision making and loss of autonomy (NANDA-I, 2014). Usually the nursing diagnosis of Moral Distress is thought of as being applied in a clinical setting to one patient and their personal situation. However, the concept of moral distress can be applied to larger environmental concerns impacting healthcare as a whole. Since healthcare is large in scope and climate change is a major environmental problem, scaling down healthcare is inevitably a necessary step to help with mitigation of climate change. However, these issues are very challenging to discuss among health professionals (Jameton, 2013).

The following is an example of a group of 786 nurses in Ohio, USA that may fit within the nursing diagnosis of Moral Distress in Nursing. Polivka et al. (2012) reported on a group of public health nurses that perceived themselves as having responsibility to address health-related impacts of climate change but lacking the ability to address these impacts. When asked if their nursing division had the responsibility to respond to health related impacts of climate change, eighty-two percent agreed. When the same respondents were asked if actions can decrease the health-related impacts of climate change, sixty percent agreed. However, only thirty-five percent agreed their nursing unit has the ability to address health-related impacts of climate change and only sixteen percent agreed that their nursing unit was prepared to address the health related impacts of climate change. Polivka et al. (2012) referred to the ANA's precautionary principle which states that when there is uncertainty on an issue of environmental harm, the nurse is to err on the side of precaution and foster preparedness for climate change

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and resultant health consequences. Polivka et al.(2012) concluded that public health nurses view the environment as under threat but recognize the limited resources and personnel available to devote to promoting environmental conservation efforts (Polivka, Chaudry, & MacCrawford, 2012).

Summary Objective One

The healthcare system takes part in the cycle of harm by improper handling of waste products. Contaminated biological waste or toxic chemicals may contaminate the water supply and circulate around the environment, when disposed of improperly. Also, healthcare can contribute to the cycle of harm by the production of greenhouse gases through fossil fuel energy use and consumption of meat based diets. This contamination can pollute water and air and add to climate change.

Healthcare staff may be lacking three key things needed to make a change in polluting behaviors. These three essentials are knowledge, resources and empowerment. Knowledge is needed of the problems and laws meant to protect the environment. Resources and finances are needed to replace obsolete or inadequate disposal systems. Empowerment is needed to have authority to request or manage improvements in the work place. Lacking the essentials of knowledge, resources and empowerment leads to participation in the cycle of harm.

Objective Two

Discuss the Health Consequences of Resultant Water Pollution and Climate Change.

Nurse's Knowledge of Climate Change and Human Health Consequences.

A study was done by Polivka et al. (2012), as noted above, to determine public health nurses knowledge and attitudes toward health related impacts of climate change. Respondents identified only five out of twelve health-related impacts of climate changes. The five climate change related health impacts acknowledged by the majority of public health nurses were vector-borne diseases, flooding related displacement, food-borne disease, mental health issues and air-quality related illness. However, the majority of public health nurses did not identify malnutrition and water availability-related illness as being part of their perception of health related impacts of climate change. Climate change has the possibility to alter normal human growth and development through malnutrition from low food supplies and increased agricultural chemicals used to encourage greater crop yields. Also the majority of public health nurses did not identify cold or heat related illness or water-borne infectious disease as expected climate related health issues. Public health nurses acknowledged that impacts of climate change would have serious health consequences in the next twenty years where they lived and worked. However, the nurses believed conditions would be worse in other parts of the USA and greater still in other parts of the world (Polivka et al., 2012).

Human Habitat Destruction and Health Risk Related to Climate Change

The following will illustrate a case in point where climate change is unfavorably impacting human health in western North America. Climate change is cited by Embrey et al. (2012) in the USA and Canada,

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as being responsible for the pine forest ecosystems being dramatically changed by an unprecedented pine beetle infestation. This ecosystem change is expected to result in negative human health outcomes. First the environmental destruction is examined by Embrey et al. (2012) and then the human health consequences are discussed.

Both warmer winter temperatures and decreased frequency of cold days have led to a destruction of millions of acres of Rocky Mountain pine forest. This type of plant disease condition is referred to as an enphytotic event. An enphytotic event is defined as a condition with plant disease persistence in a plant population over a given period of time, as is similar to endemic disease in humans. The beetle infestation causes tree mortality by interacting with a virulent blue stain fungi. Together the insect and the fungi infestation cuts off the tree vasculature, causing loss of tree circulatory function and tree death. The beetle and the blue fungi tree infestations are usually kept in check by climate. Hot, dry summers allow more beetle larva to survive and the trees are often more stressed and therefore more susceptible to attack. The primary beetle infestation that started the current tree mortality began in 1996 in north central Colorado and 1999 in British Columbia. In 2008 the range of the pine tree beetle had increased to 35 million acres in the USA and Canadian Rockies. The reported 35 million acres was ten times larger than any previous such beetle infestation recorded. The insect range is expected to increase as the climate becomes more favorable to them with the warmer temperatures. Scientist believe that there is a potential epiphytotic event in the future. An epiphytotic event is when an endemic plant disease pathogen suddenly and rabidly affects many plants in a specific area, similar to an epidemic in humans. Evidence suggests that there is a potential fifty–eight million acres of forest at risk of dying by 2020 of beetle infestation (Embrey, Remais, & Hess, 2012). As of 2015 there is a reported pine beetle infestation from western Canada to Mexico. It is reported by the National Park Service of the USA that the effects of the beetles are evident in recent years on Colorado's western slope including the Rocky Mountain State Park. The park is just one small area where trees are dying secondary to beetle infestation. The task of dealing with the infestation is so large, the park's priority is focused on removing hazard trees that may fall and dead trees that become hazard fuel. Also high value trees near park offices, camping and picnic areas are sprayed to kill beetles (Rocky Mountain National Park, 2015).

The associated ecosystem services disruption has the potential to cause significant health impacts from a range of exposures, including increased runoff and water turbidity, forest fires, and loss of ecosystem services. Ecosystem services are the benefits to people from natural resources and processes that are supplied by the ecosystem and are in four categories. The four ecosystem service groups are regulatory, supportive, provisioning and cultural. Regulatory services include the ecosystems ability to regulate air, water and soil quality. Supportive services include nutrient regulation, climate stabilization, and biomass production. With the death of pine trees, the forest loses the ability to maintain the role as a carbon sink, which leads to increased concentrations of airborne greenhouse gases. Also, with tree death is the loss of the forest's ability to regulate water flows. This can result in too much or too little water available to people at different times of the year. Flooding and water scarcity can ensue. Provisioning ecosystem services include timber and pulp wood or other forest related products. If these forest products are not available, livelihoods are lost and property may devaluate. Cultural services refer to recreational and aesthetic benefits enjoyed by visitors to the forest. If the forest is destroyed, the recreational and mental health benefits are lost along with related economic losses.

Fire risk is one of the biggest immediate health dangers to humans near the beetle devastated area. It is noted that fire risk may increase 10% in beetle infested forest areas. However, fire risk will vary with

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the stage of forest mortality. Recently dead trees with needles attached have greater risk of tree top fires. Approximately two years after beetle attack, trees lose their needles and fire risk decreases temporally for a few years. About 10 years after beetle attack, trees will fall and increase risk of ground level fires (Embrey et al., 2012).

Inhalation of windborne smoke from forest fires can put humans at risk for compromised respiratory function many miles from the burn zone. Episodes of asthma and bronchitis are at high risk of occurring during the burning. Heat exhaustion and dehydration are also likely to occur for those closer to the burn zone. Water quality and dysregulation of amount of water presents health risks for the 33 million people who depend on the Colorado River for drinking water. Increased turbidity of run-off water from deforested land is associated with increased gastrointestinal illness. Other toxins are found in runoff from fires, such as heavy metals and noxious chemicals. More research need to be done on the influences of these chemicals on human health.

The pine beetle infestation highlights the need for public health to adopt an ecological, systems oriented view to anticipate the full range of potential health impacts from climate change and facilitate effective adaptation. Climate change is rapidly emerging as an ecological stressor with shifting ecosystem dynamics. Many ecosystems are likely to be fundamentally changed. These shifts could bring subsequent human health impacts (Embrey et al, 2012).

Climate Change and Energy Insecurity among Vulnerable Individuals

Hernandez (2013) explores the increasing incidence of extreme weather events attributed to climate change, along with the increasing energy prices, that may cause major health impacts problematic to the most vulnerable people. With low-income households there can be a situation where a family may have to choose to pay for food or heating bills. While having difficulty paying for heating, the lower income families tend to live in housing that is not well weather proofed, making it more difficult and expensive to keep warm. The effects of climate change can be seen in risks for respiratory illness such as allergies and asthma, nutritional deficiencies, loss of productivity and injury and mortality. The phrase energy insecurity has been coined to describe the phenomenon of allotting a disproportionate share of one's income to utilities while dealing with sub-standard housing that induces heat-loss. Energy insecure families have been found to eat less in winter months, with a ten percent reduction in calories in cold weather. Also, the same families often have barriers in making their home more energy efficient both because of high up front cost and because the majority of the time, they are renters with little decision-making authority on building upkeep. As the global climate crisis increases, its association with the built environment and the health of vulnerable groups warrants closer attention and problem solving (Hernandez, 2013). Hernandez (2013) is a good example of a nurse who evaluates the patient's environment and resultant health consequences. This is an illustration of the American Nurse Association's principle seven, which points out that nurses participate in assessing the quality of the environment in which they practice and live (ANA, 2007).

Physical and Mental Health Nursing Diagnoses Related to Climate Change

As described earlier in this chapter, there are numerous nursing diagnoses that may apply to illness or injury secondary to environmental contaminates. Patients may be coming to health care facilities in increasing numbers for resultant health problems as represented in the following nursing diagnoses.

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The first group of nursing diagnoses include biological stressors and physical illness. The following six diagnosis will be discussed: Imbalanced Nutrition, Risk for Deficient Fluid volume, Contamination, Hyperthermia, Hypothermia and Risk for Infection. The nursing diagnosis of Imbalanced Nutrition: less than body requirements is defined by NANDA-I as an intake of nutrients insufficient to meet metabolic needs (NANDA-l, 2014). As explained earlier, crops may fail in some areas due to climate change's negative impact on agricultural conditions. This could easily result in less food available with resultant malnutrition for some people. Risk for Deficient Fluid volume is defined as the state of being vulnerable to experiencing decreased intravascular, interstitial and or intracellular fluid volumes, which may compromise health (NANDA-I, 2014). With a decrease in fresh water sources, some people may not have access to adequate amounts of safe drinking water. This lack of availability of adequate, safe water sources may result in fluid volume deficit related illness for people unable to obtain daily required fluid intake. Contamination is defined by NANDA-I as exposure to environmental contaminates in doses sufficient to cause health effects (NANDA-I, 2014). Contamination could be from many sources such as drinking water contaminated with fertilizers. More chemicals may be used to enhance crop production in an effort to produce adequate food. Hyperthermia and Hypothermia, is defined as core body temperature above or below the normal range, respectively, due to failure of thermoregulation. Hyperthermia and hypothermia both could be secondary to the extremes of environmental temperatures associated with climate change.

An additional important NANDA-I nursing diagnosis is Risk for Infection. Risk for Infection is defined by NANDA-I as being vulnerable to invasion and multiplication of pathogenic organisms which may compromise health. This could happen in connection to a disease outbreak secondary to flooding. The following is an example. The WHO reports typhoid fever as a serious disease infecting 22 million and killing about 216,000 people annually. Most of these cases were in Asia. Typhoid is caused by a bacterium, Salmonella enterica, and is passed through an oral-fecal route. Safe water for drinking and cooking and adequate sanitation systems are needed to avoid disease transmission. Typhoid vaccine use is also recommended by the WHO (World Health Organization [WHO], 2014). Climate change based flooding could easily overwhelm a marginal sanitation system, washing human waste into the drinking water supply. This would provide the oral-fecal route required for disease transmission. Also, standing water occurring after flooding allows for risk for vector-born disease associated with insects that live or breed in water. These risks of infection include dengue fever, malaria, and yellow fever, to name a few (Montgomery & Elimelech, 2007).

The second group of nursing diagnoses will concern meatal health issues. There are numerous diagnoses that could apply, however, three important mental health related nursing diagnoses will be considered in relation to pollution and resultant climate change. These three are relocation stress syndrome, impaired resilience and post trauma syndrome. Relocation stress syndrome is defined as physiological and or psychosocial disturbance following transfer from one environment to another (NANDA-l, 2014). The sea level rise expected with climate change will likely cause coastal flooding. Many people may find moving inland a necessity. Business and residences will be lost in the process. Such an unwanted move will put stress on all individuals involved. Impaired resilience is defined by NANDA-I to be the state of having decreased ability to sustain a pattern of positive response to an adverse situation or crisis, which compromises health (NANDA-I, 2014). Relocation stressors along with physical illness and economic losses may tax families coping skills to the limit. If the limit of coping is exceeded, the diagnosis of post trauma syndrome may become appropriate. Post trauma syndrome is defined as sustained maladaptive response to a traumatic, overwhelming event (NANDA-I, 2014). Some individuals may not be able to adjust to fast paced changes brought on by floods, fires and other disturbances secondary to climate

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change. The cumulative stressors of food and water shortages and possible relocations to more inland locations may necessitate special mental health services to help stabilize those individuals most severely impacted.

Summary Objective Two

Climate change can influence human health in many different ways as shown in the Rocky Mountain pine beetle example. These influences are either direct, as in a heat stroke, or smoke inhalation, or indirect for example, by temperature extremes that cause crop failures and thus resultant food shortages and malnutrition. Other climate related health effects could be secondary to increased allergens and air pollutions, and altered patterns of infectious disease vectors secondary to increased flooding (Polivka et al., 2012). It is noted that nursing diagnoses can be well utilized in connection to treatment of environmentally related illness or injury, and that is covers both physical and mental health issues. Nurses' knowledge and empowerment are improved with use of a nursing language terminology system, such as nursing diagnoses. The above section is not an exhaustive discussion of all the possible nursing diagnoses that could apply to pollution related health problems.

Objective Three: Solutions and Recommendations

Explore how the healthcare system can help to create solutions to the pollution.

Educate Oneself and Others

Becoming aware of the issues through formal education, in-service training and informal exchange of information with colleagues is important. Then one can use what is learned to educate others. Many nurses and healthcare workers may still not be aware of the growing environmental crisis and the role that healthcare plays in the cycle of harm or of the laws in place to help protect the environment. Healthcare staff should all attend in-services when offered and, if necessary, present such in-services if not available otherwise in one's healthcare facility. Public health nurses and community health educators may be in the most favorable positions to educate the public on how to protect the environment. Information on how and why water and other pollution is hazardous to the public health should be explained to the community members. Inpatient care givers may have the opportunity upon discharge planning to include patient education on the importance of water purity, environmental conservation and the connection to their own health. Perhaps even an information pamphlet distributed at discharge could be helpful. Pharmacist have an opportunity to explain to patients, at time of medication pick up, how to properly dispose of drugs to avoid water supply contamination. Reverse distribution is one solution, where the unwanted medications are collected and sent off to be incinerated (Tucker, 2011). Dietitians have the opportunity to explain to patients, during a diet consult, how a lower meat diet can improve both their health and the environment. All health providers should look for opportunities in their daily duties to educate patients, the public or other staff members.

An example of successful teaching of staff is reported by Mosquera et al. (2014). In Spain, Mosquera et al. (2014) found that healthcare waste management training improved biomedical waste management. It was noted that in recent years, there has been a significant increase in healthcare waste generation.

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Training interventions in advanced healthcare waste management improved the segregation of regulated medical waste. Such training can also reduce waste volume and cost of disposal. Mosquera et al. (2014) conducted a study of individuals who attended a waste management training session and analysis was done to compare the attendees' pre and post training waste management practices. The results showed that after the intervention, there was a significant reduction in the monthly average healthcare waste volume of six percent. Statistically significant differences in the pharmaceutical and infectious waste weight segregated before and after the training session were found. It was concluded that the healthcare waste management training improved hospital waste management at the facility, reducing the healthcare waste volume and costs (Mosquera, M., Andres-Prado, Rodriguez-Caravaca, Latasa, & Mosquera, M. E, 2014).

Successful teaching of patients is shown in one Luminary Project story. The Luminary Project is a web based effort associated with Health Care Without Harm to share stories of nurses who are making a difference in healthcare by lighting the way to environmental health. Trosch, patient care clinician, and Corna, clinical nurse specialist of Magee-Women's Hospital in Pittsburg, PA, USA, work in a busy mother and baby unit where 800 to 1,000 births occur per month. To educate the childbearing families they serve, their department began a Smart Start education program with prenatal through postpartum classes. While covering such typical topics as breast feeding, additional information was added on environmental hazards for children such as lead, pesticides, and second hand smoke. Besides the in-person classes, the families receive a brochure called *Rx for Prevention* to which they can refer for reinforcement of the information. In addition, the staff of the department underwent training so they could answer the new parent's questions related to creating a safe and healthy environment at home. This program began in 2005 and was added to in 2007 with recycling on the nursing unit and a green resource room for new parents with information on environmental concerns (Trosch, & Corna, 2015).

Not only does the healthcare community need to recognize the importance of the physical environmental quality for human health, another type of education is needed. According to Trasande et al. (2010) education is needed to improve healthcare providers' recognition and treatment of environmental contaminate victims. This will become more apparent as climate change related health problems and environmental toxin exposure become more common. Trasande et al. (2010) found that many pediatricians where unsure how to diagnose and treat environmental exposures. Because of increasing disease of environment origin a network of centers called Pediatric Environmental Health Specialty Units (PEHSUs) were established. The PEHSUs were opened with the support of the Centers for Disease Control (CDC) and the EPA. The Michigan chapter of American Academy of Pediatrics was surveyed about environmental health topics with a total of 362 participants taking part. The findings included the participants agreeing strongly that the role of the environment in health is great and that the magnitude of environmental mediated illness is increasing. It was found that only six percent knew about the PEHSUs and no pediatrician had made more than one referral. The same survey revealed that the physicians rated their confidence in management of lead exposure and second hand smoke high, while rating there confidence in management of patient exposure to pesticide, air pollution, mercury and mold as low. The authors concluded that the survey and analysis of data clearly showed a number of gaps in the protection of children from environmental hazards (Trasande et al., 2010).

Nursing diagnoses can be used to apply to teaching and learning situations. One of the associated diagnoses is Knowledge Deficit, which is defined as an absence or deficiency of cognitive information related to a specific topic (NANDA-I, 2014). This can be applied when healthcare staff lack sufficient knowledge of environmental issues related to healthcare. Another diagnosis is Readiness for Enhanced

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Knowledge, defined as the presence or acquisition of cognitive information related to a specific topic which is sufficient for meeting health related goals but can be strengthened (NANDA-I, 2014). This diagnosis is related to the worker's willingness to learn new information.

Cut Greenhouse Gas Production at Work and at Home

One thing hospital dietary departments could do to improve patient health outcomes and help mitigate environmental damage, is to serve patients a lower meat content menu. Dietary consultations for patients to continue a more plant based dietary intake once out of the hospital, can be emphasized. Nurses and dietitians can educate patients on the personal benefits to their health as well as to the conservation of the environment. Patients and community members may not be aware that there are many sources of high quality proteins that are plant based, such as nuts, beans and tofu. Animal source non-meat proteins include dairy products and eggs.

Energy use, in hospitals, especially in the intensive care units, is very high (Huffling, & Schenk, 2014). However, there are a variety of ways to cut down on energy use and not compromise on patient care. Some of these energy saving ideas include selection of energy efficient electrical equipment, such as intravenous pumps that have a favorable energy star rating. Nurses may need to gain representation on the purchasing committee to influence these equipment decisions. Also, equipment can often be put in sleep mode or unplugged entirely when not in use. Room temperature setting were noted to be varied and energy consuming, as some areas require cool temperatures, such as operating rooms and other treatment areas require warmer temperatures, such as burn units. The nurse needs to work with facility management to arrange the optimum efficient central heating and cooling temperatures for patient care areas while minimizing energy expenditure.

Other energy saving measures could include making use of solar heating by leaving blinds open to let sunlight in on cooler days and vice versa on warmer days. Changing from incandescent to fluorescent or light emitting diodes (LED) can save energy on lighting. Use of occupancy sensors can also save energy by switching off lights when no movement is detected. However, occupancy sensors cannot be used in patient care areas or medication preparation areas for safety reasons. Nurses need to work with the Information Technology department about the use of computer energy. Can computers be put in sleep mode or turned off when not in use? If not, can the screen be switched off until needed again? Nurses can see that televisions in patient rooms are turned off promptly when not needed or wanted (Huffling, & Schenk, 2014).

Beyond the on the job related energy savings that health centers can undertake as described by Huffling and Schenk (2014), there is the consideration of reductions in fossil fuels usage in transportation to the place of employment. According to Shulman et al. (2012), residents of the USA emit an average of 21 tons of carbon dioxide into the atmosphere annually and transportation related emissions account for 28% of this amount (Shulman et al., 2012). Large healthcare centers employ thousands of employees, the majority of whom traditionally have arrived alone in their private vehicles. Most healthcare workers burn fossil fuels in their daily commute to work, as do workers in other professions. Car-pooling, riding a bike or taking public transportation to work, where feasible, would assist with mitigation of greenhouse gas emissions as well as traffic jams. For those who have primarily an office-based job, one could consider the possibility of working part time from home, for example, two days a week with computer and phone connections to the job. This growing trend is referred to as telecommuting. While on location at a job site, one could consider if convening a meeting across town is really necessary, or if a phone call could

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serve the purpose as well. When getting a larger group of colleagues together from different locations, electronic teleconference meetings can be arranged complete with mutual viewing on screen.

When driving a private vehicle is necessary, a more fuel efficient model is preferable. Shulman et al. (2012) states that individuals could reduce their carbon dioxide emissions by nearly four tons annually by switching from a vehicle that gets 20 miles to the gallon of gasoline (mpg) to a vehicle that gets 40 mpg. Alternate fuel vehicles, such as electric powered cars, are becoming more commonplace. Most petroleum powered vehicles can be made to achieve better gas mileage if properly maintained and operated at lower speeds as appropriate. Employers could make a conscious effort to assist employees locating others residing in the same vicinity so that carpooling to work could be arranged among the participants. Providing preferred parking near the door for car pool vehicles is one way a health center can reward and encourage car pool formation. For those employees who feel that they can continue to work efficiently through a twelve hour shift, the employer can make such a schedule available. In this way a health worker who is on the job for three twelve hour days has completed thirty-six hour week and should be considered a full time employee with full benefits. This allows two days a week of gasoline use savings that is not needed for the employee to commute to work.

Create Less Waste and Use Better Waste Management at Work and at Home

Healthcare staff members need to know how to separate infectious waste and hazardous waste carefully, at the point of generation. Healthcare waste has several different distinct categories which each require different handling. Regular non-infectious solid waste can go in the general garbage bin but soft biohazard materials must be deposited in a red bag for disposal. At the same time, nonhazardous waste must not be in with the red bag waste. This will unnecessarily drive up cost of disposal. Sharp, biohazardous waste, such as used needles, should go in a waterproof, hard-sided red container for disposal.

Upstream management of waste refers to prevention by promoting more judicious use of hospital supplies when appropriate. It can also refer to avoidance of bringing hazardous chemicals into the system. Upstream waste management also can mean finding alternatives to harsh chemical cleaners. Mercury, polyvinyl chloride (PVC) and formalin are three substances that require changes in upstream hospital utilization. Phasing out mercury containing devices is a needed step because mercury is a neurotoxin. Hospitals can obtain help with creating a mercury-free environment through Hospitals for a Healthy Environment, whose web site is http://www.h2e-online.org. Other measures healthcare centers can take include avoidance of PVC containing products, which produce toxic smoke when burned. A needed waste management measure for formalin, a formaldehyde-based lab fixative, is to buy it in small prefilled containers that can help reduce waste, spillage and accidental exposure.

Recycling efforts and avoidance of prepackaged kits and paper gowns can cut down on waste. Solid waste items that can be reused should be divided out and recycled for home or other usage (Shaner-McRae et al., 2007). Waste can be avoided by not using prepackaged intravenous start kits, Foley catheter kits or similar prepackaged supplies. This will avoid the practice of discarding unused items in the kit. In intensive care isolation units there is a movement back to washable cloth isolation gowns to replace paper disposable gowns. This reduces paper waste a great deal. Further reduction of other isolation related waste can be accomplished by refraining from taking supplies or equipment into an isolation room until just before use (Huffling, & Schenk, 2014).

An example of a healthcare center making a waste-related positive change is seen in Australia. In Sydney, Australia, De Sousa et al. (2014) had concerns about clinical waste management in a 360 bed

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acute care hospital. The following areas were examined: mass and volume of trash, space efficiency and logistics of trash containers. Infection and injury risk to staff operating the waste disposal system were also considered along with appearances of the system, cost and efficiency. The old system of 240 liter (L) trash bins was compared to a new system of 64 liter linerless reusable trash bins Results showed inpatient workloads remained the same over the study. Staff evaluations showed a strong preference for the new system which was made available to all departments in the facility. Significance decreases were noted in clinical waste (CW) mass (53.2% less), CW volume (65.2% less), CW disposal costs (30.9% less) and labor (69.2% less). The new system was found to be more space-efficient and logistically improved. Waste segregation was markedly superior. Infection potential and injury risks seen with the 240 L system were eliminated. The study found that the use of a smaller, 64 L, linerless, reusable, hospital waste bin system had the potential to decrease costs, reduce clinical waste volumes, increase labor efficiencies, and minimize infectious potential and sharps injury risk. All of these improvements add to the quality of health care (DeSousa, Martin, & Grimmond, 2014).

Another good example of a health center being environmentally responsible is the Philippines Heart Center that took on a clean discharge water project. The center had approximately 15,000 patients in 2011 and had an average wastewater discharge of 540 cubic meters per day. In 2011 the Heart Center was appointed a member of the technical working group to revise the Department of Health's waste management manual. Through this process, the center updated its own facilities to support environmental responsibility. The Health Center built its own on-site wastewater treatment plant and all water is treated before discharge. Also the wastewater is used to irrigate the hospital grounds and future plans is to reuse it in the hospitals toilets (Health Care Without Harm, 2015).

Seek Empowerment through Collaboration with Others

All parties are needed to work together to obtain the global environmental sustainability solutions needed. All the sectors of the world compose a global community.

The problems of healthcare-source pollutant is not limited to one region of the world, but is wide reaching in scope. Many countries are looking at environmental issues with varying points of view, but with a common concern regarding health services waste management. This chapter's inclusion of a mix of countries also helps to illustrate the ANA's principle six which affirms that approaches to promoting a healthy environment must respect the diverse values, beliefs, cultures, and circumstances of the patient and their families (ANA, 2007).

In this context, the chapter author sees two applicable nursing diagnoses, which include the following examples. Ineffective Community Coping is defined by NANDA-I as a pattern of community activities for adaptation and problem-solving that is unsatisfactory for meeting the demands or needs of the community (NANDA-I, 2014). Also, Readiness for Enhanced Community Coping, is defined as a pattern of cognitive and behavioral efforts to manage demands that is sufficient for well-being but can be strengthened (NANDA-I, 2014).

Beneath the logistics and cost of better healthcare waste disposal and less resource depletion, the underlying challenges are in improving awareness of the problems and workers' empowerment to do something to improve waste management and resource conservation. Turning again to the concepts contained in nursing diagnoses, there are several nursing diagnoses besides Moral Distress, discussed above, that could apply to the current healthcare staff situation. Powerlessness is one such nursing diagnosis,

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and is defined as a perception that one's own action will not significantly affect an outcome; a perceived lack of control over a current situation or immediate happening (NANDA-I, 2014).

Beyond nursing diagnoses is the concepts contained in the Nursing Intervention Classification System (NIC) (Bulechek, Butcher, Dochterman, & Wagner, 2013). NIC has 554 comprehensive, standardized nursing interventions, containing nearly 13,000 suggested activities to address varying nursing diagnoses. Interventions span both the physiological and psychosocial spheres. One such psychosocial nursing intervention suggested for the nursing diagnosis Powerlessness is Complex Relation Building (Bulechek et al., 2013). Even though this is usually in the context of nurse and patient interactions this could be applied in a broader way to colleagues who establish a mutually trustworthy relationship that promotes insight and behavior change.

Empowerment for improvement can be built by connecting and interrelating with other concerned individuals of various professions and world regions. Other professions hold key pieces of the environmental sustainability solutions sought by healthcare providers. With healthcare workers making connections to other concerned individuals, the connections potentiating the cycle of harm can be broken. These others in the health system can include dietary and facilities management, hospital buyers, pharmacist, information technology experts and hospital administrators. Outside the health system, many other professions, such as educators, architects, environmental specialist, conservation organizations, and public policy makers are concerned and want to look for solutions to create a sustainable environment for all.

The nursing diagnoses that can be used to describe this situation include the following: Readiness for Enhanced Relationship, which is defined by NANDA-I as a pattern of mutual partnership that is sufficient to provide each other's needs and can be strengthened (NANDA-I, 2014). Readiness for Enhanced Power, which is defined as a pattern of participating knowingly in change that is sufficient for well-being and can be strengthened (NANDA-I, 2014).

Joining established groups that work for environmental causes is a way to add individual efforts to a larger movement for change. There are many organizations, Sierra Club, Nature Conservancy and Ocean Conservancy, to name a few. There are also healthcare specific groups that are environmentally concerned such as Health Care Without Harm and Alliance of Nurses for Healthy Environments.

CONCLUSION

Nurses worldwide need environmental awareness and empowerment to manage healthcare-source pollutants properly. Beneath the logistics and cost of better healthcare waste disposal and less resource depletion, the underlying challenges are in improving healthcare workers' awareness of the problems and empowerment to do something about these issues.

Nurses, other healthcare workers and healthcare systems participate in the cycle of harm. The cycle of harm includes healthcare source pollution contaminating the environment, people becoming ill secondary to this pollution and the sickened individuals coming to the healthcare system, where more pollution is created during their treatment. All must work together to find solutions to the pollution created. No one country or world region has all the pollution–related problems or all of the needed solutions alone. Countries globally are becoming aware and striving to meet the challenges of energy use and proper waste disposal.

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Nurses and other healthcare workers can prepare themselves and help to position their workplaces for the environmental related health concerns of the future. Healthcare professionals can also be leaders in role-modeling sustainable behaviors as well as in dissemination of risk and hazard information to our patients and the community at large, along with useful information of what an average household can do to mitigate pollution and climate change. There is reason to believe that the health professions can make a difference in mitigation of environmental degradation and minimize the resultant human health consequences that we will be called on to manage.

FUTURE RESEARCH

Further research is needed on best management of healthcare waste. Various approaches may be called for in different locals to fit the situation and finances available. More can be done on innovative ways to cut energy use in healthcare and thus lower carbon dioxide formation. More research and education needs to be done to prepare caregivers to recognize and treat illness or injuries related to environmental factors.

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KEY TERMS AND DEFINITIONS

Contamination: Is defined by NANDA-I as exposure to environmental contaminates in doses sufficient to cause health effects (NANDA-I, 2014).

Cycle of Harm: Includes increased acidification and heating of ocean waters secondary to release of greenhouse gases. The cycle also includes chemical and biological contamination of fresh waters secondary to improper waste disposal. Humans suffer related health consequences. People receiving treatment for resultant illnesses produces more pollution.

Hyperthermia and Hypothermia: Are defined as core body temperature above or below the normal range, respectively, due to failure of thermoregulation.

Imbalanced Nutrition: Less Than Body Requirements: Is defined by NANDA-I as an intake of nutrients insufficient to meet metabolic needs (NANDA- l, 2014).

Ineffective Community Coping: Is defined by NANDA-I as a pattern of community activities for adaptation and problem-solving that is unsatisfactory for meeting the demands or needs of the community (NANDA-I, 2014).

Knowledge Deficit: Is defined as an absence or deficiency of cognitive information related to a specific topic (NANDA-I, 2014).

Moral Distress: Is a nursing diagnosis that is defined by NANDA-I as the response to the inability to carry out one's chosen ethical or moral decision. The defining symptoms or characteristics include fear, anxiety, and expressed anguish.

Post Trauma Syndrome: Is defined as sustained maladaptive response to a traumatic, overwhelming event (NANDA-I, 2014).

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Powerlessness: Is defined as a perception that one's own action will not significantly affect an outcome; a perceived lack of control over a current situation or immediate happening (NANDA-I, 2014).

Readiness for Enhanced Community Coping: Is defined as a pattern of cognitive and behavioral efforts to manage demands that is sufficient for well-being but can be strengthened (NANDA-I, 2014).

Readiness for Enhanced Knowledge: Is defined as the presence or acquisition of cognitive information related to a specific topic which is sufficient for meeting health related goals but can be strengthened (NANDA-I, 2014).

Readiness for Enhanced Power: Is defined as a pattern of participating knowingly in change that is sufficient for well-being and can be strengthened (NANDA-I, 2014).

Readiness for Enhanced Relationship: Is defined by NANDA-I as a pattern of mutual partnership that is sufficient to provide each other's needs and can be strengthened (NANDA-I, 2014).

Relocation Stress Syndrome: Is defined as physiological and or psychosocial disturbance following transfer from one environment to another (NANDA-l, 2014).

Risk for Deficient Fluid Volume: Is defined as the state of being vulnerable to experiencing decreased intravascular, interstitial and or intracellular fluid volumes, which may compromise health (NANDA-I, 2014).

Risk for Infection: Is defined by NANDA-I as being vulnerable to invasion and multiplication of pathogenic organisms which may compromise health.

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Chapter 7
Health Policy Implementation and Its Barriers:
The Case Study of US Health System

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ABSTRACT

The chapter describes policy implementation components of a health system in United States of America and explains how they affect health outcomes (service delivery). It argues that implemented policies affect various components of a health system in terms of service delivery, workforce, information, financing, medical products, technologies, leadership and governance. Using health system as framework of analysis, the paper explains that the outcome of health policy implementation determines the availability, quality and equitability of program service delivery. The chapter goes on to argue that policy implementation barriers, such as demand-and supply-side barriers, market, insufficient resources, cultural barriers, imperfect communication, information, education, coordination, leadership and governance affect the poor and vulnerable groups in developed and developing countries from benefitting from public spending on public health policies and programs.

BACKGROUND

An important factor in socio-economic development of any nation is the extent to which that country is involved in healthcare delivery system. Good health is a vital factor of quality of life as well as a pre-requisite for achieving socially and economically productive lives of a nation. No government can function effectively without an appropriate health care system. Health care system is one of the basic institutions that is universal in nature and without which a society cannot survive. The World Health Organization Report, (2000) defines health system as comprising all the organizations, institutions and resources that are devoted to producing health actions. Health action in this context entails any effort, whether in personal healthcare, public health services or through inter-sectional initiatives, whose primary purpose is to improve health. Healthcare institutions consist of formal and informal organizations

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where preventive, social and clinical services are rendered to the members of the society. Each of the institutions has specific aims and objectives even though they all exist to promote health, to prevent the occurrence of diseases, to bring about a peaceful end for those suffering from terminal disease, and to treat human illness. Most healthcare institutions form an arm of the government. Their social structure, therefore, follows the same pattern as other government institutions. Healthcare institutions form a large social system, and within this system are other large sub-systems. The systems vary from one country to another and even slightly within the same country.

The purpose of this paper, therefore, is to examine policy implementation by institutions of health care service delivery and barriers to effective outcomes. Specifically, the paper attempts to investigate how health policies support program activities of health institutions, such as; elimination of healthcare inequities; access to healthcare facilities, products and services; availability of finance infrastructures and other resources; provision of information and education to individuals and communities to medical products, facilities and services.

Consequent upon this, the paper is structured into five parts. Part one examines the introduction, purpose, clarification of concepts and underpinning theories of health policy implementation. Part two examines the inputs required in healthcare systems, such as; finance, structures and power relationships, equipment, personal and clients. Part three discusses the processes or series of activities that transform resources (inputs) into a desired product, service or output. Part four examines the outputs – direct result of the interaction between inputs and processes in the system, the types and quantities of goods and services produced by an activity, program or project.

Finally, part five identifies the barriers to effective health policy implementation and its implications.

CONCEPTUAL CLARIFICATIONS

Health System

Health system comprises all organizations, institutions and resources that are devoted to producing health actions. Health actions in this context refers to any efforts, whether in personal healthcare, public health services or through inter-sectional initiatives whose primary purpose is to improve health. It is an open system with three components of input, processes and outputs. Inputs required in a healthcare system include: finance, physical structure, equipment personnel and clients. The process refers to a series of activities that transform inputs (resources) into a desired product, service or output. The term output is used to describe the direct result of the interaction of inputs and processes in the system, the types of and quantities of goods and services produced by any activity, program or project. On the other hand, the term outcome refers to the result of the outputs, the effects or impacts. All these depend on how efficiently the system within the operating environment is administered and how the resources are managed.

Health Policy

According to WHO, it is the approach to medicine that is concerned with the health of the community as a whole. Health policy, in other words, refers to decisions, plans, and actions that are undertaken to achieve specific health care goals within a society. An explicit health policy can achieve several things:

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it defines a vision for the future which in turn helps to establish targets and points of reference for the short and medium term. It outlines priorities and the expected roles of different groups; and it builds consensus and informs people.

In fact, the mission of health policy is to "fulfill society's interest in assuring conditions in which people can be healthy." The three core public health policy functions are:

- The assessment and monitoring of the health of communities and populations at risk to identify health problems and priorities;
- The formulation of public policies designed to solve identified local and national health problems and priorities;
- To assure that all populations have access to appropriate and cost-effective care, including health promotion and disease prevention services, and evaluation of the effectiveness of that care.

To be more precise, Health policy means more than a national law or intervention. Operational policies are the rules regulations, guidelines and administrative norms that governments use to translate national laws and polices into programs and services. Health policy can be defined as the decisions, plans and actions that are undertaken to achieve specific healthcare goals in a society. Health policy can also support program activities, such as elimination of inequities in healthcare delivery services or mobilization of community health workers.

Policy Implementation

Implementation, viewed broadly, means administration of law in which various actors, organization, states, local authorities, procedures and techniques work together to put adopted polices into effect in an effort to attain policy or program goals. For our purpose, implementation can be conceptualized as a process, outputs (series of activities) and outcome. As a process, it is viewed as a series of decisions and actions directed toward putting a prior authoritative federal legislative decision into effect by the state or local authorities or organizations. As an output, implementation can be defined in terms of the extent to which programmatic goals are supported, such as the level of expenditures committed to a program or the number of violations issued for failure to comply with the implementation directive. Policy implementation can be conceptualized as some measureable change in the large problem that was addressed by the program, public law, or judicial decisions (outcomes).

Implementation can be considered from Fullan(2007) glasses;Fullan (2007: 14) rightly notes that many change attempts fail because 'no distinction is made between theories of change (what causes change) and theories of changing (how to influence those causes)'. Therefore, it is important to point out that policy change goes hand in hand with policy implementation. Mazmanian and Sabatier (1983: 20) define implementation as 'the carrying out of a basic policy decision, usually incorporated in a statute but which can also take the form of important executive orders or court decisions'. A policy decision 'identifies the problem(s) to be addressed, stipulates the objective(s) to be pursued and structures the implementation process' (Sabatier and Mazmanian 1980: 540). Passing policies does not guarantee success on the ground if policies are not implemented well. Pressman and Wildavsky (1984) were the first ones to show that implementation dominates outcomes.

It is difficult to say which factors or conditions facilitate successful implementation since so much depends on the political, economic and social context. For instance, local factors (e.g. size, institutional

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complexity) matter for policy responses (McLaughlin 1987). In this vein, Payne (2008) argues that only looking for general solutions and not acknowledging the particular context can lead to incoherent implementation efforts. Therefore, no 'one-size–fits-all' policy exists. However, this has not stopped some scholars from trying to come up with the most important factors for certain policy areas. To take the example of education policy, according to Payne (2008), successful implementation has been evidenced in schools where there is:

- Coherence
- Stability
- Peer support
- Training
- Engagement.

Successful system reform means that a small number of powerful actors are interacting to produce substantial impact (Fullan 2009: 108). Successful implementation implies that 'agencies comply with the directives of the statues, agencies are held accountable for reaching specific indicators of success, goals of the statute are achieved, local goals are achieved or there is an improvement in the political climate around the programme' (Ingram and Schneider 1990). Local capacity and will matter for policy success; adequate resources and clear goals are important too (McLaughlin 1987). In addition, the implementation process is characterised by a 'multi-staged, developmental character' (McLaughlin 1987: 176).

Even if policy implementation appears to be successful, Fullan (2000) points out that there is no guarantee that success will last. In terms of the change process in schools, there has been strong adoption and implementation, but not strong institutionalisation. Fullan (2000; 2007) further notes that both local school development (which engage teachers and students) and quality of surrounding infrastructure are key for lasting success. But successful examples of policy change (in schools) are still in the minority (Fullan 2007). Changing policies is not sufficient if there is no 'reculturing' of classrooms (Fullan 2000; 2007). As a result, a number of conditions need to be satisfied to enhance the change of successful and sustainable implementation, though these conditions vary across systems. This adds to the difficulty of the whole process.

Top-Down and Bottom-Up Approaches

A widely used concept in the policy implementation (and change) literature distinguishes between top-down and bottom-up approaches. The two approaches vary in a number of areas, such as the role of actors and their relationships and the type of policies they can be applied to.

Top-Down Approach

Top-down theorists see policy designers as the central actors and concentrate their attention on factors that can be manipulated at the central level (Matland 1995). The most detailed top-down approach was presented by Sabatier and Mazmanian (1979), who identified a number of legal and political variables and then synthesised them into six conditions needed for effective implementation ranging from clear objectives, causal theory, legal structure of the implementation process, committed officials, supportive

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interests groups to no undermining of changing socio-economic conditions (for more detail on these conditions, see Sabatier 2005: 19). In terms of policy areas, 'top-downers' usually prioritise clear policies (Matland 1995: 155).

Strengths and Weaknesses

One strength of the top-down approach is that it seeks to develop generalisable policy advice and come up with consistent recognisable patterns in behaviour across different policy areas (Matland 1995). But top-down approaches are criticised for only taking statutory language as a starting point and hence do not consider the significance of previous actions. The approach may be said to consider implementation as an administrative process and ignores or eliminates political aspects. The emphasis on statute framers as key actors is another source of criticism (i.e. local actors are not taken into consideration).

Bottom-Up Approach

Bottom-up theorists emphasize target groups and service deliverers, arguing that policy is made at the local level (Matland 1995: 146). These scholars (e.g. Hjern and Hull 1982, Elmore 1979) thus criticize top-down theorists for only taking into consideration the central decision-makers and neglecting other actors. The bottom-up approach, developed by Hanf, Hjern and Porter (1978), identifies the networks of actors who are involved in service delivery in one or more local areas and asks them about their goals, strategies, activities and contacts. It then uses the contacts in order to develop a networking technique to identify the local, regional and national actors involved in the planning, financing and execution of relevant governmental and non-governmental programs. This provides a mechanism for moving from local actors and decision-makers such as teachers or doctors up to the top policy-makers in both the public and private sectors (Sabatier 2005: 23). In terms of policy areas, bottom-uppers examine policies with greater uncertainty in the policy (Matland 1995: 155).

Strengths and Weaknesses

Among the benefits of the bottom-up approach is its focus on centrally located actors who devise and implement government programs, thus contextual factors within the implementing environment are important. Actors and their goals, strategies and activities need to be understood in order to comprehend implementation. Bottom-up approaches do not present prescriptive advice, but rather describe what factors have caused difficulty in reaching stated goals (Matland 1995). It is significant that strategies are flexible so that they can adapt to local difficulties and contextual factors. Nonetheless, bottom-up approaches have been criticised on two counts. First, policy control should be exercised by actors whose power derives from their accountability to sovereign voters through their elected representatives, but the authority of local service deliverers does not derive from this. Second, this approach tends to overemphasise the level of local autonomy (Matland 1995).

Combined Approach

Increasingly, the literature has focused on combining (micro-level variables of) bottom-up and (macro-level variables of) top-down approaches in implementation research in order to benefit from the strengths

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of both approaches and enable different levels to interact regularly (Elmore 1985, Fullan 2007, Matland 1995, Sabatier and Jenkins-Smith 1999). Building on Matland (1995), Suggett (2011) develops a framework distinguishing areas by the level of political conflict about goals or intent of a policy, and the level of uncertainty about the means or actions to achieve the goal. The two-by-two typology captures how top-down and bottom-up approaches can vary according to policy areas.

For instance, strategies that use bottom-up approaches (e.g. networks and devolution) are more common in areas of low conflict but high uncertainty and lack of consensus about the means to achieve a goal – such as educational disadvantage (Suggett 2011:8). In contrast, strategies that use such top-down approaches as strong political direction and sound governance are more likely in areas of high conflict about the goal but relatively high certainty on how it might be implemented (e.g. taxation for a specific industry sector) (Suggett 2011: 8).

Strengths and Weaknesses

Combining the two approaches might thus draw on their main strengths while minimising their weaknesses. Policy implementation often takes place because a wide range of stakeholders interact between different levels – thus both central policy-makers and local actors on the ground are important for successful implementation. In addition, this combined approach allows for differentiating between various policy areas. For instance, while the suggested framework by Suggett (2011) in its current form could be further elaborated, it is a good start for differentiating between implementation strategies. It matters whether health care, taxation or education policies are considered. Even within policy sectors, implementation strategies are not the same for higher education and secondary education policies, for example (see Gornitzka, Kyvik and Stensaker 2005). As a result, implementation varies according to different content and type of policies.

Rational-Choice Theories

At times, researchers have looked for more sophisticated ways of theorizing about implementation by applying rational-choice approaches. In a nutshell, rational choice theories are based on the assumptions that actors have a fixed set of preferences and act rationally in order to maximise the attainment of these preferences. Politics is seen as a series of collective action dilemmas due to the lack of institutional arrangements to encourage cooperation. In addition, strategic interactions between actors determine political outcomes (Hall and Taylor, 1996, pp. 944-945).

Game Theory

One example of a rational choice approach is game theory which is ‘a mathematical treatment of how rational individuals will act in conflict situations to achieve their preferred objectives’ (Firestone 1989: 18). It is in particular helpful for theories that seek to clarify how coalitions build and pass legislation. The literature on implementation and game theory is still rather sparse in the political science literature (for exceptions, see Bardach 1977, Koremenos and Lynn 1996, O’Toole 1995). For example, Bardach (1977) considers implementation as a continuation of a political game from the policy adoption stage, but with other actors and other relations between actors. He analyses the type of games that actors apply in the implementation process in order to pursue their own interests. But these games distort implementation

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from the legislative goals (Winter 2003: 213). Despite limitations, game theoretic models are helpful for exposing points of leverage for implementation managers.

O'Toole (1995) examines the use of rational choice theories (in particular game theory) in implementation research. He argues that while game theory might enhance inter-organizational management, it has some serious practical limitations which constrain what might be theoretically possible (O'Toole 1995: 43). There are several challenges in rational-choice approaches to implementation, such as uncertainty across different areas and the lack of institutionalization in the implementation setting (since many implementation networks are not highly institutionalized). But active and skilful multilateral implementation managers can successfully intervene at several points in a network context to reduce uncertainty and institutionalize cooperation. Such strategies include facilitating moves and linking games through signaling, commitment, and iteration; influencing preferences of actors and persuading them of the benefits to encourage cooperative outcomes; developing norms of trust and cooperation; and shifting the inter-unit structure to facilitate cooperation (O'Toole 1995: 47-51).

Also drawing on game theory, Firestone (1989) offers an education policy example by analyzing an ecology of games. Individuals compete in one or few available games, which can be in government, education, business, religion or news. This model borrows from ecology as species interrelate in their environment in different ways – through competition, cooperation or interdependence (Firestone 1989). Educational games are linked through flows between them: an downward flow of resources and regulation from legislature to classroom, and an upward flow of demands from educators as well as the general public (Firestone 1989: 19). Again, the temporal dimensions and context play an important role in the implementation of education policy. Local variation should be taken advantage of, and practitioners should experiment with different models at the local level (Firestone 1989).

Agency Theory

A different application of rational choice is *agency theory* - how principals delegate implementation to state agents - which has been applied in political science, economics and sociology (Kiser 1999). Different political science scholars such as (Kiewiet & McCubbins 1991, Weingast & Moran 1983) have focused on the monitoring of agents by principals in order to reduce drift in implementation. In contrast to the economics literature on this topic, political science pays attention to three issues: third parties, administrative procedures and multiple principals. But several questions remain unanswered, such as who exactly the principal is that is supposed to monitor the actions of the agents, and how agents are selected (Kiser 1999).

Strengths and Weaknesses

Rational choice theory proposes a parsimonious framework in which actors are rational in the pursuit of their preferences and interact strategically with other actors in the system. However, as John (2003: 485) argues, 'rational choice does not offer solutions for all cases and contexts'. The theory is better at explaining outcomes when preferences are settled, rather than clarifying the origin of preferences and the reason for change (John 2003). Game theory provides several advantages, such as a rigorous deductive theory and the potential to combine top-down and bottom-up approaches by treating all relevant actors as strategic players. But, as mentioned before, there are a few challenges, such as uncertainty and the lack of institutionalization (O'Toole 1995: 54). Overall, there is considerable potential to apply rational choice theories, including game theory, to implementation, especially when there are testable hypotheses.

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CONCEPTUAL FRAMEWORK

This chapter, therefore, adopts health system as our conceptual framework of analysis as no single theory can help us explain health system variables. WHO (2000) defines health system as comprising all organizations, institutions and resources that are devoted to producing health actions. Health actions in this context refers to any efforts, whether in personal healthcare, public health services or through intersectional initiatives whose primary purpose is to improve health. Health system is an open system with three components of input, processes and outputs.

Inputs required in a healthcare system include: finance, physical structure, equipment, health information, technology, material resources, personnel, health policies and clients. The process refers to a series of actions or activities that transform inputs or resources into a desired product, service or outcome. The series of activities in the process include treatment, client education, community empowerment, official meetings and other health interventions. The term output is used to describe the direct result of the interaction of inputs and processes in the system, the types of and quantities of goods and services produced by an activity, program or project. It includes treated patient, efficient services, improved health status, community empowerment, trained staff, good quality of life and sanitation. On the other hand, the term outcome refers to the result of a process, including output, effects or impacts (Quality Assurance Project, TASC 2 Eritrea, 2003). All this depends on how efficiently the system is administered and how the resources within the operating environment. The enabling environment comprises the government, State, Local authorities, health institutions, socio-cultural and economic factors, regulatory quality control by government, rule of law, civil society, community, individuals, political stability and support, accountability and so on.

This conceptual framework is adopted because the analysis is not intended to identify causal pathway. The health system, which is an open system, is one of the basic institutions that are universal in nature and without which a society cannot survive. According to WHO,(2000), all health systems carry out the functions of providing or delivering personal and non-personal health services; generating the necessary human and physical resources; raising and pooling the revenue used to purchase services; acting as the overall steward of the resources, powers and expectations entrusted to them. The health system is, therefore, justified as our conceptual framework of analysis for this paper because large number of people and institutions are involved at different levels of health activities but are all working together to achieve the objective of improving healthcare delivery. The framework would enable us analyze and explain how different levels of government, organizations and community implement policies on health resource generation, financing, stewardship and service provision.

METHOD OF ANALYSIS

The chapter adopts qualitative research technique. The purpose is to select information that would help us describe and explain health policy implementation and barriers to its effectiveness. Data were collected from secondary sources. They include textbooks, journals, newspapers, internet and records. Data from these sources were analyzed using documentary data analysis, thematic analysis and content analysis techniques to elicit key concepts or themes. The concepts were coded and categorized into units of analyses: policy implementation of resources or inputs; policy implementation intervention process or series of activities; and policy implementation of outputs/outcomes (efficient services or improved

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health status) and subsequent barriers. Now, let us examine these concepts in the context of the health-care service delivery.

HEALTH POLICY IMPLEMENTATION (RESOURCES OR INPUTS)

Formal organizations such as health institutions are made up of people and are set up to achieve specific goals and objectives. The attainment of these goals depends on the availability of resources in the right kind, quantity and mix. Ultimately, the attainment of the goals depends on proper utilization of resources. Resources are those inputs that help, support and/or have positive impact upon the achievement of organizational goals (Peretomode & Peretomode, 2005). According to them, resources can be categorized into human and non-human resources. Non-human resources can be further categorized into financial and non-financial resources. Non-financial resources include: facilities, structures, equipment, time, technology, land, transportation, organizational climate, geography, information, policies and so on.

The provision of health care services involves putting together a considerable number of resource inputs to deliver an extraordinary array of different service outputs. Finance is an important asset in healthcare delivery services. The performance of the health system depends ultimately on the knowledge, skills, and motivation of the people responsible for delivering services. It enables health institutions to train health workers, employ physicians, pharmacists, establish health clinics/hospital buildings, procure vehicles, equipment, procure vaccines, pay labor cost and invest on new program activity or project.

GOVERNMENT INTERVENTIONS IN IMPLEMENTATION PROCESS

Perhaps the most pervasive impact of government on the delivery of healthcare services in most nations is through regulation. There are many kinds of health-care regulations, namely: facilities, costs, quality and pharmaceuticals. Governments attempt to influence health-care delivery indirectly by providing financial support for certain activities, and directly attempt to move resources around in the health industry. One such attempt is through the regulation of "healthcare facilities and more comprehensive planning for the health needs of communities" (Peter, 1988:258). Another regulatory device is the control of costs in terms of making majority of expenses paid by a third party, such as "Blue Cross or Medicare or Medicaid" in America health care system (Peter, 1988: 258). For example, the regulation of health-care quality is another area of intervention by USA government in health policy implementation. The major public instruments used for regulating the quality of medical care are the Professional Standards Review Organizations (PSROs). These organizations are designed in part to monitor costs of services provided to Medicare Patients. Some PSROs have gone as far as to establish standard profiles of treatment for certain rather common conditions and then to question physicians whose treatment differs significantly from those patterns.

Furthermore, the USA government and other nations are deeply involved in the regulation of pharmaceutical industry and in the control of substances in food and water that are potentially harmful to health. The Food and Drug Administration (FDA) in USA and National Agency for Food and Drug Administration and Control (NAFDAC) in Nigeria are responsible for most of the drug regulation. The safety and effectiveness of a drug must be demonstrated by clinical trials. Associated with drug regulation in the Food and Drug Administration (FDA). Another issue relating to the regulation of pharmaceuticals is the

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regulation of tobacco, especially cigarettes. It has been observed that smoking cigarettes is harmful to health. It requires warning labels on to be placed on packages and forbid advertising on electronic media. Cigarettes and their regulations figure prominently in financing of health care, especially increased tax on cigarettes. Moreover, competitive mechanisms using market forces to produce desired changes in the health-service industry have been on the increase in recent times.

So, government should develop institutional capacities to ensure that appropriate uptake and integration of policies into existing activities. That is, integration of policy into private sector and community programs, such as: public-private partnership and community-based distribution network. These health policies can also support other program activities:

- Elimination of health inequities or mal-distribution of medical products or vaccines through increased mobilization and distribution of services, such as modern contraceptives and vaccines by community health workers.
- Conduct of media campaigns for improved public education and information on prevention, care and treatments; demand creation for services to marginalized populations and for population mobilization for health activities, programs or projects.
- Integration of policy can also be into sectors that contribute to health, education, agriculture, roads and so on.

HEALTH POLICY IMPLEMENTATION (OUTPUTS/ OUTCOMES)

Outcomes of these activities help increase accountability and identify implementation barriers. There have been reported cases of fraud, for example in America's healthcare system. Home-health fraud, such as charging for non-existent visits to giving insulin injections- got- so bad that the "Medicare and Medicaid Centres" (CMS), which run the programs called a moratorium on enrolling new providers in several large cities in 2013. Since tighter screening was introduced under "Obamacare", the CMS has stripped 17,000 providers of their licenses to bill "Medicare"- services meant for the elderly recipients. Thousands of suppliers also quit after being acquired to seek accreditation and to post surety bonds of $50,000. It was reported that health-care fraud in America amounted to about $272 billion in 2013 (www.businessdayonline.com).

Thus, the outcome of health policy implementation is improved health status for individuals and community. According to WHO, (2000), the main objective of health action or series of health activities, whether in personal healthcare, public health services or through inter-sectoral initiatives is to improve health. Health policy implementation outcomes, therefore, can be summarized as: efficient services, improved health status, treated patients, community empowerment, trained staff, good sanitation and good quality of life.

ENABLING ENVIRONMENT IN HEALTH SYSTEM

For efficient services to emerge from health policy implementation, accountability and transparent mechanisms should be well established, so that civil society can monitor the implementation process,

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in terms of service coverage and quality, population coverage and equity, healthy behaviors by increased number of people.

BARRIERS TO EFFECTIVE HEALTH POLICY IMPLEMENTATION

1. **Economics:** The most commonly cited barrier to access to healthcare is economics. For example in USA, majority of medical care is still paid for privately. Those who lack the income or insurance to pay for medical care may not have that medical care. Many who are poor but not sufficiently poor to qualify are not eligible to receive Medicaid benefits. Many people do not have health insurance. The elderly poor who have access to Medicare as a result of their age must still pay for parts of their insurance, at a rate that may deter some taking full advantage of healthcare program. Even having insurance as well as not having it can present troubles. The principal problem is that it can minimize mobility in the economy. For example, if a person has a job that provides health benefits it is difficult for him or her to leave that job for one that may be better in other respects but does not offer insurance. Besides, if the new job does provide insurance, it may not cover pre-existing conditions, then moving between jobs may be possible.
2. **Demand and Supply Barrier:** On the demand side, the economic literature is dominated by adaptations of Grossman model that analyze individual investment and consumption decisions to improve health and utilize healthcare (Grossman, 2000). Demand is influenced by factors that determine whether an individual identifies illness and is willing and able to seek appropriate healthcare. The model levels to a demand for healthcare of a given quality that is determined by individual and community factors as well as the price of medical care and other similar goods. Individual (and household) factors include: age, sex and income. Demand barriers to utilization of healthcare include:
    a. **Information on Health Care Choices:** This provides lack of knowledge of the providers.
    b. **Education:** Low ability to assimilate health choices and negotiate access to appropriate providers.
    c. **Education and Knowledge about the Characteristics of and Need for Medical Treatment:** Information and education are related to failures, either in the form of knowledge of healthcare choices or in the ability to utilize this information in an effective way.
    d. **Indirect Consumer Costs Barriers:** Are the result partly of income distribution and partly of lack of mechanisms to spread risk across the population or across time (so that individuals can pay for care when they can afford it rather than at the time of illness). The effect of household choices in preventing access to care to certain members is likely to be mainly the result of intra-household inequity:
        i. **Distance Cost:** Long and slow travel to facilities.
        ii. Distances to facilities imposes a considerable cost on individuals and this may reduce demand.
        iii. Opportunity cost need for patient and career to stop working for long periods in order to seek care.
    e. Household preferences as a symmetric control over household resources.
    f. Community and cultural preferences, attitudes and norms: reluctance to seek healthcare for women outside home; community resistance to using modern medical care to assist pregnancy.

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For example, cultural barriers such as cultural norms, such as "purdah" restrictions can prevent women from seeking healthcare outside the home for themselves and their children (Rashid et al. 2001). The barrier is often raised still further when men provide services and has often offered as one reason why Asian women living in Western countries often make little use of healthcare services (Whiteford & SZelag, 2000). Such restrictions may also interact with other barriers. Community factors may include cultural and religious influences and other social factors that affect individual preferences. Community barriers may also be related to information failures where they arise as a consequence of a lack of information about what constitutes medical provision and how patients will be treated once at a facility. For example, information might be used to reassure female patients that they will be treated by a female doctor.

g. **Input Prices and Input Availability:** Substitute products and services patients seek treatment through providers that are inappropriate for their condition such as drug sellers (Ensor and Cooper, 2004). Price is a complex variable and includes direct price and distance cost, opportunity(time) cost of treatment-since treatment can be time consuming and any informal payments made to the facility for commodities or to staff. Quality of staff may be absent because of the price of the wages and staff not attracted to the area.
h. **Knowledge of Technology of Treatments:** Inability to treat disease with given technology.
i. **Management Efficiency:** Poor quality of management training, lack of management systems.

The determinants of demand may generate barriers to utilization of healthcare services. Education and information assist to assimilate health messages and are important in determining demand. Finally, barriers may also interact with other demand barriers and act as important determinant of the willingness to travel long distances to obtain treatment.

Therefore, increasing demand is far more complex than simply the provision of health education advice or information but is also strongly related to the relative position and education are family members. Demand barriers present in low and middle-income countries and even richer countries can be found among vulnerable groups.

When it comes to supply, the provision of healthcare is, in many ways, a monopoly or cartel. Entry into the marketplace for potential suppliers is limited by licensing requirements and further controlled by the professions themselves, which limits the number of places available in medical schools. Thus, unlike other industries, the healthcare field makes it difficult for competition to develop among suppliers. One possible means for promoting competition is to break down the monopoly held by the medical profession by giving nurse practitioners and other para-professionals a greater opportunity to practice. The medical profession rather vigorously resists such changes. Hospitals do compete increasingly for patients, however, and with that competition has come some greater attention to the quality of care.

Moreover, price and quality of drugs and other consumables and weak cold chain may cause scarcity of supplies. Thus, supply barriers affect patients in obtaining treatments, especially for the poor and other vulnerable groups.

3. **High Medical Care Cost Barrier:** Medical-care costs are problem for government as well as for private citizens. In USA, half the total medical care bill is paid by government. Because decisions about health-care spending are made not by one government but by several, including several agen-

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cies interested in healthcare, central government attempt to control medical costs have been diffused and encountered difficulty overcoming the technical and political power of healthcare providers. A number of factors have been identified as causing at least part of the increase in medical care costs. For hospitals, one factor has been a rapid increase in the cost of supplies and equipment. This has been true of large capital investments such as CAT Scanners, as well as more mundane items, such as dressings and surgical gloves. In addition, labor costs for hospitals have been increasing rapidly, as many professional and unprofessional employees unionize to bargain for higher wages (Aaron, 1991:8-37).

Besides, physician costs also have been rising, not as rapidly as hospital costs. In addition to general pressures of inflation in the economy as a whole, increases in equipment and supply costs, increased insurance paperwork, the increasing cost of medical malpractice insurance and the practice of "defensive medicine" to protect against malpractice suits by ordering every possible diagnostic procedure have all produced increases in doctors' fees (Aaron, 1991: 45-47)

Finally, the method of payment increases the cost of medical care. Over 76 percent of the hospital costs and approximately 60 percent of all medical expenses in USA are paid by third party payers (Health Insurance Association, 1993)

4. **Quality Barrier:** In USA for example, both citizens and government must be concerned with the quality of medical care being provided. Citizens' obvious expressions of concern about quality have been the increased number of malpractices suits and complaints against physicians and hospitals. State Medical Associations and their Review Boards and other professional organizations who are supposed to discipline their fellow professionals and friends, find it difficult to do so. Government concern about quality extends from the general social responsibility for regulating the safety and effectiveness of medicines and medical devices on the market to the quality of care provided to Medicare and Medicaid patients to perhaps a more philosophical concern with the efficacy of modern medical care as a remedy for the health problems of American citizens. Medical care is still a difficult product for which to judge quality. Little information on quality of medical care is available to the consumer about the quality of services consumer about the quality of services provided by individual physicians or hospitals. The public sector has been intervening to try to make more information available, but it is still difficult for the average consumer to make choices.
5. **Unequal Access Barrier:** Medical care is mal-distributed, that is, the areas and persons with the greatest needs for healthcare are not the areas and persons with the greatest access to care. For example, in USA, Hospitals, nursing homes, clinics, doctors, dentists and other healthcare professionals are disproportionately located in well-to-do urban and sub-urban areas, as the highest fees can be generated there. The residents of these areas have better access to care than do the poor and residents of rural areas. This phenomenon is particularly true for access to specialized institutions and personnel, but it is also true to a lesser extent, for general practitioners and basic care institution. Medical care is distributed on the basis of ability to pay rather than on need. The limited access pattern contributes to the poor health and shorter life expectancy of those who are poor or live in rural communities. Black infant and maternal mortality rates are nearly twice those of whites and comparable to many countries in the Third world. The average life expectancy for blacks is six years lower than that for whites (Cochran et al, 1986).

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Unequal access is significant barrier to healthcare. Gaining equality in medical care is often difficult to the poor. Geography distantly plays a significant dual role in defining access to medical care. Urban areas are generally better served with doctors and hospitals that rural areas are. Aside from this, medical services would be even more pronounced if the areas of specialization of physicians and the standards and equipment of the hospital are considered. In some parts of USA, for example, high quality medical care may not be available even for someone who can afford it, without a substantial investment in travel. Thus, the relatively high rate of infant mortality in most low-and-middle-income countries is often taken as an indicator of poor access to medical care.

6. **Overspecialization of Healthcare:** Over specialization contributes to high cost of medical care as specialists charge more and use hospitals more than do general practitioners. For example, in USA as well as other developing countries, primary healthcare physicians, - family doctors and general practitioners constitute a small proportion of American physicians. Cardiologists Pediatricians, Urologists and other specialists are the dominant figures in the medical profession. Serious consequence from the predominance of specialists may help to account for the rather poor performance on measures of infant mortality and life expectancy relative to those of other developed nations, as these measures are more sensitive to high quality routine care than to sophisticated, exceptional procedures.
7. **Financial Inequities:** Another problem to healthcare is the financial burden imposed on many individuals and families by its high cost. The gaps in public and private health insurance are wide enough to let millions fall into financial disaster. In America, five to eight percent of the population has no health insurance, public or private. Fifty to sixty million persons have no major medical coverage. The result is that nearly ten percent of all families every year have out-of-pocket medical-gross income. Most of these families are poor, so that even $1,000 out-of-pocket is a catastrophic expense. Almost half of all personal bankruptcies each year involve medical debts.

Moreover, unintended consequences are major concern, as health education policy contributes to the over-specialization of physicians and recent changes in that policy have not yet shown an effect. Public policy, again particularly Medicare and Medicaid, in American health system contributes substantially to the cost of escalation in healthcare. As health care policy reduces the financial burden on specific individual, it increases on specific individuals, and increases on the society as a whole.

Thus, the most important problem in healthcare, shared by many nations is its soaring cost to society. The chief causes of cost escalation in the United States, for example, are growing numbers of elderly, overspecialization, mal-distribution, third-party payments, modern medical technology, federal tax policy and the public's exaggerated expectations of medical science.

There are substantial problems with America healthcare policy. Many differences in quality and access to care still remain among various groups. Medicare and Medicaid have contributed to health care is inflated costs and have not challenged structural problems in its delivery. And neither regulatory policies nor Professional Standards Review Organizations (PSROs); Health Safety Agencies (HSAs); Health Maintenance Organizations (HMOs) have had the success hoped for in introducing rational co-ordination and cost control into the system.

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CONCLUSION

Within the fundamental obligations of governments at federal, state and local authorities. The National Healthcare system should be developed to support in a coordinated manner a three-tier system of healthcare. Essential features of the system should be its comprehensive nature, multi-sectoral inputs, community involvement and collaboration with non-governmental providers of healthcare. The goal of health policy should be based on primary healthcare that is promotion-based, protective, preventive, restorative and rehabilitative to every citizen of the country within the available resources, so that individuals and communities are assured of productivity, social wellbeing and improvement of living standard.

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Chapter 8
Antimicrobial Consumption and Multidrug Resistant Organisms in Intensive Care Units: Lessons from Saudi Arabia

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ABSTRACT

Improper antimicrobial use and bacterial resistance can affect an entire community, threaten public health and create economic burdens and ecological consequences on societies. This chapter discusses the importance of counteracting this public health issue. In Saudi Arabia, the appropriate use of antimicrobial agents is of particular concern. The prescribing of broad-spectrum antimicrobials in hospital settings is not highly restricted, and antimicrobials are available over the counters in pharmacies. This unwise use provides a scenario for the emergence of bacterial resistance and subsequent public health concerns. In addition, there is a lack of representative epidemiological research on antimicrobial consumption and quantitative data linking consumption to the incidence of resistance. This chapter illustrates that the implementation and the success of the strategies that monitor and control antimicrobial consumption depend on the availability of information about the extent and patterns of antimicrobial consumption. It demonstrates the potentials and recommendations on obtaining antimicrobial consumption data using defined daily dose as a unit of measurement in Saudi hospital settings.

INTRODUCTION

Bacterial resistance has been a universal public-health concern for decades (Metz-Gercek et al., 2009; Monnet, Molstad, & Cars, 2004). Based on the increasing incidence of bacterial resistance, the insufficient availability of novel and effective antimicrobial agents, and the development of resistance against new agents, physicians will be unable to treat all infections (Bassetti et al., 2000; Gandhi, DePestel, Collins, Nagel, & Washer, 2010; Metz-Gercek et al., 2009; D Plonczynski & K Plonczynski, 2005; What are

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the consequences of resistance?, 2010). Infections caused by antimicrobial–resistant microorganisms increase morbidity and mortality, length of hospitalization, and cost of health care (Jacoby et al., 2010). Under the title "Combat Drug Resistance," the World Health Organization (WHO) selected bacterial resistance and its global spread as the theme for World Health Day 2011 (WHO-World Health Day, 2011; World-health-day2011 –brochure, 2011). This public health issue was chosen to stress its significance for good health and wellbeing (WHO-World Health Day, 2011; World-health-day2011 –brochure, 2011). The WHO and the European Commission recommend more research on understanding the development and drivers of bacterial resistance, and note the importance for rational approach to constrain it (Bronzwaer et al., 2002). On World Health Day 2011, the WHO issued a call for action: "WHO will call on everyone: policy-makers and planners, the public and patients, practitioners and prescribers, pharmacists and dispensers, the pharmaceutical industry, to think, act and take responsibility for combating drug resistance (World-health-day2011 –brochure, 2011)" and stated that "No action today, no cure tomorrow (World-health-day2011 –brochure, 2011)."

Antimicrobial agents are increasingly used to treat patients (Iosifidis et al., 2008). Today, antimicrobial agents are the most frequently prescribed therapies in hospitals (Rogues et al., 2004). Some studies claim that one-third to one-half of hospitalized patients receive antimicrobial therapy (Erbay, Bodur, Akinci, & Colpan, 2005; Vlahovic-Palcevski, Morovic, Palcevski, & Betica-Radic, 2001). The use of these agents is often inappropriate and because of their liberal prescribing and misuse, they increase the risk of adverse reactions, the need for additional medical attention, and place an unnecessary burden on the hospital pharmacy and other departmental budgets, and also are associated with the increased risk of the emergence of bacterial resistance (Arda et al., 2007). In intensive care units (ICUs), most of the patients are critically ill and are at higher risk than those in general hospital wards of developing and spreading infections, especially healthcare associated infections and infections by multidrug-resistant organisms. Thus antimicrobial agents are prescribed ten times more often in such units, are used by 60- 70% of ICU patients and account for a major part of the ICU drug expenditure (de With et al., 2006; Erbay et al., 2005; Jacoby et al., 2010). Vlahovic-Palcevski et al. (2001) reported that Simmons and Stolley came up with the following two questions: (A) have we reached the point where the enormous use of antibiotics is producing as much harm as good, and (B) are the risks beginning to overweigh the benefits?

The link between antimicrobial use and bacterial resistance has been reported in many reports from single hospitals and from multicenter studies (Fridkin & Gaynes, 1999). According to Alfandari, Bonenfant, Depretere, and Beaucaire (2007) and Cristino (1999), a steep rise in bacterial resistance is linked to the therapeutic (empirical and definitive) and prophylactic use of antimicrobial agents in the individual patient, the hospital, and the community. However, the excessive prescription of such medications to hospitalized patients is associated with a higher prevalence of antimicrobial–resistant bacteria in hospital wards than in the community (Benko et al., 2009). D Plonczynski and K Plonczynski (2005) reported that if the patterns of overconsumption are not stopped, newer therapies may fail due to the development of bacterial resistance. Therefore, the use of available antimicrobial agents should be carefully targeted and well regulated to moderate the initial emergence of bacterial resistance and slow the transmission of resistant microorganisms (Bassetti et al., 2000; Metz-Gercek et al., 2009). In addition, effective primary prevention strategies, combating the threat of bacterial resistance and improving antimicrobial prescription practice require auditing the management of antimicrobial prescription, surveying of both antimicrobial consumption and bacterial resistance, providing education on their relationship, monitoring the impact of infection control measures, ensuring greater involvement from the pharmacist and

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continually educating healthcare professionals (Meyer, Schwab, Gastmeier, Rueden, & Daschner, 2006; D Plonczynski & K Plonczynski, 2005; Wise 2006; Yamashita, Louie, Simor, & Rachlis, 2000). Thus, a multidisciplinary approach involving hospital leadership is needed to counteract this problem and improve antimicrobial prescription practices (Fridkin & Gaynes, 1999). Strategies to stop the development of bacterial resistance should be implemented early because once resistance happens, it is irreversible or slow to reverse; therefore, the faster we act, the slower the rise in bacterial resistance rates (Barbosa & Levy, 2000; Livesey & Chiew, 2006; Meyer et al., 2006; Willemsen, Bogaers-Hofman, Winters, & Kluytmans, 2009; WHO, World Health Organization, 2001).

Information about the use of antimicrobial agents allows clinicians and healthcare administrations to understand local and national trends and enables them to develop and update prescription policies that aim at effective use of antimicrobial therapy. To obtain reliable data on drug consumption, the WHO endorsed the Anatomical Therapeutic Chemical classification (ATC) and the Defined Daily Dose (DDD) system (ATC/DDD) (WHOCC – History, 2009). The ATC system classifies the drugs according to the organ or organ system they act on and according to the pharmacological and therapeutic properties of the drugs (dos Santos & Lauria-Pires, 2010). The DDD is a unit of measurement that expresses drug use (WHOCC –Home, 2011). The ATC/DDD methodology allows comparisons to be made from data about drug use statistics at local, national, or international levels and has become the gold standard for drug utilization research (Vlahovic-Palcevski, Gantumur, Radosevic, Palcevski, & Vander Stichele, 2010; WHOCC –Home, 2011). Refer to the "Anatomical Therapeutic Chemical Classification System and Defined Daily Dose" section for more details.

BACKGROUND

Bacteria are prokaryotes (i.e., they lack a membrane-bound nucleus or any other membrane-bound organelles) in the Bacteria domain and the Eubacteria Kingdom (Shargel, Mutnick, Souney, & Swanson, 2007). Bacteria can be classified according to genotype and/or phenotype. The genotype classification classifies bacteria based on a specific region of DNA (16S ribosomal RNA) (Mandell, Bennett, & Dolin, 2005). The phenotype classification classifies bacteria according to (a) morphology, (b) staining properties, (c) bacterial cell shape and arrangement, and (d) other classification parameters (Shargel et al., 2007). Under the morphology (i.e., by size, shape and structure) classification, bacteria can be classified according to either the culture morphology and/or microscopic morphology. Staining properties classify bacteria by Gram staining (e.g., Gram-positive and Gram-negative), acid-fast staining. The bacterial cell shape and arrangement facilitate the classification of bacteria into cocci (spherical), bacilli (cylindrical). Scientists can also classify bacteria according to other parameters, such as motility, flagella type, and presence or absence of spores or capsules.

MECHANISMS OF BACTERIAL RESISTANCE AND GENE DISSEMINATION

Mechanisms of bacterial resistance were not understood in the 1940s and early 1950s (Evans & Brachman, 1998). Presently we have more insight into the bacterial mechanisms that spread resistance genes (Barbosa & Levy, 2000).

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Intrinsic Resistance

Bacteria are intrinsically resistant to antimicrobial agents by a number of different mechanisms, including the lack of the target site for an agent, possession of a chromosomally encoded resistance mechanism that inactivates the agent (e.g., resistance to penicillin arises because of a chromosomal β-lactamase agent in *K. pneumonia* strains), or permeability issues that prevent the agent from reaching its target site (e.g., resistance to some β-lactam antimicrobial agents arises because they cannot cross the cell membrane and reach their site of action in Gram-negative pathogens, especially *Pseudomonas* spp) (Evans & Brachman, 1998; Gillespie & Bamford, 2003).

Acquired Resistance

Previously, susceptible bacteria developed resistance to antimicrobial agents through two major mechanisms: (a) random chromosomal mutations or (b) acquiring a new genetic component that encoded for a resistant protein (Evans & Brachman, 1998; Reid, Rubin, & Whiting, 2001). An example of random chromosomal mutation is gene remodeling that alters bacterial components and thus prevents the binding of antimicrobial agents to their target sites of action (Reid et al., 2001). Acquiring a new genetic component (i.e., new DNA) causes antimicrobial agents to lose their effectiveness through five major pathways: (1) chemically modifying the antimicrobial agent that leads to its inactivation (for example, the production of the enzyme β-lactamase destroys the main β-lactam ring structure of some antimicrobial agents), (2) decreasing or preventing the penetration of the antimicrobial agent into the bacterium cell by changing the permeability of the bacterial cell envelope; (3) preventing antimicrobial agent from binding to its site of action by modifying the structure of the target site in the bacterium cell; (4) developing an alternative metabolic pathway other than that inhibited by the antimicrobial agent; and (5) developing efflux mechanisms that pump the antimicrobial agents out of the cell, thus preventing them from reaching their target sites of action (Barbosa & Levy, 2000; D Plonczynski & K Plonczynski, 2005).

MECHANISMS OF GENE DISSEMINATION

After randomly developing resistance and surviving, bacteria replicate through cell division, the most common mechanisms for bacterial replication, which occurs several times a day. Thus, the previously mentioned mutations can be rapidly transmitted to subsequent generations of bacteria, and mutant microorganisms quickly dominate the population (D Plonczynski & K Plonczynski, 2005). According to Evans and Brachman (1998), transmission of resistance determinants between bacteria can be achieved through chromosomal mutations, plasmids, transposons and integrons.

Accumulation of Chromosomal Mutations

Transformation occurs when a bacterium takes up pieces of DNA and incorporates them into its genome. Propagation of the altered gene may lead to the emergence of resistance in the bacteria (Barbosa & Levy, 2000; Gillespie & Bamford, 2003).

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Acquisition of Plasmids, Transposons, and Integrons

Conjugation occurs when antimicrobial-resistance genes carried on plasmids (circular extrachromosomal pieces of DNA) are transferred from one microorganism to another (Gillespie & Bamford, 2003). One example is the transfer of the plasmid-mediated multidrug-resistance phenotype from *Shigella* species to *E. coli* (Evans & Brachman, 1998). Transposons and integrons are transposable genetic materials that can carry resistance genes and have the ability to move between the chromosome and plasmids and from one bacterium to another via cell-to-cell (conjugal) contact (Gillespie & Bamford, 2003). Dissemination of resistance determinants via transposons and integrons is faster than via plasmids (Evans & Brachman, 1998).

Microbial Resistance: A Worldwide Public Health Problem

Resistance to antimicrobial therapies is a natural biological phenomenon (WHO-World Health Organization, 2001) and it may develop against any antimicrobial agent (Kolar, Urbanek, & Latal, 2001). However, due to its increasingly high prevalence and rapid spread of multidrug resistant strains in addition to the shortage of new antimicrobial agents, resistance has become a major worldwide public health concern that necessitates international approaches (Bronzwaer et al., 2002; Dimina et al., 2009; Hsu et al., 2010; Meyer et al., 2006; Naaber, Koljalg, & Maimets, 2000; Pelle, Gilchrist, Lawson, Jacklin, Franklin, 2006; WHO, World Health Organization, 2001). Resistance to antimicrobial therapy has developed not only among pathogenic microorganisms but also in many commensal microorganisms (i.e., microorganisms that are normally are harmless) (Willemsen et al., 2009). Bacteria can evolve and optimize their genetic arsenal to develop resistance against antimicrobial agents and thus survive and multiply in the presence of the antimicrobial agents at concentrations much higher than the therapeutic concentrations used clinically (Barbosa & Levy, 2000; D Plonczynski & K Plonczynski, 2005; Reid et al., 2001; Shargel et al., 2007; WHO, World Health Organization, 2001).

Bacterial resistance has been recognized decades ago (Vlahovic-Palcevski et al., 2001), and it has become a worldwide problem (Camberlin & Ramaekers, 2009; Naaber et al., 2000) that has challenged the management of infections in hospitals (Yamashita et al., 2000). Currently, outbreaks of resistant microorganisms are common in hospitals (Yamashita et al., 2000) and some of these microorganisms resist nearly all available antimicrobial agents (Leibovici et al., 2001; Vlahovic-Palcevski et al., 2001) making treatment of infections due to resistant bacteria a difficult task in the majority of hospitals worldwide (Lopez-Lozano et al., 2000). In the U.S., 70% of the bacteria in the hospitals resist at least one antimicrobial agent (Furtado, Perdiz, & Medeiros, 2008). Controlling the increasing prevalence of antimicrobial-resistant pathogens is a major issue in health care settings (White, Friedrich, Mihm, & Bosso, 2000) and the emergence of these microorganisms poses a significant challenge for clinicians, infection-control personnel, and hospital administrators (Fridkin et al., 1999). The rise of bacterial resistance against antimicrobial agents in current use is a real threat to human health, and according to the WHO (WHO-World Health Organization, 2001; Willemsen et al., 2009), it impacts on health care expenditure worldwide.

Antimicrobial resistance and multidrug-resistant bacteria are major determinant factors for morbidity, mortality and additional costs in hospitals and are associated with hospital-acquired infections, prolonged hospital stays, increased antimicrobial consumption, treatment failure, human suffering and lost productivity (Bosso, Mauldin, & Salgado, 2010; Camberlin & Ramaekers, 2009; Hsueh, Chen, &

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Luh, 2005; D Plonczynski & K Plonczynski, 2005; Iosifidis et al., 2008; Jacoby et al., 2010; Kuster et al., 2008; Velickovic-Radovanovic, Petrovic, Kocic, Antic, & Randelovic, 2009; Vlahovic-Palcevski et al., 2001; Yamashita et al., 2000; WHO, World Health Organization, 2001). For example, treating vancomycin resistant *Enterococcus faecium* bloodstream infections costs $27,190 more than treating vancomycin-susceptible *Enterococcus faecium* infections ($p = .04$), and this shows the impact of resistance on health care expenditures (Stosor, Peterson, Postelnick, & Noskin, 1998). In addition, the direct and indirect annual U.S. expense for health care due to infections with resistant microorganisms is approximately $5 billion (Bosso & Mauldin, 2006). Without a doubt, the emergence of bacterial resistance to antimicrobial agents will limit our ability to treat human illness and may affect our capability to overcome large outbreaks of infectious diseases (Evans & Brachman, 1998). According to Furtado et al. (2008), preventing bacterial resistance and the dissemination of multidrug-resistant organisms, reduce the morbidity, mortality, and costs of health care.

Treating infections especially in ICUs is becoming more difficult (Bennett & Brachman, 1998). The highest rates of bacterial resistance are found in ICUs (Gandhi et al., 2010). Phase I data from the ICARE project (Intensive Care Antimicrobial Resistance Epidemiology) and many other studies showed higher rates of bacterial resistance in ICUs than in other hospital settings (Fridkin et al., 1999; White et al., 2000). The mortality rate in patients admitted to ICUs can be more than 25% and it can exceed 40% in patients with complications (more than one-third of patients admitted to ICUs are complicated cases) (Bennett & Brachman, 1998). In ICUs, bacterial resistance increases the risk of mortality (Gandhi et al., 2010). In fact more than 20% of nosocomial infections are acquired in ICUs, even though these units are small (less than 5% of hospital beds) and care for fewer patients (less than 10% of inpatients) (Bennett & Brachman, 1998). In the ICUs, the financial burden of healthcare associated infections is high (Gandhi et al., 2010). Patients in ICUs are more prone to nosocomial infections and colonization by resistant pathogens, and they may initiate outbreaks of resistant organisms in hospitals due to the severity of their illnesses, prolonged hospitalization, and higher nursing index, the recurrent use of invasive devices and the massive consumption of broad spectrum anti-infective agents (Bennett & Brachman, 1998; Fridkin & Gaynes, 1999; Meyer et al., 2004a; Meyer et al., 2004b; Yamashita et al., 2000). Many of these infections are associated with multidrug-resistant organisms (Jacoby et al., 2010). Therefore, the likelihood of the emergence and spread of multidrug-resistant organisms in ICUs is very high (Meyer et al., 2004a). The expenditure on medications in ICUs comprises 40% of the total hospital drug cost (Gandhi et al., 2010), and the highest consumption of antimicrobial agents are in this type of hospital settings (Gandhi et al., 2010). Patients in these units receive antimicrobial agents more frequently and in greater quantities than any other patients in the hospital (Bennett & Brachman, 1998). These units are often the target of surveillance programs and restrictions in the use of antimicrobial agents (Yamashita et al., 2000).

Antimicrobial Agents

Before 1928, infectious diseases were the major cause of mortality (D Plonczynski & K Plonczynski, 2005). The introduction and use of penicillin caused a decline in the rate of deaths from infectious diseases (D Plonczynski & K Plonczynski, 2005). The discovery and consumption of antimicrobial agents were a revolution in the medical sciences. They have been used for decades to successfully prevent some infectious diseases, suppress the transmission of others, and cure a variety of diseases, including diseases with high mortality rates, such as puerperal fever, pneumococcal pneumonia and bacterial meningitis (dos Santos et al., 2007; Vlahovic-Palcevski et al., 2001). Antimicrobial agents were previously known

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as "miracle drugs (Dong, Yan, & Wang, 2008)." Their aim was to control infections without harming the patient (Reid et al, 2001). These treatments alter bacterial processes that are not present in human cells (selective toxicity), thereby hindering the metabolic processes of the bacteria but not of the individual hosting that microorganism (Gillespie & Bamford, 2003). Antimicrobial agents are either bactericidal or bacteriostatic (Shargel et al., 2007). Shargel et al. (2007) define bactericidal agents as those agents that kill the pathogens, whereas bacteriostatic agents that merely inhibit their growth or reproduction cycle. Whether the antimicrobial agent will combat the causative pathogen effectively is determined through performing susceptibility tests (Shargel et al., 2007). The minimum inhibitory concentration for an antimicrobial agent is the lowest concentration that prevents microbial growth after 18-24 hours of incubation (Shargel et al., 2007). The minimum bactericidal concentration for an antimicrobial agent is the lowest concentration that decreases bacterial density by 99.9% (Shargel et al., 2007). There are more than 200 antimicrobial agents that are available for clinical use (Bassetti et al., 2000). The major classes of antimicrobial agents include: aminoglycosides, carbapenems, cephalosporins, fluoroquinolones, macrolides, metronidazole, penicillins, sulfonamides, and tetracyclines.

Following the clinical introduction of antimicrobial agents in the 1940s to treat infectious diseases, antimicrobial agents have been increasingly consumed and misused not only in humans but also in veterinary medicine, plant agriculture and aquaculture (Barbosa & Levy, 2000; Kuster et al., 2008). In the U.S., the total consumption of antimicrobial agents is around 23 x 10^6 kg per year (Levy, 2002). This amount is equally divided into two parts. As 11.5 x 10^6 kg is consumed by humans, and the remaining part is utilized in agriculture and as growth promoters (Levy, 2002). The amount provided to human is generally administered parenterally in hospitals and orally in the community (Levy, 2002). In hospital settings and among inpatients, antimicrobial agents are the most prescribed therapies (15 – 30% of all consumed medications) (Velickovic-Radovanovic et al., 2009). Available data indicate that antimicrobial agents are prescribed to more than one-half of hospitalized patients (Vlahovic-Palcevski et al., 2001). Up to 40% of inpatients are treated with systemic antimicrobial agents and the use of antimicrobial agents in hospitals is increasing (Bennett & Brachman, 1998). Unfortunately, and according to Raveh et al. (2006), 15-40% of antimicrobial use is improper. And Erbay et al. (2005) found that antimicrobial consumption was inappropriate for 47.3% of antimicrobial agents used in a tertiary care hospital in Turkey. In addition, Velickovic-Radovanovic et al. (2009) reported that up to 50% of antimicrobial agents used by hospitalized patients are prescribed inappropriately.

Antimicrobial agents have been used for more than 50 years (Bennett & Brachman, 1998). Over that time, there has been continuous development and introduction of new antimicrobial agents. Unfortunately, each introduction is eventually followed by the emergence of bacterial resistance, thus changing past physicians' beliefs regarding these 'wonder drugs' and their ability to end the problem of infectious diseases (Barbosa & Levy, 2000; Bennett & Brachman, 1998; Evans & Brachman, 1998; Vlahovic-Palcevski et al., 2001; WHO, World Health Organization, 2001). With environmental exposure to antimicrobial agents, bacteria may be destroyed or mutated (i.e., produce inheritable changes in a genomic sequence) and evolve to pathogens that are resistant and more virulent (D Plonczynski & K Plonczynski, 2005). Consumption of antimicrobial agents is increasing over time, and their widespread overuse increases hospital costs and results in the emergence of bacterial resistance, which is increasing at an alarming rate and this may limit our future ability to control infections and could return us to a life without effective antimicrobial agents (D Plonczynski & K Plonczynski, 2005; Iosifidis et al., 2008). Currently, among the available antimicrobial agents for clinical use, there are no agents for which resistance has not been reported (Evans & Brachman, 1998). Both improper antimicrobial consumption and bacterial resistance

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threaten public health and create economic burdens and ecological consequences on the society (Meyer et al., 2004b; Willemsen et al., 2009). According to the WHO (WHO-World Health Organization, 2001), the appropriate use of antimicrobial agents is defined as "*the cost-effective use of antimicrobials which maximizes clinical therapeutic effect while minimizing both drug-related toxicity and the development of antimicrobial resistance."* With the current rise in resistance rates and the dwindling development of new antimicrobial agents, there is likely to be a lack of effective therapies against some pathogens within the next years; in fact, we may be moving toward the post-antimicrobial era (Naaber et al., 2000; Vlahovic-Palcevski et al., 2001; WHO, World Health Organization, 2001).

THE RELATIONSHIP BETWEEN ANTIMICROBIAL CONSUMPTION AND RESISTANCE TO ANTIMICROBIAL THERAPY

There are several interacting factors that determine the dynamic development of bacterial resistance to antimicrobial therapy, such as frequent administration of broad-spectrum antimicrobial agents, prolonged exposure to antimicrobial agents and treatment failure (wrong agent, dose, etc.), utilization of invasive devices and procedures, poor quality of available antimicrobial agents, patient compliance and other patient factors that are difficult to measure (e.g., site of infection and host status) (D Plonczynski & K Plonczynski, 2005; Frank et al., 2006; Livesey & Chiew, 2006; Mutnick, Rhomberg, Sader, & Jones, 2004; Velickovic-Radovanovic et al., 2009; Vlahovic-Palcevski et al., 2001; White et al., 2000). Table 1 summarizes some of these factors according to Wenzel (2003). The interactions between these interrelated variables have not yet been fully explored (Wenzel, 2003; WHO, World Health Organization, 2001) and ranking these variables according to their importance in influencing the prevalence of resistance is

Table 1. Some of the interactive factors that determine the dynamic development of bacterial resistance to the antimicrobial therapy

Factors Related to the Antimicrobial Agents	Dose
	Number of agents
	Length of therapy
	Antimicrobial spectrum
	Pharmacokinetics
Factors Related to the Patients	Foreign bodies
	Immunity status
	Vaccination history
	Normal flora
Factors Related to the Environments	Total antimicrobial use/threshold
	Infection control measures
	Cross transmission
Factors Related to the Organism	Mechanisms of resistance
	Ease of gene transfer

(Wenzel, 2003)

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unclear and difficult and varies among different pathogens (Wenzel, 2003). However, most researchers of antimicrobial resistance regard the inappropriate and widespread consumption of antimicrobial agents as the main driver for bacterial resistance (Fridkin & Gaynes, 1999; Livesey & Chiew, 2006; Meyer et al., 2006; Naaber et al., 2000; Wenzel, 2003; White et al., 2000; WHO, World Health Organization, 2001). There is a considerable body of evidence that supports the causal relationship between the clinical consumption of antimicrobial agents and the increasing rates of bacterial resistance (Jacoby et al., 2010; Livesey & Chiew, 2006; Velickovic-Radovanovic et al., 2009; Wenzel, 2003).

Several researchers using different methodologies have evaluated the link between the consumption of antimicrobial agents and the emerging of resistance in microorganisms (Mutnick et al., 2004). There have been longitudinal studies, case-control studies, and ecologic studies at the cross-national or national levels that used community data, hospital data, or both (Iosifidis et al., 2008). The overall consumption of antimicrobial agents in the hospital and community settings significantly contribute to the escalating rates of bacterial resistance (Dimina et al., 2009; Hsu et al., 2010; Leibovici et al., 2001; Pelle et al., 2006; Polk, Fox, Mahoney, Letcavage, & MacDougall, 2007). Reports from around the globe show that excessive consumption of antimicrobial agents correspond with high rates of bacterial resistance, which is obvious in Spain, France, the United States, and Greece; on the other hand, low consumption in Nordic countries (the Netherlands, Norway, Denmark, and Sweden) corresponds with low rates of resistance (D Plonczynski & K Plonczynski, 2005; Naaber et al., 2000). According to Raveh et al. (2006), bacterial resistance is a function of the volume of antimicrobial consumption: i.e., as more antimicrobial agents are consumed, the rate of emergence of resistant pathogens becomes greater. Levy (2002) and Patterson (2001) reported that both the quantity and pattern of consumption of antimicrobial agents are clearly related to the emergence of multidrug-resistant organisms.

The Need for Surveillance of Antimicrobial Consumption

Many international institutions, governments, clinicians, policy-makers and civil societies are searching for initiatives to fight the emergence and dissemination of bacterial resistance (dos Santos & Lauria-Pires, 2010; Loeffler, Garbino, Lew, Harbarth, & Rohner, 2003). Although the relationship between antimicrobial consumption volumes and the development of bacterial resistance is complex, we can stabilize and contain bacterial resistance in local areas (Burke & Pestotnik, 1999). According to Meyer et al. (2006), until we are fully aware of the interactions between factors that determine the development of bacterial resistance, wise consumption of antimicrobial agents should be seen as the single most important measure to control bacterial resistance. Therefore, to simplify the resistance phenomenon, we need to focus on the consumption of antimicrobial agents and the spread of resistance gene because if neither were present, the problem of bacterial resistance would not exist (Levy, 2002). To tackle the problem of increasing prevalence of bacterial resistance, both the WHO and the European Commission promote the reasonable and intelligent use of antimicrobial agents (Meyer et al., 2006; Meyer et al., 2004b). In France, national recommendations suggest limiting "overuse" and "misuse" of antimicrobial agents to control the emergence of bacterial resistance (Mandy, Koutny, Cornette, Woronoff-Lemsi, & Talon, 2004). There are many methods to optimize antimicrobial consumption (Cristino, 1999; Furtado et al., 2008; Vlahovic-Palcevski et al., 2001). Some of these methods include education programs for health care providers, introduction of order form and automatic stop orders, formulary restriction, antimicrobial use evaluations, use of antimicrobial agent assessment team, pharmacist intervention, or using national or international guidelines for antimicrobial drug use (Furtado et al., 2008; Vlahovic-Palcevski et al.,

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2001). Whatever the best method, its implementation and assessment of its success, and determining the magnitude of the resistance problem, largely hinge on drug utilization research and understanding patterns of antimicrobial consumption, particularly in ICUs (dos Santos et al., 2007; Fridkin & Gaynes, 1999). Without information about the extent and pattern of antimicrobial consumption, it is difficult to build strategies, detect problems, set priorities, control use, and evaluate the effectiveness of policies (Janknegt, Oude Lashof, Gould, & van der Meer, 2000; Popova, Popova, & Guencheva, 1997).

Having antimicrobial consumption data and monitoring bacterial resistance is essential in learning more about resistance trends and the relationship between antimicrobial consumption and development of resistance. Such information allows for the establishment of parameters for evaluating actions that improve antimicrobial consumption and prevent the emergence and dissemination of resistance (dos Santos & Lauria-Pires, 2010; Metz-Gercek et al., 2009; Yamashita et al., 2000). And according to Gandhi et al. (2010), assessing antimicrobial consumption in ICUs allows the measurement of the relationship between the consumption of antimicrobial agents and the emergence of bacterial resistance. Moreover, antimicrobial agents are expensive medications and the budgets of hospitals are markedly influenced by the consumption or overconsumption of such agents. Therefore, measuring antimicrobial consumption provides valuable data for the administrative departments, heads of clinical departments and other hospital staff. Surveillance of antimicrobial consumption is helpful in developing policies to control the consumption of antimicrobial agents, increasing treatment quality, decreasing the risk of bacterial resistance, and cutting unnecessary treatment and hospital expenditures (Dimina et al., 2009; Ruef, 2006).

The 1998 European conference "The Microbial Threat" emphasized the importance of international comparisons of antimicrobial consumption and bacterial resistance surveillance data (Velickovic-Radovanovic et al., 2009). The Centers for Disease Control and Prevention (CDC) and the National Foundation for Infectious Disease sponsored a workshop that proposed recommendations for hospitals, encouraging them to collect data on the consumption of antimicrobial agents to reduce the emergence and spread of antimicrobial-resistant microorganisms (Fridkin & Gaynes, 1999; Fridkin et al., 1999). A decade ago, Austria began collecting data on antibiotic resistance and antimicrobial consumption after the 1999 European Antimicrobial Resistance Surveillance System (EARSS) and the 2001 European Surveillance on Antimicrobial Consumption (ESAC) (Metz-Gercek et al., 2009). Recently, the European Council Recommendation, the French government, and many other organizations have recommended that the consumption of antimicrobials be studied in hospitals (Jacoby et al., 2010; Rogues et al., 2004; Vander Stichele, Elseviers, Ferech, Blot, & Goossens, 2006). And according to many professionals and international organizations that are concerned about the increasing rate of bacterial resistance, surveillance of antimicrobial consumption at the local and national levels is essential (Polk et al., 2007; Wenzel, 2003). However, in many countries, there is shortage in the availability of data on antimicrobial consumption and bacterial resistance (Barbosa & Levy, 2000). In Saudi Arabia there is a shortage of representative epidemiological studies on antimicrobial consumption and quantitative data linking the consumption to the incidence of resistance.

THE ANATOMICAL THERAPEUTIC CHEMICAL CLASSIFICATION (ATC) SYSTEM AND DEFINED DAILY DOSE (DDD)

To assess antimicrobial consumption, the specific metric that best monitors consumption has not been identified (Gandhi et al., 2010; Polk et al., 2007). In addition to current hospital information technol-

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ogy, it is not always possible to measure actual antimicrobial consumption, on individual or aggregate levels; thus it is necessary to depend on "best-guess" estimates of the consumption of antimicrobial agents (Mutnick et al., 2004). To analyze drug consumption, the Norwegian Medicinal Depot developed the ATC classification system, which is now under the responsibility of the WHO Collaborating Centre for Drug Statistics Methodology and has become the most widely used, and most useful, classification system (Hutchinson et al., 2004). The DDD methodology is the most common methodology for reporting drug consumption and it has been applied to report antimicrobial consumption by the CDC Project ICARE and the CDC National Nosocomial Infection Surveillance Project (Gandhi et al., 2010; Polk et al., 2007). The ATC system classifies drugs by dividing them into different groups according to the organ or organ system they act upon and the pharmacological and therapeutic properties of the drugs (dos Santos & Lauria-Pires, 2010). For example, Table 2 illustrates how amoxicillin is classified according to the ATC system. The South Australian in-hospital antimicrobial utilization surveillance program (2001) and the ESAC Project (2001) are examples of programs that use the ATC/DDD system (Livesey & Chiew, 2006). According to Mandy et al. (2004), the Générale de la Santé (French Public Health Office) news-letter recommends DDD as one metric that could be used for expressing antimicrobial consumption. The WHO and the Infectious Diseases Society of America recommend that hospitals use the ATC system and the DDD per 100 or 1,000 bed-days as the standard unit of measurement for monitoring antimicrobial consumption (Kuster et al., 2008; Livesey & Chiew, 2006; Polk et al., 2007). Also one of the recommendations for good antimicrobial practice in acute hospitals was to analyze and report antimicrobial consumption using the WHO DDDs as the numerator and bed days as the denominator (Nathwani, 2006).

The basic definition of DDD, extracted from the WHO Collaborating Centre for Drug Statistics Methodology, is as follows:

The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults. (WHOCC - Definition and general considerations, 2009)

The DDD is a unit of measurement that expresses drug consumption independent of the sale price and package size of the medicinal product (Natsch et al., 1998; Wenzel, 2003). Its value estimates the amount consumed independently of the dosage form and price of the drug (dos Santos & Lauria-Pires,

Table 2. ATC system classification of amoxicillin

ATC Classification	ATC Category	Description
J	General anti-infectives for systemic use	1st level (anatomical main group)
J01	Antibacterials for systemic use	2nd level (therapeutic main group)
J01C	B-lactam antibacterials, penicillins	3rd level (therapeutic/pharmacological subgroup)
J01CA	Penicillins with extended spectrum	4th level (chemical/therapeutic/pharmacological subgroup)
J01CA04	Amoxicillin	5th level (subgroup for chemical substance)

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2010). However, the DDD is a technical unit of measurement, and its value may not mirror the real daily dosage most frequently consumed and should not be taken as a standard for appropriate use (Vlahovic-Palcevski et al., 2010). The WHO states, *"It should be emphasized that the defined daily dose is a unit of measurement and does not necessarily reflect the recommended or prescribed daily dose. Doses for individual patients and patient groups will often differ from the DDD and will necessarily have to be based on individual characteristics (e.g., age and weight) and pharmokinetic considerations*. (WHOCC - Definition and general considerations, 2009)*"* For nearly every antimicrobial agent, the WHO has assigned DDD values that are updated and published on their official web site (http://www.whocc.no/) every year (Dellit, 2007; Kuster et al., 2008; Vlahovic-Palcevski et al., 2010). Calculating antimicrobial consumption according to the DDD methodology involves summing the total number of consumed (purchased, dispensed, or administered) grams of the antimicrobial agent during a specified period and dividing this total by the WHO-assigned DDD (Gandhi et al., 2010). The ATC/DDD methodology has become the gold standard for valid and reliable drug consumption research and DDD per bed-days can be used to compare data about drug consumption statistics between institutions at local, national, or international levels, independent of the formulary differences, drug potency and hospital census (dos Santos & Lauria-Pires, 2010; Vlahovic-Palcevski et al., 2010; WHOCC –Home, 2011). Polk et al. (2007) stated that *"development of DDD methodology has been a major advance in attempts to promote standardized comparisons."*

The DDD methodology has advantages and disadvantages. According to Polk et al. (2007), the main advantage of this method is that it allows standardized comparisons of aggregate antimicrobial consumption across a wide range of institutions in different localities and countries. This metric has been used by many national and international organization to assess consumption (Polk et al., 2007). DDD also helps to estimate antimicrobial consumption when automation of administration records and access to electronic pharmacy data is limited (Polk et al., 2007). In addition, the DDD methodology has been used to link antimicrobial exposure to bacterial resistance (Polk et al., 2007). However, dos Santos and Lauria-Pires (2010) mentioned that the DDD methodology does not apply to pediatric patients and does not consider prophylactic consumption use. In agreement with Polk et al. (2007) they also discuss that this method is not accurate in translating consumption in patients with renal failure because if the administered daily dosage is reduced due to renal impairment, the DDD methodology will underestimate antimicrobial exposure. In addition, Polk et al. (2007) said that changing the recommended daily dose without revising the approved DDD will lead to a different estimate of antimicrobial consumption. When comparing use over time, confusion may occur because approval of new dosages of existing drugs may lead to different WHO-established DDD values for the same drug (Polk et al., 2007). Furthermore, using DDDs as a measure of antimicrobial consumption could result in an overestimation of consumption (Kern et al., 2005; Ruef, 2006).

Reported Correlations between Antimicrobial Consumption and Bacterial Resistance

Both the volume of antimicrobial agents and the way in which they are consumed in hospitals and community have been associated with the increasing prevalence of bacterial resistance (Barbosa & Levy, 2000; Gentry, Flournoy, & Reinert, 2002; Iosifidis et al., 2008; Kuster et al., 2008; Meyer et al., 2004b; Willemsen et al., 2009). Although there is substantial evidence supporting the hypothesis that total antimicrobial consumption is the main driver in selecting bacterial resistance, the relationship

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between antimicrobial consumption and bacterial resistance is not a simple correlation (WHO-World Health Organization, 2001). Research examining the relationship between antimicrobial consumption and bacterial resistance showed varying results, including both positive and negative correlations. Some studies reported significant correlations, while others found no correlation. For example, the National Nosocomial Resistance Surveillance (NNRS) Group, one of the earliest surveillance networks of antimicrobial consumption among multiple hospitals, used antimicrobial purchase information as a measure of antimicrobial consumption and simple linear regression to examine the relationship between antimicrobial consumption and resistance (Wenzel, 2003). In 1992, the NNRS group made one of the first observations to support the quantitative association between antimicrobial consumption (ceftazidime purchase in 18 hospitals) and resistance (against *Enterobacter cloacae*) from a hospital network (Wenzel, 2003). Seven years later, the group found a significant association between the purchase of levofloxacin and resistance levels for *P. aeruginosa* (Wenzel, 2003).

In February 2000, the German Surveillance of Antimicrobial Use and Antimicrobial Resistance in Intensive Care Units (SARI) was developed to investigate antimicrobial consumption and its link to bacterial resistance. It was supported by the Ministry of Science and Education in Germany as part of the Spread of Nosocomial Infections and Resistant Pathogens (SIR) research network (Meyer et al., 2006; Meyer et al., 2004b). By December 2004, Project SARI included data on antimicrobial consumption and resistance in 40 ICUs from different German hospitals (Meyer et al., 2006). From February 2000 through June 2003, data from 38 ICUs (medical, surgical, and interdisciplinary ICUs) showed a significant correlation between consumption of ciprofloxacin and methicillin-resistant *Staphylococcus aureus* (MRSA) and between imipenem consumption and imipenem-resistant *P. aeruginosa* (Meyer et al., 2004a). Data from ICARE showed that higher consumption of third-generation cephalosporins, ureido/carboxy penicillins, and vancomycin in adult ICUs, when compared to non-ICU areas, were correlated with higher rates of the respective resistant organisms among isolates from ICU patients compared with non-ICU inpatients (Fridkin & Gaynes, 1999; Fridkin et al., 1999). The development of resistant Gram-negative bacilli in a neonatal ICU was related to the empiric consumption of an amoxicillin-cefotaxime combination (Barbosa & Levy, 2000).

The consumption of fluoroquinolones correlated with the prevalence of MRSA (Livesey & Chiew, 2006). The rate of carbapenem consumption was significantly correlated with the prevalence of imipenem resistance among *Acinetobacter baumannii* and *P. aeruginosa* isolates (Iosifidis et al., 2008). Rahal et al. (1998) reported a significant increase in imipenem-resistant *P. aeruginosa* correlated with a significant increase in imipenem consumption. Consumption of third-generation cephalosporins was correlated with the prevalence of MRSA (Livesey & Chiew, 2006). After reducing hospital consumption (parenteral and oral) of cephalosporins in a 500-bed medical center, Rahal et al. (1998) reported a significant reduction in nosocomial, plasmid-mediated, cephalosporin-resistant *Klebsiella* infection and colonization. Patterson et al. (2000) showed that low levels of ceftazidime consumption was associated with a decrease in ceftazidime-resistant *K. pneumoniae* in two university-affiliated hospitals. A significant positive correlation was reported between consumption of cefepime and resistance in *P. aeruginosa* (Frank et al., 2006). The rate of aminoglycoside consumption is significantly correlated with the prevalence of amikacin resistance *E. coli*, *P. aeruginosa*, and *K. pneumoniae* isolates (Iosifidis et al., 2008). A significant positive correlation has been reported between consumption of gentamicin and resistance in *K. pneumonia* (Frank et al., 2006). Using the logistic regression line to examine possible correlations between hospital consumption of antimicrobial agents (expressed as DDD) and resistance, a multicenter, four-country study carried out by Frank et al. (2006) showed significant positive correla-

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tions between the consumption of ampicillin and resistance in *E. coli*, consumption of piperacillin and resistance in *E. coli*, consumption of piperacillin and resistance in *K. pneumoniae*, and consumption of piperacillin-tazobactam and resistance in *K. pneumoniae*. The study included more than 6,000 patients and reported that increasing consumption of some antimicrobial agents is correlated with rising resistance rates. Some studies did not find a significant relationship between cephalosporin consumption and bacterial resistance. For example, Iosifidis et al. (2008) found a non-significant correlation between the rate of third-generation cephalosporin consumption and the prevalence of ceftazidime resistance in Gram-negative bacteria. According to Willemsen et al. (2009), there is no significant correlation between the consumption of first- and second-generation cephalosporin and cefuroxime-resistant *E. coli*. The correlation between the rate of fluoroquinolone consumption and the prevalence of ciprofloxacin resistance in Gram-negative pathogens was not statistically significant (Iosifidis et al., 2008). However, Livesey and Chiew (2006) found a significant positive correlation between the consumption of ciprofloxacin and the incidence of ciprofloxacin-resistant *P. aeruginosa* and a negative correlation between ciprofloxacin consumption and ciprofloxacin-resistant *E. coli*. On the other hand, Willemsen et al. (2009) reported a significant positive correlation between the consumption of ciprofloxacin and the incidence of ciprofloxacin-resistant *E. coli*.

Antimicrobial Consumption and Bacterial Resistance: The Saudi Perspective

In Saudi Arabia, prescribing broad-spectrum antimicrobial agents in hospital settings is not highly restricted, and antimicrobial agents are available over the counter in pharmacies, like other merchandise. This imprudent consumption provides the worst scenario for the emergence of bacterial resistance.

The incidence of bacterial resistance and the consumption of antimicrobial agents vary among hospitals and countries (Bassetti et al., 2000; Camberlin & Ramaekers, 2009; Naaber et al., 2000). Because bacterial resistance reflects local practices, it is important to have data on resistance trends and antimicrobial consumption in particular settings (Barbosa & Levy, 2000; Iosifidis et al., 2008). Information from individual hospitals about the relationship between the amount of consumption and resistance within specific wards allows for the development of targeted intervention programs (Willemsen et al., 2009). This idea is promoted by the Infectious Diseases Society of America, the special task force of the American Society for Microbiology, and a joint committee comprising members of the Society for Healthcare Epidemiology of America (White et al., 2000). Monitoring trends in antimicrobial consumption and bacterial resistance is beneficial both at the local as well as national levels (D Plonczynski & K Plonczynski, 2005) and such information allows healthcare administrations to understand national and local trends and it enables them to develop and update prescription policies to ensure effective consumption of antimicrobial agents. In Saudi Arabia, a research team at King Abdulaziz Medical City in Riyadh (KAMC-Riyadh) studied the consumption of ten clinically important antimicrobial agents as well as the incidence of infections with multidrug-resistant Gram-negative organisms (Jabri 2011). KAMC-Riyadh surveillance particularly examined the correlation between antimicrobial consumption rate and the incidence of infections with multidrug-resistant *P. aeruginosa,* and infections with multidrug-resistant *K. pneumonia* in four different adult ICUs (Jabri 2011).

Only ICUs were included in the KAMC-Riyadh surveillance study. As previously stated, the highest rates of bacterial resistance are in the ICUs and the likelihood of emergence and spread of multidrug-resistant organisms is very high in these units. In addition, containment of bacterial resistance in such settings is more important than other hospital areas (Loeffler et al., 2003). Only adult ICUs were in-

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cluded in this surveillance. At that time Pediatric ICUs were not included in the surveillance because the WHO DDD methodology is less well defined in the pediatric population, and there is no standard for antimicrobial consumption in neonates (dos Santos & Lauria-Pires, 2010; Polk et al., 2007). Four different adult ICUs were selected to reflect a range of clinical activity, patient compromise and antimicrobial prescribing practices.

The multidrug-resistant organisms of concern in this surveillance are multidrug-resistant *P. aeruginosa* and multidrug-resistant *K. pneumonia*e because (1) Gram-negative pathogens are becoming more resistant to current antimicrobial therapies (Bennett & Brachman, 1998) (2) *P. aeruginosa* and *K. pneumonia* are leading causes of healthcare associated bloodstream infections (El Amari, Chamot, Auckenthaler, Pechere, & Van Delden, 2001). The problem with *P. aeruginosa* organism is that it does not only have intrinsic resistance to many antimicrobial agents but it is also highly capable to develop new resistance mechanisms (Kato et al., 2001; Pena et al., 2009). The incidence of infections with multidrug-resistant *P. aeruginosa* in acute care settings is increasing at a worrying rate (das Neves, de Lorenzo, Almeida, & Fortaleza, 2010). *K. pneumoniae* is one of the most frequent bacterial infections in ICUs, and multidrug-resistant *K. pneumonia* is a serious therapeutic and epidemiological problem in ICUs (Sekowska et al., 2010). Multidrug-resistant *K. pneumoniae* poses a considerable health concern and interventions to prevent its emergence are crucial (Patterson et al., 2000). These pathogens not only resist most β-lactam antimicrobial agents via the production of extended-spectrum β-lactamase (ESBL) or AmpC-type β-lactamase, but their resistance to β-lactams is also often associated with resistance to aminoglycosides, trimethoprim-sulfamethoxazole, and fluoroquinolones (Patterson et al., 2000). In addition, many reports indicated that Gram-negative organisms, especially *P. aeruginosa* and *K. pneumonia*, contributed to the development of hospital acquired infections in KAMC-Riyadh more than reported by the National Healthcare Safety Network (NHSN) (Al-Dorzi et al., 2010; Balkhy et al., 2010; El-Saed et al., 2011). Moreover, the antibiograms in KAMC-Riyadh shows that resistant to both organisms is very high (El-Saed, 2011).

In KAMC-Riyadh surveillance, the choice of antimicrobial agents was made by their importance in the treatment of infections caused by Gram-negative organisms. In addition, only antimicrobial agents for systemic use were included to ensure that any prescribed amount from the pharmacy was almost administered in the ICUs.

Between May, 2010 and December, 2010, the results indicate that the patterns of antimicrobial consumption of the ten selected agents in the four ICUs were not uniform. Nevertheless, the most consumed antimicrobial agents in the four ICUs were similar. The data showed that the most consumed agents in the selected ICUs are broad-spectrum antimicrobial agents such as meropenem and piperacillin-tazobactam. Some significant correlations between the consumption of some antimicrobial agents and the incidence of multidrug-resistant organisms were demonstrated.

In KAMC-Riyadh, ceftazidime, ciprofloxacin, imipenem, meropenem and piperacillin-tazobactam are restricted antimicrobial agents (Qahtani, 2011). The approval of an infectious disease consultant is required to get these agents prescribed by physicians. However, except for imipenem, prescriptions for these agents were higher compared to the other observed antimicrobial agents. Except for the cardiovascular ICU, meropenem was the most consumed agent in the ICUs under surveillance. Meropenem accounted for more than 50% of all DDDs in the burn ICU, the medical surgical ICU, and the neurosurgical ICU. Piperacillin-tazobactam was the second most consumed agent except in the cardiovascular ICU where it was the most consumed antimicrobial agent out of the ten selected agents. Piperacillin-tazobactam

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accounted for more than 40% of all DDDs in the cardiovascular ICU. Among cephalosporins, cefotaxime and cefepime were not commonly prescribed in the four studied ICUs.

Ceftazidime was ranked as the third most consumed agent in the cardiovascular ICU, but its consumption was not common in the other ICUs. The possible toxicity and the necessity for measuring serum concentrations of aminoglycosides could explain the minimal aminoglycoside consumption in the four studied ICUs. Total aminoglycoside consumption was mainly due to gentamicin consumption. Amikacin was not prescribed in either the cardiovascular ICU or the neurosurgical ICU. Among fluoroquinolones, the preference towards prescribing ciprofloxacin over moxifloxacin was obvious in all ICUs analyzed. Although not appropriately studied, the general patterns of consumption and the extensive consumption of meropenem and piperacillin-tazobactam imply that no attempt was made to formally assess the appropriateness of antimicrobial prescribing patterns, and antimicrobial consumption did not appear to correspond to the bacteria isolated from patients with infections. Erbay et al. (2005) reported that antimicrobial consumption in a tertiary care hospital was inappropriate for 47.3% of antimicrobial agents, most obviously in surgical ICUs. The mean length of stay in the studied ICUs was different and ranged from 5.4 days to 13.6 days. As recommended by Kuster et al. (2008), KAMC-Riyadh study reported the rate of antimicrobial consumption in two formats. The DDD per 100 bed-days and DDD per 100 admissions. The DDD per 100 bed-days format may adjust for different patient-stays in different areas. Expressing the antimicrobial consumption as DDD per 100 admissions is more likely to correct for extreme values in areas with long patient-stay times. For example, the medical surgical ICU had the highest total consumption of the ten antimicrobial agents selected for this surveillance when the consumption was expressed as DDD per 100 bed-days but not when it was expressed as DDD per 100 admissions. Expressing the consumption using the admissions data as the denominator resulted in the burn ICU having the highest total consumption rate. This result may be due to the long mean length of stay in the burn ICU. However, the DDD per 100 admissions is more likely to correlate with the incidence of bacterial resistance (Kuster et al., 2008).

The aggregate data on consumption rates of amikacin, ceftazidime, and imipenem in the medical surgical ICU at KAMC-Riyadh showed lower consumption rates than reported by das Neves et al. (2010) in two medical surgical ICUs (medical surgical ICU # 1 and medical surgical ICU # 2). The rate of consumption of ciprofloxacin in medical surgical ICU at KAMC-Riyadh was 9.1 DDD per 100 bed-days, whereas das Neves et al. (2010) reported 3.4 DDD per 100 bed-days in medical surgical ICU # 1 and 11.3 DDD per 100 bed-days in medical surgical ICU # 2. However, the version of the WHO Guidelines for ATC classification and DDD Assignment used in das Neves et al. (2010) study was not clearly mentioned. As different versions of the "WHO Guidelines for ATC classification and DDD assignment" may assign different DDD values, it is important to know which versions were used for proper comparisons between studies. Comparing antimicrobial consumption (in DDD / 100 bed-days) in the medical surgical ICU at KAMC-Riyadh with that at Hospital de Clinicas de Porto Alegre, Jacoby et al. (2010) reported 91.6 DDD / 100 bed-days, while KAMC-Riyadh surveillance had 84.8 DDD / 100 bed-days. However, the antimicrobial agents under study were not similar to the ones in the KAMC-Riyadh surveillance. In KAMC-Riyadh surveillance, carbapenem (imipenem and meropenem) consumption rates (in DDD / 100 bed-days) in the medical surgical ICU and the neurological ICU were shown to be 12 times (46 versus 3.8) and more than 13 times (42 versus 3.1) the consumption reported from the National Nosocomial Infections Surveillance system in medical surgical ICU and neurosurgical ICU respectively (NNIS. National Nosocomial Infections Surveillance (NNIS) System Report, 2004). However, the following issues should be considered: (a) the National Nosocomial Infections Surveillance data were from 61

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medical surgical ICU and 11 neurosurgical ICU, (b) they used the 2004 WHO DDD values whereas KAMC-Riyadh surveillance used the 2011 version of the "WHO guidelines for ATC classification and DDD assignment" (unfortunately, being unable to find the WHO-assigned DDD 2004 version, no comparison was done to verify if its DDDs are similar to the 2011 version), (c) the time of the study should be considered as the pattern of antimicrobial consumption changes with time.

In 2004, carbapenems were relatively new medications when compared to 2010. Moreover, bacterial susceptibility in 2010 is not as it was in 2004. This difference in the rate of consumption may be because of bacterial resistance to other agents were less and thus there was no need for prescribing carbapenems. The previously mentioned carbapenem consumption rate in the medical surgical ICU (46 DDD / 100 bed-days) in KAMC-Riyadh surveillance was much more higher than the three rates reported by dos Santos and Lauria-Pires (2010) in three medical surgical ICUs at three different hospitals (HSL = 17.5; HRC = 25; HRT = 25.7) using the 2005 version. However, the consumption rate (DDD / 100 bed-days) of cephalosporins was higher in the three ICUs (HSL = 21.9; HRC = 43.5; HRT = 26.4) than in the medical surgical ICU (2 DDD / 100 bed-days) at KAMC-Riyadh. But in KAMC-Riyadh surveillance, cephalosporins included cefotaxime, ceftazidime, and cefepime whereas their cephalosporins included ceftriaxone, ceftazidime, and cefepime (unfortunately, being unable to find the WHO-assigned DDD 2005 version, no comparison was done to verify if its DDDs are similar to the 2011 version). The medical surgical ICU in KAMC-Riyadh surveillance had approximately three times the use of meropenem (43.2 versus 14 DDD / 100 bed-days) and around three times the use of carbapenems (46 versus 15.5 DDD / 100 bed-days) than reported by dos Santos et al. (2007) in their medical surgical ICU. But in their study, dos Santos et al. (2007) did not state if ertapenem, imipenem, or both were added along with meropenem. The medical surgical ICU at KAMC-Riyadh administered fewer amount of ciprofloxacin (9.1 versus 13 DDD / 100 bed-days) and aminoglycosides consumption in KAMC-Riyadh unit was less by more than three times (2.5 versus 9.5 DDD / 100 bed-days). Again, KAMC-Riyadh surveillance studied only amikacin and gentamicin but it was not clear which agents were analyzed in the study done by dos Santos et al. (2007). In KAMC-Riyadh surveillance, pooled means of ciprofloxacin consumption rates (6.7 DDD / 100 bed-days) and imipenem (1.8 DDD / 100 bed-days) in the four adult ICUs were lower than what reported by Meyer et al. (2004b) (10.4 and 4.9, respectively) in 35 different ICUs (10 medical, 11 surgical, and 14 interdisciplinary). However, the pooled means of carbapenems (imipenem and meropenem) consumption rate in KAMC-Riyadh surveillance was four times higher (35 versus 8.4 DDD / 100 bed-days). According to Meyer et al. (2004b) the German SARI ICUs had higher carbapenems (imipenem and meropenem) consumption than the US American ICARE/AUR (Antimicrobial Use and Resistance) ICUs. In KAMC-Riyadh surveillance, it has been demonstrated that a medical surgical ICU in a Saudi hospital administered larger quantities of carbapenems than ICUs in other countries. Differences in the versions of the "WHO guidelines for ATC classification and DDD assignment" and not reporting the type of the ICUs that were included or the list of antimicrobial agents, hinder more consistent comparisons. However, such comparisons are useful for the establishment of initial parameters. The striking differences in antimicrobial prescribing practices in different countries underline the need for improving the quality of antimicrobial prescribing.

In KAMC-Riyadh surveillance, the incidence of infections with multidrug-resistant Gram-negative organism in the medical surgical unit was higher than the incidence of such infections in the neurosurgical and cardiovascular ICU. This high incidence correlated with higher antimicrobial consumption in the medical surgical ICU than in the other two ICUs. This shows that high antimicrobial consumption in a single unit may promote resistance. During the surveillance period, the incidence of infections

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with multidrug-resistant *K. pneumonia*e was higher than that for multidrug-resistant *P. aeruginosa,* and this was mostly constant over time. The general incidence of infections with multidrug-resistant *P. aeruginosa* (0.17 positive cultures per 100 bed-days) was higher than that reported by das Neves et al. (2010) (0.048 positive culture per 100 bed-days), although KAMC-Riyadh surveillance included only four ICUs, while das Neves et al. (2010) study included 18 different hospital units. As already stated, das Neves et al. (2010) study included two medical surgical ICUs: medical surgical ICU # 1 and medical surgical ICU # 2, with incidences of multidrug-resistant *P. aeruginosa* infections of 0.18 per 100 bed-days and 0.24 per 100 bed days, respectively. The incidence of infections with the same pathogen in the medical surgical ICU at KAMC-Riyadh was similar (0.26 per 100 bed-days) to what was reported by das Neves et al. (2010).

Higher rates of infections with multidrug-resistant organism are linked to the extensive consumption of antimicrobial agents, both in prophylaxis and in therapy (Bassetti et al., 2000). In KAMC-Riyadh surveillance, and among the ICUs, the consumption rates of some antimicrobial agents significantly correlated with the incidence of infections with multidrug-resistant *P. aeruginosa* and multidrug-resistant *K. pneumonia*. For example, there was a significant positive correlation between the rate of consumption of imipenem and the incidence of infections with multidrug-resistant *K. pneumonia* resistant to imipenem. A significant negative correlation was obtained between the gentamicin consumption rate and the incidence of infections with multidrug-resistant *K. pneumonia*e. However, the correlation between the consumption rates of other agents and the incidence of infections with multidrug-resistant *P. aeruginosa* and *K. pneumoniae* resistant to those agents were not statistically significant. For example, the rate of consumption of imipenem was positively correlated with the incidence of infections with multidrug-resistant *P. aeruginosa* resistant to imipenem but this correlation was not statistically significant. Hsueh et al. (2005) found a significant positive association between the consumption of carbapenems (imipenem and meropenem) and the incidence of infections with multidrug-resistant *P. aeruginosa* in the hospital, particularly in ICUs. das Neves et al. (2010) reported a significant positive correlation between the consumption rate of imipenem among 18 hospital units for adult patients and infections with multidrug-resistant *P. aeruginosa* ($r = 0.87$, $p < .001$). The analysis of KAMC-Riyadh surveillance showed negative correlations between the rate of consumption of ciprofloxacin and the incidence of infections with multidrug-resistant *P. aeruginosa* resistant to ciprofloxacin ($r_s = -0.48$, $p = 0.233$). das Neves et al. (2010) reported a significant positive correlation between the ciprofloxacin consumption rate and the incidence of infections with multidrug-resistant *P. aeruginosa* ($r = 0.71$, $p = 0.001$). However, the routines for performing culture and the definition of multidrug-resistant organisms were not similar in the two studies. Moreover, there could be some differences in the breakpoints between the methods that may have contributed to some of the differences in the results. Furthermore, in the correlation analysis of KAMC-Riyadh surveillance, the rate of consumption was expressed as DDD per 100 admissions, whereas das Neves et al. (2010) used DDD per 100 bed-days to express the consumption rate. In addition, the correlation that was found in the analysis of KAMC-Riyadh surveillance was in an individual ICU while the analysis done by das Neves et al. (2010) focused on the overall consumption and resistance within the 18 hospital units studied.

Jacoby et al. (2010) reported no correlation between fluoroquinolones consumption and multidrug-resistance *Pseudomonas* spp. However, their expression of antimicrobial consumption in the correlation analysis was not consistent. Sometimes they express it as DDD per 100 bed-days and sometimes as DDD only. The matched case-control study performed by Paramythiotou et al. (2004) showed that the length of ciprofloxacin therapy was an independent risk factor for infections with multidrug-resistant *P.*

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aeruginosa resistant to ciprofloxacin in ICU patients. However, their definition of multidrug-resistant *P. aeruginosa* was not the same as the definition used in KAMC-Riyadh surveillance. Previous exposure to ciprofloxacin was not associated with an increased risk of resistance to ciprofloxacin in the case-control study conducted by El Amari et al. (2001) which aimed to determine whether recent exposure to antimicrobial agents was associated with an increased risk of bacterial resistance toward these drugs. However, Fortaleza, Freire, Filho, & de Carvalho (2006) stated that case-control studies that investigate risk factors for bacterial resistance have major methodological problems, and the effect of antimicrobial consumption could be confounded by individual patient characteristics or length of hospitalization. Jacoby et al. (2010) was able to find significant correlations only when they performed correlation analysis on multidrug-resistant organisms in ICU and antimicrobial consumption at the hospital level. But they did not find similar correlations after considering antimicrobial consumption at the ICU level. Data from ICARE revealed that heavy antimicrobial consumption was not always correlated with high prevalence of bacterial resistance (Cristino, 1999). In addition, the relationship between antimicrobial consumption and bacterial resistance may vary even within the same antimicrobial class (MacAdam, Zaoutis, Gasink, Bilker, & Lautenbach, 2006). Therefore, studies that examined the relationship between antimicrobial consumption and bacterial resistance have shown variable positive and negative correlations. Some studies obtained significant correlations, while other found no correlation. These variations in the reported correlations coincide with the point that the relationship between antimicrobial consumption volumes and the development of bacterial resistance is complex and not a simple correlation (Barbosa & Levy, 2000; Burke & Pestotnik, 1999; Iosifidis et al., 2008; Meyer et al., 2006; WHO, World Health Organization, 2001), although there is a substantial body of evidence considers the total antimicrobial consumption as the main driver in selecting resistance (WHO-World Health Organization, 2001). Difficulties in quantifying antimicrobial exposure and methodological variations among studies have led to different conclusions (Iosifidis et al., 2008; Wenzel, 2003). Furthermore, there are several interacting factors other than antimicrobial consumption that determine the dynamic development of bacterial resistance to antimicrobial therapy and may account for changes in the epidemiological behavior of the organisms and may have confounded the results of KAMC-Riyadh surveillance and other research on the correlation between consumption and resistance. For example, the transfer of patients within and among medical institutions, infection control measures, the level of bacterial resistance in the community, antimicrobial residues in the environment (Iosifidis et al., 2008; Levy, 2002) different bacterial resistance mechanisms among different geographical areas, the patterns of antimicrobial prescription in these areas (Fortaleza et al., 2006) and other poorly explored factors (WHO-World Health Organization, 2001). Age is another factor that can confound the results of observational studies examining the relationship between antimicrobial consumption and bacterial resistance (Lipsitch, 2001).

Failure to control for confounders, study biases, and lack of uniformity in susceptibility testing and in defining bacterial resistance may contribute to the inability of reporting interdependence (Hsu et al., 2010). In addition, the following are likely to have exerted some influence over the results of KAMC-Riyadh surveillance and may explain why some of the obtained correlations in this surveillance were not significant: (a) the characteristics of the studied ICUs, (b) the antimicrobial restriction and infection control policies, (c) previously existing infections acquired in the community, (d) the ability to buy antimicrobial agents without a prescription in Saudi Arabia, and (c) results could be affected by the short duration of the study. The ability to buy antimicrobial agents without a prescription may contribute to inappropriate consumption of these agents, thereby leading to the emergence of bacterial resistance.

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According to Gulbinovic et al. (2001), the consumption of antimicrobial agents in the outpatient setting have influence on bacterial resistance more than the influence that is exerted by the consumption of these agents in the hospital. Regarding the duration of the study, longer surveillance period is needed to allow for seasonal variations and more incidences of infections with multidrug-resistant organisms that yield meaningful statistics and facilitate proper analysis of the data. Studying the correlations between antimicrobial consumption rates and incidence of multidrug-resistant *P. aeruginosa* or *K. pneumonia* could not be performed in some of the selected ICUs in KAMC-Riyadh surveillance because of lots of zeros in the microbial resistance data. For example, the correlation between consumption rate of ciprofloxacin and incidence of infections with multidrug-resistant *K. pneumonia* resistant to ciprofloxacin was not examined in the cardiovascular ICU (Table 3).

Another example was from the burn ICU where the correlation between consumption rate of piperacillin-tazobactam and incidence of infections with multidrug-resistant *P. aeruginosa* resistant to piperacillin-tazobactam was not analyzed (Table 4).

Because there are many possible interacting factors that determine the dynamic development of bacterial resistance to antimicrobial therapy and because of several confounding factors that may affect the emergence of multidrug-resistant organisms, it is not easy to establish relationship between antimicrobial consumption and antimicrobial resistance. Therefore, finding a correlation signifies that it is almost certainly of major importance and indicates that controlling the antimicrobial consumption will affect the emergence of antimicrobial resistance (Livesey & Chiew, 2006). Studies that evaluate the link between the consumption of antimicrobial agents and the emergence of bacterial resistance in microorganisms should be performed using similar methodological approaches and standards in several settings (Fortaleza et al., 2006) for the corroboration of findings. For example, studies should differentiate between infections and colonization and between hospital-acquired and community-acquired infections.

The research that was performed in KAMC-Riyadh has several limitations, including the small number of studied units and the short duration of the study (8 months). The consumption of antimicrobial agents could have been quantified by other measurement units (e.g., day of therapy) that may have some advantages over the DDD methodology (Polk et al., 2007), however, the DDD methodology is recom-

Table 3. Consumption rate of ciprofloxacin (DDD/100 admissions) and incidence of infections with multidrug-resistant K. pneumonia resistant to ciprofloxacin (per 100 admissions) between May 2010 and December 2010 in the cardiovascular ICU at KAMC-Riyadh

Month	Consumption Rate of Ciprofloxacin	Incidence of Infections with Multidrug-Resistant *K.* Pneumonia Resistant to Ciprofloxacin (per 100 Admissions)
May	0	0
June	0	0
July	0	4
August	32.5	0
September	0	0
October	0	0
November	46.5	0
December	0	0

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Table 4. Consumption rate of piperacillin-tazobactam (DDD/100 admissions) and incidence of infections with multidrug-resistant P. aeruginosa resistant to piperacillin-tazobactam (per 100 admissions) between May 2010 and December 2010 in the burn ICU at KAMC-Riyadh

Month	Consumption Rate of Piperacillin-Tazobactam	Incidence of Infections with Multidrug-Resistant *P. Aeruginosa* Resistant to Piperacillin-Tazobactam
May	79	0
June	184.8	7.69
July	129.2	0
August	0	0
September	297.1	0
October	249.7	7.7
November	593	0
December	1435.7	0

mended by the WHO and many other organizations, it is applied all over the world, and investigators in this field are well aware of any potential limitations. The data for the correlation between antimicrobial consumption and incidence of infections with multidrug-resistant organisms were collected at one medical center, and the ICUs were chosen by convenience and may not reflect situations in other hospitals. Another limitation is that in some of the ICUs, and because of the short duration, a relatively limited number of multidrug-resistant Gram-negative organisms were recovered therefore data from such ICUs were not analyzed for correlation. To study the extent and patterns of antimicrobial consumption and their relationship with bacterial resistance, consumption and resistance data must be obtained over a sufficient period of time to account for seasonal variations and to have meaningful statistics by having both reasonable consumption data and more number of bacterial isolates. Furthermore, KAMC-Riyadh surveillance included most but not all of the antimicrobial agents that are used in the ICUs. For example, the surveillance did not include vancomycin which aids the spread of multidrug-resistant *P. aeruginosa* even though it is not active against *P. aeruginosa* (das Neves et al., 2010). In addition, and because only aggregated pharmacy data were available at KAMC-Riyadh, the antimicrobial consumption rates and bacterial resistance data were aggregate data and could not be related to patient and disease; thus, no inference of the distribution of exposure and effects could be made with respect to the individual patient (ecological fallacy). Therefore, the correlations between the consumption of antimicrobial agents and the incidence of multidrug-resistant organisms should be interpreted with caution. The ecologic nature of KAMC-Riyadh surveillance has its disadvantages. This study and similar studies, only suggest potential correlations. Thus a cause and effect relationship between the rate of antimicrobial consumption and the incidence of multidrug-resistant Gram-negative organisms cannot be concluded. Establishing an etiologic relationship may require other research methodology. However, ecological fallacy does not invalidate the analysis of aggregate data, and ecologic studies suggest links between antimicrobial consumption and bacterial resistance and may identify relationships that are missed in individual base studies (das Neves et al., 2010; Iosifidis et al., 2008). das Neves et al. (2010) explained that there is a sound argument for conducting ecological studies on this topic because several factors contribute to the spread of multidrug-resistant organisms.

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According to Gould and Van der Meer (2005), many studies used aggregated antimicrobial consumption and resistance data. In addition, to counteract the increasing rates of resistance in bacteria, many organizations have recommended that aggregate data on the consumption of antimicrobial agents at the local and national levels should be measured and analyzed together with bacterial resistance data to develop strategies that aim at appropriate consumption of antimicrobial agents (Hsueh et al., 2005; Jacoby et al., 2010; Polk et al., 2007; Ruef, 2006). Unevaluated confounders such as inappropriate dosages, different case-mixes, and prevalence of cross-transmission may have affected the results. Unfortunately, KAMC-Riyadh surveillance could not distinguish between community- and hospital-acquired infections due to the unavailability of data. Data on patient severity or invasive procedures were not available and should have been added in the analysis, but this was beyond the scope of KAMC-Riyadh surveillance. Finally, differences in indications for performing cultures and time between admission and culture were unknown.

In linking the consumption of antimicrobials in hospitals to resistance in these settings, there are several areas for further refinement of the data such as the exclusion of prophylactic consumption from the antimicrobial consumption data and community-acquired infections from the antimicrobial resistance data. Unfortunately, because of the unavailability of data, these exclusions were not possible in the current KAMC-Riyadh surveillance. Also, data collection should be extended for a longer period of time. The influence of antimicrobial consumption on bacterial resistance to other agents also needs to be explored. Cost-effectiveness analyses of antimicrobial consumption that include the cost of bacterial resistance should be performed. In addition, the analysis could be refined by applying time-series analysis and the autoregressive integrated moving average (ARIMA). This way of analysis offers advantages over correlation analysis or simple liner regression (Bosso & Mauldin, 2006). With this type of analysis, we can model the relationships between antimicrobial consumption and bacterial resistance and reveal temporal relationships. According to Lopez-Lozano et al. (Lopez-Lozano et al., 2000), this analysis allows researchers to (1) "quantify the fraction of the resistance series explained by the past behavior of both the resistance and use series"(2) estimate the delay that exists between variations in antimicrobial consumption and subsequent variations in bacterial resistance, and (3) quantify the effect of antimicrobial consumption on the percentage of bacterial resistance. This type of analysis was not performed in KAMC-Riyadh surveillance because of its short duration and limited data points. According to Monnet et al. (2001), investigating the relationships between antimicrobial consumption and bacterial resistance by time-series analysis requires a minimum of 60 observations or time intervals or approximately 15 years of trimester-level data, 5 years of monthly data or about 1 year of weekly data.

KAMC-Riyadh surveillance emphasized on the importance of assessing the consumption of antimicrobial agents in the hospitals especially in the ICUs in order to improve the quality of antimicrobial prescribing and investigate the correlation between antimicrobial consumption and bacterial resistance to counteract the upward trend in bacterial resistance. Monitoring trends of antimicrobial consumption and providing data on bacterial resistance patterns are recommended to both explore any link between antimicrobial consumption and incidence of bacterial resistance and to recognize areas with heavy antimicrobial consumption. These studies can then provide feedback to clinicians and practitioners in order to develop interventions to control the high expenditure on such expensive medications and establish a national surveillance system. This surveillance is an important way to solve local problems of antimicrobial prescribing and counteract bacterial resistance. As previously mentioned, both have global consequences. Further on-going surveillance studies will follow trends in antimicrobial consumption and help in identifying changes in bacterial resistance.

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FUTURE RESEARCH DIRECTIONS

The discovery of antimicrobial agents was ranked second among the "greatest medical advances since 1840. (Hsu et al., 2008)" However, increasing bacterial resistance and the slowing of the development of new antimicrobial agents have weakened the clinical usefulness of antimicrobial agents (Hsu et al., 2008).

The emergence of antimicrobial resistance and multidrug-resistant bacteria are major determinant factors for morbidity, mortality and costs in hospitals, and the increasing rate of bacterial resistance is becoming a major worldwide public health concern that necessitates international approaches. To reverse the emergence of bacterial resistance, according to Levy (2002), the focus should be on one factor at a time instead of switching from one issue to another so as not to aggravate the overwhelming nature of the resistance problem. The seriousness of bacterial resistance, the importance of appropriate antimicrobial therapy, and the fact that there is a decrease in the development of new antimicrobial classes should be stressed in more detail in the curriculum of medical schools (e.g., colleges of medicine, pharmacy, nursing, public health). More information should be gathered about the perceptions of healthcare providers on antimicrobial therapy and the impact of the pharmaceutical companies on clinicians for prescribing expensive antimicrobial agents. Ongoing education of hospital staff regarding the use of broad-spectrum antimicrobial agents is needed. Healthcare providers, hospital administrators, and policy makers should be aware of the antimicrobial resistance problem and how multidrug-resistant organisms increase the mortality and morbidity and waste healthcare money. They should also be aware that as more antimicrobial agents are consumed, the bacterial resistance problem becomes lager; thus, improving the consumption also improves patient outcomes, reduces antimicrobial resistance, and decreases the overall cost (CDC - Why Inpatient Stewardship? - Get Smart for Healthcare, 2010). Hospital polices should mandate infectious disease consultation prior to the prescription of antimicrobial agents and 3-5 days subsequently, after obtaining laboratory results and/or clinical changes that could influence the treatment. Prescribing any of the broad-spectrum agents without obtaining approval should be abandoned to control the high cost of such agents and the incidence of multidrug-resistant organisms. Clinicians should consider cycling antimicrobial agents, especially when new ones are available for clinical use. This approach, and especially in the ICUs, has been seen as one way to control bacterial resistance (Furtado et al., 2008). Traditional infection control measures alone are likely insufficient to prevent the emergence of multidrug-resistant Gram-negative organisms.

Antimicrobial selection and antimicrobial pressure are important factors in the prevention of such pathogens (Patterson et al., 2000). Combining the two approaches is important for preventing the occurrence of multidrug-resistant organisms, but according to some studies, controlling antimicrobial consumption is the most important intervention (Patterson et al., 2000). However, especially in the ICUs, infection control procedures should be enforced. Health professionals must be advised to wash their hands between patient visits to reduce the spread of infection and, thus reduce the need for antimicrobial agents. The active involvement of pharmacy, infection control, and microbiology personnel should be implemented in an attempt to improve the appropriateness of antimicrobial choice. Both the total amount of antimicrobial agent consumed and how it is consumed are critical, and inappropriate consumption of antimicrobials through unnecessary therapy, inadequate dosing, poor adherence, poor drug choice and sub-standard antimicrobial agents may have as important a role in increasing resistance as overconsumption (Gulbinovic et al., 2001; WHO-World Health Organization, 2001). The Saudi Ministry of Health should mandate collecting and reporting antimicrobial consumption trends across Saudi Arabia. Because the antimicrobial stewardship programs have proven to improve patient outcomes, reduce bacte-

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rial resistance, and decrease hospital expenditures (CDC - Why Inpatient Stewardship? - Get Smart for Healthcare, 2010), the Saudi Ministry of Health should enforce each healthcare facility to implement an antimicrobial surveillance and antimicrobial stewardship program to monitor and assess prescribing trends and bacterial resistance rates. Likewise, healthcare providers, hospital administrators, policy makers should work on implementing and actively support antimicrobial surveillance and antimicrobial stewardship programs. The consumption of antimicrobial agents in the community may contribute to the emergence and spread of bacterial resistance in hospitals (MacDougall, Powell, Johnson, Edmond, & Polk, 2005). Therefore, the Saudi Ministry of Health should also consider regulating antimicrobial consumption in the community and these agents should be regulated by legislation to require a prescription before they can be obtained and should not be available as over the counter medications. Finally, pharmaceutical industries should be encouraged to develop new antimicrobial agents with new targets that block the mechanisms of resistance.

WAY FORWARD AND RECOMMENDATION

Obtaining antimicrobial consumption data using the DDD methodology in the Saudi hospitals is possible and recommended, especially for ICU settings. A standardized approach is required in order to allow meaningful comparisons of antimicrobial consumption at the local, national, and international levels. The analysis of antimicrobial consumption data in terms of DDDs is useful for antimicrobial surveillance studies, aids in the implementation of antimicrobial stewardship programs and can explore the relationships between antimicrobial consumption and bacterial resistance patterns. An expanded hospital antimicrobial agent consumption database is necessary for adequate planning. Understanding the link between antimicrobial consumption and bacterial antimicrobial resistance is an essential step towards optimizing antimicrobial prescription policies and counteracting the problems of bacterial resistance.

Hopefully, clinicians and other health-professionals will consider the consequences of prescribing antimicrobial agents on the emergence of bacterial resistance. A cross-country comparison of the antimicrobial prescribing patterns and the incidence of resistance from patients in ICUs are necessary. It is important for more data to become available on antimicrobial consumption and bacterial resistance from communities, hospitals (outpatient and inpatient) and other medical centers in the region to achieve the benefit of making the correlations, identifying useful interventions, and benchmarking. Although Burke (1995) wrote, “Despite the multifactorial nature of antibiotic resistance the central issue remains quite simple: the more you use it, the faster you lose it”, we believe that further studies are required to consider the role of factors other than antimicrobial consumption (e.g., adherence to guidelines for doses and duration of antimicrobial therapy, infection control practices, utilization of invasive devices and procedures, poor quality of available antimicrobial agents, and patient compliance) in predicting resistance to antimicrobial therapy.

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KEY TERMS AND DEFINITIONS

Anatomical Therapeutic Chemical Classification (ATC): A system that classifies the drugs according to the organ or organ system they act on and according to the pharmacological and therapeutic properties of the drugs.

Antimicrobial Therapy: Therapy that aims to control infections by altering metabolic processes in bacterial cells without harming the patient.

Bacteria: Prokaryotic microorganisms that lack a membrane-bound nucleus or any other membrane-bound organelles.

Bacterial Resistance: A natural biological phenomenon that may develop to any antimicrobial agent allowing the bacteria to survive and multiply in the presence of the antimicrobial agent even in concentrations much higher than therapeutic concentrations used clinically.

Defined Daily Dose (DDD): A unit of measurement that expresses drug consumption.

Intensive Care Units: Units that care for critically ill patients through intensive observation, diagnosis, and therapeutic procedures.

Surveillance of Antimicrobial Use: Measuring antimicrobial consumption patterns that provide valuable data to develop policies to control the consumption of antimicrobial agents, increase treatment quality, decrease the risk of bacterial resistance, and cut unnecessary treatment and hospital expenditures.

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Chapter 9
Genomics Applications in Public Health

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ABSTRACT

In the transformation of health, through genomics applications in public health, many of the disease burdens which were incriminated for low life expectancies are being scientifically challenged. However, efficient environmental sanitation played a major role in the eradication of hitherto life threatening vector-borne diseases. However, the outbreaks of emerging infectious diseases and chronic and degenerative conditions pose new challenges. Dr. Zerhouni, the former director of the National Institutes of Health meticulously identified the aging phenomenon. Health disparities and emerging and re-emerging infectious diseases and emerging non-communicable (obesity) as the precursors new health problems which demand innovative strategies. He has suggested, as key of the components of the future paradigm, the four Ps which comprise predictive, personalized, preemptive and, participatory techniques to combat national and international public health challenges. This innovative approached is currently being utilized to preempt the onset of many chronic and degenerative diseases.

INTRODUCTION

Having read this chapter, the learner should be able to:

- Provide a conceptual framework for innovations, and capacity building in genomic technology
- Assess existing infrastructures for genomic technology
- Assess the background of genomic workforce
- Specify genomic applications with reference to genetic diseases, and
- Develop logic model to integrate genomics into public health centers.
- Discuss the genomic characteristics of BRCA1 and BRCA2 mutations
- Advocate the adoption of the Health Belief Model for the dissemination of health education worldwide to prevent the onset of breast cancer in women

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- Access pertinent sources of health information about breast cancer and assistance for at-risk patients in developed and developing nations
- Emphasize the importance of health education of the public using female humanitarian with high international profile to mitigate the impact of breast cancer
- Accentuate the impact of precision (P4) medicine in preventing and managing the lethal consequences of breast cancer

GENOMIC APPLICATIONS IN PUBLIC HEALTH

Based on epidemiological trends and scientific clinical observations, genomics is bound to play significant role in public health. Genomics as the study of the entire human genome is poised to have numerous role not only on public health but create the incipient stage of scientific revolution which is about to improve clinical medicine while as well accentuate the relevant of preventive disciplines and behavioral interventions in the clinical management of the health problems of healthcare consumers worldwide. Genomics is a branch of biological science which focuses on the development and application of very effective mapping, sequencing and bioinformatics computational techniques. Scientists trained in genomics and other molecular biologists apply large-scale molecular techniques for linkage analysis, physical mapping, and sequencing of genomes to generate detailed data which are subjected to analysis using high-speed computer facility.

The new international tools of genomics include the high-throughput deoxyribonucleic acid (DNA) sequences, genotyping machines and large-scale DNA arrays (DNA chips). These scientific tools have the capacity to analyze thousands of genes promptly and accurately. These devices can be used to study the cells of virtually all living organisms. To reiterate a typical genome is the entire collection of chromosomes which are present in the nucleus of each cell of an individual organism.

In nations where there are adequate technological resources, genomic science continues to revolutionize public health as we move into the 21stcentury. As a result of the numerous milestone accomplished in sequencing the human genome, public health career is steadily becoming a pre-eminent preventive medicine discipline. Evidenced-based public health activities are now obvious in neonatal screening for genetic, chronic and degenerative diseases. Besides, genomics now plays significant impact in environmental health in enabling scientists to identify microbial agents which can be applied to identify microbial agents for carbon dioxide sequestration which is a predominant greenhouse gas. Two decades into the 21stcentury, the highly industrialized nations are now able to comprehensively utilized the anticipated benefits of genomics in molecular medicine, microbial genomics, risk assessment, bioarcheology, anthropology, evolution, and human migration. Innovative DNA identification process are now being retroactively applied to free incarcerated prisoner who were present in heinous crime scenes but had nothing to do with specific crimes. Genomics technologies are now being applied to revolutionize agriculture, livestock breeding and bioprocessing

We must reiterate that the completion of the human genome sequencing (HGS)sponsored by the U.S. Department of Energy and the National Institutes of Health (NIH) is comparable to the feat associated with theory of relativity propounded by Albert Einstein in the 20th century. In 1915, Einstein completed his general theory of relativity, a theory of gravity which demonstrates more precision than that of Sir Isaac Newton. Besides, Einstein also illustrated that photoelectric effects involving ejection of electrons from metal by action of light can be explained, if light has particle nature as well as wave characteris-

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tics. These discoveries have many and varied implications in engineering, physics, electronics and our understanding of the global planetary systems (Einstein, 2000). However, the contrast with the human genomic sequencing involved the individual feat of Einstein whereas in genomics, the main collaborative group includes scientists at the NIH, the U.S. Department of Energy, and numerous scientists from the European Union, Japan, and China. This scientific team is now described as the International Human Genome Sequencing Consortium (IHGSC).Seven years span, post-completion of the human genome project, biology not only assumed the status of a pre-eminent science, but in the industrialized nations, genomic technology canters emerged, commercialization of genomic-oriented medical establishments was developed, and biotechnological enterprises flourished. They were developed to focus on the domestic health needs and environmental challenges of these nations. Inadvertently less emphasis was placed on the endemic diseases and teethingeconomic problems of the developing nations. Against this background, the study described here, was designed to: compile technological centers and anticipated benefits of genomics which are required to meet the needs of developed nations, characterize the imminent technological set-backs in developing nations in the age of innovative genomic science, explore the impact ofinadequate access to Internet and associated communications network as the underlying factors which exacerbate poverty, ignorance, and diseases in developing nations, and illustrate the relevance of a seamless linkage among governments, industries, academic institutions, venture capitalists, and enlightened public in developing nations to harness the medical and commercial benefits of genomic science.

Genomic Technologies and Resources

Once the HGS was accomplished by April 2003, new genomic technologies start-up companies were established. These innovative companies include the 454 life sequencers manufactured by Roche Diagnostics (Brandford, CT), chromatography and electrophoresis, gene amplification, capillary analysis, polymerase chain reaction tests, microarray sequencing and isoelectric focusing, high-performance computing equipment, broadband infrastructure, data visualization equipment, biophotonics, robotic equipment, vision science equipment, climate research atmospheric science equipment, and bioprocessing engineering equipment, among others. A comprehensive list of this state-of-the-science technology was reported by Ebomoyi and Srinivasan (2008).

The U.S. Department of Energy (2008), in its microbial genome program emphasized the applications of genomic technologies in molecular medicine, microbial science, risk assessment activities, bio archaeology anthropology, evolution and human migration pattern. Additional applications of genomic resources consist of forensic science, agricultural development especially livestock breeding and bioprocessing.

In order to facilitate the process of data storage, data mining and processing, the U.S. Department of Energy at its Oak Ridge National laboratory recently upgraded a CrayXT5 high-performance computing system by transforming it to the "Jaguar" supercomputer as the world's fastest. This computer is the most powerful computational machine for finding solutions to some of today's intricate and tantalizing problems. This upgrade consumed 19.9 million dollars under the U.S. Recovery Act, 2010 (Tripp &Grueber, 2011).At the NIH, new powerful DNA sequencing technologies were developed; the transformation of genomics from technology to biology-driven science was amplified. By2007, genes responsible for some of the leading causes of death were sequenced and the precursors of 10 most common diseases in the United States were identified in a span of three years. New ways of monitoring personal environmental exposures were scientifically characterized.

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Japan has also established a viable genomic institute; and the government continues to invest colossal sums of money to develop authentic technologies and build competent molecular sciences workforce. Recently, the high-speed large capacity disk array system was installed in one of the nation's genome institutes. This computational machine was developed to handle copious amounts of data and maintain the capacity to save such data. Besides the data backup capability, their new computer has the capacity to protect sensitive research data from unexpected loss. The intrinsic goal of the Japanese human genome center is to contribute to human society through the development of efficient diagnosis of illnesses, prevention and the application of effective therapeutic interventions to meet the needs of the society. Besides, Japan now leads the world in fermentation technologies and is growing plastic car parts from bacteria and plants.

Beijing Genomic Institute (BGI) is one of China's leading research facilities on through put sequencing-based profiling tools; and the institute is committed to excellence in genome sciences. BGI continues to conduct a large-scale genomic research inbioinformatics; genome dynamics and genotyping with over 100 bioinformatics specialists. Research scientists at BGI have focused their investigations on the Human Hap-Map project, the super-hybrid Rice Genome project, silkworm genome, chicken genome variation in collaboration with U.K. and U.S. partners and the Sino-Danish pig Genome project.

Other technologically savvy developing nations such as Brazil, Korea, and India have directed their research interest on their pharmaceutical industry; systematically using genomic science and bioinformatics to develop agriculture, chemicals, bio defense and energy. Brazil now leads the world in bio-fuels and the prevention of citrus diseases. Korea continues to invest in cloning and tissue engineering. As these technological initiatives occur at exponential rate in the developed nations, we continue to observe imminent set-backs in developing nations owing to incessant political crisis and economic hardship.

Innovations in Capacity Building in Genomics Technology

The relevance of innovations in capacity building in genomic technology has become very crucial. This crucial nature arises because of the prohibitive cost of utilizing the sophisticated services associated with HGS, which are the components of personalized, predictive and preventive medical services. The genomic infrastructures are those tools which provide essential services to the international scientific community for basic and applied research. To augment the list summarized in Table1, genomic infrastructures include the 454 life nanotechnologies, libraries, databases, biological archives, scrupulously clean rooms, communication networks, research vessels, satellites and aircraft observation facilities, coastal observatories, telescopes, synchrotrons and accelerators, broadband access and integrated data system among others (United States Department of Energy, 2008; Ebomoyi, 2005).

The recently developed nanotechnology has applications for micro-fabrication and nanofabrication of complex structures from patterning and processing designs which are used to test finished products which include microelectronics to integrated optoelectronics and silicon-based and compound semiconductors (Table 1).

Nanotechnology involves the science and technology that creates or manipulates materials at the nano scale. In genomic and biotechnology industries, nanotechnology exploits novel properties associated with matter in minute size (<100 nm) to produce novel medical and diagnostic products and more effective bio-drugs. Nanomaterials can deliver radioactive compounds for radiotherapy or diagnosis, nanocapsules, magnetic nanoparticles for detoxification use, and nano porous electrode materials for artificial retinal implants among other medical interventions (Borst&Borst, 2008).

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Table 1. Infrastructures for genomics technology

Infrastructures For Genomics Technology	
• Genome Analyzer equipment • High performance computing equipment • Broadband infrastructure/networks equipment (including last 500 metre linkages) • Mass spectrometry equipment. • Data visualization equipment • *Biotech & life sciences* Bioinformatics Animal models of disease equipment (Transgenic/mouse models) • Bioprocessing (NRC) Biomedical imaging equipment • Biophotonics (NRC) Chemical biology equipment • Robotics equipment • Vision science equipment • Climate research Atmospheric science equipment (including invasive species & biodiversity) • Environmental genomics equipment • Toxicology equipment • Bioprocessing engineering equipment • Cellular regulations equipment • Gene control and Gene expression equipment • Workforce preparedness equipment • Negotiation equipment • Automation equipment	• Advanced Information Technologies equipment • High performance Computing system equipment • Cyber infrastructures to deliver Data • 2000 processors in Linus Windows and MAC OS x configurations equipment • Application porting, tuning and optimization; database systems computer programming and Web portal services design equipment. • Polymerase Chain Reaction (PCR) • Simple Tandem Repeats (STR) • Simple Sequence Repeats (SSR) • Deoxy Ribonucleic Acid (DNA) • Mass Spectrometry (MS) • Capillary Electrophoresis (CE) • Open Reading Frames(ORF) • Centre d'Etudes du PolymorphismeHumaine (CEPH) • Sequence Tagged Site (STS) • Variable number of Tandem Repeat (VNTR) • Restricted Fragment Length Polymorphisms (RFLPs) • The Kuomintang (KMT) • International management equipment • Innovative workplace strategies equipment
Bio-Informatic Components	
• *Information & Communication Technology* High speed Computers • Wireless graphic High speed Computer • Voice over IP Digital media High speed Computers • Health informatics (NRC) E-commerce High speed Computers • E-health Global health High speed Computers • Quantum computing Human-computer interface High speed Computers	• Bionanotech High speed Computers • Broprocessing High speed Computers • Health Informatics High speed Computers • Medical photonics High speed Computers • Computational biochemistry High speed Computers • Population health High speed Computers • Software engineering High speed Computers • Photonics High speed Compute

Sources: United States Department of Energy (2008); and Ebomoyi(2005).

The challenge of enhancing innovation in genomics technology in United States involves tripartite collaboration between the government, medical scientific institutions and the existing commercial companies (venture capitalists). To illustrate, the Michigan Center for Genomic technology has developed, and now provides full genomic services by utilizing expression analysis involving microarrays, Affymetrixgene chip arrays, Illumina, bead chip arrays, Agilent gene expression arrays custom oligoarrays, and quantitative reverse transcription (RT)-polymerase chain reaction tests. In many genomic applications (e.g., the widely used microarray chips from Affymetrix), samples of RNA rather than DNA are analyzed directly. Therefore, the measurement of RNA transcripts represents the measurement of gene expression, which is a very dynamic process which is influenced by a number of host and environmental factors.

Innovations to enhance genomic technology at U.S. federal level, is not a trivial issue; because the National Human Genome Research Institute (NHGRI), an arm of the NIH, is committed to making DNA sequencing faster and more cost effective. By 2006, a total sum of 13 million dollars was earmarked for biomedical and clinical research investigators to speed the development of innovative technologies that could reduce the current prohibitive cost of DNA sequencing. The investigators are expected to investigate techniques to expand use of genomics in medical research and health care. NHGRI had conceived of multiple practical mechanisms of innovations to make sequencing faster and more costeffective. Since

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1990, over 380 million dollars have been invested to develop and improve DNA sequencing technologies. In a gradual but systematic process, investment on innovation has yielded so many dividends, because the cost of sequencing has now fallen more than 50-fold over the past decade (Genome.gov, 2006). In fact, the vision of NHGRI is to reduce the cost of whole-genome sequencing to 1,000 dollars or less. It seems axiomatic, that most insurance companies will find this amount, reasonable for many insurance companies to pay health care providers. Currently, NHGRI continues to solicit revolutionary research proposals on genome sequencing technologies that unequivocally state as their goals, the development of breakthrough technologies that will make a human-size genome to be efficiently sequenced for 1,000 dollars or less and at the same time adopt methodology that complies with the NIH's competitive and rigorous protocols (Spencer, 2006; Genome.gov, 2006).

Besides, the serendipitous benefits of globalization have facilitated the process of disseminating innovative precision medicine to the developed, developing and least developed nations worldwide. The authors provided a list of potential humanitarian agencies from which indigent patients could solicit assistance to ensure that their positive diagnostic test for breast cancer gene(s) does not culminate in their imminent death sentence. Finally, recommendations were made about compliance with stringent exercise schedules and consumption of diet rich in polyphenols and other photochemical nutrients to sequester lethal gene chromosomes, while enhancing those genes that code for graceful aging.

PRECISION MEDICINE (THE P4 MEDICINE)

Precision (P4) Medicine and Screening for the Incipient Stages of Breast Cancer

The complete set of inherited genetic materials is encoded in our DNA. During reproductive behavior, the parents' sperm and egg (DNA) combine to contribute to a genome an entire amount of genetic information to the fertilized embryo. Scientifically, since the same amount of genetic information is present in the cells which eventually make up an organism, humans are usually at risk of having single-gene diseases inherited from parents or carry complex diseases which parents have in their genes. Global genomic epidemiology attempts to assess the frequency of occurrence of specific genetic and complex diseases in several parts of the world. Whereas, genomic epidemiology is the link uniting the intersection between genetic and molecular epidemiology. It focuses on the determinants and distribution of diseases and injuries in human population (Ebomoyi& Ebomoyi, 2014).

Global Genomic Epidemiology of Breast Cancer

In the 21stcentury, the global incidence of breast cancer has risen due to the inadvertent impact of globalization, inherited gene chromosomes, ingestion of alcohol, and smoking behavior in both developed and developing nations. Currently, breast cancer has become by far the most common cancer diagnosed in women worldwide. An estimated 1.38 million women in the world were diagnosed with breast cancer in 2008 and this statistic accounts for 23% of all cancers diagnosed in women. The newly diagnosed cases of breast cancer are usually higher in the developed than in the developing nations. However, as a result of innovative genomic medical interventions and in spite of the higher frequencies of the incidences of

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diagnosed breast cancers in the industrialized nations, more women in developing nations will encounter higher frequencies of death from the disease. Boyle and Levin (2008) emphasized the role of multiple risk factors in the incidence of breast cancer worldwide. While incidence is generally higher in the developed nations than in the developing nations, breast cancer incidence has increased in the last decade in developing nations due principally to globalization, acculturization, and exposure to environmental carcinogens, reproductive behavior, use of exogenonous hormones, as well as to a sedentary lifestyle, and the inertia to breast fed and being nulliparous mothers. By 2008, the incidence data ranged from about 20/100,000 in Eastern Europe and West and North Africa to 90/100,000 in Western Europe. The nations with the highest incidence statistics are the highly developed Denmark and Belgium (101/100,000 and 109/100,000, respectively).

Economic Impact of Breast Cancer

In assessing the economic impact of cancer worldwide, the American Cancer Society (2008), report by Boyle & Levin revealed how cancer has the most devastating economic impact of any cause of mortality in the world. The total economic impact of premature death and cases of morbidity attributed to global cancer statistics has been estimated to be 895 billion dollars as of 2008. This statistics represents 1.5% of the world gross domestic product (GDP). The economic catastrophe attributed to cancer is nearly 19% higher than heart disease, the second leading cause of death worldwide, which involves an economic loss of between 895 billion dollars and 753 billion dollars, respectively, even without including the direct medical costs. By far most crucial, the lost years of life and economic productivity due to cancer represent the single most crucial drain on global economy compared to other etiological agents of death including heart disease, HIV/AIDS and other infectious diseases (Boyle & Levin, 2008).

The economic loss from the 15 top global causes of death indicates that cancer by far exceeds the other diseases listed in Figure 1. A recent report has vividly revealed that breast cancer, lung cancer, and colon/rectal cancer account for the largest economic costs on an international scale. Use of innovative genomic medical science can lead to prevention, early detection, and effective treatment of cancer which could save numerous lives.

Genomic Sequencing of BRCA1/BRCA2 and Associated Genes

Hereditary breast cancer (BRCA1 and BRCA2) involves deficiency of the DNA repair system and breaks by homologous recombination, which triggers cancer susceptibility genes leading to breast cancer and ovarian cancer. A detailed epidemiological profile of BRCA1 and BRCA2 has been provided elsewhere; it must be emphasized that by the year 2030, the use of innovative genomic technology, geneticists and modern genome epidemiologists will have the capacity to identify numerous genes that predispose at-risk patients to early detection of those deleterious gene chromosomes (Ebomoyi, 2011).

Innovative genomic sequencing technologies and other molecular diagnostic techniques have shown *BRCA1 and BRCA2* are not the only genetic mutations that increase the risk of breast cancer. The other recently sequenced genes include TP53, PTEN, STK11/LKB1, CDH1, CHEK2, ATM, MLH1, and MSH2. The genome-wide association studies (GWAS) of breast cancer recently identified multiple single-gene nucleotide polymorphisms (SNPs) that are associated with increased incidence of breast cancer in the general population. Some of the alleles at the three of these SNPs in FGFR2, TNRCq, and

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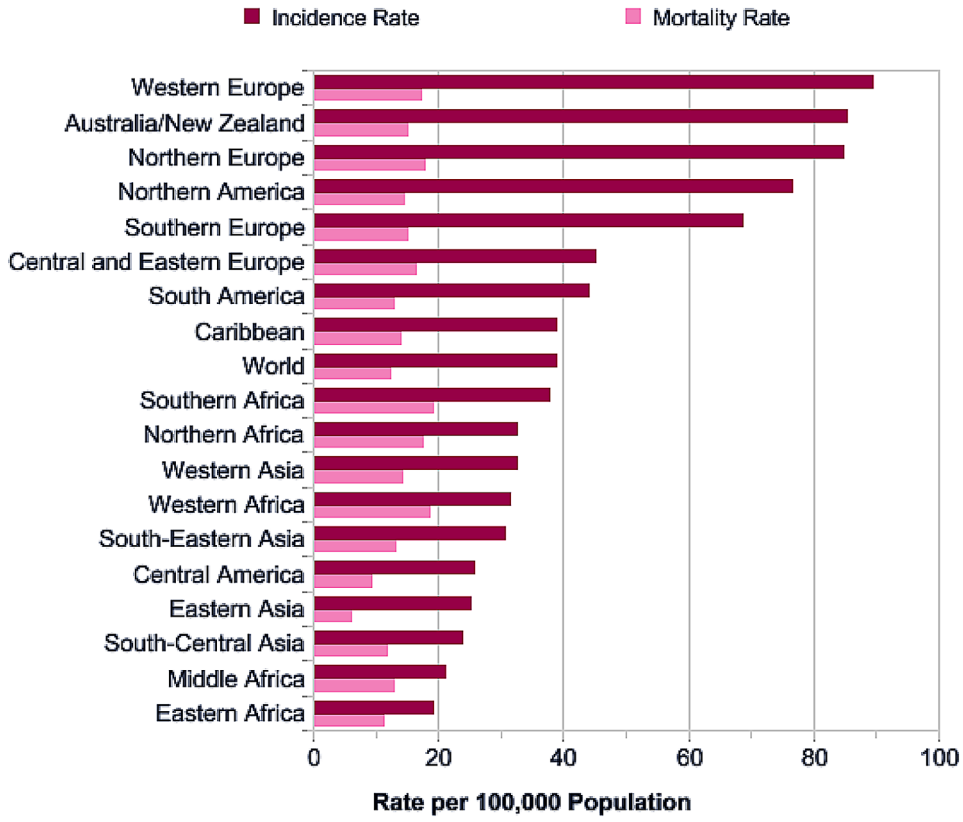
Figure 1. Breast cancer (C50): 2008 estimates
Source: http://info.cancerresearchuk.org/cancerstats/faqs/#How



MAP3K increase the risk of breast cancer for BRCA1 and BRCA2 mutation carriers. In the general population, besides those reported with higher prevalence rates, three specific SNPs rs3817198 at LSP1 and rs13387042 at 8q24 have also been shown to associate with onset of breast cancer (Malone et al., 2011; Antoniou et al., 2009).

Genomic Sequencing of BRCA1/BRCA2

In genomic medicine, BRCA1 and BRCA2 are not the only genetic mutations that increase the risk of breast cancer. Innovative sequencing recently revealed many other genes such as the TP53, PTEN, STK11/LKB1, CDH1, CHEK2, ATM, MLH1, and MSH2. The GWAS of breast cancer recently identified multiple single-gene SNPs that are associated with increased incidence of breast cancer in the general population. Some of the alleles at the three of these SNPs in FGFR2, TNRCq, and MAP3K create increase the risk of breast cancer for BRCA1 and BRCA2 mutation carriers. In the general population, beside those reported with higher prevalence rates, three specific SNPs rs3817198 at LSP1 and rs13387042 at 8q24 have also been shown to associate with onset of breast cancer (Malone et al., 2011; Antoniou et al., 2009). These recently detected mutations account for only a fraction of hereditary breast cancer. These genes mutations account for at least 5% to 10% of the total ovarian cancers among Caucasian women in the United States. BRCA2 is located on chromosome 13 and the risk of developing breast

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cancer in women diagnosed with BRCA2 mutations is similar to the risk of BRCA1 patients (Antoniou et al., 2009). The GWAS of breast cancer continue to identify multiple SNPs, which are associated with increased risk in the general population. A detailed account of such global genomic study is beyond the scope of this project.

Mortality Statistics in the United States

The American Cancer Society gave an estimate of 562,340 cancer deaths in the United States, made up of 292,540 males and 269,800 females (American Cancer Society, 2009). Cancer sites in men for which African-American recorded deaths (313.0/100,000) by far exceed those of their Caucasian counterparts with rates of 230.7/100,000. In the United States, the money expended on cancer alone by the government is over 104 billion dollars annually. The National Cancer Institute gave an estimate of new cases of cancer each year to be 1,221,800 (Mariotto, 2011).

As revealed by the American Cancer Society, over 90% of all cancers are not necessarily genetic in nature (American Cancer Society, 2009). This group of cancers includes breast, lung, stomach, colon, skin and prostate cancers. The etiological agents of these cancers are largely due to tobacco and environmentally induced. These etiological agents are age, use of excessive amount of alcohol, exposure to radiation, chemotherapy, hormone therapy, immunotherapy, radionucleotides. The warning signs of the cancers are sores that do not heal, consistent history of breast cancer in the family, unusual bleeding, lump in the breast, changes in the size of warts, and chronic cough. Genomics interventions and the application of magnetic resonance imaging have revealed the genetic association between BRCA1 and BRCA2 and the onset of ovarian cancer. There are various malignant growths that begin in the breast with ductile carcinoma and lobular carcinoma portraying stage 1, stage 2, and stage 3, which are most receptive to primary and secondary prevention, and prophylactic treatment if detected early (Figure 1). From epidemiological studies, gender is the single most important risk factor for breast cancer, but that does not rule out the onset of breast cancers in males. Family history and genetic etiology are common with BRCA1 and BRCA2. The hormonal replacement therapy, iatrogenic-induced radiation therapy, obesity are also causes of cancer. However, the crucial and most effective intervention against cancer is early detection through breast self-examination, clinical assessment, and mammograms performed at least twice a year. The non-modifiable risk factors are the inherited genes, intra-familial characteristics, parity, age, exposure to radionucleotide, reproductive history, menstrual history, and ethnicity. The modifiable risk factors include obesity, ongoing exercise, breastfeeding, use of alcohol, hormone replacement therapy, use of birth control pills, and infertility or parity status.

Coping with Trends in the Escalating Cost of Breast Cancer

Angela Mariotto reported that the cost of management of cancer could exceed 200 billion dollars by 2020 (Mariotto, 2011). Although the incidence and survival of cancer have improved in recent years, more expensive technology and the changing population characteristics have contributed to the increasing cost of cancer treatment. With the elderly population constantly growing, the cost of cancer management will continue to increase. By 2011, the NIH has projected the cancer costs could reach 158 billion dollars in 2020 (United States Department of Health and Human Services, 2011). Using the demographic data on U.S. population, medical expenditures for cancer in the year 2020 could be very costly due principally to the use of the newly developed tools for cancer diagnosis, treatment, and follow-up.

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The environment, diet, and other haplotype characteristics influence gene mutations, which account for at least 5% to 10% of the total ovarian cancers among Caucasian women in the United States and in other parts of North America. Antoniou et al. (2009) reported that BRCA2 is located on chromosome 13 and the risk of developing breast cancer in women diagnosed with BRCA2 mutations is similar to the risk of BRCA1 patients.

After the accomplishment of the HGS by March 23, 2003, many industrialized nations invested their resources to train the new generation of molecular biologists, bench scientists, clinicians, and other behavioral scientists. As a result of the lethal impact of breast cancer and the global financial loss sustained from death and morbidity associated from breast cancer, it is imperative that the Health Belief Model (HBM), which is most applicable and culturally relevant, be applied in disseminating health education to prevent the incipient stages of breast cancer by sensitizing at-risk patients to the predictability of breast cancer from family history analysis. The cautionary caveats echoed by Epstein (2006) focused on the training of clinical medical geneticists, which he emphasized may not suffice to practice innovative genomic medicine. He provided a synopsis of the current training which consists of Mendelian disorders, dysmorphology, chromosomal disorders, inherited metabolic diseases, the multifactorial basis of complex diseases such as breast and ovarian cancer, and cardiovascular diseases, which are caused by high penetrance and susceptibility genes (Epstein, 2006). To function as an effective practitioner of genomic medicine, sound cognitive and eclectic training of medical geneticists and primary care physicians must include population genetics, quantitative epidemiology, bioinformatics, pharmacogenetics, and intensive instruction in population risk assessment, and the ethical legal and social implications of genomics is imperative.

Adoption of the Health Belief Model to Disseminate Global Health Education

Modern genome epidemiologists and prevention research scientists routinely assess logically and statistically, the theoretical models that are most applicable in explaining individual health behaviors that could maximize public health worldwide and minimize the harm associated breast cancer worldwide. The most appropriate model for controlling the incidence of breast cancer is the HBM developed by Geoffrey Hochbaum and associates (Rosenstock, 1966). In fact, among the other behavioral theories, hardly do we find many of them that have transcended cultural and national boundaries as the HBM, the social cognitive theory (SCT) by Albert Bandura and the Innovation Diffusion Model by Rogers (Bandura, 1977).

This theoretical model was developed in the 1950s to explain why medical screening programs offered by the U.S. Public Health Service were not very successful (Hochbaum, 1958). The original concept focused on how human health behaviors are determined by personal belief or perception about a given disease. To Hochbaum (1958), a person's perception is influenced by the range of intrapersonal perceptions affecting a given behavior. That perception which depends on personal factors involves the level of education, and the parental background of the individual. The person's phenomenological experience about the agonizing knowledge that one's mother encountered the morbidity associated with breast cancer and eventually died from the disease can trigger psychological outburst of painful memories. The major theoretical constructs are illustrated in Figure 2. The key components of the HBM consist of perceived susceptibility to a disease such as breast cancer. Genomic interventions and the application of the magnetic resonance imaging have revealed the genetic association between BRCA1 and BRCA2 and the onset of breast cancer and with imminent onset of ovarian cancer. The associated etiological

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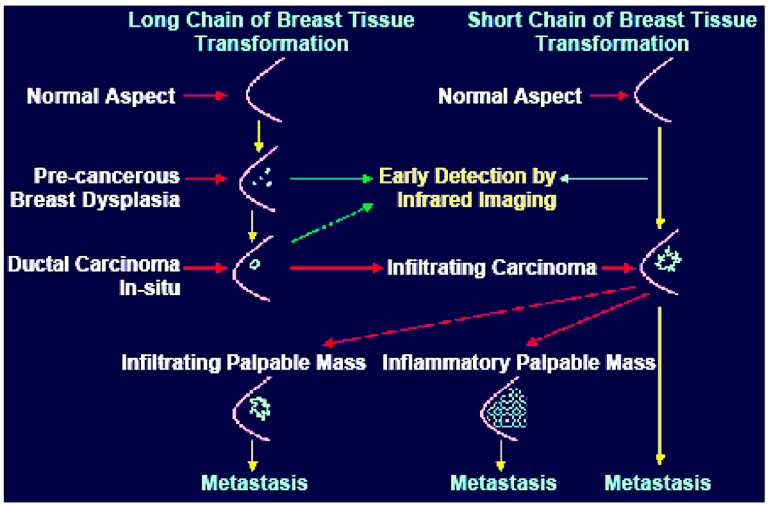
Figure 2. Natural history of breast cancer



agents for breast cancer are family history, age, use of excessive amount of alcohol, exposure to radiation, chemotherapy, hormone therapy, immunotherapy, radionucleotides, and use of birth control pills, physical inactivity, obesity, and ingestion of dietary lipids. The warning signs of cancers are sores that do not heal, unusual bleeding, solid lump in the breast, changes in the size of warts, and chronic cough.

Family history and genetic etiology are common with BRCA1 and BRCA2. Hormonal replacement therapy, induced radiation therapy, and obesity contribute to the onset of breast cancer. However, the crucial and most effective intervention against cancer is early detection through breast self-examination, analysis of family history, clinical assessment, and mammograms performed at least twice a year by a competent oncologist.

Perceived Seriousness of Breast Cancer

Scientific data reported by the Worldwide Breast Cancer Organization (2013) have revealed how nearly 1.5 million people were diagnosed with breast cancer. In fact, breast cancer is not only the most common cancer in women internationally, but it is also the main etiological agent of death from cancer in the world. As a result of the egress of technological development, even with the high incidence rate in industrialized nations; 89% of the women diagnosed with breast cancer are still alive, five years post-diagnosis. The United Kingdom and the United States have one of the highest incidence rates worldwide, making these nations a priority for breast cancer screening awareness. The mortality associated with the developing nations is probability one of the highest in the world because of late stage of diagnosis and the inadequate medical resources required for the management of breast cancer. Regarding perceived susceptibility, the (International Agency for Research on Cancer, World Health Organization, 2013) emphasized one third of these cancer deaths could be decreased if early screening leads to early detection and prompt medical treatment. On a global context, this implies nearly 400,000 lives which could be saved yearly. The impact of precision medicine which consists of predictive analysis of family history, preventive program, personalized treatment, and participatory activities must be accorded the requisite priority so as to save the lives of women worldwide (World Health Organization, 2012).

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Very comprehensive data derived from genomic epidemiology, molecular biology, and oncology have revealed scientific indicators about the high case fatality rate associated with the breast cancer. The incidence and prevalence of breast cancer occur in epidemic proportion not only in United States, but also worldwide. Scientifically, there are several genetic variants of breast cancer. The disease is literally incurable; the disease is associated with the deadly ovarian cancer. The morbidity and mortality associated with the various variants of breast cancer genes demonstrate a heightened concern that the perceived seriousness of breast cancer cannot be overstated. The perceived seriousness of breast cancer should motivate female of child-bearing age to consider participating in regular screening for breast cancer using the services of a qualified oncologist.

Modifying Variables

The major modifying variables identified are the demographic characteristics, socio-psychological and structural variables. BRCA1 and BRCA2 and ovarian cancer affect virtually those women who carry the lethal genes through intra-familial linkages with affected mothers. The World Health Organization (2013) and the American Cancer Society (2012) have confirmed how breast cancer affects a broad spectrum of women with family history of this disease irrespective of their level of education, social class, personality, and education level. However, knowledge about the disease is crucial in internalizing the crucial impact of innovative genomic technology, which has the potential to prevent and save human lives when they are proactive and knowledgeable about the perceived threat of the disease, such as breast cancer, which is very lethal.

The perceived threat of BRCA1 and BRCA2 and ovarian cancer and their variants are extremely high. Epidemiological studies have confirmed that there are the high case fatality and morbidity rates associated with breast cancer. (CDC, 2015)

Professor Geoffrey Hochbaum (1958) meticulously suggested that health behavior is influenced by cues to action. To him, cues to action, are specific events, people, innovative discoveries that motivate people to change their behaviors. Today, innovative genomic epidemiology consistently reveals several lethal variants of BRAC1 and BRCA2 and ovarian cancer. Today, we are able to observe recent diagnosis of a family member with BRCA1 and BRCA2. Besides, we participate in mourning the death of mothers and aunties who are dying from BRCA1 and BRCA2 and ovarian cancers. Among the various cues to action, the most powerful motivating cue is the death of one's mother more so, when a daughter has tested positive (a case of True Positive) for the BRCA1 and BRCA2 gene chromosomes. The probability of having BRAC1 mutation is between 1 in 500 and 1 in 800. The incidence of BRCA2 mutation is even lower. However, among individuals of Ashkenazi Jewish background, there is an increased incidence of BRCA1 and BRCA2 mutations (Kunjumoideen, 2011).

Globalization has exponentially advanced the impact of mass media campaigns and Internet resources which keep flourishing to alert at-risk women to the crucial role of Ms. Angelina Jolie, a humanitarian known for her magnanimity and her international profile of being a mother of six children, a daughter to a mother who died from breast cancer. "The Oscar-winning actress recently revealed in an emotional state that she underwent a double mastectomy earlier this year after a blood test showed she was genetically susceptible to cancer." She further affirmed: "The truth is I carry faulty gene, BRCA1 which sharply increases my risk of developing breast cancer and ovarian cancer." I decided to be proactive and to minimize the risk as I could; I made a decision to have a preventive double mastectomy." (Angelina, 2013; Donnelly; 2013).

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In this century, prevention research scientists, geneticists, and the medical scientific community will be moved with so much awe and appreciation to observe the singular act of courage, the vivid and empirical demonstration of cue to action by Ms. Angelina Jolie. Her courageous initiative should accord precision medicine the attention it deserves. Therefore, the international scientific community, medical administrators and world leaders need to create the necessary platform to integrate genomic medicine into conventional medical and public health practice worldwide.

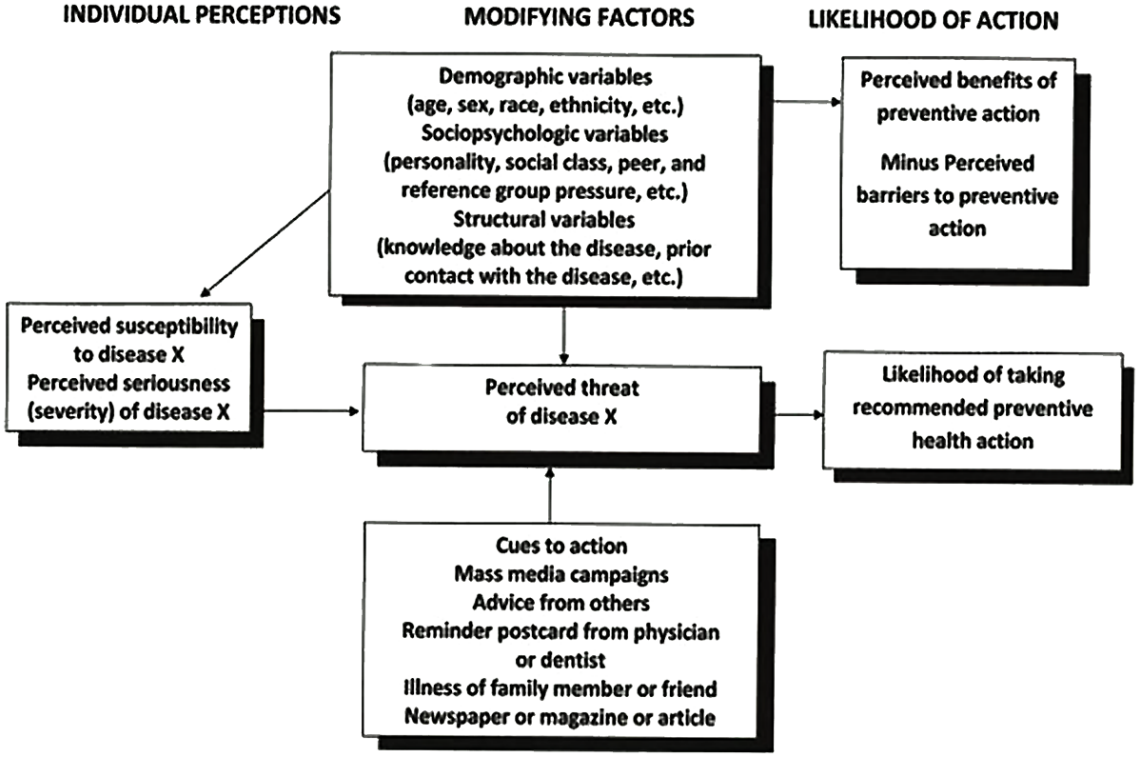
The federal Centers for Disease Control and Prevention (CDC) have intensified their efforts to alert the public by creating global awareness about the unacceptable morbidity and mortality statistics of breast cancer and the ethnic disparities associated with death from this preventable disease.

Apart from postcards mailed to clients by their family physicians, there is a high frequency of public health service announcements mass media campaigns designed to protect the public. Health education programs are provided in many churches whereby volunteer health professional teach the congregation members about the availability of inexpensive screening services being performed in nearby clinics (Figure 3).

Likelihood of Action

Using this framework, the likelihood of taking action, such as screening for breast cancer, could be quite high. On reflecting on commonsense and scientific theory, Hochbaum (1992) maintained that scientists

Figure 3. The Health Belief Model (Hochbaum, 1958)



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need to be mindful about Kurt Lewin's widely cited pronouncement that "there is nothing as practical as a good theory."

Self-Efficacy

When the HBM was conceptualized in the 1950s, the concept of self-efficacy was not a component of the model. A plethora of studies by several socio-psychologists created the impetus to incorporate self-efficacy (Rosenstock & Stretcher, 1997). Dr. Bandura (1977) integrated self-efficacy, which he defined as the conviction that one can successfully execute the behavior required to produce the outcome. It is also described as one's ability to perform a certain task or specific function. Self-efficacy, which Bandura (1988) later described as SCT, explained that behavior is determined by expectancies and incentives:

A. Expectancies about environmental cues; that is, the belief about how events are connected;
B. Expectancies about the consequences of one's own actions (that is, opinions about how individual behavior is likely to influence outcomes), which is described as outcome expectations; and
C. Expectancies about one's own competence to perform the behavior needed to influence outcomes.

Based on Bandura's views, incentive (or reinforcement) is defined as the value of a particular object or outcome. The outcome in this discourse, is preventing the deadly consequences of breast cancer.

In personal communication with Bandura (2004), he passionately echoed how the development of self-efficacy in daughters at-risk cohort is developed through parental nurturing, instilling confidence and a sense of self-worth in one's children to enable them to develop based on their genetic endowment. The lived experiences of the children enhance their cognitive, psychosocial, and emotional growth which allows people to make valid informed choices in life about health enhancing behavior such as compliance with preventive medicine.

Perceived Benefits of Preventive Action

The likelihood of taking the desired action is contingent on the perceived benefits of preventive action. Regarding breast and ovarian cancers, the awareness of preventing mortality and morbidity associated with these diseases outweighs the multiple barriers to taking the relevant action such as primary prevention, which includes monthly breast self-examination. This process provides a relatively simple, low-cost technique of early detection that can be performed more frequently than the clinical breast cancer examination. This practice is very crucial for those women with a family history of breast cancer.

The perceived barriers to primary prevention are cost of physician visits for the overwhelming number of women worldwide that are financially indigent. Additionally there are numerous clinical sites, which are not readily accessible to the public, and the cost of radical mastectomy, which could be in the range of 30,000-40,000 dollars. In the United Kingdom, Sumby (Ajmc.com, 2013), who was considering the U.K. for treatment, stated, "Unfortunately, I just received the estimated cost of treatment and it is a whopping 150,000 dollars; where is a 27-year-old with no insurance expected to get such an amount from?" The cost of medical management of BRCA1, BRCA2 and ovarian cancer is prohibitive, mostly if one is medically isolated or without health insurance. This financial hardship is very common in many parts of the world particularly in the developing and least developed nations found predominantly in South East Asia and Sub-Saharan Africa.

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In order to mitigate the fear of most at-risk patients, the following list provides the numerous sources of health education to assist at-risk women about the sources of primary prevention and financial assistance in order to be proactive in taking the recommended action in the age of genomic scientific medicine.

A List of Pertinent Breast Cancer Prevention Resources and Sources of Assistance for At-Risk Patients Worldwide

- **European Union and Worldwide Cancer Research Worldwide:** Worldwide cancer factsheet of cancer incidence worldwide. http://publications.cancerresearchuk.org/downloads/product/CS_FS_WORLD_A4.pdf.
- **Cancer incidence:** http://surveillance.cancer.gov/statistics/types/incidence.html.
- **Breast Cancer (c50):** World age standardized incidence and mortality rates among females in regions of the world, 2008 estimates; Download Publication - Publications - Cancer Research UK; publications.cancerresearchuk.org
- **Global Statistics on Breast Cancer 2012–2050:** http://www.cancer.org/research/cancerfactsfigures/globalcancerfactsfigures/index
- **Global Cancer Facts and Figures 2012–2050 ; Breast Cancer Walk 2013**
- **2014 TAMPA APOS:** APOS referral organization for cancer patients and caregivers
- **Fourth Angel Aminat Melanoma and American Cancer Society:** www.cancer.org
- **Cancer Net and Cancer and Pregnancy:** Cancer Forward http://www.cancer.net/
- **Cancer Hope Network:** cancer survivors' network
- Candle-lighters; Imerman Angels; Inflammatory Breast cancer; Lauren's light
- Living beyond breast cancer; Lymphoma Research Foundation; Mesothiolama prognosis; www.lbbc.org
- Meta-cancer Foundation Inc; Patient partner project; Pleuralmesothioloma.com; Pregnant with Cancer Network
- **National Cancer Institute:** www.cancer.gov/cancertopics/breast
- Steps for Living, Strength for Caring; Super Sibs; Women Stories; Psychosocial Oncology Society
- **The Breast Cancer Foundation of Arizona:** http:www.bcfuz.com/
- **The Breast Cancer Network of Strength; Breast Cancer Research Foundation:** (https://www.linkedin.com/company/breast-cancer-network-of-strength)
- The Centers for Disease Control and Prevention; the U.S. Food and Drug Administration (FDA)
- **The FDA Mammography Program; Friends of an Earlier Breast Cancer Test:** http//www.earlier.org/
- The National Breast Cancer Foundation; The National Cancer Institute:
- **The National Consortium of Breast Cancer; The National Women's Health Information Center:** www.breastcare.org/
- **The National Women's Health Information Center; The National Women's Health Resource:** http://www.healthywomen.org
- **The Society for Women's Health Research:** http://swhr.org
- T**he Susan G. Komen Breast Cancer Foundation:** breast cancer we need your help www.komen.org

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IMPACT OF PRECISION (P4) MEDICINE

Biological and Genetic Basis for Personalized Medicine

Powerful and sophisticated genomic technologies have created hitherto unknown innovations to improve genomic medicine. Besides, numerous value-added scientific benefits derived from genomics are now revolutionizing the treatment of patients who suffer from breast cancer. To illustrate, high-throughput technologies, computational frameworks, and molecular biological science and bioinformatics techniques currently facilitate the examination of biological systems in unbelievably copious details. Comprehensive genomic profile of patients which include epigenome, the transcriptome, the proteome, metabolome, and antibodyome, among others, are valuable in the predictive, preventive, personalized, and participatory care of cancer patients.

The recent act of courage demonstrated by Ms. Angelina Jolie, an actress and a humanitarian, in complying with the clinical tenets of precision medicine must be recognized, publicized, and carefully recommended. Besides, Ms. Jolie recently donated the sum of 200,000 dollars to the Malala Fund, an organization for the education of young girls. The recipient informed the audience, which included Hillary Clinton, "I invite all of you to support the Malala Fund and let us turn the education of 40 girls into 40million girls."(The Guardian, 2013)

In the era of genomic science, insights about precision medicine have been professionally analyzed. According to Dr. Elias Zerhouni, the former director of the NIH, the new medicine must anticipate and interrupt the disease process, thereby preventing the patient from being overwhelmed by the actual disease burden (Ebomoyi, 2010). (Institute for Systems Biology, 2010), defined (1) a predictive approach as the development of probabilistic health projection for a person based on their DNA and protein expression; (2) preventive medicine is the creation of interventions or therapeutic that will prevent a disease; (3) personalized medicine refers to treating individuals based on their unique human genetic variations; and (4) participatory medicine implies a patient's active, informed involvement in their medical choices, treatment, and acting in partnership with their health care providers. The various accomplishments of effective sequencing of DNA from many types of cancer including breast cancer enable many physicians and competent oncologists to effectively treat at-risk patients even at the incipient predictive stage of their BRCA1 and BRCA2 with effective medical intervention. With pharmacogenomics, chemotherapy is personalized. In the participatory phase, patients are engaged in cooperative network which consists of healthcare providers, the patients and their family members (Zerhouni, 2007).

Health Education Implications

From the Joint Committee on Health Education and Health Promotion Terminology (2001), health education was defined "as any combination of planned learning experiences based on sound theories" such as the HBM, SCT, and the Diffusion of Innovation Model developed by Rogers and Associates. Based on Breslow's (1999) reaction, "each individual person has a degree of health that may be expressed as a place in the spectrum." From that perspective, promoting health must place emphasis on enhancing people's capacity for living and protecting themselves from breast cancer and other chronic and degenerative diseases.

Global health initiatives to minimize the overwhelming mortality and morbidity associated with breast cancer must utilize the international mass media campaign process. The existing global television

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networks associated with the Global Health Council, which has linkages with several academic institutions in the world has a duty to include the cancer prevention education in their series of programs. There is have a resounding obligation to inform international viewers about the lethal impact of breast cancer and how innovative precision medicine can drastically reduce the medical, economic, and emotional distress associated with breast cancer (Global Health Council, 2013). Evidenced-based and balanced scientific discourse is required to educate the global community about the importance of genomic innovative medical care. Culturally sensitive, health education videos should be developed; ensuring that learning resources are tailored to suit the religious, economic, educational and societal norms of nations worldwide. The overarching themes must focus on the improving the health status of at-risk women and mothers of child-bearing age. Medical administrators and political leaders worldwide need to develop the requisite platform for integrating genomic medicine into conventional medical practice and public health systems

In 1965, the Centers for Medicare and Medicaid program were established in the United States. The two centers became the major sources of insurance for the elderly and the indigent population. These two programs must be revised to accommodate and reimburse services for predictive, preventive personalized and participatory services. We must emphasize, genomics has revealed the molecular underpinnings of etiology of BRCA1 and BRCA2 and associated lethal gene chromosomes. It is imperative that physicians, nurses, and other clinicians be retrained to become more competent in the provisional of personalized medicine. In providing health education to abate the incipient stages of breast cancer, breast self-examination need to be performed at least twice a month. The advantages of the cultural observances of many societies involving prohibition of alcohol and tobacco use by women need to be encouraged.

Researchers who conducted extensive nutritional studies at Johns Hopkins Medical School recommended consumption of fruits, vegetables, and whole grain, which had been analyzed to contain phytochemical nutrients with antioxidants and antiestrogen. The identified anticancer vegetables include cruciferous vegetables as broccoli, cauliflower, kale, cabbage, and Brussels sprout. The leafy vegetable which are also quite protective consist of lettuce, spinach, Swiss chard, endives, beet greens and romaine. The umbelliferous vegetables are celery, parsley, fennel, carrots, and parsnip.

Vegetables that are the alliums are garlic, onions, shallots, chives, and leeks. The legume series include soybeans, peas, chickpeas, lima beans, peanuts, and dried beans and lentils. The cucurbitaceous group of vegetables includes pumpkin, squash cucumber, muskmelon, and watermelon.

The most appropriate exercise for cancer survivors include walking, bicycling, swimming, aerobic jogging elliptical machines, dancing, and circuit training. The American Cancer Society (2012) recommends at least 30 minutes of exercise at least four days a week. The health promotion initiatives most appropriate for cancer survivors are gardening, shopping, and household chores. These physical activities have the potential to improve human self-esteem, physical fitness, body composition, and overall quality of life. By far most crucial is for all cancer survivors to avoid a sedentary lifestyle, and the use of tobacco and alcohol.

Prevention research scientists, physicians and other educators have the responsibility to alert and solicit the support of the World Health Organization (WHO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the United Nations Children Emergency Fund (UNICEF) about the singular importance of harnessing the medical innovation from precision medicine to combat breast cancer ensuring that the services provided are tailored to the crucial needs of women in both the isolated geographical villages and urban parts of the industrialized nations.

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Chapter 10
Modeling Energy Portfolio Scoring:
A Simulation Framework

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ABSTRACT

U.S. regions are expected to follow the national trend towards investment in renewable energy as part of their electricity portfolio. The progress of energy portfolios that typically involves traditional methods, such as centralized nuclear and coal-fired generation, and towards cleaner- and renewable-source generation will impact economic growth and public health. Renewable electricity production must strike a balance among cost, reliability, and compatibility. The economic and health benefits obtained from developing an efficient energy portfolio make renewable energy alternatives an important consideration for regions endowed with natural resources. A portfolio mix of production method that considers the economic benefits while limiting adverse health and environmental impacts is attractive. This research proposes a System Dynamics simulation framework to support policy-making efforts in assessing the impact of energy portfolios. The authors demonstrate the utility of the framework by means of analyzing data that pertain to the U.S. Hampton Roads - Peninsula Region.

1. INTRODUCTION

The development of the modern economies has been significantly influenced by the availability of energy derived from abundant fossil fuels (Toman and Jemelkova 2010). The growing demand of the industrialized and emerging economies suggests that requests for affordable energy is likely to remain (Sorrell, Speirs et al. 2010). Electricity generation is traditionally classified as non-renewable (i.e., conventional)

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and renewable (i.e., non-conventional) sources. Non-renewable sources of energy production include fossil fuels that are extracted from finite deposits. Nuclear fuel may also be included in this category. Electricity production and distribution from non-renewable sources contribute to particulate air pollution which has been related to health threats, climate change, and reductions in the quality of the built environment (Haines, McMichael et al. 2010).

Since renewable sources are derived from primary sources such as wind and solar energy, they have been termed 'clean' sources (Bilgen, Kaygusuz et al. 2004). It has been contended that the utilization of these sources may have comparatively fewer public health effects while maintaining and inducing economic growth since stimulates job creation, and therefore, consumption (Johnstone, Haščič et al. 2010, Wei, Patadia et al. 2010, Timilsina, Kurdgelashvili et al. 2011). However, there are limiting issues associated to the utilization of these sources that include economies of scale, incompatibility with existing power infrastructure, reliability, and negative impacts on viewscape (Jacobsson and Johnson 2000, Painuly 2001, Jacobsson and Bergek 2004).

The development of wind and solar electricity as a sustainable source of energy may have a positive impact on both health- and environment-related issues for a region. These forms of electricity production are becoming widely accepted as reliable as advances in engineering and technology are progressively becoming more efficient. The cost of renewable energy production, many forms of which may be produced domestically if not relatively close to the point of consumption, may be insulated from the severe price swings associated with a heavy reliance on fossil fuels (Akella, Saini et al. 2009). However, there may be economic cost associated to growing regional portfolio's share of renewable sources. Fossil-based energy production generated electricity is still at a substantial competitive advantage cost-wise relative to its renewable-based energy production counterparts (McVeigh, Burtraw et al. 2000, Palmer and Burtraw 2005). Some have disputed, though, that these shortcomings stem from the fact that the market cost for electricity generated from fossil fuel does not consider critical exogenous variable of energy production related to poor air, water, and ground quality and the attendant public health issues (e.g., Ratliff and Smith (2005)). That is, external to the compilation of the price of electricity to the consumer are the quality of life and medical costs imposed upon the communities. Internalizing these externalities into the cost of fossil-based electricity would, intuitively, lessen the price competitive advantage of fossil- over renewable-generated electricity.

Although the identification and quantification of these factors external to those parties explicitly involved in the transaction may be difficult and counterintuitive to established approaches, the inclusion of these externalities into the cost structure may be necessary for informed policy formation (Haines 2001, Hirschberg, Heck et al. 2004, Oikonomou, Becchis et al. 2009). These costs may be borne by the consumers either directly or indirectly (Menegaki 2008).

The increased production and distribution costs related to newly emergent renewable energy production is largely transferred to the consumer in the costs of goods and services (Menanteau, Finon et al. 2003). Likewise, educational and governmental institutions are also large consumers of energy whose costs are essentially passed along to taxpayers (Owen 2006). Potentially, this may generate an adverse economic effect for the region since an increasing portion of a regional income is spent on energy, therefore, leading to less available resources for investment or purchasing of goods and services. In addition, some territories such as the US territory may present dissimilar sources for renewable energy among endowed regions. Thus, if a region becomes a net-exporter of electricity generated by renewable sources, regional job creation and retention of wealth may materialize (Lund and Münster 2003). An evaluating

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structure that acknowledges these relevant interactions is an important goal in reducing uncertainty and informing policy makers.

The goal of this paper is to provide a framework that characterizes an energy portfolio and enables the evaluation of relevant social and environmental impacts that stem from different combinations of energy generation, transportation, and distribution methods. This framework allows explicitly modeling the intersection between potential near-future electric energy portfolios and public health. The inclusion of health-related externalities is essential in assessing the costs of alternate energy source portfolio combinations.

A feasible energy portfolio evaluation that exhibits a reduction of negative health impacts over time assists on creating a favorable public perception towards an electricity generation portfolio. Public endorsement is required to guarantee that further investment flows can be enticed. Although desirable, these measures cannot be independently verified with actual data due to a lack to physical significance attached to them. Nevertheless, they have interpretational relevance and hence are key indicators of interest for policy makers.

To demonstrate the functionality of the proposed framework, the model is both calibrated and simulated using actual data from the U.S. Hampton Roads - Peninsula Region for the years 1996 through 2002. The utility of the suggested framework is confirmed by means of executing a theoretical case study that presets several project investment scenarios.

The following sections of this paper provides a background on traditional views on evaluating energy portfolio, explicate the components that form energy portfolio model, followed by a brief example illustrating the approach. The results stemming from these scenarios are provided. We then revisit and summarize the contributions of this work.

2. BACKGROUND

The production cost of fossil-based generation of electricity has been known to fluctuate greatly over relatively short periods. Short-term instability and uncertainty in oil and natural gas prices may stem from geo-political circumstances as well as both speculated and real disruptions in the supply chain. The cost of renewable energy production, many forms of which may be produced domestically if not relatively close to the point of consumption, may be insulated from the severe price swings associated with a heavy reliance on fossil fuels (Ayompe, Duffy et al. 2011).

Energy portfolio planning has been conventionally viewed as an investment decision problem in which the energy enterprise has to choose among available portfolio options to maximize profits within the context of acceptable risk. It has been typically addressed using the ‘least cost approach’ in which the production method with the least ‘standalone’ cost is selected to expand the existing grid.

The Mean-Variance Portfolio (MVP) theory in this context argues that the presence of high priced (often renewable) sources of electricity generation and distribution in a portfolio may not necessarily imply an increase in the overall portfolio price. This may be explained as the portfolio is conditioned upon a reduction in the price uncertainty (risk) involved with such alternatives. The MVP method for evaluating electricity portfolios that assumes a relative stability in the fossil fuel prices and low rate of technological progress and innovation is employed by Awerbuch (2006). Marrero and Ramos-Real (2010), Westner and Madlener (2010), and Guerrero-Lemus, Marrero et al. (2012) also applied MVP theory in which it is considered the average costs and the risks associated with alternative combina-

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tions for generating electricity. A recently a detailed report utilizing the MVP theory in the context of a Brazilian electricity generation mix is found in Losekann, Marrero et al. (2013). However, nowadays, the application of these techniques may be limited given the volatile nature of fuel prices (Sunderkötter and Weber 2012). Major world's economies have experienced the adverse economic and political effects stemming from fluctuations in the price of fossil fuels. Thus, it may be argued that assessments of electricity generation options require a more comprehensive 'portfolio analysis' perspective as conventional analysis present substantial limitations in characterizing the uncertain and complex nature of the energy scenarios over time.

Environmental and health concerns have become essential considerations in the energy generation decision-making process. For example, based on perceptions of the public health and the environmental impacts, nuclear power and waste disposal facilities have long been the target of public hostility (Ferreira and Gallagher 2010, Spence, Poortinga et al. 2010, Corner, Venables et al. 2011, Visschers, Keller et al. 2011, Hartmann, Apaolaza et al. 2013). Greenberg and Truelove (2011) indicate a strong public opposition to locate coal fired and nuclear power generation in their vicinity. In contrast, acceptance is relatively higher for renewable energy production in the form of wind power (Swofford and Slattery 2010) and solar (Kaldellis, Kapsali et al. 2012). However, renewable energy production may still face opposition (see West, Bailey et al. (2010) and Bidwell (2013)), although the reasons are varied (see Musall and Kuik (2011), Shamsuzzoha, Grant et al. (2012), and Read, Brown et al. (2013)).

Emissions stemming from fossil-based electricity generation are a primary health concern for local and federal governments. For example, in the U.S. Virginia, on average, the state produced 4.3 lbs of sulfur dioxide, 1.7 lbs nitrogen oxide, and 1,254 lbs carbon dioxide per megawatt hour generated (EPA 2010). Urban areas tend to have higher carbon dioxide emissions relative to rural areas (O'Neill, Liddle et al. 2012). Emissions from coal-fired power plants have long been recognized as contributing to the respiratory conditions, hospital admissions among adults and children, premature births (Yogev-Baggio, Bibi et al. 2010, Cropper, Gamkhar et al. 2012, Liu, Lessner et al. 2012) and premature mortality (Cropper, Gamkhar et al. 2012). Urban air pollution stemming from the combustion of fossil-based fuels is characterized by atmospheric gases and particulate matter. Short-term exposure to airborne particulate matter (PM) in our urban environments has been associated with adverse pulmonary health effects and respiratory distress, for both children and adults (Franck, Herbarth et al. 2011, Maestrelli, Canova et al. 2011, Yeh, Chang et al. 2011, Saravia, Lee et al. 2013). The composition and size of this airborne matter, usually in the form of breathable particles in the range of 10μm or less, allows it to enter the respiratory system resulting in any number of symptoms including wheezing, coughing, infection, and impaired lung function. The literature widely agrees that electricity generation from renewable sources has fewer adverse health-related effects relative to traditional gas- and coal-fired plants mainly due to differences in type and quantity of emissions.

Uncertainty in the availability and cost of fossil fuels contributes to heightened risk that may not be compatible with assuring long-term sustainability in shareholder value. In addition the vagaries of public opinion contribute heavily to the regulatory environment; decision-making processes are vulnerable and responsive to public perception. The impact of electricity generation and distribution on public health and the environment are essential cornerstones in the public's perception. Public objection regarding environmental pollution has become more inclusive covering viewscape spoilage, built environments and neighborhood property values, grid reliability, and wildlife habitat infringement. Simply, the question of what combination of energy generation and distribution network is appropriate has become multifaceted and the most inexpensive option is no longer accepted prima facie as the optimal option.

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The above discussion illustrates the benefits of portfolio-based analysis of electricity generation and distribution using methods such as MVP as well as relevant aspects related to impacts of energy production. These approaches are yet unable to address the changing decision-making environment over time within which regulatory energy policy and public perception forms. Public participation and consensus are modern components of our public decision-making processes (Rowe and Frewer 2000, Beierle and Cayford 2002, O'Faircheallaigh 2010, Kleinman, Delborne et al. 2011). Energy policy issues are multi-objective and involve competing interests and stakeholders (e.g., utilities, investors, government agencies, and public representatives). Most analysis methods provide limited benefit when it comes to capturing the contribution of participation and consensus building in energy portfolio formation. This paper suggests using a simulation framework to be able to capture and assess complex elements of the decision-making process, e.g., public health, environmental, and economic impacts over time. This characterization forms a framework for evaluating decisions related to the formation of an electricity portfolio through a holistic basis and with due consideration for specific economic and public issues.

3. RESEARCH QUESTIONS AND APPROACH

An evolution in portfolio mix away from traditional methods of generation and towards cleaner- and renewable-source generation can be expected to impact the externalities associated with public health, thus affording the region a 'health dividend' (McCartney, Hanlon et al. 2008). In particular, U.S. regions and states can be expected over the next several decades to mirror the trend, seen nationally across many other states, towards experimentation and application of innovative renewable energy approaches as part of its electricity portfolio. However, it is uncertain the various impacts on the intersections between public health, environment, and economic growth stemming from different energy portfolio mixes.

Although the implementation of these programs is attractive from the institutional perspective, the outcomes are less known. As pointed out above, many studies model the population and economic impacts at a macro level while disregarding price volatility and health impacts over time. Thus, this study suggests a System Dynamics framework that allows users to investigate the short- and long-term dynamics associated with adopting various energy portfolio mixes. Furthermore, it allows decision makers to assess prospective adjustments to regulatory policies that may affect cost-benefit relationships among alternatives.

The proposed simulation model allows examination of energy combinations that consider health and environmental impacts while simultaneously considering its economic effects. Größler, Thun et al. (2008) argue in favor of using system dynamics structures for investigating this type of managerial issues since this approach acknowledges feedback loops, accumulation processes, and delays that actually exist and are commonly found in complex problems. The model provides useful managerial insights into how the initial estimates of the energy generation may change as equilibrium among the cited variables are established.

In order to accomplish the central objective, this study will seek to address following specific research questions through proposed model and analysis:

- What are the relevant components of the energy portfolio that considers health, environment, and regional economies?

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- What interdependencies are critical for evaluating the performance and sustainability of the energy portfolio mix of an affected region?
- How does a proposed system dynamics framework provide a means to characterize and evaluate energy portfolios?
- What forces create mismatch between supply and demand and how to address this mismatch and potential barriers to energy portfolio?

To provide a response to these questions, it is critical to analyze the effects of different parameters over time. The optimal mix of parameters within an electric energy production, storage, and distribution system designed to maximize efficiency alone may be quite different from a complex mix that balances efficiency with public health. System Dynamics has been extensively used as a reliable approach that captures and analyzes the dynamic, complex interaction among dissimilar subsystems (Sterman 2000).

The use of System Dynamics to analyze complex issues related to energy is not anew. It has been used as a framework to study renewable energy within broader systems (Gravouniotis and Bauen 2008, Gravouniotis, Bauen et al. 2012), e.g., to analyze countries' energy situations (Ballardin, Di Giulio et al. 2008); to determine the best strategy to meet future energy demand while reducing CO2 emissions (Jogleka and Graber–Lopez 2008); to model changes of energy intensity in residential sectors (Jamshidi 2008). In addition, researchers have successfully included in System Dynamics models searching mechanisms that allow plausible combinations of parameters that optimize a set of goals (Graham and Ariza 2003).

This paper suggest using a System Dynamics approach that includes: (1) identifying electric energy generation sources that have the potential to be included within a near-future electric energy portfolio, (2) defining the public health costs associated with each component of the electric energy sources, (3) modeling the interactions among the source-components and their associated public health costs to produce a best-feasible energy portfolio solution, and (4) simulating and analyzing the proposed energy portfolio.

4. POLICY ENVIRONMENT

The Environmental Protection Agency's Clean Air Interstate Rule (CAIR), targeting largely the eastern half of the United States (east of the Mississippi), compels states to permanently reduce NOX and SO2 emissions to predetermined caps by the years 2009/2010 and 2015. Virginia's NOX reductions, relative 2003 levels, constitute roughly a 53 percent decrease by 2009 and a 61% decrease by 2015 (1.5m and 1.3m tons, respectively). SO2 reductions are 45 percent by 2010 and 73 percent reductions by 2015 (3.6m tons and 2.5 m tons, respectively). The Clean Air Mercury Rule (CAMR), national in scope, sets for petroleum-based electricity facilities allowances that may be bought and traded in efforts to meet targets set for 2010 and 2018. Conceptually, Environmental Portfolio Standards (EPS), common in many states, set targets for the percentage of electricity sold within the state that must be produced by renewable sources. The State of Virginia itself has set a nonbinding Renewable Portfolio Standard (RPS) for utilities with the state-wide goal of 12 percent of energy sales to be derived from renewable energy by 2022 with an emphasis on solar initiatives (more precisely, 12 percent of 2007 base year sales by 2022 (State of Virginia 2007).

An important number of US States are now covered by renewable energy/electricity standard (RES), with a total of twenty-eight already, which have approved RPS (Solangi, Islam et al. 2011). These standards contain targets for the proportion of a state's portfolio of electricity sources that must be gener-

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ated by means of renewable energy. A region's evolution towards a more diversified portfolio of energy sources may be viewed as laudable due to a string of expected benefits derived from such evolution. These benefits may include less dependence on foreign oil, decreased degradation of the environment inclusive of global warming, and a range of community and environmental health issues (Johansson and Burnham 1993, Romm and Ervin 1996). However, given the potential diversity in the composition of a region's electric energy generation and distribution system, there may be great variation in the public health impact (Ratliff and Smith 2005).

The latent renewable energy potential for a region, stripped of other concerns, is driven by geography. Some regions, due to climate, elevation, and proximity to water, may be relatively rich in a particular potential renewable and deficient in others. Some regions have witnessed an emphasis of interest in solar photovoltaic applications due to climate, while others with conducive topography may have a stronger suit in land-based wind- and hydro-generated electricity, and still others with proximity to oceans and bays have entertained offshore wind- and tidal-generated electricity. Secondary to geography, the focus on type of renewable energy source may be conditioned by current land use (e.g., competition with agriculture, urbanization, state and national parks and recreation areas, etc.), public acceptance of altered viewscapes (e.g., horizon containing wind farm turbines, transmission and distribution lines, etc.), and wildlife protection/conservation efforts (e.g., facility encroachment on protected or fragile ecosystems).

Within U.S. Southeastern Virginia there has been, for example, considerable discussion of the potential for offshore wind initiatives within the context of the impact of altered viewscapes on tourism and property values. The intensity and direction of these secondary drivers on the penetration of renewable energy sources into the marketplace has been, and will continue to be, a product of balance struck within the political system. The goal here is not to predict which combination of energy sources will be employed to serve Southeastern Virginia but, rather, to develop a tool that provides referential information regarding the various impacts of likely energy portfolios.

5. THE FRAMEWORK

The model characterizes the electric energy generation sources and their potential to be deployed within the evolving portfolio. This entails considerations of two broad categories, the first of which is the variety of potential energy sources such as nuclear, coal, oil, natural gas, solar voltaic, wind, biomass, municipal solid waste landfill gas, hydro, tidal, and thermal. The electricity production model used in this paper is applicable to thermal power stations only. Thermal power stations may utilize a variety of fuels like coal, light oil, heavy oil, natural gas, and municipal solid waste. The second consideration is the magnitude or centrality of the energy production within any of these energy sources. A distributed-laden system may contain a decentralized network of energy production sites as may be employed in a residential distributed photovoltaic (PV) energy arrangement or may be spatially concentrated to a utility scale as found in concentrated solar power (CSP). A national clean energy smart grid may direct energy long distances over high voltage lines from a renewable-rich region to requiring regions.

The design and construction of traditional electric energy systems has been heavily influenced by the desire to generate reliable, cost-efficient electricity, often at a distance from urbanized areas. The emphasis on cost efficiency led to reliance on energy-rich – and emission-laden – fossil fuels and a more centralized system of production. The public health impact of such an approach has been well documented. For example, for several decades it has been acknowledged that fine particle emissions generated from

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the combustion of fossil fuels in the generation of electricity contributes adversely to the health of the residents of a region (Responsibility 2009). But other forms of energy production, including renewable energy sources, while attractive relative to fossil fuels, may have other definable public impacts as well (Krewitt, Friedrich et al. 2002, Rabl and Dreicer 2002). For example, the physical location of a biomass fuel production site, concentrated solar power site, or the more distributed placement of PV and the associated storage and transmission infrastructure (Ferrey 2007) may condition property values and the built environment.

The built environment may condition retail options, recreational choices, and availability of medical venues, all of which may be connected to our health. Collectively, the placement of an electricity network will surely impact the qualitative environment, viewscapes, green space, public space, and property values (GAO 1995, Akella, Saini et al. 2009). Further, these changes in the landscape may have disparate impacts upon traditionally underserved populations. Unlike standard assessments of proposed portfolio mixes, our approach captures and quantifies the qualitative public health concepts that traditionally have not been considered an optimal energy source mix within a portfolio.

5.1. Electricity Portfolio Model

The energy portfolio comprises the electricity generation methods for the particular studied region. The size of each generation facility is characterized as a proportion in the portfolio. The size also determines the relative impact of the generation method on the critical grid attributes and the resulting effect on the grid. The electricity portfolio is primarily shaped by the energy policy and public assessment. Regional Energy Demand and Production is traditionally characterized to estimate the region as either a net importer or exporter of electricity. The net import/export of electricity effect has an economic impact which justifies a region's investment in electricity production.

Energy Demand represents the electricity requirements of a region expressed as a function of the regional population. Utility customers may be household or commercial, with the commercial customers consuming significantly higher amounts of electricity. However, the commercial activity can be assumed as a function of population. As such, the total demand of electricity is expressed as a function of population and per capita electricity consumption (household and commercial). In terms of generation, thermal power plants may utilize specific combinations of the aforementioned type of fuels depending on availability and cost. Also, a number of heat units are consumed to produce one unit of electricity depending on plant efficiency. Assuming constant plant efficiency, electricity produced may be modeled as a function of the quantity of each type of fuel burned and the respective heat content per unit. Figure 1 presents a causal loop diagram that integrates the public health and economic assessment within the energy portfolio. A brief explanation of main components follows.

5.1.1. Portfolio Dimensions

The central idea of the proposed approach is to suggest a mechanism that aids in evaluating each generation method considering the relative importance of relevant attributes. Based on the energy portfolio literature and the context discussed above, the following portfolio dimensions have been deemed as significant in terms of the impact that generate on energy portfolios:

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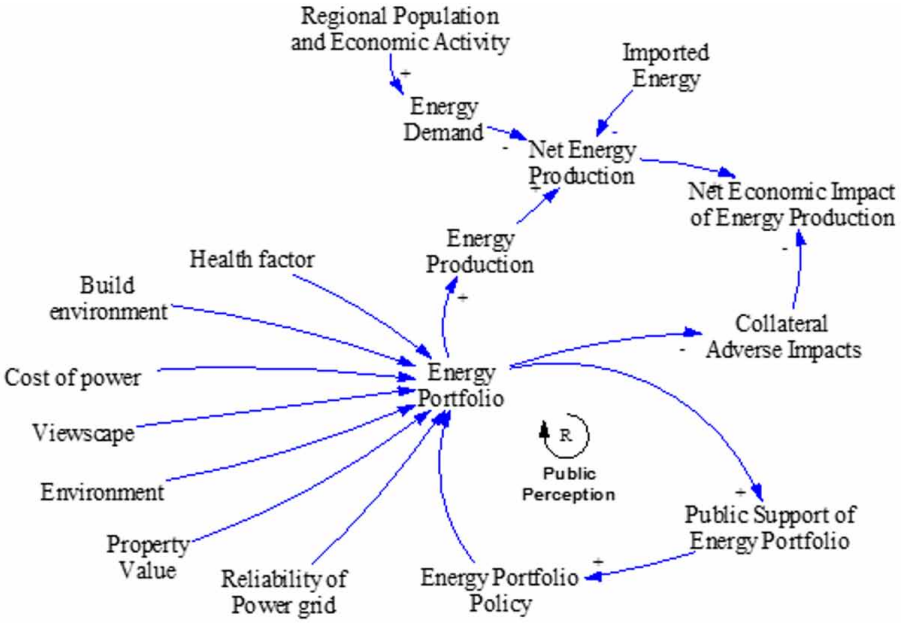
Figure 1. Causal-loop diagram



- **Reliability:** This factor represents the capability of a particular source to supply electricity with minimal and predictable interruptions. Generally, conventional sources of power are known to have higher reliability. Renewable sources such as wind and solar are known to be less reliable. Other factors that may influence reliability are fuel availability and the risk to supply disruptions;
- **Impact on Build Environment:** Neighborhoods in the vicinity most type of power plants and distribution infrastructure contribute to poor build environment. Power plants are likely to cause air and noise pollution. The local water sources may also be affected. Perceived radiation concerns are associated with nuclear plants, while wind power generation may contribute to noise pollution. In many cases, power plants will have a negative impact on the surrounding residential communities;
- **Impacts on Property Value:** The value of properties in the vicinity of power plants is likely to depreciate as they lose their attractiveness and perception that proximity may increase health risks. This may not be an issue if the plant is located in an industrialized zone or away from residential populations. The relative impact of this factor also depends on the type of power plant under consideration as well as the initial value of the properties impacted;
- **Impacts on Viewscape:** Obstructions of hill views or interruptions of horizon views from beaches are considered viewscape degradation. This particularly is an issue with wind power generation. This factor may have negative impact on tourism as well as on high valued properties in the vicinity. This may generate public opposition;
- **Cost:** A portfolio that contributes to an overall increase in the electricity cost is likely to draw public criticism. Generally, conventional sources are known to be the most inexpensive. However, as mentioned previously, other approaches like MVP may be able to lend economic justification for costly renewable sources, especially in light of highly fluctuating fossil fuel prices;

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- **Environmental Impact:** This factor considers the likely environmental impact of the proposed project. This depends on the awareness among the public on environmental issues. It is anticipated that this factor will have a strong influence on public support for the portfolio under consideration;
- **Public Health Impact:** This factor attempts to take into account the wider impact that electricity generation has on wellness;
- **Cost Impact Evaluations:** This dimension captures the assessment of the aforementioned factors using a monetary cost perspective. The results are deducted from the net anticipated economic benefit of the proposed portfolio project. In spite of the limitations imposed by capturing these costs, attempts are made to include and evaluate such factors. Such attempts are a critical necessity to evaluate potential environmentally sustainable energy generation;
- **Net Economic Benefit:** The net economic benefit factor forms a basic framework for evaluating the net economic impact of the proposed portfolio. Export of electricity from the region is considered as a positive economic impact, while import of electricity is considered as a negative impact. Similarly, public health and environmental cost impacts are deducted from the net economic benefit.

5.1.2. Evaluation Scheme

The evaluation scheme employed in this framework is centered on calculating the Scored Net Benefit and expressed as a weighted sum of the grid attributes as described above. Thus, different portfolio combinations may be evaluated on the basis of their performance on the 'Scored Net Benefit' factor. Furthermore, the factors indicated above are used to rate each type of power on each on reliability, build environment, property value, viewscape, and cost using the Likert scale (1-5).

The score is then multiplied by the share of that particular power type in the portfolio. This calculates the contribution of that power type in the overall score of that particular factor. The power types considered in this paper include Renewable power, Fossil Fuel power, and Nuclear power. The environmental factor is expressed as a function of the share of renewable energy in the portfolio. Then, cumulative scores obtained from factors per type of power type are determined. Each of these factors is multiplied by a weight assigned by subject matter expert (SME) to take into account the relative importance of each factor in public support and the resulting values are added together to get the final value of 'Scored Net Benefits.'

Notice that the development of a mathematical rigorous economic and environmental analytical framework is beyond the scope of this paper. This framework provides measures of performance relative to cost benefit of competing portfolios. Although this framework is not designed to provide prediction in real terms, it provides a starting point to incorporate and develop more sophisticated economic measures of performance. The scheme suggested in this work may assist decision makers in anticipating likely reactions to particular electricity portfolios in the consensus-building and decision-making process.

6. CASE STUDY

U.S. Virginia as a whole, and Southeastern Virginia specifically, can be expected over the next several decades to follow the trend towards the application of state-of-the-art renewable energy method as part of its electricity portfolio. The portfolio of sources employed in the generation of the total megawatt

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hours produced state-wide includes coal-fired (38.7 percent), natural gas-fired (18.8 percent), petroleum-fired (1 percent), nuclear (35.9 percent), hydroelectric inclusive of pumped storage hydro (3.2 percent), and other renewables including geothermal, photovoltaic, wind, municipal solid waste biogenic, and biomass (2.2 percent). Exclusive of pumped storage hydroelectric, in total renewables account for just 3.8 percent of the electricity generation.

Currently, there is negligible solar and wind contribution to the power grid serving greater Hampton Roads. While the region's potential for engaging renewable energy sources has not yet been realized, there are technological, geological, atmospheric, cultural, and social parameters that place practical limits on both the state and region's capacity to evolve its energy portfolio towards renewable energy generation. Despite the technological advances in the design and construction of wind, solar and geothermal systems within the past 40 years, the initial capital cost to purchase and install many of these systems make them, in the short term, less economically attractive relative traditional sources of power such as coal and natural gas (Karmis, Abiecunas et al. 2005). Government regulation can help spur the development, adoption, and implementation of clean coal technologies, but their emissions are still greater than other generating technologies (Center 2000). Despite these very real constraints, the size of the region's appetite for electric consumption has grown by roughly 3 percent per year. The Virginia Energy Plan, adopted by the state in the Fall, 2007 and extending through 2016, seeks to slow this rate of growth (especially through energy conservation) as well as increase electricity production to meet the expanding demand.

6.1. Energy Sources

The U.S. Hampton Roads region is home to three coal-fired plants, two natural gas plants, and one of the state's two nuclear power plants (the plant, in Surry County, contains two reactors). Aside from nuclear, coal is the state's primary resource for electricity generation. While the majority of Virginia's coal resources are located in the Central Appalachian Basin (Dickenson, Wise, and Buchanan Counties), roughly one-third of the coal consumed for electric power generation comes from the nearby coal fields in West Virginia and Kentucky. In addition to this 'imported' coal, in total nearly one-fifth of the electricity consumed within Virginia comes from neighboring states. In this context, the model includes as energy sources: load production, Wind, Photovoltaic, Landfill Gas, Hydro Electric, and Biomass.

6.2. Public Health

The complexion of the energy system is dependent, in part, on advancements in technology and the public's acceptance of the risks and costs associated with adopting the technology. The availability and access to affordable technology condition public health. In less developed regions, fuels such as wood, charcoal, and coal may be used for cooking and heating within the home, contributing to poor indoor air quality and associated poor health conditions. In more developed regions where the combustion of fuel is centralized and the generated electricity is distributed, the health-related impact stemming from proximate biomass conversion within the home is reduced (Wilkinson, Smith et al. 2007).

The current system is dominated by the coal- and gas-fired generation of electricity at centralized locations and the high voltage transmission across long distances to stations where it is distributed at lower voltage within a localized system. Relative to pre-centralized energy generation, the use of petrochemical products and the centralized generation of fossil-derived electricity has contributed substantially to better health and increased quality of life (Wilkinson, Smith et al. 2007, Frumkin, Hess et al. 2009).

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In addition, modern industrialized nations have seen gains in energy efficiency (e.g., decreases in the amount of energy to produce a lumen of light, propel an automobile, transport via airplane a person or cargo across the continent, or heat a typical residence). However, these efficiencies have also coincided with the overall growth in both affluence and energy consumption which, in turn, implies increased emissions stemming from combustion of fossil-based fuels (Tatum 1994).

Combustion produced emissions associated with electricity generation is a primary health concern. On average, the state produced 4.3 lbs of sulfur dioxide, 1.7 lbs nitrogen oxide, and 1,254 lbs carbon dioxide per megawatt hour generated (EPA 2010), although urban areas tend to have higher carbon dioxide emissions relative rural areas (Parshall, Gurney et al. 2010). Emissions from coal-fired power plants have long been recognized as contributing to the respiratory conditions and hospital admissions among adults and children (Cifuentes, Borja-Aburto et al. 2001, Peel, Metzger et al. 2007, Szyszkowicz 2008) and premature mortality (Hermann, Divita et al. 2004).

Urban air pollution stemming from the combustion of fossil-based fuels is characterized by atmospheric gases and particulate matter. Short-term exposure to airborne particulate matter (PM) in our urban environments has been associated with adverse pulmonary health effects and respiratory distress (Dockery, Ware et al. 1982, Ezzati, Lopez et al. 2002, Dockery 2009). The composition and size of this airborne matter, usually in the form of breathable particles in the range of 10μm or less, allows it to enter the respiratory system resulting in any number of symptoms including wheezing, coughing, infection, and impaired lung function. We can place an economic valuation (from a statistical life approach) on the premature mortality, illness, loss from work, and occupational exposure associated with the various combinations of electricity sources within an energy portfolio (e.g., Bird, MacIntosh et al. (2004), and Levy, Baxter et al. (2009)).

Electricity generation from renewable sources has fewer detrimental health-related outcomes relative to traditional gas- and coal-fired plants due to differences in type and quantity of emissions. While particulate matter in the form of air pollution possess a particular burdensome health concern, the construction and maintenance of the power systems including the transmission and distribution systems impose occupational hazards (Bird, MacIntosh et al. 2004) as well as the potential for accidents and terrorism (Karmis, Abiecunas et al. 2005).

Health disorders among the residents proximate conventional electricity generation, especially thermal power plants, have long been attributed to the presence of the plant. A host of disorder may arise due to air and water pollution resulting from power plants. In the present study, an attempt is made to statistically model the relationship between particulate pollution caused by thermal power plants and the occurrence of asthma in the surrounding area (measured by the asthma discharge rate).

Fine particulate matter (PM2.5) has been known as a dominant cause for aggravating asthmatic conditions in patients with this disease. Sources of PM2.5 can be broadly classified as mobile and point sources. The major mobile source of PM2.5 is vehicular traffic (on and off road) while a major point source are power plants. Laden, Neas et al. (2000) have reported that PM2.5 emissions from mobile sources have greater impact on public health as compared to non-mobile sources. However, they also warrant that the results need further validation. Hence, this study initially assumes that the emission from the power plants have a less impact as compared to mobile sources. This is accomplished assigning relevant weights to the respective emission source. As indicated by Laden, Neas et al. (2000), investigation to validate this assumption in this context is necessary.

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The PM2.5 emission from a thermal power plant will depend on the type of fuel burned. This relation has been expressed as multi factor regression in the present study. Modeling the emission factors for other point sources, mobile sources are beyond the scope of this study.

6.3. Data

Energy production rates are obtained from 1996-2006 and consider monthly plant-level data on generation, fuel consumption, stocks, and fuel heat content from utility and non-utility power plants (EPA, 2013). These data points are collected monthly from a model-based sample of plants. A regression-based imputation procedure is used to estimate state and national totals from the sample. After the end of the calendar year, annual data is collected from all plants not in the sample. The facility level data is for the most part observed data collected from the survey frame. Values for some observations may be estimated since either the facility did not respond in whole or part to the survey, or the observed data failed edits and could not be corrected or verified. In such case, the estimation procedure involves using a regression technique to determine generation values. Theoretical values include those assigned for a weighted evaluation scoring process that involves key portfolio attributes: Health factor, Build Environment, Environmental factors, Property Value, Reliability of Power grid, Viewscape, and Cost of power.

6.4. Numerical Analysis

The ability of the framework to support decision-making processes is evaluated in terms of its capacity to generate reliable output data by providing a simulation-based scoring method. The expectation is that the output data from the simulation model reflects actual data, thus, simulated values from the proposed model are generated without utilizing the actual values of the same parameter.

Three measures of performance in terms of energy production, public health, and environmental impact are thermal power generated, emission from power plant, and the asthma discharge rate per ten thousand population. Table 1 exhibits PM2.5 emissions for the Hampton Roads while Table 2 display the actual versus simulated values for power generation. The simulated values are based on regression equations generated to model the relationship between the corresponding predictors and response. These equations are embedded into the model and measures of performance are collected after model execution.

Table 1. Actual vs. simulated PM2.5 emissions

Year	Actual Emission PM2.5	Simulated PM2.5 Emission	Difference
1996	607	556	8.44%
1997	553	598	8.17%
1998	1,301	1,312	0.88%
1999	1,465	1,426	2.67%
2000	1,393	1,390	0.23%
2001	1,686	1,698	0.72%
2002	2,159	2,138	0.95%

Table 2. Actual vs. simulated power generation

Year	Actual Data (MMBTU)	Simulated Data (MMBTU)	Difference
1996	2,532,448	2,502,136	1.20%
1997	2,504,799	2,497,177	0.30%
1998	3,778,792	3,812,902	0.90%
1999	4,166,928	4,087,986	1.89%
2000	3,560,256	3,596,655	1.02%
2001	5,014,009	4,908,059	2.11%
2002	574,553	502,363	12.56%

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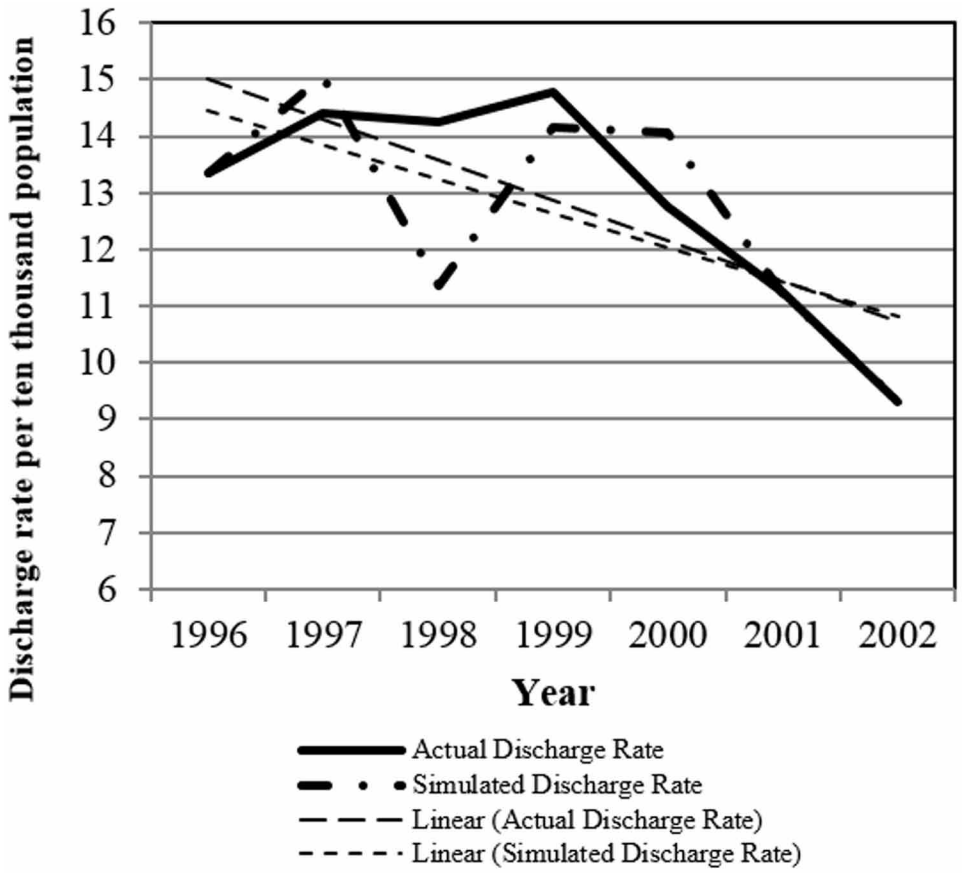
The comparison of actual and simulated values demonstrates a very close match which is expressed in the column *Difference*.

Comparison of actual and simulated asthma discharge rates is shown in the Figure 2. These results indicate that there is a reasonable match between actual and simulated values trend-wise. The deviation observed at some points can be attributed to other factors that are known to affect asthma patients but are out of scope of this study (e.g., natural factors like pollen, weather conditions such as humidity and temperature). However, as described by its behavior, the model is capable of mimicking asthma discharge rates for the region, which may be used to assess the impact of combinations of energy sources on such public health.

The primary parameters of interest in the output of the simulation are the 'Expenses for the region' from the portfolio and the 'Net Benefit' considering both public health and environmental impacts. Three potential theoretical scenarios that represent different portfolios combinations subject to discussion, adjustments, and approval from stakeholders may be described as follows. The scenario 1 represents a rather conservative energy portfolio that denotes a potential status quo of the current situation in which weights corresponding to Health, Build environment, Environmental, Property Value, Reliability of Power grid, Viewscape, and Cost of power factors are relatively low and maintained constant. The sec-

Figure 2. Actual vs. simulated asthma discharge rates



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ond scenario represents a moderate situation in which a relative importance is assigned to Health and Environmental factors while it assumed that reasonable investments are realized in the cleaner technology energy sector. The third scenario portrays a situation in which substantial importance is given to Health and Environmental factors accompanied by significant investments in renewable energy-generating technology that decreases the importing of energy from other regions. In the first scenario, is assumed that revenue is limited to $6.22 per unit produced. The revenue value per unit produced is assumed to be $6.67 and $7.24 for scenarios 2 and 3 respectively. These values assume an increase in the development and implementation of regional renewable technologies that decreases the necessity of the region to import energy from other states. Due to increases in regional energy consumption, increases in the magnitude of revenue per unit generated in the region are assumed. Results from the simulated environment in terms of net benefits for the region are exhibited in Figure 3.

As indicated, these measures cannot be independently verified with actual data since their lack to physical significance linked to them. Nevertheless, they have interpretational relevance, and hence, are relevant indicators of interest. Net Benefits for the region, shown in Figure 3, as stated before, stimulates public perception of the value of renewable electricity grid serving the affected population. Since the public is the ultimate customer for the grid, their perception is an important consideration in portfolio investment decisions. As expected, the conservative scenario (Scenario 1) does not show any significant change as the time goes by. In contrast, the moderate and significant renewable energy-generating investment situations show larger net benefits for the region as the time progresses. Clearly, the risk of the third scenario is higher as this scenario assumes that higher investments in renewable energy-generating lead to improvements in the reliability of the grid and obtainable economies of scales. Benefits of renewable energy for population health and the environment are largely documented in the literature. For example, as fewer particles are discharged in the environment due to the use of renewable energy technology, the expenses for treatment of asthma patients are expected to decrease for the region. As the number of people who suffer asthma decreases, the higher is the probability of incorporating these individuals to the regional workforce. It is widely known that this increase in the workforce leads to an increase in consumption and the revenues generated by taxes paid by these individuals that ultimately impact the economic growth of the region. The expenses for the theoretical scenario for region are presented in Figure 4.

Figure 4 indicates that Regional expenses decrease by scenario as more renewable energy portfolios are implemented. The linear increase observed in each scenario may be attributed to the increase of energy consumption in the region. The scenario that presents the most conservative portfolio costs more to the region since it assumes that renewable technology is marginally developed. This cannot offset the cost generated by importing energy from other regions. Scenarios 2 and 3 show cost improvements as the region becomes less energy-dependent from other regions while embracing renewable-energy technologies that positively impact the quality of life of the citizens that reside in the studied region. As indicated above, this scenario also assumes that an increase in the dependability of renewable portfolio is realized, and thus, potential economic efficiencies may be developed.

7. CONCLUSION

The evolution of an electricity portfolio does not take place within a static regional environment; it is expected that the region's demand for electricity will grow over the coming decades, despite conservation

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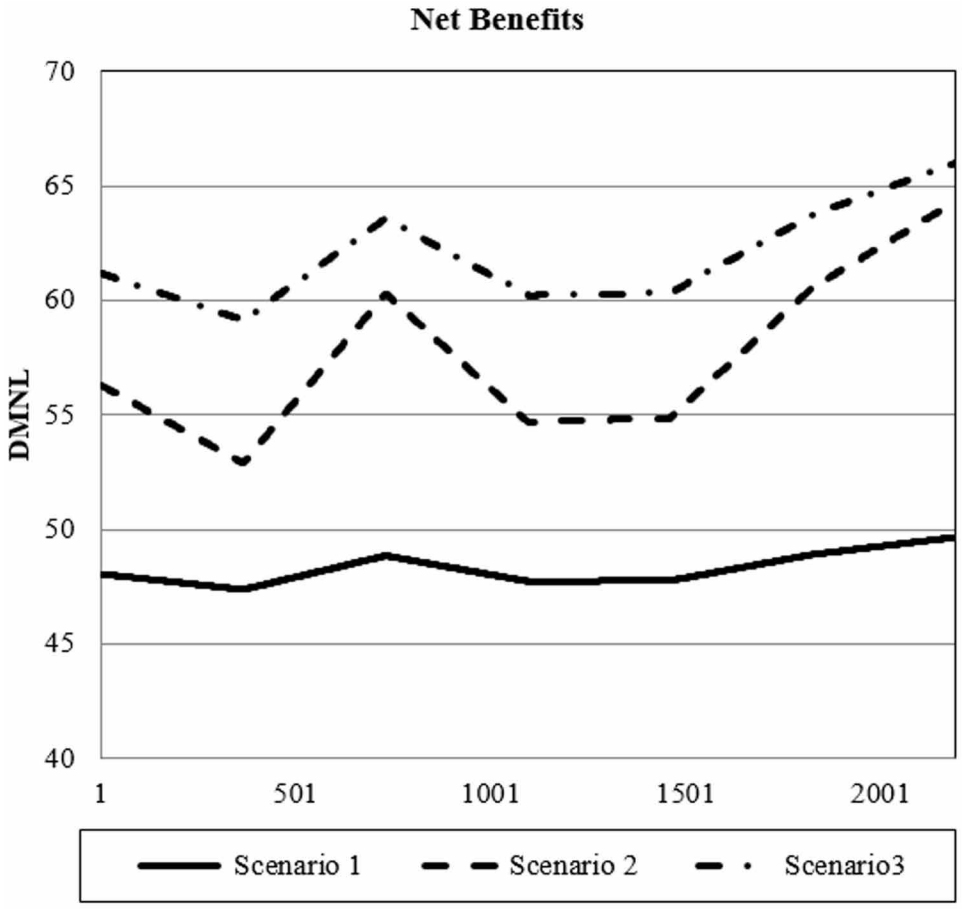
Figure 3. Trend for net benefit



and efficiency. Growth in the share of the region's electricity generation stemming from renewables (and less carbon-intense methods) does not necessarily assure a decrease in related disease and chronic conditions. It is conceivable, with the expansion in demand, that even modest growth in renewable-generated electricity may cover only this increased demand, let alone the replacement of electricity generated from retiring coal-fired plants or less-emissive gas-fired plants. The complexity of the system is evident: there is an imperative to meet exiting demand as well as the anticipated growth in demand, but this is within the constraints of the EPA's regulations and emissions caps, maintaining reliable and affordable electricity, and improving the quality of public health. The diffusion across the U.S. Hampton Roads region of less carbon intense forms of electricity production may not solely be a matter of technology, but one of cautious acceptance as the socio-political environment weighs the competing cost-benefit claims relating to economics and community health.

Embedding an optimization model that efficiently explores the complex decision space is proffered to find the optimal values considering the nature of the energy sources, storage, and transmission, as well as the health within communities. Thus, we envision developing and incorporating the most effective

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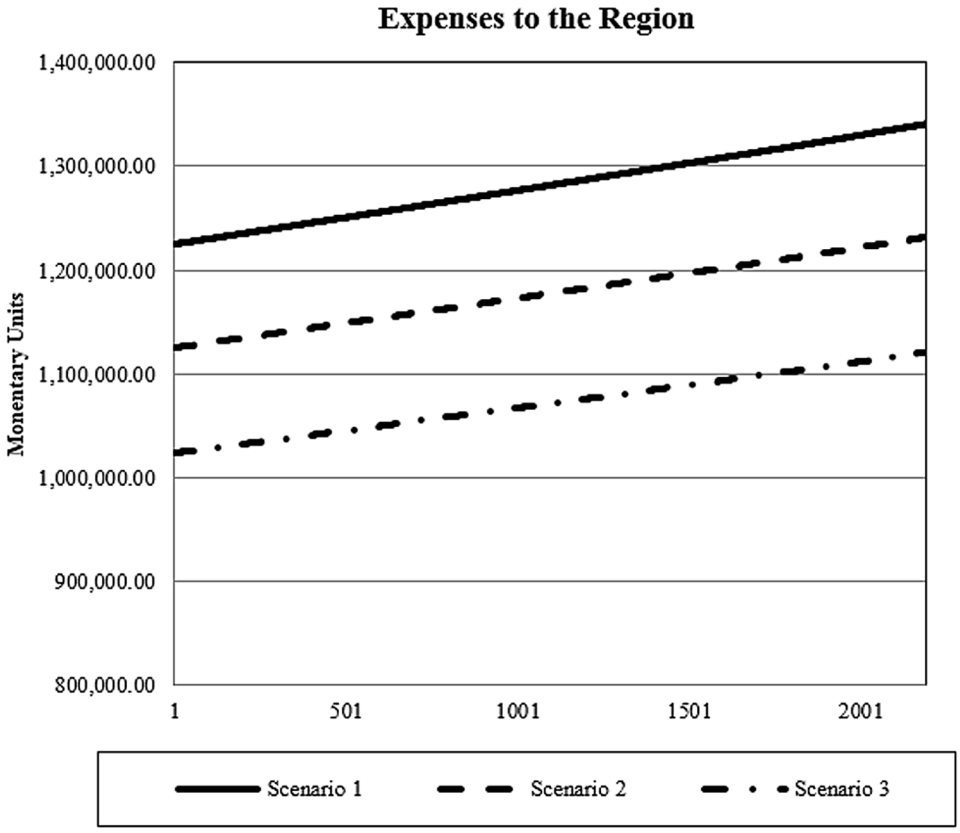
Figure 4. Expenses for the region



optimization technology to determine the set of values that solve the multiple and conflicting goals of maximizing energy efficiencies, minimizing non-renewable fuels, while minimizing socio-economic impact. Thus, future research includes embedding and adjusting a goal-seeking structure that assist in finding the values that strike these balance between these conflicting variables. An investigation of the elasticity related to relevant variables is required to accomplish this goal.

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Chapter 11
A Framework to Analyze Variation of the Satisfaction of Patients for Outpatient Needs: A Case of West Bengal, India

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ABSTRACT

This study explored outpatient healthcare seeking behavior in India and estimated predisposing and enabling factors that influenced the satisfaction derived from the health care activity. The study assumed that if these gaps are fulfilled in the local facilities, this might invigorate lesser popular public providers within the neighborhood. The study was conducted in the state of West Bengal India. A multilevel framework was developed to incorporate factors affecting the satisfaction of the healthcare activity. Analysis revealed dependency on regional facilities and extensive traveling. Excessive traveling affected satisfaction negatively whereas in cases where respondent availed services from local primary health centers had positive impact on satisfaction. On the route to daily activity, ability to visit referred facility and visit to facility with modern amenities often triggered satisfaction. Segmented policy designed to fulfill these preferences might be indispensable to enhance local sufficiency.

1. INTRODUCTION

Ensuring availability, accessibility, affordability and acceptability of health care facilities might facilitate outpatient needs in developing countries. Providing appropriate health care facility within the neighborhood is a necessity to incubate self-sufficient neighborhoods and to enable outpatient health care activity. Health care seeking behavior in developing nation like India depicts a complex tradeoff manifested by variations in selection of health care facility and travel patterns. It is generally hypothesized that demand

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supply mismatch (*enabling factors*) often instigate search for opportunity based on *predisposing* factors, further influenced by *needs* (Andersen, 1968). Traveling for longer period, dependency on existing social networks, & delay endorses low acceptability and mismatch of expectations especially due to defunct and dilapidated state of the health care facilities plagued with lack of trained medical personnel. In the context of India, detouring of the local facilities have been observed and reported (Duggal, 2001), consequently, local public health care facilities often are unable to attract consumers (K. D. Rao, Peters, & Bandeen-Roche, 2006) and remain underutilized.

In India, governmental initiatives have often been criticized for concentrating more on building health care infrastructure while neglecting policy measures to assure quality and integrate hierarchy and referral systems (Nundy, 2005). As availability of public facilities were being ensured, Ergler, Sakdapolrak, Bohle, and Kearns (2011) based on their study in India, reported that availability of health care facilities (HFs) within walking distance is a necessity but does not ensure satisfactory access. Inability to provide patient centered facilities (for details see (Jayasinghe et al., 2008; Stewart, 2001)) often expanded the gap, generating mistrust and forsaking of the service, in both urban and rural areas (Hammer, Aiyer, & Samji, 2007) highlighting 'acceptability'. Private HFs although are often accused of inequity and consumer exploitation (Purohit, 2001), attracted patients as it filled in the gaps, by providing user friendly interfaces. It has been reported that between 1986–7 and 2004, the absolute expenditure per outpatient visit and inpatient visit in rural and urban areas have increased phenomenally (K. S. Rao, Selvaraju, Nagpal, & Sakthivel, 2005). However it should be noted that all public facilities, including general outpatient wards or specialized services, offer services at nominal prices (Kumar et al., 2011). In this context, the field surveys conducted in West Bengal, India, yielded the following observations: It was observed that although the local public facilities might be cheap, but overall health care seeking episode often remained incomplete due to defunct medical equipment or unavailability of prescribed medicines. Therefore, consumers tend to (1) undertake additional commuting to other facilities and (2) often spent beyond their expected limits, with undesired consequences such as health shock (Mahal, Karan, & Engelgau, 2010). Regional public services were mostly overcrowded and the patient to doctor contact time was relatively low. Those visiting private general physicians (GPs) incurred higher out of pocket expenditure but experienced satisfactory contact period. People in general opined that single window health services (enablement) often added to higher satisfaction as it reduced insecurity and uncertainty.

Inherently, patients and their family often undertook complex trade-off to engage in health care activity. Predisposing factors such as preferences, attitude, and trust played a vital role in health care seeking behavior and often affected the overall satisfaction of the health care seeking activity. Researchers often regarded satisfaction as a function of expectations and experiences of the users (McKinley & Roberts, 2001; Thompson & Sunol, 1995) and considered satisfaction as an indices of service delivery and means for evaluation of the HFs (Baker, 1996). In this purview, it can be argued that higher satisfaction might assure continued use of the selected medical service (Jang, Kim, & Chiriboga, 2005; Thomas & Penchansky, 1984). For outpatient health care activity, enablement factors such as, wait for an appointment, ease of access to information, and sympathetic communication, is reported to affect satisfaction significantly (Salisbury, Wallace, & Montgomery, 2010). However, there are limited numbers of studies that looks into interaction of the predisposing and enabling factors on the satisfaction of the outpatient health care activity in developing nations, under variable constraints and tradeoffs. Our quest in this research is to (1) assess the role of predisposing and enabling factors on satisfaction of health care activity, (2) analyze the interaction of the factors at two levels, namely patient level and HF level and (3) formulate strategies to improve the user ship of public HFs.

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The following sections are organized as follows. In the second section, the suggested methodology and the data is described. Section three elaborates the results of the application of the suggested framework on West Bengal, India, following a discussion on the policy implications. The final section concludes the study.

2. METHODOLOGY AND RESEARCH FRAMEWORK

In line with the 'Andersen's utilization of health care model' (Andersen and Newman, 2005; Andersen, 1995), the authors argue that two distinct levels of interactions interplayed in the health care seeking process: Firstly, the 'predisposing' characteristics of the patients and secondly the 'enabling' factors (extrinsic health care facility characteristics). It is evident that the enabling factors influence the health care seeking processes at the individual (patient) level. Hence, the constructs are defined at different levels, and the hypothesized relations between these constructs operate across different levels. Identification of the factors at both levels might be helpful in health care infrastructure planning and policy formulation, while improving 4As on one hand and increasing the user-ship of local public HFs on the other. Table 1 describes the predisposing and enabling factors used in the analysis and following sections describes the variables briefly.

The "self-rated satisfaction" was considered as the dependent variable. The respondents were asked to answer the following question "Rate the satisfaction of the health care seeking activity considering travel and health care activity in the scale of 1 to 5?" Following the rule 1 = highly unsatisfied and 5 = highly satisfied.

Variable depicting location based socioeconomic status, 'enabling' travel characteristics and associated social interaction and collaboration, 'predisposing' characteristics of the patients and the 'need' have been included at the patient level. It is noteworthy to mention that the authors did not consider the educational parameters as Muller (2002) pointed out that the lack of a high school education accounts for an income inequality effect.

Demographic data and socioeconomic status - In accordance with the brimming disparity between urban and rural areas in India and differential price indexes, the authors defined the location into three sub groups namely, urban, rural and suburban; and economic status into two subgroups namely 'poor' and 'others'. Economic segregation were derived based on: Occupation pattern such as 'poor' were represented by temporary labor jobs, rickshaw pullers, workers at unorganized sectors etc., whereas those with permanent jobs, regular wage earners, professionals and entrepreneurs were classified as other. The economic classification was further verified with respect to type of cooking fuel used. Those using firewood, coal, coke and dung cakes were classified as poor. The location based economic variables were thus subdivided into six groups (see table 1).

'Enabling' travel characteristics and need for social interaction variables have been incorporated as follows:

- One-way travel time from patient's residence to the selected HF
- Type of trip; which was segregated as local trips or regional trips, where local trips are those which are restricted within one's own neighborhood/district, whereas, regional trips are those which are beyond one's own district or even state (but within country) (Bardhan, Varghese, and Jana, 2015).

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Table 1. List of variables

Variable Name	Description	
IID	*Patient code*	*(n=125)*
HID	*HF code*	*(n = 42)*
Overall Satisfaction	*Dependent Variable; Revealed satisfaction of the patient* *Scale:* *1= Strongly dissatisfied (4%); 2= dissatisfied (17.6%); 3=neutral (24.8%); 4=satisfied (45.6%); 5=Highly satisfied (8%)*	
Predisposing factors (Individual Characteristics)		
Travel time	*One way travel time from the patient's residence to the chosen HF (in minutes).*	(μ=29.33; σ=48.68)
Number of companions	*Number of accomplice in the trip*	(μ=1.10; σ=0.76)
Automobile Availability	Number of motorized vehicles available in the household	(μ=0.85; σ=1.02)
Trip	*Type of trip; 0 = same day; 1 = multi day*	
Location and Economy	*Socio economic segregation based on the location aspects.* *1 = Urban Others (35.2%); 2 = Urban Poor (16%); 3 = Suburban Others (20%); 4 = Suburban poor (8%); 5 = rural others (16.8%); 6 = rural poor (4%)*	
Need		
Disease typology	1 = long term non critical illness (D1); 2 = long term critical illness (D2); 3 = short term non critical illness (D3); 4 = short term critical illness (D4);	
Enabling Factors depicting availability, accessibility, affordability, and acceptability (4As)		
Connectedness	1 = if the reason of selection of doctor is accessibility; else 0	(μ=0.26)
Goodwill	1 = if the reason of selection is reputation of the doctor ; else 0	(μ =0.50)
Price	1 = If the relative price of the chosen HF is cheaper; else 0	(μ =0.36)
No other option	1 = if the patient is familiar with the HF or knows somebody in the HF; else 0	(μ =0.40)
Referred	1 = If the patient have been referred to the HF ; else 0	(μ =0.21)
Family Doctor	1 = If the visited doctor is family doctor; else 0	(μ =0.66)
Modern amenities	1 = if the reason of visit is the higher LOS; else 0	(μ =0.18)
On the route	1 = if the HF falls on the route to the work place; else 0	(μ=0.17)
Convenient timing	1 = if the chosen HF falls within the convenient time of the patient and the respective companions; else 0	(μ=0.30)
Collaborating households	Number of participating households in the health care episode	
Enabling Factors (Characteristics of the HF)		
Provider	Typology of service provider; 1 = Public and 0 = Private	
LOS	Level of service of the HF 2 = LOS-2; 3 = LOS-3; 4 = LOS-4; 5 = LOS-5;	
Overall cost	1 = Low; 2 = Medium; 3 = High The overall cost of the health care activity has been calculated taking into account the cost of transportation, health care service, medicine and allied diagnostic checkups. Assuming that the price component associated with the travel and other allied are indispensable, the authors converted the continuous cost variable into categorical variable by agglomerative hierarchical clustering method (Clatworthy, Buick, Hankins, Weinman, & Horne, 2005) in R (version 2.15.2). We divided the data into three cluster based on the squared Euclidean distance between the pair of objects measuring (dis) similarity between pairs.	
Waiting time	Waiting time of the patient at the HF. (in minutes)	(μ=43.99; σ=32.04)

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- Number of motorized vehicle (two and four wheelers) available in the household.
- Information on accomplice and interaction among different households in activity

Measuring predisposing and enabling variables constituting availability, accessibility, affordability, and acceptability (4As) - The purpose was to understand the influence of subjective and cognitive understanding of the patients on variables such as, ease of access, familiarity, quality of service and price.

- Accessibility:
  a. Connectedness & spatial accessibility - if the reachability of the HF is considered high
  b. Trip chaining - on the route to daily activity and
  c. Temporal accessibility – if no rescheduling of general activity is observed by the patient and companions.
- Acceptability
  a. If the selection was due to the unavailability of the preferred HF,
  b. If referred by a well-wisher
- Availability
  a. No other options
  b. Reputation or goodwill,
  c. Availability of modern facility and required amenities and
- Affordability
  a. Expected price suiting the budget of the patient.

2.1. 'Enabling' Health Care Characteristics (Facility Level)

To analyze the effects of the health care infrastructure on the patients, following variables were considered: the type of service provider (public or private), the LOS of the service provider, activity wait time at different HFs and the reported total expenditure towards the health care activity. Cost of service becomes imperative due to unavailability of outpatient medical insurance system. However, the public health care service fee is nil in rural primary health centres (PHCs), public health care dispensaries in urban areas charged a nominal registration fee. In most of these public facilities, diagnostic tests are also conducted free of charge with certain documentation and provide medicines free of cost to the patients depending on availability. In private facilities, there is a cost component associated with all the services.

Considering the ordinal nature of the dependent variable, the authors applied ordinal probit regression technique on a hierarchical data. Ordered probit models have been quite widely used to analyze self-rated responses in patient and consumer satisfaction (Carlsena & Grytten, 2000), health status (Rivera, 2001), and severity analysis (Abay, 2013; Yamamoto, Hashiji, & Shankar, 2008). Application of multi-level models has been effective in several health care and related researches (Ichida et al., 2009; Murayama, Wakui, Arami, Sugawara, & Yoshie, 2012; Oshio & Kobayashi, 2009). Additionally multi-level models could be instrumental in analyzing patient's experience and satisfaction. Moreover, this methodology might be appropriate for avoiding atomistic fallacy (Hox, 2002), ecological fallacy (Freedman, 1999), introduction of independent variables from different levels and to allow interaction of variables between levels. The model assumed that the regression coefficients apply equally to all contexts (Goldstein, 2003; Luke, 2004). For example, individuals visiting different HFs, presumed that the given selection

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would yield higher satisfaction over the others and this selection was again a function of several enabling characteristics of the HF itself.

To analyze the effects of the ordinal responses, it was assumed that there was an unobserved latent variable (∂) which was related to the actual response through the "threshold concept". In this research as there are five responses (see Equation 1), hence threshold values ∂_1, ∂_2, ∂_3, and ∂_4 were assumed, where ∂_0=-∞ and ∂_j=∞.

$$Y_{ki} = \begin{cases} 1 \text{ if } & -\infty \le Y'_{ki} \le \partial_1 \\ 2 \text{ if } & \partial_1 < Y'_{ki} \le \partial_2 \\ 3 \text{ if } & \partial_2 < Y'_{ki} \le \partial_3 \\ 4 \text{ if } & \partial_3 < Y'_{ki} \le \partial_4 \\ 5 \text{ if } & \partial_4 < Y'_{ki} \le \infty \end{cases} \quad (1)$$

Based on the research quest, there were k = 1, ….N level-2 (HFs) and I = 1, …n level-1 units (patients) nested within each HF (level-2 units). The mixed effect regression model for the latent response variable Y_{ki} could be thus written as follows (Equation 2):

$$Y_{ki} = x'_{ki}\beta_k + w'_{ki}\alpha + e_{ki} \quad (2)$$

where w_{ki} is the p x 1 covariate vector and x_{ki} is the design vector for *r* random effects, both vectors being for the *i^{th} level-1 unit nested within HF level-2 unit k.* α is the p x 1 vector of unknown fixed regression parameters, β_k is the *r x 1* vector of unknown random effects for the HF level-2 unit k, and e_{ki} were the model residuals. The distribution of the random effects was assumed to be multivariate normal with mean vector μ and covariance matrix Σ_β, and the residuals were assumed to be independently normally distributed with mean = 0 and variance σ^2. Due to the increasing nature of the ordered classes, the interpretation of the model's primary parameter set α was as follows: positive sign indicate higher satisfaction level as the associated variables increase, while the negative signs suggested the converse.

2.2. Study Area and Data Collection

The study was conducted in the state of West Bengal, India. Administratively the city of state of West Bengal is divided into several districts, where each districts housed its own administrative headquarters. These administrative headquarters are the majorly urban nodes housing state and district health care facilities. The survey was conducted in few wards of Kolkata Metropolitan city (KMC), in the suburban areas of KMC and in the rural areas in adjoining district of KMC. Kolkata is the administrative capital of the state West Bengal India and houses major health care research institute and hospitals. A detailed health infrastructure survey was conducted followed by questionnaire survey in November 2012. The study area exhibited the presence of different service providers offering varied level of services (LOS). The LOS of the providers were calculated on basis of the variables such as number of beds, number of doctors, number of departments or specialization, number of diagnostic tests that can be conducted at the facility and availability of medicine. Each of the service providers were differentiated into five major levels, where, G5 (state hospital and above) or P5 (multi-specialty private hospital) being the highest

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LOS and G3 (PHC) or P2 (General Physicians (GP)) being the lowest LOS considered in the research. These included some of the large public medical college hospitals to sub-health centers and vice versa for the private services as well.

A paper based close ended questionnaire survey was designed to capture the health care seeking behavior of the respondents. A total of 125 samples were collected. A household was selected if any of the resident members undertook outpatient health care seeking tour in last one month from the date of survey. The survey considered cases based on the following conditions, (1) if the age of the patient was above 18, and (2) did not considered diseases and ailments such as maternal care and pregnancy, psychological disorder, accidents and burns. In addition to the socio-economic and socio demographic information, data pertaining to the perceived impression of health infrastructure in the neighborhood, health care travel activity diary of the individual and the companions were collected. Respondents visited 42 different HFs. The disease typology was categorized into four classes as proposed by Kato, 2011, namely: long term critical (D1), long term non-critical (D2), short term critical (D3) and short term non-critical (D4). The cross tabulation of the data showed that 32% of the respondents visited HFs within the neighborhood. 53.6% travelled to other neighborhood within the district, out of which 76.1% had at least one companion. Remaining 14.4% travelled beyond the district and were accompanied by at least one companion.

3. RESULTS

In the random intercept and slope (base) model, the patient level predisposing variables corresponding to the activity, such as numbers of accomplice and household characteristics like automobile availability and travel time were tested on the overall satisfaction of the health care episode. Analysis of the three covariates, emphasized that the travel time had a negative effect on the satisfaction, whereas, automobile availability and number of companions, had a positive effect on the satisfaction levels. The effect of 'travel time' and 'automobile availability' on satisfaction level of patients did not differ across HFs, whereas, the effect of number of accomplice was significant. The model 1B was formulated as follows:

$$Y_{ki} = \beta_{k0} + \beta_{k0} Ncomp_{ki} + \alpha_0 + \alpha_1 Ncomp_{ki} + \alpha_2 Travtime_{ki} + \alpha_3 Auto_{ki} + e_{ki}$$

where the vector of the unknown parameters β_t in the mixed effect regression model was extended to include both intercept and slope effects.

The intra-cluster correlation coefficient (Killip, Mahfoud, & Pearce, 2004) for the model was calculated to be 0.292, which indicates that 29.2% of the variance could be attributed to the differences between HFs. The between HF variance reduced from 0.41 to 0.33, which suggested that distribution of patients by number of companions differs from HF to HF. Based on the findings from the previous model, we a series of models were constructed to infer the contextual impact on the satisfaction level of the patients (see Table 2 & 3). Travel time and support for the activity, i.e. number of companions were retained in the model, being the compulsory part of the activity. Subsequently, 'location based socio-economic variables', outpatient trip typology as undertaken by the patients, and the 4As that prompted the health care activity were incorporated discretely in random intercept models. The multi-day tours might have

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Table 2. Model incorporating 4As

Fixed Effects	Estimate	t value
Intercept	2.04	4.69**
Travel time	-0.01	-3.20**
Number of companions	0.66	3.30**
4As		
Well connected	-0.32	-1.03
On the route	0.70	2.08*
Convenient timing	0.19	0.67
Preferred HF were unavailable	-0.42	-1.60
Referred	0.65	2.03*
No other option	-0.09	-0.36
Goodwill	0.32	1.26
Modern Amenities	0.84	2.32*
Price	-0.11	-0.33
Thresholds		
∂_2	1.34	4.90**
∂_3	2.36	7.21**
∂_4	4.29	9.78**
Random effects	Variance	
HID (Intercept)	0.12	
Number of companions	0.02	
Deviance	289.44	

Note: '***' 0.001 '**' 0.01 '*' 0.05

a lower satisfaction with respect to the same-day tours, but overall effects were not significant. It was observed that in most cases the destination of the multi day tours were metropolitan urban areas (patients mainly visited Kolkata). Hence, there remained a possibility of mixing the purpose of the trip with social activity (visiting relatives and extended family such as family member immigrated to the city for job or other purposes) and retail activity in addition to health care activity. However, it should be noted that trip typology, economical factors and locational parameters did not affect satisfaction level significantly.

In spite of connectedness being a prime accessibility factor, it exhibited an insignificant yet negative impact on the satisfaction derived from the overall activity, this might be linked to other enabling factors influenced by health care infrastructure itself, such as, pricing, goodwill and type of services offered and so on). The variable 'HFs on the route to the mandatory activity' was found to be positive and significant, whereas 'convenient timing' for the patient and his/her companions was positive but insignificant. Inability to visit preferred HF decreased satisfaction and trips to a HF as there was 'no other option' had a negative effect. Reputations of the HF, such as the goodwill and the availability of modern equipment, had a positive effect whereas price had a negative effect on overall satisfaction. Availability of modern facilities as understood by the patient and their family often affected satisfaction significantly.

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Table 3. Results of the models depicting the patient level and HF level characteristics

	Predisposing (Individual Characteristics)		Enabling (HF Characteristics)	
Fixed Effects	**Estimate**	**t Value**	**Estimate**	**t Value**
Intercept	1.70	4.10**	1.71	5.21**
Travel time	-0.01	-2.62*		
Number of companions	0.59	2.99*		
Automobile Availability	0.20	1.46		
Urban poor	-0.12	-0.30		
Suburban poor	-0.14	-0.27		
Rural poor	-0.21	-0.37		
Modern Amenities	0.87	2.48*		
Referred	0.48	1.99*		
On the route	0.77	2.45*		
HF wait rime			0.00	0.58
Exp_cost_high			0.68	1.90
Exp_cost_low			-0.33	-0.47
G3			0.05	0.06
G4&G5			-0.32	-0.42
P4&P5			-0.30	-0.70
Thresholds				
∂_2	1.32	4.73**	1.08	4.83**
∂_3	2.31	7.06**	1.87	7.25**
∂_4	4.21	9.67**	3.61	9.99**
Random Effects		Variance		Variance
Intercept		0.38		0.23
Number of companions		0.02		-
Deviance		291.90		323.85

Note: '***' 0.001 '**' 0.01 '*' 0.05

3.1. Analyzing the Role of Individual Characteristics and HF Level Characteristics on the Satisfaction

The estimation results of two ordered probit models (a) based on predisposing individual characteristics (patient level) and (b) based on enabling HF level attribute are presented in Table 3. At the patient level: the urban, suburban and rural poor had a relatively negative satisfaction level with respect to the 'others', however, it was not significant. The typology of service providers, LOS of the HF, overall expenditure pattern of the health care activity at the chosen HF, and the waiting time at the respective HFs were incorporated. Prolonged waiting time, did not affect the satisfaction significantly.

The estimation results of the interaction of the patient level and HF level variables are presented in table 4. The interaction between travel time and typology of HFs showed some intriguing results, highlighting locational disparity among several types of service providers.

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Table 4. Result of the model incorporating interaction

Fixed Effects	*Estimate*	*t value*
Intercept	1.08	2.03*
Number of companions	0.90	4.26*
Automobile Availability	0.17	1.19
Ensuring 4As		
On the route	0.70	2.20*
Referred	0.52	2.45*
Modern Amenities	1.30	3.50*
HF wait	0.01	1.12
Exp_cost_high	0.20	0.64
Exp_cost_low	-0.22	-0.46
Travel time X P2	0.02	2.06*
Travel time X P4&P5	-0.01	-2.87*
Travel time X G3	-0.01	-0.33
Travel time X G4&G5	-0.02	-3.54*
Suburban X Public	-1.11	-1.49
Rural X Public	0.14	0.23
Thresholds		
∂_2	1.38	4.59**
∂_3	2.44	6.46**
∂_4	4.45	8.58**
Random effects		Variance
HID (Intercept)		0.34
Number of companions		0.08
Deviance		272.96

Note: '***' 0.001 '**' 0.01 '*' 0.05

4. DISCUSSIONS

It was observed that under the given supply situation, the mean travel time to the health care facility varied with respect to LOS chosen, such as for GP: time (μ=18.13; σ=17.15); for private multispecialty & general hospital: time (μ=40.40; σ=62.09); for general and multi-specialty public medical college hospitals: time (μ=76.56; σ=86.09). Although travel time to the facility exhibited negative relationship with overall satisfaction, but for GP and PHC the relationship was not significant. Therefore if the existing PHCs are upgraded to fulfill the 'need' of the users; it might lead to local sufficiency, curbing the travel needs. The health care seeking survey revealed that travel to particular facility was governed by the seriousness of illness as well. The factor of uncertainty based on previous experience that the local PHCs/GPs might not be able to provide adequate treatment, often triggered selection of facility with higher LOS. Constraints like restricted mobility, unavailability of specialist especially for NCDs (Non-communicable diseases), and unavailability of laboratories also affected the selection.

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Models depicted that the effect of travel time to GP was positive and significant, whereas in case of higher LOS (for both public and private providers), it was negative and significant. Distinct differences in the user ship of the public and private providers offering higher LOS facilities were observed. 82% of the people attending the public service can be categorized as 'poor', whereas for the private counterpart the user ship of 'poor' was almost null. Moreover, it seemed that the public facilities in suburban areas were yielding negative satisfaction with respect to their rural counterparts. This might be due to the predominance of private providers in suburban areas.

4.1. Policy Intervention

With regard to the inadequacy of the "expectation-fulfillment" (Baron-Epel, Dushenat, & Friedman, 2001), we tried to emphasize on the predisposing and enabling characteristics that might be affecting the satisfaction. It had been already been pointed out that distance to HFs in India negatively affected the demand for outpatient health care needs, and demand was found to be price and income inelastic (Sarma, 2009). Moreover availability of HFs essentially did not corroborate utilization (Nair, Thankappan, Vasan, & Sarma, 2004). These additionally suggested that without essential upgrade, new facilities might be underutilized. The default growth of private HFs(Costa & Johannson, 2011) has a close connection with the underperformance of the public facilities.

Following the results of the estimated models, the major causes of dissatisfactions were travel time, availability of desired services and facility, amenities housed within a health care facility and cost, we suggested policy interventions to (1) improve utilization rate of the neighborhood HFs, (2) reduction of travel demand for outpatient needs. Another motive was to reduce the regional tours and decrease mobility based dependency. We propose infrastructure scenarios, which might be instrumental in reducing out of neighborhood trips and companionship (Jana, Harata, Kiyoshi, & Ohmori, 2014), consequently lowering out-of-pocket expenditure.

This study shows that to facilitate 4As, it might be essential to: (1) Upgrade the existing facility especially the PHCs and the sub-health centers in the rural and urban areas to house 'modern amenities' thereby ensuring utilization and enhancing 'goodwill'; (2) Allocate transportation facility especially in the rural areas, where the availability of impromptu rented services is a rarity, this might ensure 'well connected; and (3) Instigate self-sufficiency of neighborhood while reducing travel demand at the source, initiation of the telemedicine services might an alternative. Moreover, telemedicine would be resourceful in communicating with specialist, which could instill the perception of ability to communicate with desired resources. This can be achieved through better outreach programs and design policies for segmented target groups such as elderly. In this regards, it is noteworthy to mention interventions such as 'National Programme for Health Care of the Elderly' (NPHCE) by Ministry of Health and Family Affairs, Government of India, which seeks to address "accessible, affordable, and high-quality long-term, comprehensive and dedicated care services to an Ageing population" (Ministry of Health and Family Welfare, 2011). Currently the 'Rashtriya Swasth Bima Yojna' an insurance scheme initiated by Ministry of Labour and Employment, Government of India aims to provide insurance to population below poverty line in India, however, such schemes are not applicable for outpatient needs. Moreover the 'National Urban health mission 2013' and 'National Rural Health Missions 2005' have been formulated to undertake necessary architectural corrections, to reinvigorate the defunct and dilapidated health care facilities and house them with adequate medical personnel at the same time upgrade and modernize the facilities.

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As in most cases, it was observed that regional tours initiated from the neighborhoods where there was unavailability of emergency service. People tend not to take risk but to travel to the HFs operational with greater time window. Hence, it might be prudent to initialize greater time window or strengthen emergency services in selected PHCs depending upon the existing infrastructures and population density.

5. CONCLUSION

This paper explored the variation of the satisfaction of patients availing different HFs for outpatient needs. Analysis revealed the importance of enabling 4As on satisfaction, emphasizing the needs to design policies towards enhance of availability, accessibility, affordability and acceptability (4As). Understanding the factors that affected the selection of health care service is prudent for future health care provisioning. In the resource constrained countries like India, the research framework proposed might be provide base for prioritization of health care development policies. Based on the knowledge of the author, this is perhaps the first study on developing country like India, on which both the predisposing characteristics and enabling characteristics have been estimated simultaneously emphasizing 4As. The paper points out the need for segmented approach of policy intervention to meet the needs of the diversified socio economic groups in developing nations.

There are several limitations is this study. Firstly, models would have been more sensitive, if they were segmented, based on 'socio-economic classifications' and further validated with segmented models based on 'tour type'. In this study, the authors could not perform such analysis owing to sample size, which remains a major task for future research. Secondly, the scenario of 'do-nothing' was not considered in this research; there remains a job for future undertaking. Thirdly, the strategies described have not been validated with respect to the existing health care policies and five-year plan of the India. Fourthly, although the strategies have been based on certain statistical findings, but there is a need to evaluate with larger perspective of socio-economic dynamics. Additionally people's feedback and acceptance of these strategies needs to be carefully analyzed and sought.

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Chapter 12
Promoting Health Literacy in Global Health Care

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ABSTRACT

This chapter emphasizes the prospect of health literacy; the evaluation of health literacy level; health literacy and health communication; health literacy and health information; and the current issues of health literacy in global health care. Good health literacy is important because patients are living longer and experiencing a wider range of health issues. Health professionals must commit to promoting for improved health literacy in health care organizations and should establish the specific health care goals toward improving health literacy in strategic plans, performance plans, programs, and educational initiatives. Health professionals can utilize a broad range of health communication strategies to ensure patients understand their options and share their health care decisions. Through health education and training, effective health information can help promote patients' health literacy level in global health care.

INTRODUCTION

Health literacy is recognized as the important domain in a conceptual model of health promotion (Šramová, 2015) and is related to the effective health indicators that include self-reported health, daily functioning, risk for hospitalization and death, and use of health care services (Bostock & Steptoe, 2012). Nowadays, reliable health information is essential and currently easily available to most patients in the health care industry (van der Vaart et al., 2012). Low health literacy is the important problem in low and middle-income countries as these countries have high poverty rates and low rates of health education (Keikelame & Swartz, 2013). Patients with low health literacy have poor knowledge about their illness, experience difficulties in accessing health care, have poor self-care, have lower levels of quality of life, and have poor health outcomes (Elliot & Shneker, 2009), including higher risk for premature deaths (Barnett & Kaske, 2012).

The communication between health care professionals and patients should encompass educating patients about the knowledge and the processes to enhance the quality of care in health care settings

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(Kazandjian, 2012). To prepare for the transition from pediatric to adult-oriented health care systems, adolescents must develop the ability to obtain, process, and understand basic health information; make appropriate health decisions; and effectively interact with health care professionals (Huang, Tobin, & Tompane, 2012). Health literacy is an important factor in health disparities (Morrison, Brousseau, Brazauskas, & Levas, 2015). Al Sayah et al. (2013) stated that inadequate health literacy has been found to adversely affect health outcomes, especially in low-income patients with chronic diseases. Berkman et al. (2011) indicated that routine screening for inadequate health literacy in health care settings has led to an increased interest in health literacy evaluations.

Suitable health care interventions (e.g., materials written in plain language and brief counseling approaches) effectively improve the parent's health knowledge and medical adherence (DeWalt & Hink, 2009). Low health literacy is associated with individuals from lower socioeconomic groups, among older persons and racial minorities (Bautista, Glen, Shetty, & Wludyka, 2009), and from those living in rural areas because of low education levels, high unemployment rates, low wages, and lack of health insurance (Wood, 2005). Patients must have the ability to obtain, process, and understand the basic health information and services through health education and training regarding health literacy (Peerson & Saunders, 2009).

This chapter aims to bridge the gap in the literature on the thorough literature consolidation of health literacy. The extensive literature of health literacy provides a contribution to practitioners and researchers by describing the current trends and issues of health literacy in order to promote the health care literacy in global health care.

BACKGROUND

Health literacy first appeared in the 1974 paper calling for minimal health education standards for all grade levels in the United States (Mancuso, 2009). Since then, a stream of descriptive research has sought to examine the concept of health literacy, its measurement, and the problem of low health literacy in the health care industry (Schulz & Nakamoto, 2013). There has been a growing interest in the concept of health literacy, together with an increased emphasis on the individual's responsibility for health and self-management of chronic illness (Salmon & Hall, 2004). While health information has the potential to increase patients' knowledge and equalize the effective communication between patient and health care provider, availability of information does not automatically lead to the involved patients (McCray, 2005).

Inadequate health literacy is more extensive among the elderly, those with lower levels of educational attainment (Kutner, Greenberg, Jin, & Paulsen, 2006) and with chronic disease (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Omachi et al. (2013) stated that limited health literacy is related to poor outcomes in many chronic diseases. Inadequate health literacy is associated with poorer self-management skills, less successful navigation of the health care system, and higher mortality (Herndon, Chaney, & Carden, 2011). Paiva et al. (2014) indicated that health literacy should be higher in physicians, followed by health researchers, people with a similar academic degree in areas which are non-related to health, and people with the lower levels of education attainment.

Although the skills of patients are important, health literacy also includes health care providers and caregivers (Grice et al., 2013). Low health literacy has been reported to have a great impact on the interactions between patients and health care providers (von Wagner, Steptoe, Wolf, & Wardle, 2008). Improving health literacy requires health care providers and health care organizations to clarify com-

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munication, provide support for creating health-related skills, and organizational changes to reduce demands on patients. Health care providers should evaluate their patients' level of health literacy in an attempt to improve health outcomes by means of effective interventions (Lee, Lee, Kim, & Kang, 2012). Recognition of patient's health literacy ability can help health care providers find the communication approaches that fit their health-related needs.

SIGNIFICANT ASPECTS OF HEALTH LITERACY IN GLOBAL HEALTH CARE

This section highlights the prospect of health literacy; the evaluation of health literacy level; health literacy and health communication; health literacy and health information; and the current issues of health literacy in global health care.

Prospect of Health Literacy

Health literacy refers to a range of health literacy capacities that affect health-related behaviors and clinical decision making (Sharp et al., 2013) and is correlated with health status (Sentell & Braun, 2012) and health behavior in modern health care (Ishikawa, Nomura, Sato, & Yano, 2008). Social networks among health care providers and patients can provide health information that influence and support health behaviors in the health care industry (Goodman et al., 2012). High levels of health literacy without a high degree of patient empowerment creates an unnecessary dependence of patients on health professionals, while a high degree of empowerment without a corresponding degree of health literacy poses the risk of dangerous health choices (Schulz & Nakamoto, 2013).

Health literacy is a multidimensional phenomenon that involves the comprehension of oral as well as written information (Mazor et al., 2012). This is an important omission because oral communication is essential to most physician–patient encounters, as well as to media channels, such as television news (Mazor et al., 2012). The ability for self-care requires understanding and utilizing health-related information, as well as informed decision making (Lee et al., 2012). Variables, which have been shown to predict the higher health literacy levels are the presence of a chronic condition (Jovic-Vranes, Bjegovic-Mikanovic, & Marinkovic, 2009), income (Pizur-Barnekow, Doering, Cashin, Patrick, & Rhyner, 2010), and perception of individual's own health status (Jovic-Vranes et al., 2009).

Willis et al. (2014) indicated that strategies found to be associated with the improved organizational capacity for delivering the health literacy services are categorized into three perspectives (i.e., government action, organizational/practitioner action, and partnership action). Government action includes developing policies to reinforce social norms; setting standards for education; conducting research; and measuring health literacy levels. Organizational/practitioner action relates to the appropriate models of leadership regarding both high-level government engagement and distributed leadership. Partnership action includes collaborations with media outlets, those producing electronic materials, community organizations, and school-based programs (Willis et al., 2014).

Health literacy has been linked to disease self-management and various health outcomes, and can be separated into components of functional, communicative, and critical skills (Lai, Ishikawa, Kiuchi, Mooppil, & Griva, 2013). Functional health literacy is different by age, marital status, employment, education, material status, self-perception of health, and health status (Jovic-Vranes & Bjegovic-Mikanovic, 2013). In addition to the ability to read and write text, functional literacy includes the ability to apply the

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content of the text to relevant activities (Sharp et al., 2013), information processing, working memory, problem-solving skills, and quantitative ability (Nutbeam, 2008).

Cancer is a complex and prevalent disease, and primary and secondary prevention are recognized as the major factors in controlling cancer morbidity and mortality (American Cancer Society, 2010). Understanding of cancer prevention and messages is essential if such messages are to be successful in helping individuals make decisions about health behaviors (Mazor et al., 2012). Inadequate health literacy predicts negative outcomes specific to cancer control, including poor understanding of cancer risk (Brewer et al., 2009) and the need for screening, as well as lower rates of participation in cancer prevention efforts (Lindau, Basu, & Leitsch, 2006). Cancer patients with poor health literacy tend to be diagnosed at a later stage (Bennett et al., 1998) and to have difficulty providing informed consent for treatment (Davis, Williams, Marin, Parker, & Glass, 2002).

Inadequate health literacy is most prevalent among those reporting poor health (Speros, 2005). Older people (Ginde, Weiner, Pallin, & Camargo, 2008), men (Parikh, Parker, Nurss, Baker, & Williams, 1996), people with a lower level of education (Downey & Zun, 2008) show lower levels of functional health literacy. Improved awareness of health literacy issues among adolescents with chronic disease is needed among health care providers and health care systems in modern health care (Huang et al., 2012). Patients with lower health literacy tend to have less understanding of their illness (Gazmararian et al., 2006). higher psychosocial distress (Sharp, Zurawski, Roland, O'Toole, & Hines, 2002), poorer self-reported health (Lindau, Tomori, McCarville, & Bennett, 2001), worse health outcomes (Schillinger et al., 2002), higher rates of hospitalization (Baker et al., 2002), higher health care costs (Eichler, Wieser, & Brugger, 2009), and higher risk of death (Sudore et al., 2006).

Evaluation of Health Literacy Level

To gain the insight into patients' health literacy level, it is essential to properly measure the health literacy skills (Shaw, Ibrahim, Reid, Ussher, & Rowlands, 2009). Most instruments of health literacy measures need to be evaluated by a health professional, which is time-consuming and unfeasible in clinical practice. Underlying constructs and content of the existing instruments vary, and only few instruments are based on the proposed definitions and underlying models of health literacy (Pleasant & McKinney, 2011). In addition, most existing health literacy measures focus primarily on reading health comprehension, while health literacy comprises more than only functional literacy, namely the skills to utilize health information in an effective manner (Jordan, Osborne, & Buchbinder, 2011).

An important trend toward developing the measures that capture health literacy level within a specific context has been growing (Kim et al., 2012). For example, there are the health literacy measures that focus on diabetes management (Nath, Sylvester, Yasek, & Gunel, 2001), asthma (Apter et al., 2006), and genetics (Erby, Roter, Larson, & Cho, 2008). The disease-specific health literacy tools are more useful when they are effectively applied to a group of patients in need of managing a specific chronic illness (Nielsen-Bohlman, Panzer, & Kindig, 2004). The disease-specific health literacy tools can provide health care providers with the useful assessments of patients' educational needs and can function as the effective evaluation tools for the targeted disease-specific interventions (Kim et al., 2012).

Evaluating health literacy is vital to design the health education program (Chang, Hsieh, & Liu, 2012). Han et al. (2011) stated that accurate evaluation of health literacy is the first step toward understanding and emphasizing health issues related to individual's low health literacy. Health professionals should

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conduct the health literacy evaluation for adolescents before designing health education programs for those with low health literacy to develop health literacy skills toward performing health-promoting behaviors (Chang, 2011). Ownby et al. (2014) indicated that in order to evaluate intervention effectiveness and provide a method to evaluate health literacy as a construct, it is necessary to measure it.

The most broadly utilized measure of health literacy is the Test of Functional Health Literacy in Adults (TOFHLA) (Parker, Baker, Williams, & Nurss 1995). The Rapid Estimate of Adult Literacy in Medicine, or REALM (Murphy, Davis, Long, Jackson, & Decker, 1993), asks that patients read aloud a list of health-related words. The REALM is a word recognition test comprised of medical terms and is believed to capture a component of functional health literacy (Sharp et al., 2013). REALM requires less time to complete than the TOFHLA, but does not evaluate whether the patient understands what individual reads or numeracy skills (Ownby et al., 2014). Common measures of health literacy (e.g., TOFHLA and REALM) may introduce discomfort and embarrassment particularly in clinical settings, especially for those with inadequate health literacy (Al Sayah, Williams, & Johnson, 2012).

The TOFHLA has been found to be an effective tool for identifying people with inadequate functional health literacy, however it takes up to 22 minutes to conduct. (For a quicker evaluation of people's health literacy, the S-TOFHLA was developed, involving two prose passages with a total of 36 cloze items and four numeracy items. The total time to conduct the S-TOFHLA is 12 minutes or less (Baker, Williams, Parker, Gazmararian, & Nurss, 1999). Numerous studies have employed the S-TOFHLA to identify predictors of health literacy. In addition to the S-TOFHLA, the Newest Vital Sign (NVS) is the health literacy evaluation tool that is developed for utilizing in primary care settings (Heinrich, 2012) and requires three minutes to administer (Sharp et al., 2013).

Health Literacy and Health Communication

Health literacy researchers are currently examining other components of the health context, such as the complexity of health materials, the demands and assumptions of health institutions, and the communication skills of health professionals (Rudd, 2010). Research in health communication, specifically in patient-physician health communication, has greatly contributed to physician practice and training (Passalacqua & Segrin, 2012). The understanding of the relationship of health literacy to health status is essential to develop health communication and health education efforts for older adults in nursing practice (Kim, 2009).

Health communication between health professionals and patients, and between health educators and the public, is necessary in order to have the ability to improve health outcomes (Smith & Duman, 2009). The use of language which the patient is comfortable with is critical for improving health literacy level (Nemutanzhela & Iyamu, 2016). The increasing attention has been devoted to a patient-centered approach to health communication (Rosenthal, 2008). Several studies have found an association between high health literacy and better patient-physician health communication (Mancuso, 2010). Oral communication between physicians and patients has been shown to affect the patients' knowledge, motivation, decision making, engagement, empowerment, and health (Schonlau, Martin, Haas, Derose, & Rudd, 2011).

To improve patient-physician health communication, interventions must be tailored to the patients' health literacy level (Mullen, 2013). Many intervention studies have aimed to improve health outcomes by developing computer programs and establishing telephone follow-up systems aimed at patients with low health literacy (Long & Gambling, 2012). Innovations in health information technologies have en-

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abled researchers in the patient-physician communication to expand beyond face-to-face interaction to include communication by phone and online between encounters (Fortney, Burgess, Bosworth, Booth, & Kaboli, 2011).

Health Literacy and Health Information

With the increasing availability of connected health care organizations through modern technology, important health information can be easily accessible at the point of care (Taweel, 2016). Health literacy is a complex phenomenon involving access to health-related information to improve the health-related decision making, behaviors, and outcomes (Wawrzyniak, Ownby, McCoy, & Waldrop-Valverde, 2013). Patients' inability to utilize health information for their own benefit causes a gap between the expectations laid on them to participate in their own health care, and their actual health literacy skills (Jordan, Buchbinder, & Osborne, 2010). This health care-related gap should be narrowed by adapting the reading level of the provided health information on the one hand, and by increasing patients' health literacy level through health education on the other hand (van der Vaart et al., 2012).

In health care organizations, there is an increasing amount of health information (Pereira, Portela, & Abelha, 2016). Health information is an important component of the health care services (Sriganesh, 2013) and for patients to understand and engage in the management of their health conditions (Ishikawa & Yano, 2008). Information behavior perspectives can enrich the conceptual base of health literacy, contributing a deeper understanding of people's use of health information in the context of their lived experience with health conditions (Souden & Rubenstein, 2010). Simmons et al. (2015) indicated that public health nurses should understand the high utilization of anonymous sources, particularly for mental health information, and focus efforts on helping individuals navigate the health care-related resources to ensure they obtain the accurate health information about symptoms.

The potential to collect, organize, integrate, and disseminate health information from a multitude of sources enables health analytics to improve the current health status of communities (Raghupathi & Raghupathi, 2013). The application of online health information empowers people to utilize the online health services (Mano, 2014). The incorporation of a credible online health information resource into school health education curricula is a promising approach for promoting health literacy (Ghaddar, Valerio, Garcia, & Hansen, 2012). Gutierrez et al. (2014) stated that despite the growing body of health information available online, patients with limited health literacy may lack either Internet access or skills necessary to utilize this information.

Gilmour et al. (2012) stated that developing patient competency in evaluating online health information should be recognized as an integral aspect of illness management education. Organizations that embed the practices of human capital and competency across a range of human resource management activities effectively create and develop a boundary spanning culture connecting with various organizational disciplines in the global knowledge economy (Kasemsap, 2016a). As health care services increase in significance, the knowledge acquired and used in executing its services becomes vital (Iyamu & Mkhomazi, 2016). The goal of health care knowledge management is to provide the effective, optimal, and timely health care knowledge to physicians and especially to patients whenever and wherever they need it, to support them in making effective patient care decision and promoting health literacy level (Akaichi & Mhadhbi, 2016).

Creating health information and make it readable by physicians has become the crucial task in modern health care (Peixoto, Domingues, & Fernandes, 2016). Health education is essential to enhance the

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mental health knowledge, thus reducing the health literacy-related stigma and improving the effective access to health care (Kelly, Jorm, & Wright, 2007). Numerous approaches to providing literacy-sensitive health care have been proven effective, such as distributing health education materials written at 6th grade literacy levels or below (Robinson, Calmes, & Bazargam, 2008), providing visual information to explain medication regimens (Yin et al., 2008), and providing audio-recorded health instructions (Doak, Doak, & Root, 1996).

Health care-related education materials using pictographs provide the effective strategies in improving the discharge education for the low-literate older adults in the acute health care settings where nurses have primary responsibility as the first line of health care providers (Choi, 2011). Stigma around health literacy-related mental illness has two aspects (i.e., public stigma and self-stigma). Public stigma refers to the negative prejudicial attitudes and discrimination toward individuals with mental illness endorsed by the general population, while self-stigma describes an individuals' internalization of these negative attitudes and beliefs (Corrigan & Rao, 2012).

Health care-related illustrations are frequently utilized in health information, for example in materials about cancer (King, 2015). People typically learn better from text-illustrated information compared to text only (Mayer, 2002). Using illustrations is recognized to positively affect the individuals' attention to the health message (Delp & Jones, 1996) and understanding of information described in the message (Brotherstone, Miles, Robb, Atkin, & Wardle, 2006). People with limited health literacy have shown to benefit from the illustrated messages (Meppelink, Smit, Buurman, & van Weert, 2015), and the application of illustrations is recommended for this target group (Doak et al., 1996).

Current Issues of Health Literacy in Global Health Care

Health care policies and programs are needed to respond to the extent and impact of low health literacy in global health care (Jovic-Vranes & Bjegovic-Mikanovic, 2013). Low health literacy has been shown to be associated with a limited health vocabulary and it limits how individuals understand the concept of screening and their awareness of its benefits (Pagán et al., 2012). Low health literacy is widespread in the elderly, those with low socioeconomic status and minority groups (van der Heide et al., 2013) and is recognized as a strong contributor to health inequalities (Sudore et al., 2006). Socioeconomic status is strongly associated with health status (Hoffman-Goetz, Meissner, & Thomson, 2009). Lindquist et al. (2011) indicated that seniors themselves often have low health literacy, which suggests the greater requirement for caregivers to have adequate health literacy.

It is essential that health care providers understand the role that they have in the identification and promotion of health literacy to encourage the optimal health outcomes (Carollo, 2015). For the patient with low health literacy, the stigma associated with the condition has the potential to negatively impact communication with the clinician and staff, reduce the effectiveness of health care, and impact the quality of care and quality of life (Carollo, 2015). Successful health care management requires an effective partnering among clinicians and health care providers who have the responsibility to identify what is occurring with the patient regarding effective health care interventions, and the patient's responsibility to correctly adhere to the prescribed intervention (Mayer & Villaire, 2007).

To address health literacy in the technology-rich health care environment, there is a strong need for the effective computer-based tools to evaluate health literacy level (Collins, Currie, Bakken, Vawdrey, & Stone, 2012). Electronic health literacy is composed of two types of skills: general skills and specific skills (Institute of Medicine, 2009). General skills include traditional literacy (e.g., reading, writing,

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and numeracy), media literacy (e.g., media analysis skills), and information literacy (e.g., information seeking and understanding). Specific skills include computer literacy (e.g., information technology skills), health literacy (e.g., health knowledge comprehension), and science literacy (Institute of Medicine, 2009). Electronic health information is emerging as a source to effectively manage own health (Yim, Khuntia, & Argyris, 2015). Increased public access to electronic health information and a shift in modern technology to more user-driven content significantly require communication technologies that support the patient as a partner at the center of the health care system by providing information access and assistance when and where it is needed (McCray, 2005).

Kamimura et al. (2013) indicated that health literacy education, mental health services, and social support are the significant health services needed by the free clinic patients to achieve better health. Health skills can be successfully introduced in adult learning environments (Diehl, 2011). However, the majority of online health information is difficult to read and understand, which is a problem for people with limited health literacy (McInnes & Haglund, 2011). Not everyone benefits from the abundance of information because selecting, understanding, and applying health information requires the adequate health-related knowledge and skills (Fransen, van Schaik, Twickler, & Essink-Bot, 2011). Smith et al. (2014) stated that health literacy skills are important for people affected by cancer as they are exposed to the complex treatment and follow-up care information.

Inadequate health literacy levels have been linked to a myriad of health-related outcomes, including increased mortality, lower physical functioning and quality of life, suboptimal utilization of health services, decreased capacity for disease self-management, elevated risks of medication errors, and increased health care costs. Low health literacy is related to inappropriate medication intake and an inability to understand health labels and health-related information (Berkman et al., 2011), and such health perspectives generate the poor treatment adherence. Across conditions of diabetes and cardiovascular disease, poor medication adherence and disease self-management have been recognized as the possible mediators between low health literacy and inadequate disease outcomes (Nam, Chesla, Stotts, Kroon, & Janson, 2011).

Fry-Bowers et al. (2013) indicated that comprehensible child health information is vital to any parent. Positive child health outcomes result from effective communication between a parent and their child's health care provider (Hart, Kelleher, Drotar, & Scholle, 2007). Effective communication encourages trust in the therapeutic relationship, improves parental satisfaction with care, promotes adherence to health care regimens, and increases the parental disclosure of psychosocial concerns (Rosenthal et al., 2007). Parent-provider communication, particularly within the context of pediatric ambulatory care, is not ideal. Parents with limited education and economic perspectives, members of racial minority groups, and non-English speakers are at risk for poor communication with health care providers (Bloom, Cohen, & Freeman, 2011). Substantial racial and ethnic disparities exist for the health care provider elicitation of parents' developmental concerns and for experiences of family-centered care (Guerrero, Rodriquez, & Flores, 2011).

FUTURE RESEARCH DIRECTIONS

The classification of the extensive literature in the domains of health literacy will provide the potential opportunities for future research. Limited health literacy affects patients of all ages, races, incomes, and education levels, but its greatest impact is among lower socioeconomic and minority groups, where it

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underlies health disparities. Health education is a social science that draws from the biological, environmental, psychological, physical and medical sciences to promote health and prevent disease, disability and premature death through education-driven voluntary behavior change activities. Health education is the development of individual, group, institutional, community, and systematic strategies to improve health knowledge, attitudes, skills, and behavior.

Communities of practice (CoPs) help promote a growing cycle of knowledge sharing activities that allow for the members to regularly meet, reflect, and evolve in the knowledge management environment (Kasemsap, 2016b). The use of social media can result in better communication and collaboration (Kasemsap, 2016c). Total quality management (TQM) practices in quality performance has the potential to improve organizational performance (Kasemsap, 2015). Facilitating both health literacy and health education in the health care industry with the utilization of CoPs, social media, and TQM practices will be the valuable issue for future research direction.

CONCLUSION

This chapter explained the prospect of health literacy; the evaluation of health literacy level; health literacy and health communication; health literacy and health information; and the current issues of health literacy in global health care. Good health literacy is important because patients are living longer and experiencing a wider range of health issues. Health literacy measures to be conducted by health care providers are very important in order to know the patients' health literacy level and prepare the health care education toward increasing the patients' health literacy level and promoting the quality of care. Training health care staff will increase the awareness of the need for addressing health literacy and improve their health care-related skills for communicating with the public.

Health professionals must commit to promoting for improved health literacy in health care organizations and should establish the specific health care goals toward improving health literacy in strategic plans, performance plans, programs, and educational initiatives. Health professionals can utilize a broad range of health communication strategies to ensure patients understand their options and share their health care decisions. Implementing health care metrics for health care organizations will help establish the accountability for health literacy activities. Promoting patients' health literacy skills means they are better able to take care of their health and engage with the health care systems. Through health education and training, effective health information can help promote patients' health literacy level in global health care.

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KEY TERMS AND DEFINITIONS

Communication: The two-way process of reaching mutual understanding, in which participant not only exchange information, news, ideas, and feelings, but also create and share meaning.

Health Care: The act of taking the preventative or necessary medical procedures to improve a person's well-being.

Information: The data that is organized for a specific purpose and presented within a context that gives it meaning and relevance.

Knowledge: The understanding of a circumstance gained through experience.

Literacy: The ability to read and write.

Patient: A person who is receiving medical care, or who is cared for by a particular doctor or dentist when necessary.

Skill: The ability acquired through the deliberate, systematic, and sustained effort to smoothly and adaptively execute the complex activities.

Understanding: The knowledge about a situation.

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Chapter 13
Accountability and Public Reporting:
Publication of Performance to Improve Quality

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ABSTRACT

Patient engagement is based on the assumption that making patients co-producers of their health might enhance their satisfaction and responsibility with the healthcare system and it strictly linked with the health provider choice. Making patients active participants in their healthcare is considered a crucial component of high-quality healthcare services. Quality of care is a central concern for health systems: accountability, transparency, and public reporting are some key factors in promoting healthcare improvement. In the healthcare field, public reporting is one of the major tools in supporting patients' decisions making process, by providing structure, process and outcome measures. We performed a web-based analysis of the major initiatives of public reporting in order to highlight their main characteristics: properties (public or private), data source (health providers, ad hoc surveys, etc.), general information reported (i.e. size, language spoken, amenities), doctors' information, patients' ratings (satisfaction / experience), clinical indicators.

INTRODUCTION

In this chapter, moving from the link between quality in healthcare and patient/consumer engagement, as driving concept, we deeply explain interactions between some challenging topics in the healthcare sector: quality of health care, accountability, transparency and public reporting.

In the first part of the chapter, more theoretical, we provide a synthesis of the literature about the topics.

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Patient engagement – borrowed from the marketing conceptualization of consumer engagement – is based on the assumption that making patients/clients co-producers of their health might enhance their satisfaction and responsibility with the healthcare system, by improving positive clinical outcomes and reducing health delivery costs (Graffigna, Barello, & Triberti, 2015).

A recent report on patient engagement in health care, identifies an Engagement Behavior Framework, as a qualitative description of the behaviors that individuals must perform to optimally benefit from their care, based on ten types of tasks, that deals with the healthcare process as a whole, from the choice to the payment of providers, from health promotion and prevention to the end of life planning (Center for Advancing Health, 2010).

Making patients active participants in their healthcare is considered a crucial component of high-quality healthcare services. Since 2001, the Institute of Medicine's report "Crossing the Quality Chasm" (2001) has been recognizing patient-centered care as an essential dimension of high-quality care (Clancy, 2011). In 2006, the World Health Organization indicates patients and the population engagement as one of the six domains of quality interventions (World Health Organization [WHO], 2006).

Wide definition of quality and quality improvement and a focus on quality measurement are proposed.

Several formulations of quality definition are both possible and legitimate: all the stakeholders involved in the healthcare sector consider different aspects of quality of care depending on where they are located in the systems of care and on the nature of their responsibilities.

Avedis Donabedian, known as the founder of the theory of quality in healthcare stated that "quality of care is the kind of care that is expected to maximize an inclusive measure of patient welfare after one has taken into account the balance of expected gains and losses that attend the process of care in all its parts" (Donabedian, 1980). His definition can be synthetized by this quote: "Do only what is useful (effective theory), in the best way (effectiveness) with the least cost (efficiency), for who (accessibility), and only to those who really need (appropriateness), making do care who is competent to do it (competence), obtaining the best results considered (satisfaction)" (Donabedian, 1980).

Quality of healthcare has been one of the most challenging issues for researchers for many years. Taking part from quality of healthcare definition, other streams of research emerged: quality assessment or measurement, quality improvement, measurement of quality improvement approaches, and many other still appears. Furthermore, quality of healthcare dominates and leads public policy agenda, so that it has been defined as a process for making strategic choices in health systems, as World Health Organization stated in the subheading of a report published in 2006 (WHO, 2006). Thus, quality of healthcare connects with one of the most important Public Health movement of the last decades, the Clinical Governance, that promotes continuous quality improvement by creating an environment in which excellence in clinical care will flourish (Scally & Donaldson, 1998) and many other current concept, such as accountability and transparency, that encompasses procedures and processes by which healthcare organizations try to reach their goals in terms of quality improvement.

On the patient side, this reflects on better clinical experiences, greater appropriateness of care, increased trust in the patient-physician relationship. Moreover, patients own more information that make they able to choose the providers that better meet their needs, aware about the care they receive and involved in their health plans, becoming engaged in their health and care. Public reporting has a great role in this frame, as it refers to the publication of information and reports on the quality of care delivered by providers, that could support patient choices.

Patients have to decide whether and when to seek care, which plans and providers meet their needs, how to manage their health (Clancy, 2011). Provider choice is one of the most important patient engage-

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ment pillar. But, are patients informed about the best care that they could receive? Do they know how to choose hospitals, health plans or professionals to address their healthcare needs? Are there tools able to support and guarantee aware choices?

Usually patients choose providers who meet criteria such as geographic access, personal style, often advised from friends or family. Preferences for characteristics vary across patient, and they also vary depending on the type of provider to choose (e.g. hospitals, primary care doctors, home care or care home providers) (Kumpunen, Trigg, & Rodrigues, 2014). It would be better if patients will use also comparative performance information, from public reporting initiatives, to identify the provider that better meets their need.

In the second part of the chapter, moving from this theoretical frame, we will present the result of a web based analysis aimed at comparing major initiatives of public reporting, classified by the following characteristics: properties (public or private), data source (health providers, ad hoc surveys, etc.), general information reported (i.e. size, language spoken, amenities), doctors' information, patients' ratings (satisfaction /experience), clinical indicators.

PATIENT ENGAGEMENT AND QUALITY IN HEALTHCARE

Western societies are facing some changes of scenario at the economic, social, and environmental levels that reflects also on the healthcare sector calling for revisions in policies and interventions (Graffigna et al., 2015). The economic crisis, the ageing of populations and the rise of chronic conditions are just some of these challenges that every country should take on in order to improve systems sustainability. Promoting patients engagement in healthcare management, by supporting them in the decision-making and in enacting healthy behaviors, is one of the actionable intervention for achieving such goals.

Why "engagement"? The word engagement derives from the verb "to engage" that "implies a dynamic and relational context, in which two parties agree on the goals of an action and on the phase of its process" (Graffigna et al., 2015). It has been introduced in the healthcare field not long ago to indicate a renewed partnership between different actors and institutions involved in health and care management (Hibbard, Stockard, Mahoney, & Tusler, 2004). The expression patient engagement has been borrowed from the marketing conceptualization of consumer engagement that refers to the (potentially positive) attitude of a consumer toward brands, products, services, or even media events (Gambetti & Graffigna, 2010).

The concept of patient engagement is based on the assumption that making patients/clients co-producers of their health might enhance their satisfaction and responsibility with the healthcare system, by improving positive clinical outcomes and reducing health delivery costs (Graffigna et al., 2015). It can be seen as a key qualifier of the exchange between the demand (i.e. citizens/patients) and the supply (i.e. healthcare system) of healthcare services in the different phases of the care processes. Understand and manage the strategic levers that sustain patient engagement is crucial to innovate healthcare systems and to improve their sustainability (Graffigna et al., 2015).

It seems that patients engaged in their health and care may reach better quality of care and patient/health provider relationship, thus improving patient's clinical indicators and compliance to recommended treatments; on the contrary, patient not engaged in their health and care may cause waste of resources and poor clinical outcomes (Greene & Hibbard 2012; Graffigna et al., 2015).

The concept of patient engagement can be seen as an evolution of Patient Centered Medicine.

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Patient Centered Medicine replaced the historical dominant bio-medical paradigm, bringing back "patients' voices" at the center of the healthcare processes. Even though it has been shown that Patient Centered Medicine contributes to clinical effectiveness improvements and psychological sustainability of care practices, it has not always been translated into real practice, usually as a resistance to organizational change. Nevertheless, if involvement and participation of consumers/clients of healthcare services have to be seen as a priority, patient engagement could be useful, as a qualifier in the exchange between the "demand" and "supply" of healthcare (Graffigna, Barello, Riva, & Bosio, 2014).

A recent report on patient engagement in health care, identifies an Engagement Behavior Framework, as a qualitative description of the behaviors that individuals must perform to optimally benefit from their care, based on ten types of tasks, that deals with the healthcare process as a whole, from the choice to the payment of providers, from health promotion and prevention to the end of life planning (Center for Advancing Health [CFAH], 2010). Making patients active participants in their healthcare is considered a crucial component of high-quality healthcare services.

The World Health Organization identifies patients and population engagement as one of the six domains of quality interventions. It is defined as critical to quality improvement, because individuals and communities play many roles within health systems. In fact, directly or indirectly, they finance care, work in partnership with health workers to manage their own care, they are sometimes the arbiter of what is or is not acceptable across all the dimensions of quality. Thus, ensure patients and population engagement is seen as a challenge, the heart of all policies and strategies for quality improvement. Policies and strategies to this end are likely to improve health literacy, self-care, and patients' experience with the health system. Patients and population would be involved in the governance of the health system, influencing decision-making trough their views and preferences and sharing responsibility for their own health. New interventions in quality must take into account these strategic fundamentals (WHO, 2006).

QUALITY IN HEALTHCARE

Quality in Healthcare: Definitions, Dimensions, Measurement

Quality of patient care is a central concern for health systems, especially in an era of unprecedented financial constraints, and rising demand and expectations. Thus, the focus on quality has intensified because of the concern that healthcare is costly, may sometimes be dispensed inappropriately and inequitably, and varies unduly among physicians and location.

The gap between the quality of healthcare possible and that currently provided has been referred to as a chasm. The reason way health systems globally frequently fail to provide patients with quality healthcare have been proposed as follows: an increase in chronic conditions, poorly organized systems for healthcare delivery, limited use of information technology, and the increased complexity of care as a result of medical advances (Institute of Medicine [IOM], 2001).

What is quality of care? How can it be defined? Quality is a complex and multi-faceted concept which have been defined in many different ways for the last decades. Several formulations of quality definition are both possible and legitimate: all the stakeholders involved in the healthcare sector consider different aspects of quality of care depending on where they are located in the systems of care and on the nature of their responsibilities. For example, doctors may consider medical outcomes or processes; economists may focus on social welfare, including features that consumers happen to care about, but that clinicians

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do not (i.e. appearance and size of hospital rooms); health plans may reflect on concepts of preventive care or organizational efficiencies (Wong, McNamara, & Greenberg, 2004; Cantù & Tzannis, 2011).

Firstly, quality can be referred both to healthcare and health systems. First of all, it reflects the extent to which an healthcare service or product produces a desired outcome (Runciman, Merry, & Walton, 2007). Furthermore, quality can be defined as a principle to assess if health system is performing well in its mission to improve health (National Health Performance Committee [NHPC], 2001). Avedis Donabedian, known as the founder of the theory of quality in healthcare, defined "Quality of care" in 1966 in its article, "Evaluating the Quality of Medical Care" (Donabedian, 1966) that has been cited by 4428 authors during the last 50 years. His revised definition stated that "quality of care is the kind of care that is expected to maximize an inclusive measure of patient welfare after one has taken into account the balance of expected gains and losses that attend the process of care in all its parts" (Donabedian, 1980). His quality definition can be synthetized by this quote: "Do only what is useful (effective theory), in the best way (effectiveness) with the least cost (efficiency), for who (accessibility), and only to those who really need (appropriateness), making do care who is competent to do it (competence), obtaining the best results considered (satisfaction)" (Donabedian, 1980). Furthermore, Donabedian highlights three principal quality dimensions:

- The structure (organizational quality), the static part of the system, the equipment
- The process (professional quality), the behaviors of personnel and customers on a scientific, ethic and social basis (diagnostic procedures, continuity of care, professional standards, comfort, privacy, etc.)
- The outcome (perceived quality) that is the evolution of the patient's health due to the care process (Donabedian, 1988; Cantù & Tzannis, 2011).

In the following years several authors gave highlighting definitions across a continuum of more or less operational and generalizable dimensions, such as: "excellence" (Samuel, Grant, & Irvine, 1994), "expectations" or "goals which have been met" (Ellis & Whittingham, 1993; Steffen, 1988), "zero defects" (Crosby, 1979) and "fitness for use" (Juran, 1988; Campbell, Roland, & Buetow, 2000). Nevertheless, the "Hippocratic Oath" seems to be one of the link between all the definitions of quality in healthcare provided, surely the oldest and the most complete one.

It was 1990 when the US Institute of Medicine, by assuming that healthcare ought to be safe, effective, patient centered, timely, efficient and equitable, introduced the well-known definition of quality: "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (IOM, 1990).

The Institute of Medicine's definition relates quality to the goals of the healthcare system. Quality of care is often defined trough individual dimensions or components that allows recognizing its complexity: when viewed in combination the dimensions offer more specific definitions of quality (Campbell et al., 2000). Table 1 shows main dimensions according to some of the most important definitions of quality of care (Campbell et al., 2000).

For the World Health Organization quality is made by six areas or dimensions:

- Effectiveness, as adherence to evidence base medicine and improvement of health outcomes for individuals and communities, based on needs;
- Efficiency, as maximization of resources use and reduction in wastes;

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Table 1. Quality in healthcare: main classifications through dimensions (Modified by Campbell et al., 2000)

Donabedian (1990)	Maxwell (1992)	HSRG (1992)	O'Leary and O'Leary (1992)	Campbell et al. (2000)	WHO (2006)
	Accessibility	Accessibility	Accessibility	Accessibility	Accessibility
		Patient centredness	Patient perspectives		Patient centredness
Effectiveness	Effectiveness	Effectiveness	Effectiveness	Effectiveness	Effectiveness
Efficiency	Efficiency	Efficiency	Efficiency		Efficiency
		Continuity/ Co-ordination	Continuity		
Efficacy			Efficacy		
Acceptability	Acceptability				
Equity	Equity				Equity
Legitimacy					
		Comprehensiveness			
	Relevance				
					Safety

- Accessibility, as the ability to face medical needs in a timely and geographically reasonable manner, provided in a setting where skills and resources are appropriate;
- Patient-centeredness, taking into account preferences and aspirations of individual service users and cultures of their communities;
- Equity, avoiding discrimination because of personal characteristics such as gender, race, ethnicity, geographical location, or socioeconomic status;
- Safety, minimization of risks and harm to service users (WHO, 2006).

Appropriateness is another important quality dimension. The UK Department of Health, introducing appropriateness, defined the quality of care as: "doing the right things (what); to the right people (to whom); at the right time (when); and doing things right the first time. Such a document also stressed on patient centeredness in quality appraisal, thus including the degree to which healthcare interventions are delivered responsive to patients' needs and preferences" (Department of Health, 1998).

Quality definition is preparatory to quality measurement: it is essential to reach an agreement on the element that constitute it before starting quality assessment, otherwise the risk is to court disaster (Donabedian, 1988).

The relevance of healthcare quality measurement is well-known for a long time. Famous is the quotation attributed to Florence Nightingale: "The ultimate goal is to manage quality. But you cannot manage it until you have a way to measure it, and you cannot measure it until you can monitor it" (Eagle & Davies, 1993).

At present, measurement and evaluation of the quality of health systems/ organizations is aimed mainly at determining the degree to which health systems successfully pursue the objectives of maintaining and increasing the health status of the population and how the health system respond, both in structural and organizational terms, to the expectations of all those who benefit. At national and international level, it

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should be noted that the emergence of problems related to the restructuring of health systems must be framed within the broader context of crisis in welfare states.

Quality of care refers to the level of performance that characterizes the healthcare provided. Such a quality can be assessed with quantitative measures, where delivered healthcare is compared with the healthcare that is expected/ought to be delivered, sometimes referred to indicate care or quality standards. Measures of quality of care would encompass, for example, measures of effectiveness and patient satisfaction or patient-centeredness. Mortality, morbidity, and patient satisfaction were identified as key criteria for assessing the quality of care (Hinshaw, 1992).

Patient satisfaction is both a dependent variable of quality of care and a predictor of subsequent health related behaviour, since satisfied and dissatisfied health care consumers behave differently (Ware, Davies-Avery, & Stewart, 1978; Pascoe, 1983; Ware & Davies, 1983; Tzannis & Nadin, 2011). Satisfied patients lead to higher levels of profitability, market share and, likely, to higher levels of clinical outcomes (Greenwich, 1993).

As quality measurement is a costly and time consuming activity, indicators must be selected that contribute to an aggregate understanding of health-care quality is imperative. Sources of information would include administrative/clinical data collected by healthcare providers and patients' reports collected through population or patient surveys, the so-called patient reported outcome measures (Streiner & Norman, 2008).

Quality Improvement

It seems dramatically clear that healthcare will not realize its full potential unless change making becomes an intrinsic part of everyone's job, every day, in all parts of the system. John Øvretveit defined quality improvement in healthcare as a better patient experience and outcomes achieved through changing provider behavior and organization through using a systematic change method and strategies (Øvretveit, 2009). Such a combined and unceasing efforts of everyone -healthcare professionals, patients and their families, researchers, payers, planners and educators- is important to make changes that will lead to better patient outcomes, better system performance and better professional development (Batalden, 2007).

Actually multiple strategies and tools to improve quality exist but which one works?

Groene, Kringos and Sunol on behalf of the DUQuE Project (2014) identified seven ways to improve quality in hospitals:

- Align organizational processes with external pressure
- Put quality high on the agenda
- Implement supportive organization-wide systems for quality improvement
- Assure responsibilities and team expertise at departmental level
- Organize care pathways based on evidence of quality and safety interventions
- Implement pathway-oriented information systems
- Conduct regular assessment and provide feedback.

In most reports emphasis is placed on crosscutting issues such as oversights and leadership, building support systems for quality improvement and providing the necessary resources for high quality care to be provided. Approaches on quality improvement has been developing into a major strand of research during the last decades.

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Common approaches to quality improvement (Boaden, Harvey, Moxham, & Proudlove, 2008) came from industrial approaches:

- Total Quality Management, defined as a participative, systematic approach to planning and implementing a continuous organizational improvement process (Kaluzny, McLaughlin, & Simpson, 1992)
- Business Process Reengineering that is the redesign of systems and processes used to produce, deliver and support patient care in order to achieve improvements in organizational performance within a short period of time (Carmichael, 1994)
- Plan- Do- Study- Act (PDSA) cycles, small tests of change in which a change practitioner will plan a test of change (plan), carry out the change (do), study the results (study) and act on them in the next cycle of change (act) (Deming, 1986)
- Lean Thinking that is an integrated system of principles, practices, tools and techniques focused on reducing waste, synchronizing work flows, and managing variability in production flows (Joosten, Bongers, & Janssen, 2009)
- Six Sigma defined as "an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates (Linderman, Schroeder, Zaheer, & Choo, 2003)
- Statistical process control, that leads to quality improvement by learning through data and is based on the theory of variation (Carey, 2003).

But, which approaches are likely to really improve quality of care? Unfortunately, no clear evidences still exist on this topic. A systematic review synthetizes existing evidence on interventions to improve quality of care in an hospital based setting. It shows that that despite the very large volume of literature on quality of care improvements, only a few hospital interventions have a theoretically based design or implementation. Studies varied from small scale improvements for specific patient groups to large scale quality improvement programs across multiple settings. Interventions were usually divided into two categories: interpersonal and technical. Interpersonal interventions sought to improve patient satisfaction and tended to be implemented by nursing staff while technical interventions were generally implemented by physicians and reported measurable improvements in medical outcomes for patients with specific illnesses (Conry et al., 2012).

Towards a Clinical Governance Approach

Quality of healthcare is not only one of the major strand of research of the last decades but also on important topic for the government all over the world. It dominates and leads public policy agenda, so that it has been defined as a process for making strategic choices in health systems, as World Health Organization stated in the subheading of a report published in 2006 (WHO, 2006). Thus, quality of healthcare connects with one of the most important Public Health movement of the last decades, the Clinical Governance, that promotes continuous quality improvement by creating an environment in which excellence in clinical care will flourish. The introduction of clinical governance aimed at improving the quality of clinical care at all levels of healthcare provision (Scally & Donaldson, 1998).

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Each intervention aimed at improving Clinical Governance is likely to positively influence healthcare quality and consequently appropriateness of care (Specchia et al., 2015). Quality of care permeates many other current concept, such as accountability and transparency, moreover linked to Clinical Governance, that encompasses procedures and processes by which healthcare organizations try to reach their goals in terms of quality improvement.

ACCOUNTABILITY AND TRANSPARENCY

Measuring quality of healthcare is a key factor to promote improvements in the delivery of care and to increase accountability and transparency (Chassin, Loeb, Schmaltz, & Wachter, 2010). On the other hand, implementing public health policies based on accountability and transparency of the actions can encourage quality improvement and the ability for people to make informed choices.

Over the years, various definitions of accountability in healthcare have been given. It has been defined as the activity of "taking into account and responding to political, commercial, community, and clinical/ patient interests and expectations" (American Hospital Association Board of Trustees, 1999). Furthermore, it may be defined as the process by which health leaders pursue the objectives of efficiency, quality, and access to meet public interests and expectations (AHA Board of Trustees, 1999). In general, accountability is the obligation of individuals or agencies to provide information about, and/ or justification for, their actions to other actors (Brinkerhoff, 2003). Therefore, a subject is accountable if he reports, explains, or justifies something on which he is responsible and has the duty to answer (AHA Board of Trustees, 1999).

Given the relevant role of the healthcare organizations for the society as a whole, expectations on their activities and capability to provide good quality healthcare services and to be performant is very high and not only limited to specific legal and regulatory standards. Healthcare organizations are responsible for a broad range of activities including patient care, community services, and business functions and have to be accountable for a series of activities. First of all they have to taking into account the expectations and interests of their different stakeholders. Furthermore, of great relevance, they have to measure and evaluate their performance in multiple areas, including quality, access, efficiency and finance, continuously improving their performance in each of these areas. Finally, they have to communicate their performance to the stakeholders (AHA Board of Trustees, 1999).

Individuals and institutions that have interest in healthcare providers' accountability are many: purchasers and payers of healthcare services, patients, advocacy groups, regulators, stockholders and lending institutions, health policy makers, practitioners, hospital staff/employees, media, and generally the community. They expect that the institutions that provide healthcare services will act in the best interests of the people who need its services and provide safe, effective and high quality care (AHA Board of Trustees, 1999).

In this perspective, accountability could represent a fundamental issue to implementing health reforms and improving health systems performance (Brinkerhoff, 2003).

In all the health systems there are different types of relationships among different actors, that may partially vary according to the healthcare system type. Principal speakers of these relationships are health ministries, insurance agencies, health services' public and private providers, legislatures, finance ministries, regulatory agencies (Brinkerhoff, 2003), exercising a mutual role of control, cooperation and reporting. In the healthcare area, main domains of accountability are: professional competence, legal and

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ethical conduct, financial performance, adequacy of access, public health promotion, and community benefit (Emanuel & Emanuel, 1996).

The most relevant element of accountability is answerability, according to the idea that to be accountable means to have the obligation to answer questions regarding decisions and actions. There are two levels of accountability: the first deals with the need to be informed, the second deals with the need to know and understand the reason of a choice and its implementation. The need to be informed implies a one-way transmission of information from the accountable actor to the actor who needs to be informed. The need to know and understand the reason implies a two-way transmission of information, requiring a dialogue between the accountable actor and the overseer actor.

In these terms, the informing aspect of answerability that characterized accountability, deals with the idea of transparency in a democratic government (Brinkerhoff, 2003). To be transparent mean give access to public data and information, building the capacity of civil society to monitor the management of resources, and on the other side the capacity of government to implement effective policies.

Accountability refers to three different areas: financial accountability, performance accountability and political/democratic accountability. Financial accountability concerns laws, rules and regulations regarding financial control and management, focusing on allocation, disbursement and utilization of financial resources. Performance accountability concerns performance measurement and evaluation, focusing on healthcare services, outputs, and results. It is linked to financial accountability because of financial resources are essential to product services for citizens. Political/democratic accountability deals with mechanisms to ensure that government plans are realized and respond to citizens' interests (Brinkerhoff, 2003).

These three specification of accountability are linked with its objectives. Control of use and abuse of public resources is directly related to financial accountability. Support and promote improved healthcare services delivery and management is linked with performance accountability. Finally, belonging to all accountability's specification, is the assurance that resources are used and authority is exercised according to appropriate and legal procedures, professional standards and societal values (Brinkerhoff, 2003).

Transparency is considered a driver of public service reform worldwide. It derives from theories of civic responsibility of the 1980s. Though there is a growing interest in transparency in healthcare sector, as it may be a predictor for services and productivity improvement, transparency is not yet widely implemented (Henke, Kelsey, & Whately, 2011).

The IOM (2011) defines healthcare transparency as "making available to the public, in a reliable and understandable manner, information on the healthcare system's quality, efficiency and consumer experience with care, which includes price and quality data, so as to influence the behavior of patients, providers, payers and others to achieve better outcomes".

The American College of Physician (2010) identifies eight major domains of healthcare transparency:

- Clinical quality and safety, that deals with structure, process and outcome measures;
- Resource use, expressed as episode of care, yearly and per capita costs, number of hospital bed days, etc;
- Efficiency, measured as clinical quality outcome related to resource utilization;
- Patient experience of care, typically relived by ad hoc survey;
- Professionalism, measured as qualifications, professional standing and training;
- Healthcare system/ facility recognition accreditations for meeting national standards, that deals with accreditation;

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- Financial relationship between physicians, other healthcare professionals and industry, measured by public reporting of relationship;
- Health insurance company processes, expressed in terms of medical loss ratio, efficiency of claims processing, criteria for preferred provider status.

Transparency might impact on six areas: accountability, patients' choices, productivity, quality of services delivered, social innovation and economic growth (Henke et al., 2011). In fact transparency forces healthcare regulators to be accountable; guides informed choices thanks to the availability of comparative and complete information; drives providers to efforts effective and cost-effective services, encourages patients to be more informed, transforming the relationship between patients and providers; opens new opportunities for public and private providers, stimulating competitiveness.

Many potential benefits from increased healthcare transparency emerged both for patients and health systems, like improving availability of information needed to make informed healthcare choices, increasing trust in the patient-physician relationship and improving quality, safety and efficiency due to competition and availability of clinical benchmarks (Colmers, 2007; Collins & Davis, 2006; Snyder & Leffler, 2005). Furthermore, above all in publicly funded and administered healthcare systems, transparency is considered a main value: professionals and the other health sector employees must behave professionally and ethically, avoiding to commit fraud, accept bribes, or leak confidential information.

In the early part of the twentieth century, Codman (1975) promoted the importance of publicly reporting the results of hospitals activity in order to promote quality improvement, physician learning and patient choice, inspiring the current healthcare transparency movement.

The most recurring information showed about hospitals performance are: clinical quality as adherence of services provided to evidence-based, structured, clinical process or positive health outcomes benchmarks or guidelines), resource use (both structural and human resources) and experience of care (patients' view of the care received from providers). Even though it's well known that transparency could increase healthcare quality, many hospitals aren't ready to face the transparency challenge, staying reluctant to disclose their performance data.

Transparency is more than access to healthcare data: information to be effective must be shown in a way that reflects different users' abilities to understand and use information. Data should be not too much detailed and complex, not too much aggregate (IOM, 2010).

Moreover, transparency can encourage the practice of results based management in healthcare. In particular, there are three primary aspects of transparency relevant to management practice: information disclosure, clarity and accuracy

Finally, it's useful not to confuse transparency for knowledge: transparency causes an increase in knowledge, it may facilitate knowledge, but it's not knowledge itself (Schauer, 2011).

PUBLIC REPORTING IN HEALTHCARE

Definitions and Objectives

In the healthcare field, a well-trodden path to provide transparency and to be accountable is the public reporting. There is growing interest in public reporting of information on the quality of healthcare delivered by different providers (i.e. physicians, hospitals, health plans), as it is strictly linked to the account-

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ability of health systems and transparency of information and processes. It has become an increasingly common health policy tool (Faber, Bosch, Wollersheim, Leatherman, & Grol, 2009), both in publicly and privately funded systems.

Public reporting of performance information and feedback to providers is one of the major approaches to improve quality of care, because on the one hand allows to evaluate your own performance, on the other pushes the comparison with other providers; moreover, allowing patients to make informed choices stimulates competition. Furthermore, information supports patients' and users' decision making process, facilitating choices in selecting providers that best meet needs and preferences (Rice, 2001; Kumpunen et al., 2014), by comparing differences across them. Information on the quality of providers should be accurate and timely accessible (Victoor, Delnoij, Friele, & Rademakers, 2012).

Many author and national agency provide definitions of public reporting.

Public reporting refers to the publication of information and reports on the quality of care delivered by providers. Information is made available on the internet, on paper and in other formats for use by patients and users (Kumpunen et al., 2014).

It is defined as the way to promote high quality and efficient healthcare delivery and to increase the transparency of quality information enabling disparities in access to such information (Cacace, Ettelt, Brereton, Pedersen, & Nolte, 2011). It is also a strategy to address quality and cost making available to consumers, payers and healthcare providers information about performance and insurance plans and it should provide information on patient's satisfaction (James, 2012).

Actually, the Agency for Healthcare Research and Quality public reporting definition is the most widespread: "Public Reporting is data, publicly available or available to a broad audience free of charge or at a nominal cost, about a healthcare structure, process or outcome at any provider level (individual clinician, group, organization)" (Totten et al., 2012). The main objective of Public Reporting is to help actors of the health system to be accountable by spreading information about their performance in order to enable their stakeholders to make informed decisions and to support patients in choosing their own provider. Furthermore, it should promote healthcare quality improvement encouraging providers' competition and behavioral change (Cacace et al, 2011).

A Theoretical Framework: The Berwick Model

In public health field, information systems involve three kind of actors: patients or users, providers and regulators. Given the relationship between these three types of subjects, the main lever to induce quality improvement is providers behavioral change (Berwick, James, & Coye, 2003). This behavioral change could be induced acting on the side of demand for health services or on the side of production of health services, linking the processes of measurement pathways to the processes of improvement. According to Berwick's framework, exist two principals through which measurement and reporting can induce providers behavioral change: improvement through selection and improvement through selection (Berwick et al., 2003). The first pathway is based on the assumption that information on healthcare services' quality enables patients or users to select providers according to quality criteria, making informed decisions on their providers. Furthermore, regulators may use the information on quality to make decisions on payment, activating incentive mechanisms such as reward for high quality performance or penalty for low quality performance. In the second pathway, healthcare services' quality information is used by providers themselves to identify underperformance or good performance areas in order to stimulate competition on services quality and to act an organizational behavioral change.

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These pathways may stimulate behavioral changes only if there is providers' intention to compete and maintain or increase their reputation (Cacace et al., 2011). The will to be competitive with other providers and to maintain a good reputation to attract patients should stimulate behavioral changes aimed at improving performance.

It is also important to observe that providers have two different kind of functions on two different levels. First of all, they are information users in order to make decisions about their operative strategy and organization, on the other side they are the main information providers and target audience of information systems and their capacity to produce information is decisive to healthcare quality. On the second level, in more operative terms, providers do not only react to the output of information systems, such as outcome indicators, they also produce information to make possible these comparisons and stimulate competition and quality improvement (Cacace et al., 2011).

Furthermore, it is relevant to note that the literature has suggested that patients choose their healthcare providers considering a wide range of services' characteristics: in addition to the quality of care or positive evaluations of the outcomes, could also affect other non-clinical elements such as the proximity of the provider, good ancillary services (food, cleanliness, etc.) or a previous experience (Kumpunen et al., 2014). A relevant aspect is the measurement of patient expectations and perceptions. This represent a valuable dimension of the process by which the quality of health care service is evaluated. Administrators should understand the areas in which expectations are particularly high so that the service delivery process can be tailored to meet those expectations (Babakus & Mangold, 1992).

Main Characteristics of Public Reporting: Indicators and Availability

A public reporting system is based on a set of indicators through which provide information to different stakeholders. The first important step to take when building a system of public reporting is to identify a set of indicators suitable for measuring the activity. In healthcare, public reporting of services' quality is strictly linked and influenced by the multidimensionality of quality, so it is necessary to identify different indicators able to measure all the quality dimensions. Usually, three types of indicators are used in order to monitoring quality of healthcare services: structural measures, process measures and outcome measures (Donabedian, 2005).

Structural indicators monitoring structural, technological, organizational and professional resources of healthcare providers, measuring tangible aspects, such as number of physician for patients, bed's occupancy rate or operating rooms' utilization rate. They are easy to measure and probably are the more easily to understand for patients. Process indicators measure the appropriateness of the care process and usually are classified into organizational process indicators that measure volumes (i.e. number of admissions; length of stay), waiting times for services and continuity of care, and professional process indicators that measure appropriateness of care decisions, correctness of execution and timeliness of care. Outcome indicators measure the health status of a patient resulting from care process, highlighting a change of health status, for example in terms of mortality or morbidity, but also in terms of quality of life or satisfaction. Often it is too difficult to link both structural and process indicators outcomes measures, making an integrated interpretation.

Data can be reported at different levels of care: physician level, measuring the quality of care provided by a single healthcare professional; hospital ward or specialty level, measuring a team performance; hospital level, measuring the entire organization performance.

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The use of public reporting could encourage physicians or providers to adopt opportunistic behaviors, in terms of selecting services or patients in order to obtain better results, or to focusing on the clinical care that are monitored, omitting provision of other important care. A solution to try to avoid these behaviors is the utilization of risk and case-adjustment methods in calculating indicators (Kumpunen et al., 2014).

Generally, the data used to public reporting may come from three kind of sources: administrative, surveillance and *ad hoc* (Kumpunen et al., 2014).

Health administrative databases are information flows for monitoring the delivery of health services in which data are routinely collected to produce administrative reports. Despite their goal was predominantly the accounting, they have proved to be the best sources available as regards the aspects of monitoring accessibility and completeness of care. Health surveillance databases aims to routinely collect to detect anomalies or changes in providers activities or performance.

Health *ad hoc* databases are realized to collect specific information about an event that needs to be monitored, so data are collected specifically to monitor some aspects of quality and performance. Intervals for collecting data may vary according to the kind of information to provide: routine collection, regular intervals collection or ad hoc collection (Kumpunen et al., 2014).

Always more frequently a source of healthcare quality information is represented by patients or users themselves. In fairly recent times it occurred the development of a number of sites or blogs where patients give information, exchange opinions and make ratings. These kind of initiatives have both many vantages and disadvantages. For example, patients who directly received care can comment many aspect of care process, also not included in conventional surveys. On the other side, patients may not have technical or specific knowledge on some complex aspects of care and it is very difficult to verify identity and credibility of those who write a comment. Furthermore, given the complexity of understanding statistical information, it may happen that anecdotal personal information are favored in making choices (Trigg, 2011).

One of the most common and easily available source on healthcare quality information is Internet that makes possible a direct and fast access to information. This way of access allows to have ever up to date information, being able providers to timely updates them. Furthermore it is possible to create web sites customized to the users' preferences and easy to consult. However, the use of Internet could exclude to the access of healthcare quality information people without internet availability or unable to use it (Kumpunen et al., 2014).

The Evolution of Public Reporting In Healthcare

The great interest in quality management and improvement in healthcare induced systematic assessment and international benchmarking of quality of care provided. Many quality or performance assessment frameworks implemented at national, regional or local level have been developed as quality or performance improvement is possible only if measurement is fulfilled (Cacace et al., 2011). Measurement allows for monitoring effectiveness, guarantee patient safety, support decision-making and insurance value for money among other things (Smith, Mossialos, & Papanicolas, 2008).

Moreover, data on the quality of healthcare, compared between healthcare providers, has been publicly widespread producing the public reporting phenomenon. The first important public reporting initiatives date back to the 1980s and were developed in the United States: the publication of mortality rates by the Health Care Financing Administration (today Centers for Medicare and Medicaid Services) in 1986 and the New York State and Pennsylvania's Cardiac Reporting Systems in 1989 and 1992 (Schneider

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& Epstein, 1998; Shahian et al., 2011). Afterward, many other high-income countries, especially in the West, have experienced public reporting in their healthcare systems (Faber et al., 2009).

The effects of the first implementation of public reporting varied widely among providers: many sustained that data did not take into account some patients' characteristics (i.e. age, comorbidities) that might influence their performance (James, 2012).

Actually, though there is a great number of public reporting websites they differ in many characteristics. First of all, websites should be managed at local, regional or national levels and should be operated by different stakeholders (i.e. governments, insurers or commercial organizations). Websites should be targeted at purchasers, regulators, providers or patients. Even the contents vary: not only performance information, that are the most common from waiting times to more complex clinical and patient experience indicators, but also information about structure, facilities and so on (Kumpunen et al., 2014).

There are, additionally, significant differences between public reporting due to healthcare system model. In example, in some insurance funded systems some data must be published (e.g. hospital admissions in Germany) and those are used at national level, regional or insurance level. In private insurance systems, like the United States one, where there is an high fragmentation of public reporting initiatives, a larger quantity of administrative and quality data are available, that makes the use of information more complex for all the stakeholders (Marshall, Shekelle, Davies, & Smith, 2003; Kumpunen et al., 2014).

Effects of Public Reporting In Healthcare

Which are the real effects of public reporting since its implementation? Is it able to support stakeholders' decision making and patients in choosing their own provider? Does it allow healthcare quality improvement?

Public reporting is supposed to: support and empower consumers/ patients to choose their provider and/ or to share their opinions or preferences; help purchasers in their decision making processes, choosing providers that create value reaching population health goals; increase self-regulation among providers (Leatherman & McCarthy, 1999).

How should public reporting improve healthcare quality?

At first public reporting might help patients and referring physicians select high-quality providers. This happens if patients access the information, are able to understand the quality rankings and believe them and act on the information itself or if referring physicians use it. Even though patients and referring physicians don't use it, purchasers should use public reporting data in order to select or establish providers' contracts. Then rated providers should react to public reporting by improving the quality of the delivered care in three different ways: remediation (providers change their practices to improve quality); restriction (providers stop supplying care for which they rated poorly); removal (low-quality providers exit the healthcare market). It might also encourage quality competition, so that providers might compete on quality to maintain or improve their market share. Finally, public reporting might improve providers' accountability (Werner & Asch, 2005).

How Does Public Reporting Improve Healthcare Quality?

The growing interest in public reporting leads many authors to investigate the use and impact of publicly released performance data. Conflicting results emerged. A recent systematic review highlighted that outcomes' heterogeneity and moderate evidence's strength make it difficult to draw definitive conclu-

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sions. Particularly, public reporting seems to have a positive impact on quality measures, although quality varies across plans or patients' subgroups. As regards harms or unintended negative effects, more evidence of no harm than evidence of harm emerged, especially on access. Providers seems to react to public reporting by changing positively their behavior, though evidences are scant and not available for all settings. Regardless of the setting, public reporting appears to little or no influence the selection of health services providers by patients, usually because they do not know that quality information is available, the information do not meet their needs or are not available when needed or are not understandable. It determines an effect if it is used by some subgroup of patients (i.e. younger, more educated patients). There is a few evidence about which report characteristics affected the impact of public reporting on any outcome. Some evidences show that public reporting is more effective in competitive markets and if referred to providers with initial lower scores (Totten et al., 2012). Intermediate and ultimate healthcare outcomes could be influenced by the way in which healthcare data are publicly reported. There are some specific examples of report characteristics that seems to be associated with public reporting effects:

- Acceptable/ appropriate: data should be believable, high quality and accurate
- Accessible: reports should be understood by target populations; it deals both with format, language, and graphics and advertising and promotion
- Actionable: on the patient side reports should help in keeping a decision; on the provider side (individuals or organizations) reports are related to factors they can influence (Totten et al., 2012).

The cost-effectiveness evaluation of a public reporting initiative is difficult, because a comparison between public reporting and other quality improvement intervention in terms of costs, benefits and risks is needed. The costs of public reporting typically include development of measures, methods and information systems, data collection and preparation, analysis and auditing, and public dissemination and education (Leatherman & McCarthy, 1999). More detailed analysis is needed to address this issue.

Analysis of the Major Initiatives of Public Reporting

The concept of patient engagement is based on the assumption that making patients co-producers of their health might enhance their satisfaction and responsibility with the healthcare system (Graffigna et al., 2015) and it strictly linked with the health provider choice. In the healthcare field, public reporting is one of the major tools in supporting patients' decisions making process, by providing structure, process and outcome measures. Nowadays, many public reporting initiatives exist that differ in some characteristics such as: the management that can be at local, regional or national levels, the property that can be public or private (i.e. governments, insurers or commercial organizations), the target (i.e. purchasers, regulators, providers or patients), main contents (i.e. performance information, waiting times patient satisfaction), the healthcare system model.

A web-based analysis of the major initiatives of public reporting was performed in order to highlight their main characteristics: properties (public or private), data source (governmental, not governmental, ad hoc surveys) and type of data reported (general information, doctors' information, patients' satisfaction). Two independent reviewers searched public reporting websites. The information was collected in an *ad hoc* database. The reviewers solved disagreements through discussion to reach a final consensus. Only public reporting websites in English or Italian were searched, as the languages spoken by the reviewers. Furthermore, public reporting initiatives if they did not allow comparison between providers.

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Forty-one public reporting websites were identified, but only 18 were searched because in English or Italian. The excluded one were public reporting initiatives from Netherland, Denmark, Germany, Finland, Sweden and Norway. This is one of the major limit of our analysis as they could add further information about different items considered.

Seven out of 18 websites were subsequently excluded as they did not allow comparison between providers.

The analysis was conducted on 11 public reporting websites: 8 from the United States, 2 from Great Britain and 1 from Italy. Table 2 shows main characteristics of public reporting initiative investigated. Nine out of 11 were private initiatives, 2 were public. The property did not influence the data source

Table 2. Main characteristics of public reporting initiative investigated

Public reporting website	State	Web-site	Properties	Data source	Aim
United States: Medicare.gov	USA	http://www.medicare.gov/_	Public	Governmental data	To find providers and compare the quality of their care
Leapfrog	USA	http://www.leapfroggroup.org_	Private	Ad hoc surveys	To promote transparency through data collection and public reporting initiatives
U Compare Healthcare	USA	http://www.ucomparehealthcare.com/_	Private	Governmental data. Ad hoc surveys	To help people make better decisions about their healthcare choices
California Nursing Home Search	USA	http://www.nursinghomeguide.org/NHG/nhg_txt_home.lasso_	Private	Governmental data. Ad hoc surveys	To help people search for a nursing home in California
National Committee for Quality Assurance (NCQA)	USA	http://www.ncqa.org/HomePage.aspx_	Private	Ad hoc surveys	To help people select a health plan or physician
US News Health	USA	http://health.usnews.com/	Private	Governmental data	To provide consumer guides that include rankings of hospitals, nursing homes, health plans
The American Hospital Directory	USA	https://www.ahd.com/_	Private	Governmental data. Not governmental data	To provide information about hospitals
Quality Check	USA	http://www.qualitycheck.org/consumer/searchQCR.aspx_	Private	Not governmental data	To providing meaningful information about the comparative performance of accredited organizations
NHS Choices	GB	http://www.nhs.uk/Pages/HomePage.aspx_	Public	Governmental data. Ad hoc surveys	To create a new information, feedback, transactions and participation service delivered through mobile apps, SMS, phone lines and online channels
Dr. Foster	GB	http://myhospitalguide.drfosterintelligence.co.uk/_	Private	Governmental data	To use information to improve lives
Doveecomemicuro	IT	http://www.doveecomemicuro.it/_	Private	Governmental data. Not governmental data	To find providers and compare the quality of their care

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utilized: 8 out of the 11 websites used governmental data, of which 5 combined governmental data and other data source (not governmental or ad hoc surveys), 2 websites used only ad hoc surveys and 1 website used only not governmental data.

Regarding the type of data reported, all the public reporting websites investigated showed general information about providers such as structural and/ or processes indicators, 5 reported also information about doctors, 2 reported data also about patients' satisfaction /experience ratings and 6 reported also clinical indicators. Only the NHS Choices website showed all the type of data searched. The California Nursing Home Search and Quality Check reported only general information about providers.

As regard the aim of the public reporting initiatives searched, the interest in supporting patients choices showing providers information emerged as a common feature.

CONCLUSION

As a result of what was discussed, it emerged that involving patients in decisions about their health is a crucial component for the quality improvement of healthcare services. As previously mentioned, the IOM's report "Crossing the Quality Chasm" has been recognizing patient-centered care as an essential dimension of high-quality care (Clancy, 2011). In 2006, the World Health Organization indicates patients and the population engagement as one of the six domains of quality interventions (WHO, 2006).

Being patient involved and engaged, strictly connected with healthcare quality improvement, is important to stimulate strategies to make informed patients and able to take informed decisions about their health.

A well-recognized strategy to inform patients is the public reporting of health care information. This kind of strategy is relevant on a side to allow patients to take informed decisions on healthcare services according to their needs, on the other hand to guarantee accountability and transparency in provision.

As mentioned, accountability have to represent a fundamental issue to improving health systems performance and transparency increases benefits both for patients and health systems, improving availability of information needed to make informed healthcare choices, increasing trust in the patient-physician relationship and improving quality, safety and efficiency due to competition and availability of clinical benchmarks.

Public reporting of performance information and feedback to providers is recognized as one of the major approaches to improve quality of care, thanks to the possibility for providers to evaluate your own performance and to make a comparison with other providers and for patients to make informed choices. Furthermore, well designed public reports help patients making informed choices. Public reports seem to improve citizens and health consumers empowerment (Totten et al., 2012; Silenzi et al., 2013).

Because of the relevance of public reporting in improving quality of care and stimulating patient engagement, there are many public reporting initiatives, across different countries, that differs for many characteristics. In this chapter we reported the results of a web based analysis aimed at comparing major initiatives of public reporting, classified by the following characteristics: properties (public or private), data source (health providers, ad hoc surveys, etc.), general information reported (i.e. size, language spoken, amenities), doctors' information, patients' ratings (satisfaction /experience), clinical indicators. The results show that main common feature is the declared aim of all the initiatives analyzed: to support patients' choices showing providers information, despite consistent differences in properties of the initiatives or data sources.

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In conclusion we believe that a good strategy aimed at informing patients about providers' performance through initiatives like public reporting websites could represent a way to improve healthcare quality, stimulating accountability of providers and transparency of decisions and making patients co-producers of their health.

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KEY TERMS AND DEFINITIONS

Accessibility: The opportunity to have access to the care according to our healthcare needs.

Answerability: Responsibility for explaining or justifying one's actions.

Clinical Governance: Systematic approach to maintaining and improving the quality of patient care within a health system.

Disclosure: The act or process of revealing. Public disclosure is a situation in which an organization makes information available by publishing it.

Effectiveness: The capability of producing a desired result. In medicine, effectiveness relates to how well a treatment works in practice.

Efficiency: The ability to do things well, successfully, and without waste. Efficiency in healthcare is the capability to use resources to get the best results in terms of care with the less waste of resources.

Equity: The absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically.

Evaluation: Is a systematic determination using criteria governed by a set of standards.

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Section 2
Tools and Technologies

This section presents an extensive coverage of various tools and technologies available in the field of Public Health and Welfare that practitioners and academicians alike can utilize to develop different techniques. These chapters enlighten readers about fundamental research on the many tools facilitating the burgeoning field of Public Health and Welfare. It is through these rigorously researched chapters that the reader is provided with countless examples of the up-and-coming tools and technologies emerging from the field of Public Health and Welfare. With 13 chapters, this section offers a broad treatment of some of the many tools and technologies within the Public Health and Welfare field.

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Chapter 14
The Role of Management Accounting Systems in Public Hospitals and the Construction of Budgets: A Literature Review

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ABSTRACT

The role of management accounting systems (MAS) in the construction of budgets in the public health sector has been one of the least studied topics in the international literature. Furthermore, several studies have confirmed the loss of relevance of traditional approaches to budgeting due to the need to implement techniques that are more performance-oriented. Since public hospitals are organisations that depend significantly on public funds, with substantial impacts on governments' budgets, the pressure for reducing expenditures is strong, causing increased difficulties in hospital management. In order to analyse the role of MAS in the preparation of hospital budgets, this chapter presents a literature review on this topic. This review allows to understand the loss of relevance of traditional budgeting techniques and to present alternative approaches. In this process, the implementation of different kinds of budgeting is heavily influenced by governments and professionals. Nevertheless, the research on this topic is still very scarce, evidencing the need to continue studying it.

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INTRODUCTION

The relevance of the information produced by management accounting systems (MAS) in public or private organisations is currently widely recognised. Like in the private sector, also in the public sector several organisations operate in an environment where cost information can be classified as a strategic resource for long-term financial sustainability. The imbalance in government accounts, due to excessive expenditures, and the complex nature of several public sector organisations – a reality of our days, make management accounting an urgent need also for these organisations.

As to the environment of the health care sector, a set of features must be pointed out, distinguishing this from other sectors, namely, the strong component of ethical judgments, uncertainty, economic inefficiencies and, ultimately, the conviction that health, together with the values of human life, is not measurable. Nevertheless, health care costs must be identified, planned, managed and controlled.

The increase in public health expenditure in recent decades has been a great concern in most of the Organisation for Economic Cooperation and Development countries. According to Organisation for Economic Co-operation and Development ([OECD], 2014), in 2012, the total health expenditure in Portugal corresponded to 9.5% of the Gross Domestic Product (GDP), slightly above the average for all member countries (9.3%).

This progressive growth of health expenditure is mainly due to: technological and scientific progress achieved in this area, which has led to significant improvements in services; the increasing use of prescription drugs; the growing prevalence of treatable chronic diseases; among other factors (Kaplan & Porter, 2011; Lapsley, 2001; Shortell & Kaluzny, 2006). As a result, people can now live longer and healthier lives.

The public sector is the main source of health financing in virtually all OECD countries (OECD, 2014). According to the same source, in Portugal in 2012, 65% of health expenditures were financed by public funds, i.e. taxes.

The changes made on the budget preparation methods have been one of the major responses of the Portuguese Government to this issue. Such changes include, for example, the implementation of the "program-contracts" in the health care sector. It is expected that, among other things, the budget promotes accountability in outcome management, as well as performance evaluations.

The budget has a central role in public sector management. This document relates to a specific period of governance and presents a set of expenditures and revenues that policy makers intend to carry out in the various budget items. Wildavsky (1975) argues that the budget is a vital element of any government because it reflects the action plan in the implementation of public policies.

Although some empirical studies show that the budget is one of the most important tools in planning and controlling organisations, there is an ongoing debate about the usefulness of traditional budgets (Abernethy & Brownell, 1999; Uyar & Bilgin, 2011; Tayles, Pike & Sofian, 2007). There is a growing recognition, by several authors, of the limitations of conventional budgets (Abernethy & Brownell, 1999; Andrews & Hill, 2003; Anessi-Pessina, Barbera, Rota, Sicily & Steccolini, 2012; Finkler & Ward, 1999; Hansen, Otley & Van der Stede, 2003; Hanninen, 2013; King, Clarkson & Wallace, 2010; Libby & Lindsay, 2003, 2010; Marginson & Ogden, 2005; Mikesell, 1995; Neely, Sutcliff & Heyns, 2001; Sandino, 2007; Tayles, et al., 2007; Uyar & Bilgin, 2011). Some suggestions for improvement point to other budgeting approaches such as "performance-based budgeting" (PBB) (Andrews & Hill, 2003; Kong, 2005), "zero-based budgeting" (ZBB) or "priority-based budgeting" (PYBB) (Chartered Institute

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for Public Finance and Accounting [CIPFA], 2006; Tayles et al., 2007; Worral, Collinge, & Bill, 1998), and "activity-based budgeting" (ABB) (Hansen et al., 2003; Pinto & Santos, 2005).

In the health sector, the strong pressure from governments for reducing public expenditures and rationalisation of resources is an incentive for carrying out reforms to achieve a greater sophistication of MAS (Arnaboldi & Lapsley, 2005; Young & Pearlman, 1993). In this context, the ability to anticipate and respond to opportunities and pressures in organisational management is critical for obtaining the desired results. But is the public health care sector in Portugal prepared for these new requirements?

In recent times, the literature on management accounting has given more attention to budgeting and the role of MAS as a diagnosis tool in managing performance assessment (Helden, 2005; King et al., 2010; Tayles et al., 2007; Uyar & Bilgin, 2011). Additionally, there is a small number of empirical studies that analyse the relationship between MAS, contextual variables and performance (Abernethy & Brownell, 1999; Ezzamel, Robson & Stapleton (2012); Hammad, Jusoh & Oon, 2010; Johansson & Siverbo, 2014; Pizzini, 2006). However, the issue of adequacy of MAS to budgetary techniques used in the public sector, particularly in the health care sector, and its relationship with organisational performance, has been scarcely researched.

The purpose of this chapter is to present a literature review on the role of MAS in the preparation of hospital budgets, namely advancing how the introduction of new approaches to budgeting has evolved in this context. Additionally, the chapter also summarises some of the contributions made in the Portuguese public hospitals setting.

The next section offers an overview of the relevance of the MAS in the health care sector and the subsequent sections describe the role of budgets in MAS and the relevance loss of traditional budget techniques. The concern is to explore alternative budgeting approaches and analyse the main contributions that have been made to the Portuguese health care sector. The final section will comment on the main results of a literature review on the role of MAS and budgets in public hospitals.

THE RELEVANCE OF MANAGEMENT ACCOUNTING IN THE HEALTH CARE SECTOR

Considering the complex nature of health care, management accounting in this setting has assumed an important place and high visibility in the literature. The increase in average life expectancy, the development of new medical treatments and the latest advances in technology seem to have led to an unstoppable rise in health care costs all over the world (Kaplan & Porter, 2011; Lapsley, 2001; Shortell & Kaluzny, 2006).

Alongside these aspects, other factors such as the highly complex nature of health care organisations and the relevance of technical and hierarchical authority play an important role in the development of accounting information systems and, ultimately, in the quality of services provided. In recent years, these factors have received special attention by health authorities (Finkler & Ward, 1999; Hammad et al., 2010; Nyland & Pettersen, 2004).

Within the existing official health care organisations, hospitals tend to stand out due to their size and complexity. In Portugal, according to a survey carried out by the National Statistics Institute (Instituto Nacional de Estatística [INE], 2012), for the 2007-2011 period, only the general and specialised hospitals belonging to the public sector (including Corporate Public Entities, so-called EPE hospitals) were

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responsible for 38%, on average, of current health expenditure (7% more than in the 2000-2008 period (INE, 2010).

Data obtained by Brignall (1997), Hammad et al. (2010), and Pettersen and Nyland (2004) show that hospitals, defined as complex health care providers, have services which are sometimes difficult to define. According to these authors, the size, the institutional context and the complexity of these services explain most of the obstacles found to measure performance, results, and calculate costs. For example, in Portugal, the mandatory implementation of the Analytical Accounting Plan for hospitals (PCAH), since 1996, includes the deployment of hundreds of cost centres (Leite & Rodrigues, 2010). Hence, hospitals are expected to invest in the development of MAS, improving decision-making processes and operational planning and control, promoting economic growth, as well as high degrees of efficiency and effectiveness.

Traditionally, the use of MAS has not been a major concern within the public sector, health care in particular, given the inevitable costs and the lack of profit-oriented objectives. Additionally, it is also true that the value of human health is priceless. However, the need to manage and control the rising costs and rationalise resources, which are scarce, has placed a great deal of importance on the current role of MAS in hospital organisations (Kuchta & Ząbek, 2011; Pizzini, 2006).

Kaplan and Porter (2011) believe that if something cannot be measured, it cannot be managed or improved. Drury (2004) also argues that the main purpose of management accounting is to provide organisations with valuable information supporting managers in decision-making processes and promoting operational efficiency and effectiveness. The importance of management accounting has been highlighted in the literature, as it enhances the decision-making process (Drury, 2004), the flexibility to serve different purposes (Pizzini, 2006), taking into account the costs associated with a specific decision context (Smith, 2007).

Some international studies have considered the introduction of both management accounting and control techniques, and performance evaluation measures as the most significant changes in the accounting systems of the public sector over the past few years (Eriotis, Stamatiadis & Vasiliou, 2011; Jackson & Lapsley, 2003).

Finkler and Ward (1999), Jackson and Lapsey (2003), and Nyland and Pettersen (2004) argue that MAS are essential tools in the production of relevant information to support the decision-making process in management, budget control and accountability. For example, Jackson and Lapsley (2003) studied the use of management accounting techniques in the public sector. They found out that the activity-based-costing (ABC) method was the most used method for calculating costs, mainly in the health care sector. Following the same line of thought, other authors have also advocated the advantages of the application of the ABC method in hospitals: ... *one of the most important contributions of the ABC method is that it helps improving financial decision making, as well as other decisions at the level of reorganisation and service provision* (Moreno, 2007, p. 122).

In Poland, the study conducted by Kuchta and Ząbek (2011) confirms the usefulness of ABC for hospitals, as it allows: the evaluation of resource consumption and its distribution among different organisational units; the analysis of the existing variations between budget planning and execution; and the implementation of activities that add more value to the organisation.

Ramsey (1994) states that hospitals should be allowed to increase or eliminate production lines and services in order to meet the needs of citizens and create value. The author presents three pillars that support the functioning and utility of MAS in hospitals: (1) increasing cost efficiency without reducing quality of medical services; (2) maximising internal resources through the internal management of

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production lines and services; and (3) identifying opportunities for continuous improvement. Hence, Pizzini (2006) claims that cost reduction, performance improvement and profit increase can all be achieved if hospitals also focus on direct cost containment, instead of focusing only on the promotion of administrative efficiency. However, the author also pinpoints that detailed information does not itself reduce health care costs.

Despite the growing importance of MAS in the health care sector, which have been greatly emphasised in the international literature (Finkler & Ward, 1999; Jackson & Lapsey, 2003; Kuchta & Ząbek, 2011; Nyland & Pettersen, 2004; Ramsey, 1994), there has been some discussion on the fact that cost awareness in public social services has not been considered as important as in the services provided by private entities. Pizzini (2006) argues that the effective costs of health care services are unknown. The author adds that hospitals only use MAS with the main purpose of gaining external credibility. This view is also supported by Pettersen (1995) who argues that accounting information can serve the purpose of maintaining legitimacy, mainly because budgeting is often misaligned with operational services. By studying the ambulatory health care services in Poland, Kuchta and Ząbek (2011) also found that most of the existing problems are due to the lack of accurate information on costs, leading to inefficient management.

Some of the issues which have been emphasised in the literature are based on the belief that management accounting aims to provide awareness of the costs arising from the activities carried out by health professionals within a hospital setting, since they are responsible for the highest consumption of resources, especially in the case of doctors and nurses (Hill, 2000). Nyland and Pettersen (2004) argue that there is still a long way to go before medical decisions legitimise information about costs. The authors also add that most of the professional groups see accounting information as useful if related to performance evaluation systems and incentive schemes.

A study conducted in England by Jones and Dewing (1997) confirmed that the awareness of hospital costs and revenues was based on accounting abstraction, with very little or no contribution of health professionals and directors. The interaction between managers and professionals is considered by some authors as tense and dichotomous. The reason for this relates to the fact that managers are more concerned with organisational aspects, such as efficiency, economy and cost imposition, whereas health professionals are more focused on the provision of medical care guided by a set of ethical principles. For example, Hewison (2002) showed the complex relationship existing between these two groups of professionals, challenging managers to reconsider a change in their leadership style. This author encourages managers to assume the role of a mentor and facilitator in finding solutions to problems, together with health professionals.

Most of the difficulties found in measuring and controlling health costs are: legitimacy issues (Pettersen, 1995; Pizzini, 2006); problems in production of accounting information by a large group of professionals who are not interested in these issues (Hewison, 2002; Jones & Dewing, 1997; Nyland & Pettersen, 2004); and a reduced use of such information in decision-making (Kuchta & Ząbek, 2011; Leite & Rodrigues, 2010; Pizzini, 2006). However, management accounting is still an important system of information in hospital settings all over the world.

In Portugal, under the New Public Management (NPM) wave, several changes have occurred in the legal status of hospitals, mainly due to the application of private sector management methods and greater accountability. These reforms, along with the conviction that public service management models were inefficient (Leite & Rodrigues, 2010), have favoured the need to improve management accounting and control in hospital settings.

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Until the 1980s, in the Portuguese health care sector, there were a few incentives to invest in this kind of systems (Pereira, Sá & Jorge, 2009). The main objective of the management accounting systems that were implemented was to produce information on costs for external supervisory bodies, such as the Central Administration of the Health System (ACSS), mainly for financing and budgeting purposes. However, with the introduction of financing mechanisms based on the assignment of fixed values for each service (Diagnosis Related Groups – DRG), hospitals became responsible for the existing inefficiencies. Old management methods have been challenged by the growing demand for greater transparency in public expenditure and the increasing emphasis given to results, without neglecting the quality of the services provided to the community. This explains why MAS have assumed such an important role in Portuguese hospitals over the last few decades (Barros & Simões, 2007; Leite & Rodrigues, 2007, 2010; Pereira et al., 2009).

Despite the relevance of this issue, research studies in the health care sector are still scarce in Portugal. The few studies that have been conducted recognise that the role played by MAS in the Portuguese public hospitals is quite limited, since information providers mostly limit themselves to comply with the legal requirements issued by the supervisory bodies, neglecting the internal value of that output.

Leite and Rodrigues (2010) analysed 26 Portuguese EPE hospitals and concluded that standard cost indicators show inefficiencies from hospital to hospital. However, a sole cost benchmarking analysis is not sufficient since features of each organisation should be considered, such as its context, complexity, and clinical data. The authors conclude that political, cultural and social factors are more important than efficiency, making cost standardisation irrelevant to management.

In a study on the role of management accounting practices in performance monitoring and evaluation of Portuguese EPE hospitals, Leite and Rodrigues (2007) identified other gaps, such as: the low level of implementation of the PCAH; the lack of guidance in the calculation of profits and in the establishment of parameters for budgeted costs and the lack of management indicators for efficiency evaluation.

The implementation of new management accounting techniques is not a panacea for solving, by itself, the inadequacies found in the management of Portuguese hospitals. But, it is also true that strong institutional pressures to reduce costs in a context of financial crisis is a motivation for carrying out reforms to ensure greater sophistication of MAS (Arnaboldi & Lapsley, 2005; Young & Pearlman, 1993). Therefore, the challenge is to develop transversely new concepts, practices, and ways of addressing problems, promoting the active collaboration of governments, managers and health care professionals. But is the health care sector in Portugal prepared for these new challenges?

MANAGEMENT ACCOUNTING SYSTEMS AND BUDGETS

The definition of the objectives of management accounting systems (MAS) for the public sector by the International Federation of Accountants reinforce the importance of budgeting as a planning and control tool (International Federation of Accountants [IFAC], 2000). According to this organisation, the pressures set by governments for budget cuts in tandem with public service improvement, require extensive knowledge of the entities' cost structures. For better decision making, the full use of management accounting is crucial (IFAC, 2000, p. 5).

In recent decades, the international literature has come to recognise the budget as one of the main vectors in performance evaluation and innovation of MAS, especially in those organisations facing strategic change (Abernethy & Brownell, 1999; Anessi-Pessina et al., 2012; Ezzamel et al., 2012; Jo-

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hansson & Siverbo, 2014), with particular emphasis on the health care sector (Abernethy & Brownell, 1999; Jackson & Lapsley, 2003; King et al., 2010; Lapsley & Wright, 2004; Macinati & Rizzo, 2014).

Abernethy and Brownell (1999) argue that an appropriate response of MAS is essential for the survival of organisations. Based on the data collected in 63 Australian public hospitals, the authors emphasize the value of using budgets adjusted to strategic changes, especially at the level of goal-based performance, performance evaluation and greater accountability of managers. The budget is, thus, considered a core pillar in most MAS, representing an important tool for the coordination and communication of the strategic priorities of top management to low-level management.

Considering the tight connection between contingency factors, budgeting practices and the performance of organisations, King et al. (2010) presented relevant evidence for Australian primary health care units. From 144 answers in a universe of 988 members of the Australian Management Practices Association, they found that the contextual factors identified by contingency research are useful to identify budgeting practices and the extent of such use. In addition, the authors have presented evidence of the relationship between budgeting practices and performance. They concluded that the performance evaluation of an activity is related to the choice of budgeting practices.

From the point of view of both top managers and policymakers, Macinati and Anessi-Pessina (2014) confirm most of King et al.'s (2010) results through a recent questionnaire that was mailed out to all Italian public health care organisations. Their findings mostly suggest that cost-containment strategies encourage more sophisticated MAS. Furthermore, the use of MAS is directly and indirectly influenced by contingency, organisational, and behavioural variables. The authors also found a significant positive relationship between MAS use and financial performance.

In a bottom-up analysis, Wickramasinghe (2015) also reflected on management accounting and health care budgets. His analysis of Sri Lankan health care reform suggests that*: cost accounting acts as a mediating instrument: it begins to loosen the old Keynesian post-colonial bureaucratic budget confinements, creates a social space for individuals to consider cost-saving experiments, and addresses wider policy concerns about hospital resource management* (Wickramasinghe, 2015, p. 323).

Following this thought, another study on the use of budgets in the health care sector draws attention to the level of motivation of the clinical management of an Italian hospital, in the pursuit of participatory budgeting and its connection with individual and organisational performance (Macinati & Rizzo, 2014). The results show that the budgetary participation motivates clinical managers to comply with budget targets. They also conclude that budgetary participation can shape the culture of these agents, increasing the level of their identification with organisational goals. Based on this result, the authors emphasise the idea that committed clinical managers are more likely to use budgetary information, therefore suggesting that the convergence between individual and organisational goals should be seen as a key element in management accounting and control systems.

Similar to Macinati and Rizzo (2014), Johansson and Siverbo (2014) also draw attention to the surprising problem of the reduced number of studies analysing the design, the use and the effectiveness of budget control systems in the public sector. For these authors, the budget and budgetary control are the main goal of planning, control and accountability in the public sector. The budget deviations in this sector represent an important performance dimension. The study analyses the current political and institutional pressures regarding the performance of public organisations, to prevent them from overspending or falling below budget. Based on the information collected from the analysis of 196 Swedish municipalities, it was concluded that in a more turbulent budgetary environment, the implementation of strict budgetary control is the functional response that increases the probability of complying with

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the budget targets. However, if the budgetary turbulence is only marginal, municipalities tend to carry out activities similar to those of the previous year, and the implementation of strict control mechanisms has no effect on budget deviations. According to Johansson and Siverbo (2014), the most significant contribution of their work was the assessment of the impact of the political and institutional environment and tight budget control on budgetary performance.

Beyond the health sector in particular, public sector in general has been the object of international research, with the aim of analysing the changes and innovations deriving from the adoption of management accounting practices. The diffusion and innovation of MAS has assumed, in the public sector, a new importance due to the reforms occurring in the context of NPM (Jackson & Lapsley, 2003; Lapsley & Wright, 2004). In addition to cost calculation methods and performance measurement tools, the main innovations also include budgeting techniques.

The work developed by Lapsley and Wright (2004) demonstrated the power of political and governmental influence in the adoption of these techniques. Based on a questionnaire made to 258 members of Scottish organisations in the public sector, the authors concluded that, from the several budget techniques used, the resource management technique (RM) was the most popular, with 34% of public organisations using this tool.

The introduction of new budget practices in institutional change settings, with a very distinct and competitive logic, served as a basis for the study of Ezzamel et al. (2012). The authors divided their empirical analysis into two stages: in 1990 and in 2011, including the tensions identified between the reforms carried out in the education sector in the UK (primary and secondary education), which led to the materialisation of the business logic (the dominant logic), as well as the professional and governance logics. Based on the neo-institutional theory, the authors observed the introduction of new budget practices centred in the allocation of resources and in the creation of centres for budget accountability, aiming to understand the role of MAS in institutional change processes, especially after the Education Reform Act 1988. The budget changes materialised a business logic which, in turn, allowed restructuring the schools. Since the management model used by the local education authorities was no longer efficient, the new budgetary process introduced new budgetary planning and accountability practices, involving teachers and school principals.

Planning and management modernisation processes in the public sector emphasise the relevance of adopting new management mechanisms and techniques. In addition to the innovations observed in financial accounting and in techniques used to support daily management (Hood, 1991; Lapsley, 1999), budgetary reforms were also carried out. The role of budgets was considered key in MAS and administrative management (Anessi-Pessina et al., 2012). According to these authors, management reforms in the public sector promoted the budget as an essential tool in supporting organisational action, creating cost limits by nature, function and responsibility centres; defining functions in decision-making; specifying criteria and parameters for service provision, monitoring and performance evaluation and aligning the individual interests with those of the organisation.

As a result, the administration of public entities and their management accounting and control systems have gained greater relevance in recent years. In addition, the need to improve and redesign alternative budget formats has increased significantly (Abernethy & Brownell, 1999; Anessi-Pessina et al., 2012; Finkler & Ward, 1999; Hansen et al., 2003; King et al., 2010; Marginson & Ogden, 2005; Sandino, 2007; Tayles et al., 2007; Uyar & Bilgin, 2011).

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It is in this environment of institutional pressures for more efficient performance in resource allocation in the public sector that researchers draw attention to the urgent need to go beyond existing budgeting models, creating new definitions, objectives and interpretations of budgets, one of the main vectors of MAS.

The following table (Table 1) summarises some of the key studies discussed in this section indicating the object of study, problem, main results, theories and approaches used, and the publication journal.

Table 1. Empirical research on budgets and management accounting systems

Author(s)	Object of Study	Problem	Main Results	Theories/ Approaches	Journals[1]
Abernethy & Brownell (1999)	Australian public hospitals	The importance of using budgets adjusted to strategic changes.	Budgets should be used interactively, and not only as a means of diagnostic. They play a key role in goal-based performance, performance evaluation and greater accountability.	Organisational change theories; Strategic change / style of budget use/ performance style	AOS
Lapsley & Wright (2004)	The Scottish public sector (health sector)	Diffusion and improvement of MAS practices in the Scottish public sector.	Political and governmental influence in the adoption of these techniques. The budget-oriented technique was the most used for resource management. The ZBB technique was the most prominent in the health sector.	An approach based on the diffusion of MAS innovation in the public sector	MAR
King et al. (2010)	Australian primary health care units	The relationship between contingency factors, budgeting practices (technique used) and performance.	The adoption of "written budgets" is positively related to organisational size and structure. The extent of such use is also related to strategy and perceived environmental uncertainty. It was concluded that the performance evaluation of an activity depends on the choice of budgetary practices.	Contingency theory	MAR
Ezzamel et al. (2012)	Primary and secondary education schools in the UK	Introduction of budgeting techniques in the field of education (Education Reform Act 1988).	Some reforms (within the scope of NPM reforms) materialise the implementation of business logic (the dominant logic) at the level of budget management. As a result, changes have been made in schools and new budgetary planning and accountability practices have been adopted.	Neo-institutional theory	AOS
Johansson & Siverbo (2014)	Swedish municipalities	The tight budgetary control in the public sector in the face of budgetary turbulences.	A high degree of budget turbulence generates a tight budgetary control which increases the likelihood of compliance with the budgetary centres. However, if the budget turbulence is only marginal, municipalities tend to carry out activities similar to those of the previous year and the implementation of tight control mechanisms has no effect on budget deviations.	Contingency theory	MAR
Macinati & Rizzo (2014)	An Italian Hospital	Analysis of motivation levels of clinical management in participatory budgeting and its connection with performance.	Budgetary participation does not directly influence the use of budget information, but the latter is encouraged by the level of budget goal commitment which, as a result, is influenced by the positive motivational consequences of participative budgeting (Macinati & Rizzo, 2014: 228).	Goal-setting theory	HP

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RELEVANCE LOSS: TRADITIONAL BUDGETING TECHNIQUES AND ALTERNATIVE APPROACHES

Since 1990, the Governmental Accounting Standards Board has emphasised the need to strengthen the development of new management accounting practices in the public sector. These practices are intended to provide a better performance measurement, helping to achieve governmental goals (Governmental Accounting Standards Board [GASB], 2005).

Anessi-Pessina et al. (2012) conducted a study on budgetary practices within the European public sector based on the analysis of papers published in international journals in the field of management accounting. The aim of the study was to identify the different dynamics of two reference periods: (1) the 1980s – a period characterised by studies which focused on the analysis of the budgeting process, and (2) the 1990s – a period when studies became more focused on the changes of budgeting processes. In the first period the main aim was to contribute to the existing body of research on budgeting in the public sector. In the second period, the aim was to contribute to the body of scientific knowledge and to improve the understanding of ongoing reforms. The present research is included in this second phase and aims to provide valuable insights into the major paradigm shifts in budgeting processes.

Traditional-Based Budgeting (TBB)

From an international perspective, most of the studies carried out over the last decades in the field of management accounting have assumed, with rare exceptions, that budgets have a diagnostic role (Abernethy & Brownell, 1999; King et al., 2010). According to this approach, budgets seem to fulfil the traditional role of allocating available resources.

As a result, several studies address the general issue of budgeting and the fact that the traditional budgets (line-budgeting) have lost relevance (Abernethy & Brownell, 1999; Andrews & Hill, 2003; Anessi-Pessina et al., 2012; Finkler & Ward, 1999; Hanninen, 2013; Hansen et al., 2003; King et al., 2010; Lindsay & Libby 2003, 2010; Marginson & Ogden, 2005; Mikesell, 1995; Neely et al., 2001; Sandino, 2007; Tayles et al., 2007; Uyar & Bilgin, 2011). Some proposals for enhancement point to alternative budgeting approaches, namely "performance-based budgeting" (PBB) (Andrews & Hill, 2003; Kong, 2005), "activity-based budgeting" (ABB) (Hansen et al., 2003; Pinto & Santos, 2005), and "zero-based budgeting" (ZBB) (Akten, Giordano & Scheiffele, 2009; Finkler & Ward, 1999; Lapsley & Wright, 2004; Pyhrr, 1973,1977; Wildavsky, 1975) or "priority-based budgeting" (PYBB) (CIPFA, 2006; Tayles et al., 2007; Worral et al., 1998).

According to Faria (2010), in Portugal, the current budget process can be characterised as traditional, with an incremental basis (functional departments based on line-items) and a rigid expenditure structure (budget appropriations). Furthermore, the implementation of performance management is still incipient. Therefore, the need to control inputs, to promote accountability in outcome management, and to undertake systematic performance evaluations and assessment of budgetary outcomes, require changes in the budgeting process, such as behaviours and the redefinition of the information systems.

Traditionally, similarly to what happens in Portugal, most governments have decided to adopt the incremental budgeting approach. In this technique, the budget preparation for the following year is based on the approved budget for the current year plus an increased amount considering inflation. This is the simplest budgeting method, in which the main focus of the incremental approach is the input control (Andrews & Hill, 2003), promoting a system of accountability and budget execution control (Pinto &

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Santos, 2005). However, as this technique is based on the budget approved for previous periods, it does not promote medium and long-term planning or the effective achievement of objectives, regarding the use of available resources or their efficient allocation.

Therefore, in traditional budgeting the definition of the amount of resources to be allocated to the various public entities or departments is based on patterns of previous periods, including marginal additions. The decisions made and the priorities established in the past are more likely to remain unchanged in the future. The reassessment of the needs and priorities of subsequent periods does not take place, meaning that this kind of budget does not promote strategic options, maximisation of value, opportunity and efficiency in resource control, evaluation of results and performance.

Mikesell (1995) draws attention to the fact that incremental budgets tend to emphasise the adequate utilisation of available funds, as they are not prepared to enhance the best decisions in the allocation of resources. Accordingly, the author argues that the public sector traditional budget appeared in a period when the main concern in budget preparation and control was essentially the prevention of fraud and corruption. Although more recently governments have progressed beyond this stage, the traditional approach is still present in the current budget practices.

The study by Neely et al. (2001) presented the most cited weaknesses of traditional budgeting. Some of the major disadvantages identified in the study were: the lengthy process, the high preparation costs, and mainly the lack of focus on strategy. The study also highlights the fact that this budgeting model does not favour the increment of the organisations' value, given its strong focus on cost reduction and departmental barriers.

Similarly, Hansen et al. (2003) also highlight the emphasis given to financial measures in these traditional models. According to the authors, this is related to the concentration of efforts in reducing costs, more than value maximisation.

In a more recent study, developed by Uyar and Bilgin (2011), the disadvantages of the traditional model are also highlighted. The excessive time spent in the management process is one of the gaps of the traditional model. Some findings suggest that the traditional planning and budgeting processes may consume up to 20% of the whole management time (Libby & Lindsay, 2003).

Consequently, some authors regard this technique as a "relic" (Hanninen, 2013) since it prevents some historical reactions but it cannot be adapted to the changes and current requirements of organisational management. Similar results were discussed by Libby and Lindsay (2010) in their study. The authors report that the traditional budget does not consider strategy. Additionally, it is expensive and slow at detecting problems, becoming obsolete very quickly.

Performance-Based Budgeting (PBB)

The new budgeting approaches take place in this scenario of relevance loss of traditional models. The advantages of the implementation of the PBB approach are also evidenced by Kong (2005) in a study on USA public administration. The central question raised by the author was: what is new about PBB when compared to conventional budgeting techniques (incremental line-items)? The author identifies three key vectors in the conventional public budgeting structure: the allocation of resources, organisational management and citizens. Incremental line-items budgets are mainly focused on the allocation of resources, including financial, human, and technical resources. The first versions of PBB were, according to the author, connected with organisational elements, including the definition of key objectives, political goals and activities. Later versions, in the 1990s, focused on the outputs, service quality and

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citizen's satisfaction. The author could not guarantee that the change from a traditional to a PBB model could be done in a short period of time since PBB has a long term view.

With the aim of studying performance evaluation, Andrews and Hill (2003) developed a study on the performance-based budgeting (PBB) technique, comparing it to the traditional approaches. They concluded that most American states had carried out reforms on PBB implementation, yet very few presented behavioural changes resulting from such reforms, both in terms of overall development and of response to new incentives based on performance or on resource allocation. The authors also explain that the PBB approach is applied simultaneously with traditional techniques, influencing the type of PBB to be implemented, rather than complementing existing budgetary practices.

It can be concluded that the effectiveness of the PBB technique is enhanced when the old budgeting systems are totally replaced, as observed in the experiences carried out in the States of Florida and Virginia. These states included (Andrews & Hill, 2003: 152): management accounting and auditing systems based on performance; adjustment of the existing budgeting systems to strategic changes, according to the specificities of the various bodies (tailoring model); introduction of responsibilities in required levels of performance; and behavioural uniformity in budget compliance, which should include simple rules, clarity and seriousness in the announcement of performance expectations by budget managers.

As discussed earlier in this chapter, the traditional budgeting process is not designed for managers to evaluate and rethink their models of action or to evaluate their performance if, for example, economic recession persists. Contrarily, most of the current budgets are anchored to the budgets of previous periods, improved only by the adjustment to the rate of inflation or the specific trends of products or services (Akten et al., 2009).

Activity-Based Budgeting (ABB)

Activity-based budgeting (ABB) also emphasises outputs and value creation. Many authors argue that ABB is the most common alternative technique to the traditional approach. This approach provides a high level of detail, when compared to other techniques (Pinto & Santos, 2005).

According to Hansen et al. (2003), the financial guidance of traditional budgets is, undoubtedly, problematic. In other words, they do not favour the understanding of financial data by operational managers. Furthermore, if the top-down process is not aligned with the activities, the budget cycle should respect the preparation of financial budgets after the operational budgets are prepared. The idea is to create a new budgeting model that allows for greater flexibility in the organisation while dealing with unexpected events, emphasising thus the importance of operational planning (Hansen, 2011).

ABB highlights communication and internal cooperation since it focuses on activities rather than on responsibility centres, showing the imbalances, the useless activities and other information that can be used to enhance operations where resources are actually needed (Pinto & Santos, 2005).

Even though this model is oriented towards continuous improvement, with an emphasis on the outputs, the ABB process is still a relatively new concept and its practical advantages are yet unknown. Hansen et al. (2003) draw attention to the lack of scientific evidence to support its benefits and its pragmatic viability.

Zero-Based Budgeting (ZBB) and Priority-Based Budgeting (PBB)

Zero-based budgeting (ZBB) technique seeks to overcome the criticism that is usually attached to the TBB. The concept of ZBB emerged in the 1960s to address the failures of incremental budgeting (Drury,

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2004). This denomination was used for the first time by Pyhrr (1973), who developed the process for Texas Instruments. Due to its success in the private sector, this model was also applied in the preparation of the 1973 budget by the Governor Jimmy Carter in the State of Georgia.

Drury (2004) defined this technique as an approach where all activities are justified before the decision on the amount of resources to be allocated to each activity. In the ZBB approach, the focus is given to programs or activities instead of focusing on the functional departments (typical of traditional approaches).

According to Finkler and Ward (1999), the four main objectives of the ZBB approach are: (1) to analyse the activities performed within the organisation, (2) to understand the origin of those activities, (3) to study the most efficient and effective way to accomplish those tasks, and (4) to identify the vital activities of the organisation and their cost. The authors also highlight the ZBB focus on budgeting expenditure, identifying another positive aspect of this technique: the special emphasis given to non-acceptance of longstanding government budget surpluses.

Many articles were published in the 1970s about the ZBB technique, even though the number decreased rapidly in the early 1980s (Drury, 2004). Currently, they are almost non-existent (Tayles et al., 2007). The gap between the years of successful research and present research has obscured the theory and the practice of ZBB technique, together with the political burden involved.

Several academics have provided a few reasons for this lack of success; the powerful message that "the expenses have to be fully justified"; excessive bureaucracy; high costs; professional awareness and consequent long procedures (Drury, 2004; Tayles et al., 2007; Worral et al., 1998). Success will depend, according to Worral et al. (1998), on the implementation of a solid strategic process.

Wildavsky (1975) presented an unsuccessful case in the US Department of Agriculture. The reasons for failure were mainly: the allocation of specialised human resources for the exhaustive and systematic task of identifying priority needs; the need to justify things from scratch, even though that was not possible with programs that could not be replaced or changed and, finally, the non-acceptance, felt by the professionals, of the economic rationality logic, pressured by the constant monitoring of the tasks performed, even though they recognised the advantages of this technique.

On the other hand, the study by Akten et al. (2009) presented a positive experience in the application of the ZBB technique. The authors identified a European telecommunications group which, in the implementation process, began to disaggregate their expenses into "logical decision units", considering new types of expenses, such as capital expenditures (for example, building a third generation network). Each decision unit of capital expenditure was classified into the following categories: (i) reviewing, (ii) maintaining, and (iii) cutting down capital expenditures. The authors discussed the financial priority of each capital expenditure and its alignment with the company's strategy. After a few interactions, the company reached the goal of reducing capital expenditures by about 20%.

Pyhrr (1977) summarised the main goal of the ZBB technique, which was based on two key issues: (1) efficiency and effectiveness of the activities carried out by an organisation, and (2) the possibility of eliminating or reducing organisation's activities to afford new programs or simply help reduce the budget.

Drury (2004) argues that the ZBB approach assumes that the need to present the different expenses related to the activities in a ZBB ensures the allocation of all resources on a "cost-benefit" basis. Following this principle of allocation, organisations and governments will be one step closer to ensuring "value-for-money", questioning old assumptions and implementing a systematic analysis tool which might, for example, be able to declare the abandonment of unproductive contracts, projects or programs. Nevertheless, supported by the bottom-up strategy, the implementation of the ZBB technique implies the justification of all expenses, therefore introducing a certain economic rationality.

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Lapsley and Wright (2004) argue that the adoption of new techniques of accounting and management control is largely stimulated by the government. After analysing the Scottish health care sector, the authors concluded that the ZBB technique was the most used by these bodies: *The health care sector made particular use of budgeting techniques, with organisations using zero-based budgeting (ZBB) as well as one or other of management (RM) and activity-based management (ABM). In contrast, its use in local authorities and government agencies was much lower, with over half of these organisations not using any of these techniques* (Lapsley & Wright, 2004, p. 358).

According to this study, the National Health Service units are under high pressure to ensure any future savings and efficiencies. The adoption of the ZBB technique is defended by the government to establish areas of cost savings. On the other hand, according to managers of health care organisations, the ZBB technique is complex and time consuming (3/4 months to be completed), with very low returns for the organisation. Nevertheless, one of the main results of the interviews carried out in this study classified the ZBB technique as one of the most efficient techniques within the MAS.

The debates about the pros and cons of the ZBB approach have been mostly supported by empirical research (Akten et al., 2009; Pyhrr, 1977; Wildavsky, 1975). But, research on the ZBB approach has become scarce, namely from the 1980s. Despite the relevance loss in this period, ZBB seems to have again become an interesting research challenge with the main purpose of producing empirical knowledge about this technique and assess its effectiveness within organisations, namely, within the health care sector. As this sector becomes more complex, with increasingly higher costs, the need for new and better management accounting methods and tools also becomes stronger, especially for the entities which are subject to government pressures.

The priority-based budgeting (PYBB) approach is a technical extension of the zero-based budgeting (ZBB) approach. The main objectives of the PYBB model are to emphasise corporate priorities in line with budget increasing. According to the Chartered Institute for Public Finance and Accounting (CIPFA, 2006) its mode of operation is based on the review of current departmental services and its evaluation requires the definition of some parameters: purpose of the services; standards for the provision of services and operating alternatives for such services. It is based on the analysis of these parameters that the items of expenditure for each unit of revenue will be ranked, which is a beneficial and highly expected factor for management decision makers.

Within this approach, Worral et al. (1998) demonstrated that the laws of a local government in the UK favoured, among other aspects, the implementation of strategic priorities. The authors relate strategy-based budgets with the PYBB technique. In their study, it was concluded that 60% of the analysed councils had submitted a strategic plan, although there was no consensus on the definition of "strategic management". The authors classified "strategy" as the management of a set of activities that will meet priority objectives based on values of equality and local democracy in detriment of more "sophisticated" purposes which were less adjusted to the real needs of organisations. As resources become scarcer, local political forces tend to focus more on their priorities. Even though many bodies are still acting according to the paradigms of the 1970s, there is strong evidence that most governments are rethinking the process of strategic definitions to achieve a mutual consensus on the effectiveness of the achieved results.

In order to provide a synthesis of the main advantages and disadvantages of the different budgeting approaches analysed in the present study, Table 2 was prepared.

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Table 2. A comparison of different budget styles

Budget Style	Strengths	Weaknesses	Research
Traditional budgeting (incremental, line-items)	Simplicity, inexpensive.	Lack of strategy link; focus on margins; the cuts are arbitrary; delays in procedures	Andrews & Hill, (2003); Anessi-Pessina et al. (2012); Mikesell (1998); Neely et al. (2001).
Performance-based budgeting	Focused on outputs, quality of service and citizen's satisfaction.	Few changes in behaviour	Andrews & Hill (2003); Kong (2005).
Activity-based budgeting	Emphasis on outputs and value creation, reduction of bureaucracy; focus on activities and on the operational plan.	Reduced practical implementation; little knowledge of its real advantages.	Hansen at al., (2003, 2011); Pinto & Santos (2005)
Priority-based budgeting	Budget connected with strategy; global and participatory perspective.	Laborious, difficult to implement.	CIPFA (2006);Tayles et al. (2007); Worral et al. (1998).
Zero-based budgeting	Resources needed in a "cost-benefit" basis; focus on programs and activities; economic rationality.	Complexity in implementation, high costs, excessive bureaucracy, procedural delays.	Akten et al. (2009); Finkler & Ward (1999); Lapsley & Wright (2004) ; Pyhrr (1973, 1977); Wildavsky (1975)

WHAT CONTRIBUTIONS HAVE BEEN MADE TO THE PORTUGUESE HEALTH SECTOR?

Government management standards have changed over the last years and Portugal is no exception. In 2008, the OECD highlighted the need to restructure the Portuguese budgeting process: *The adoption of approaches oriented towards budget and management performance is of utmost importance for Portugal* (OECD, 2008, p. 4). Nevertheless, OECD (2008) proposes that this implementation is based on three main stages: a first stage where a medium-term budget program is developed (corresponding to a legislative period – 4 years – which is already included in the current Portuguese legal budget framework – paragraph 2 of Article 21-A of Law No. 41/2014); a second stage, which included the development of performance information for the various programs and ministries and the identification and creation of the necessary information systems; and finally a last stage in which performance information should be gradually integrated in the decision making process.

Following the meeting of the Council of Ministers held in April 2015 (Portuguese Government, 2015), Portugal approved a new draft budgetary framework for 2016, which follows the guidelines of the current budgetary framework (Law No. 41/2014) and the international and European standards. Nevertheless, this proposal provides an integrated budgeting system, implying a change in the whole structure and composition of the Budgetary Framework Law regarding its principles and rules, implementation and control systems. Based on this draft, Portugal intends to give emphasis to those programs which are focused on results rather than on resources, meaning that the program budgeting is not necessarily a way to reduce public spending. Its main objectives are the improvement of the accountability of the sectoral ministries in a logic of top-down budgeting, and ensure that the program budgeting is, in fact, focused on results that can be evaluated using the most relevant indicators.

Furthermore, the medium-term horizon recommended by OECD (2008), and apparently accepted by the Portuguese government, contributes to the stability and credibility of these urgent reforms.

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In the public health care sector, the budget of Portuguese hospitals was based on the previous year's funding for many years. According to Amaro, Borges, Candoso, Ferreira and Valente (2008, p. 1):

… in 1997 a new activity-based resource allocation model was adopted, the case-mix[2] was introduced (inpatient and ambulatory surgery were classified using Diagnosis Related Groups - DRG) and a growing portion of the budget was based on the prevision of the hospitals activity (from 10% in 1997 to 50% in 2002).

In 2002, with the corporatisation of some Portuguese hospitals, the traditional public sector hospital was replaced by corporate public entities, adopting new legal statutes, with private management techniques and procedures. Moreover, the financing of public hospitals started to be made mostly from current transfers from general government on a contract performance basis. This model of financing is established according to a contract performed between three entities: the Ministry of Health, represented by the Central Administration for the Health System (ACSS), the Regional Health Administrations (ARS), and Hospitals.

Major and Magalhães (2014) argued that the retrospective type of financing was over because the hospital activities were no longer funded by the Portuguese state, as occurred in the past. The state intended to only provide funding to the activities contracted by the ACSS and hospitals at the beginning of each calendar year (a prospective nature). Therefore, after consulting the State Budget and the funds allocated to the health care sector, the Ministry of Health shall define, a priori, the hospital production amount to be "bought" annually for each hospital.

Contracting has been an important process used to improve performance within the Portuguese health care sector. It aims to encourage providers to increase quality and efficiency of services, especially when facing the dilemma of the increase of health care needs, due to demographic factors and technological progress, on one hand, and the urgency to reduce expenditures, on the other hand. The hospital should commit itself to establish quantity and quality goals for particular activities (to be negotiated among all entities involved) and the budget should only cover expenditures that can be justified (Lopez-Valcarcel & Perez, 1996).

Hence, the "program-contracts" have emerged, establishing a commitment between the purchaser (hospital) and the funder (ACSS), in which the hospital budgets for the subsequent year shall depend on the performance outcome of the previous year. Thus, if the hospital produces more and, therefore, overexpends what is stated in the "program-contracts", it will not be reimbursed by the Portuguese State in accordance with the new management model adopted for the National Health Service (NHS).

To ensure that such goals and contractual clauses are respected, the monitoring of contracts should be supervised and precisely regulated by the State (Araújo, 2005). The most important attraction of the "program-contract", according to Lopez-Valcarcel and Perez (1996, p. 378), is that health planning becomes easier mainly due to the link established between hospital activities and the epidemiology goals previously included in the health agenda, and the possibility to allow planners to benchmark health care levels across different locations.

Valente (2010, p. 39) also highlighted several advantages for all agents involved in this process. According to the author, this model has *introduced dynamism, improved knowledge regarding supply and demand, promoted information sharing between those responsible for the distribution of resources and the care providers, being an incentive to the accountability of all stakeholders involved in the process by the way resources are expended*.

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Despite the relevance of contracting and the performance-oriented logic involved, there has been some discussion about the gaps found in this process, mainly due to the identification of the activity costs.

The study conducted by Borges et al. (2010) allows to understand the importance of implementing a costing system tailored to the needs of the different actors involved: *A costing system allows a better understanding of costs as well as a growing awareness of the limitedness of financial resources, making it essential to any health care system* (Borges et al., 2010, p. 112). The authors researched the reasons why the Portuguese Ministry of Health launched, in 2007, the ABC project in five pilot hospitals within the NHS. They explained the numerous advantages of the ABC method, especially at the level of cost calculation per activity, identifying the most prominent advantages, and their ability to provide clues for a more efficient utilisation of resources. Despite all the advantages found, the study also detected some gaps related to the recent implementation of the ABC project in the pilot hospitals, which, at the time of the study, had only been concluded in three of the five national hospitals that integrated the initial group. The definition of the activities, the identification of activity and cost drivers, the involvement of professionals with different profiles and their fear related to performance evaluation were the main challenges and difficulties of this project.

Despite these arguments, the importance of the management accounting tools and budgeting techniques is undeniable, as stated in the study of Vicente, Major, Pinto and Sardinha (2009) on the role of management controllers in Portugal. The authors concluded that budgets and the deviation analysis are the most prominent tools in Portugal (as in the United Kingdom).

The strong institutional pressures resulting from the current economic and financial environment and from the deficit in current government accounts impose stringent measures related to public hospital budgets. The adoption of new legal statutes by Portuguese hospitals, with the improvement of greater performance and accountability, implies the implementation of management accounting tools that meet the essential needs of budget discipline. But there is still a long way to go! Quoting "The European Public Health Alliance" (EPHA, 2014, p. 5) *activity to control healthcare expenditure growth and implement hospital reform in Portugal is said to be 'ongoing' in the draft budget, but details are not given*.

FINAL REMARKS

The public sector evolves in a complex organisational environment with an increasing pace of change in recent years. In a context of organisational reforms, new public management paradigms and current pressures from governments, for greater and more effective rationalisation of resources, the change in MAS is inevitable.

It is true that when the governments' control is very tight, little room is left for the implementation of strategic changes. However, assuming a causal link between management accounting practices, institutional pressures and performance, the reforms carried out in the public sector have encouraged the introduction of new approaches to MAS, namely in budgetary techniques, considered a key factor in improving organisational performance.

Budgets are a major feature of MAS. Currently, it is clear that these information systems are totally dependent upon the achievement of the organisations' priorities and strategic objectives, whether public or private. Some literature findings suggest that MAS use is directly and indirectly influenced by contingency, organisational, and behavioural variables (Abernethy & Brownell, 1999; King et al., 2010; Macinati & Anessi-Pessina, 2014).

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Considering this interaction, the literature review in this chapter has reflected the need to integrate new budgeting approaches due to the inefficiency of traditional techniques. Until a few years ago, the incremental line-items budgetary approach seemed to be sufficient, because public expenditure was fairly stable. The imbalance in current government accounts tends to influence organisations to define and rethink the management accounting practices of the last years (Jackson & Lapsley, 2003; Lapsley & Wright, 2004). Macinati and Anessi-Pessina (2014) suggested that cost-containment strategies lead to more sophisticated MAS.

Budgetary techniques can also be used as important tools for the interactive implementation of strategy, activity management, learning, dialogues and output analysis (PBB ABB, ZBB or PYBB approaches). For example, with the potential implementation of the ZBB technique in the public sector in Portugal, already incorporated in the government's budget legislation since 2012, and with the priority-based interaction, it is possible to promote new attitudes, concepts and practices which are more appropriate to face the current institutional challenges.

In the health care sector, much of the international empirical research to date has concluded that the successful implementation of the alternative budgeting approaches will depend on the willingness of governments and professionals to accept these changes. In this scope, there is a recent important scientific contribution to this chapter, considering the authors reflect one the gap that one wants to fill: *Reforms of the public health-care sector have emphasised the role of management accounting. However, there is little systematic evidence on its use and benefits (*Macinati & Anessi-Pessina, 2014, p. 98).

Despite the governmental initiatives, such as the corporatisation of some hospitals and the implementation of "program-contracts" in the Portuguese scenario, and despite the academic studies on the role of MAS, there are indeed still few empirical research studies that examine how the MAS can contribute to the implementation of alternative budget techniques that are more output and performance oriented.

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KEY TERMS AND DEFINITIONS

Activity-Based Budgeting: Budgeting technique that involves determining which activities incur costs, establishing the relationships between them, and then deciding how much of the total budget should be allocated to each activity.

Case-Mix Index: Ratio that represents the production of a hospital in relation to other hospitals in terms of their highest or lowest proportion of patients with complex pathologies, and the number of resources used.

Diagnosis Related Groups: Financing system based on the assignment of a fixed amount of cost for each hospital pathology.

Line-Items Incremental Budgeting: Budgeting technique in which the budget is prepared in an incremental approach, taking previous periods as a reference. In this system the focus is on inputs.

Performance-Based Budgeting: Budgeting technique in which budgets are prepared according to programs and the funding for each program is compared with expected results.

Program-Contracts: Commitment between the service provider (hospital) and the purchaser/funder (Ministry of Health), in which the hospital budgets for the subsequent year depend on the performance outcome of the previous year.

Value-for-Money: Analysis technique that assesses how resources are successfully transformed into valued outcomes.

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Zero-Based Budgeting: Budgeting technique in which all activities are justified before the decision on the amount of resources to be allocated to each activity.

ENDNOTES

[1] Journals: AOS – Accounting, Organisations and Society; MAR – Management Accounting Research; HP – Health Policy.

[2] The Case-Mix Index (CMI) is the sum of the DRG relative weights divided by the total number of equivalent patients, namely: CMI = $\sum$ (DRGi equivalent patients x DRGi relative weights) Hospital/ $\sum$ DRGi- equivalent patients.

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Chapter 15
Laboratory Information Management Systems:
Role in Veterinary Activities

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ABSTRACT

The Laboratory Information Management System (LIMS) is recognized as a powerful tool to improve laboratory data management and to report human health as well as veterinary public health. LIMS plays an essential role in public health surveillance, outbreak investigations, and pandemic preparedness. The chapter aims is to provide an overview of LIMS use in veterinary fields as well as to report 20 years of experience of a Veterinary Public Institute in working with LIMS, illustrating the features of the LIMS currently in use in the institute and highlighting the different aspects that should be considered when evaluating, choosing, and implementing a LIMS. In depth, the chapter illustrates how LIMS simplifies the accreditation path according to ISO IEC 17025 and the role in the epidemiology and veterinary public health. For this aspect, it is very important to collect clear data, and for this reason, a LIMS has to activate formal checks and controls on business rules. To facilitate this issue, an interconnection between LIMS and other applications (internal or external to laboratory) could be improved to allow automatic data exchange. At the same time, the unique data encoding at national/international level should be used.

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INTRODUCTION

The Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "Giuseppe Caporale" (IZSAM) is a public health institute with administrative and managerial autonomy, which operates as a technical and scientific arm of the Italian State and the Abruzzo and Molise Regions, performing analytical work for the public veterinary services and providing the technical and scientific collaboration necessary to enable them to carry out their functions in the field of veterinary public health.

The main tasks of the Institute, as defined by the Italian legislation, are experimental research into the aetiology and pathogenesis of infectious diseases of domestic and wild animals; hygiene in animal breeding and livestock production; tests for laboratory diagnosis of animal diseases, tests for microbiological and chemical safety of food of animal origin destined for human consumption and livestock; epidemiological surveillance in the field of animal health and hygiene in the production of livestock and food of animal origin; production of vaccines, reagents and immunological products for the prophylaxis and diagnosis of animal diseases; consultancy, technical assistance and health information for breeders for the purpose of improving health standards and hygiene in livestock production; training for veterinarians and other operators in veterinary public health.

All the Institute's activities have been constantly certified and subjected to rigorous quality control since 1995, when the Institute became the first public veterinary body in Italy to be certified in accordance with international quality standards for performing laboratory tests in the chemical, microbiological, virological and serological fields (UNI CEI EN ISO/IEC 17025:2005– former 45001). Since 1991, the Institute uses a LIMS (named SILAB), which has the possibility to be constantly modified to suit the new health care needs and be adapted to the emerging technological innovations.

Taking advantage of these twenty years of experience, the chapter expresses some general considerations about the role played by LIMS in public health surveillance, outbreak investigations and pandemic preparedness.

The main objectives of chapter are to provide an overview of LIMS features, identify strengths, challenges and lessons learnt in terms of development, placement, use and maintenance as well as to illustrate the LIMS role in epidemiology and veterinary public health.

BACKGROUND

Veterinary services are essential to assure the health and welfare of both human and animal populations, as well as an optimal relationship between humans, animals and environment.

The slogan is ONE HEALTH - ONE MEDICINE. This approach recognized, already in the middle of the XX Century, that human and animals health are ONE and that it is more effective and efficient to prevent human disease working on animal population medicine. Moreover, it also led to the understanding that man and animals shared the same world and had a mutual influence with the environment they lived in (ONE PLANET).

The main missions of Veterinary services are to fight animal disease, including zoonosis, and to assure food security and safety worldwide with positive cost-benefit ratio for the international community, in particular:

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- To reach the absence of diseases, including zoonosis, as well as food security and food safety, as primary factors for the welfare of human beings.
- To increase the availability and the quality of proteins for the human population and help to decrease crop waste.
- To prevent human affections.

Health and welfare of both humans and animals are closely interrelated. In Italy, the role of veterinary medicine in food security, food safety and prevention of human diseases, has been recognized since 1888 through first "Health Code" (Act December 22, 1888, n. 5849), establishing the role of the provincial veterinarian, in the context of public health. Since 1946 the General Directorate for veterinary services was included in the Ministry of Health.

The public veterinary laboratories, as the Institute's ones, are accredited in accordance with international quality standards UNI CEI EN ISO/IEC 17025:2005, for performing laboratory tests in different fields such as chemical, microbiological, virological and serological fields, while human health laboratories refer to ISO 15189 norm for accreditation. However, ISO 15189 meet the requirement of ISO/IEC 17025 and the principles of ISO 9001. ISO 17025 born from ISO guide 25 and from the experience in the use of EN ISO 45001 norm, which after became ISO/IEC 17025.

ISO IEC 17025 considers the processes related to the laboratory test results as well as the features of the system which support the analysis process itself. ISO 15189 deals with the processes inherent the pre-analysis activities, the processes inherent the analysis activities and those of the system in support of the analysis itself, as well as the processes concerning the post-analysis tasks (Montebelli & Pradella, 2010).

Accreditation according to the ISO 15189 specifies requirements for quality and competence in medical laboratories like ISO 17025 specifies requirements for quality and competence in all other labs.

Briefly, ISO 17025 meets the requirements of all ISO 15189 points that are referred to the management of laboratory activities, while the remaining points are covered with ISO 9001.

ISO 15189 includes additional requirements for the competence of medical laboratories, for example, in relation to the acceptance of patients, sampling and care of patients (including accommodation and environmental conditions), and considers also the post-examination processes. In addition, ISO 15189 is also more stringent than the ISO/IEC 17025 when requirements of other disciplines are considered, such as safety, security of the sensible data, environmental management.

LIMS BASIC FUNCTIONALITIES

A LIMS should not be simply a software-based laboratory and information management system oriented to collect all data related with samples and tests. It should also provide the following basic functionalities (Figure 1):

Entry Order and Sample Reception

During the process of samples acceptance, all requests about samples to be tested are recorded. Data concerning the testing purpose, the area of competence (human or animal health, food safety, feed analysis, environment), the customer and other information concerning the sample (such as geographical origin, animal species, number and type of material) are recorded into the system.

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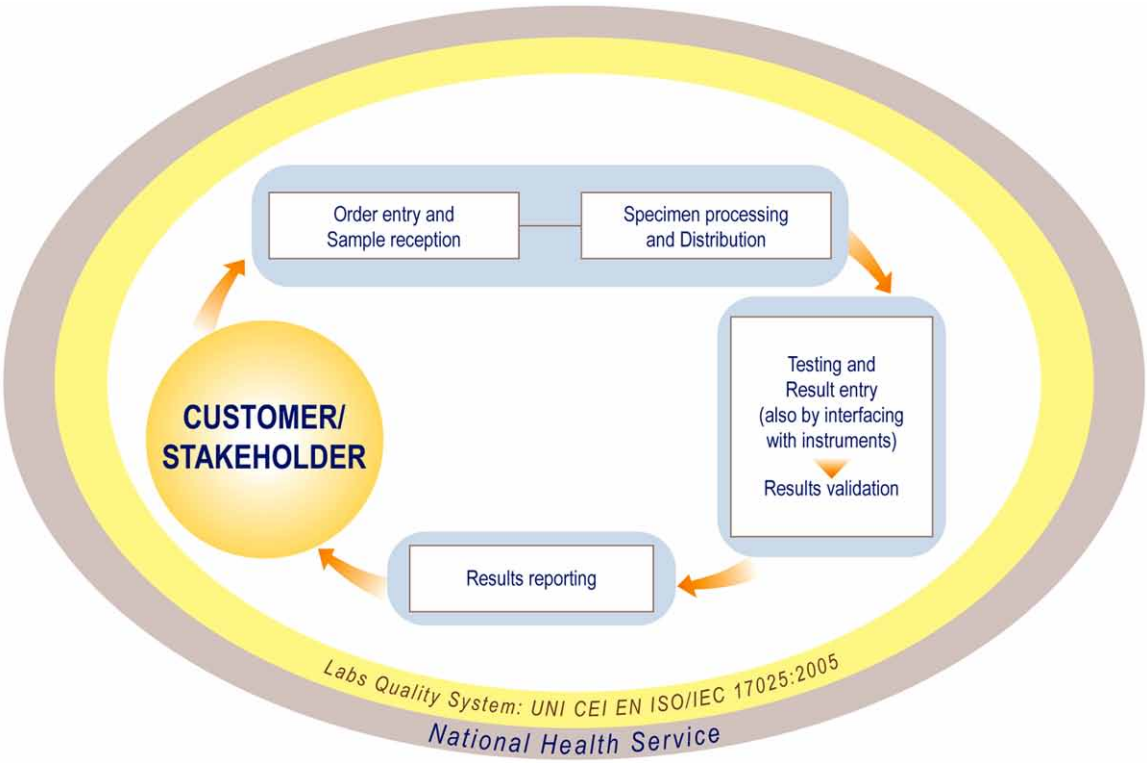
Figure 1. LIMS context and basic functionalities (© copyright 2013,Patrizia Colangeli, used with permission)



At this stage, additional information may be requested (referential number of authorities report, number of aliquots, condition of the sample, type of container, etc.), when they are necessary for sample's management and epidemiological purposes.

Specimen Processing and Distribution

After univocal identification of the sample by the generation of a label including barcode, samples are distributed to the different departments to undergo the tests requested by the customer.

In order to cut down working time, samples distribution by groups may be automatically performed: the operator can select a distribution group (previously created on purpose), with which samples are distributed to all tests and laboratories included in the group.

Entered data and distributions are reported on electronic work-lists, which can be used both as data verification and as a working sheet.

Testing and Results Entry

The technician, after having received the coded samples, performs the required tests according to the assigned distributions and then enters results into the information system (data acquisition step). Where appropriate, he/she can insert interpretive comments.

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In some cases, data acquisition is done directly by interfacing the instrument used for analysis. In instruments that allow it, this connection may also be at 2 ways (from LIMS to instrument and vice-versa). Integration with laboratory instruments increase quality of data and reduce time for typing results and their validation.

At this phase, the system produces work-lists to facilitate batch processing and resulting and 'pending result' lists to track remaining orders.

Results Validation

After results are entered, the head of the laboratory validates data in order to comply with general and specific requirements and satisfy customer needs. Results cannot be communicated to the customer until data are not validated.

Results Reporting

At the end of the diagnostic route of the sample, the test report is issued and sent to the customer requesting the diagnostic tests. The test report varies according to the kind of tests performed.

The report is dispatched by e-mail or ordinary mail after having been signed (with electronic signature) by the head of the department.

For notifiable diseases, electronic alerts may be sent to local, regional and national level.

Data Enquiries

It is possible to have progress reports on registered samples by enquiring at any time the system (number of samples accepted, distributed, validated, etc…).

Data Security and Integrity

The application manages different levels of security for users. Each user has username and password, a role that assigns functionalities as well as the area of competence.

Other important issues concerning security are firewalls, antivirus/malware software, which has to be installed in each PC's, Uninterruptible Power Supply (UPS) for server and system for data backup and disaster recovery. Disaster planning is also a critical function that all LIMSs need to consider.

Domain Tables Management

An "ideal" LIMS should be code-oriented, and internal codifications used should be linked to descriptions. All codes and relevant descriptions are entered into domain tables; for example, all species of interest are codified so that in the data tables codes are reported, while in domain tables codes are linked to the relevant description and additional information. The management of domain tables is run by the application itself: some tables can be accessed by everyone (clients, users..); some others (tests, assays,…) only by departments heads or by Administrator role.

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Management of Payment

The system needs to collect billing information, which may be different from those of the client, and interface with the billing system or directly issue the invoice.

OTHER FUNCTIONALITIES

In addition to the basic functionalities, a LIMS may also contain other features, such as:

- A management tool: LIMS may also be able to monitor customer service in terms of the gap between actual response and expected time, technical efficiency in terms of gaps between actual time requested to perform a diagnostic test and the same time predetermined in standard situations, as well as able to collect data on the frequency of acceptance of samples and, analyzing these data, allows to adjust the presence of personnel (Figure 2).
- From an epidemiological point of view, LIMS may be an essential instrument since it may collect a considerable amount of data in the context of research programs, surveys, clinical investigations, control, and eradication programs. Usually it is difficult to make use of these data for epidemiological considerations, since it is not always given that data will be representative of the event under study. In the case of clinical investigations for leishmaniasis, for example, inferences about the disease status of the canine population are derived through the serological diagnoses on specimens submitted under suspect. This sample represents only a subset of the real animal population and the probability that an animal sampled is conditioned by several aspects such as its apparent health status, the decision of the owner to undergo his pet to a clinical examination and the decision of the clinician to carry out a serological examination. In this scenario, the output of the system is largely biased by all these variables in data collection. An example of data generated by a LIMS and suitable for epidemiological analysis may be represented by those collected in the context of the Italian eradication program for bovine brucellosis which has the objective to test periodically all the bovine herds existing on the national territory. This means that blood samples are collected from all cattle every year in order to screen for brucellosis. In this case, the output of the system may be considered as representative of the real situation in the field, given that the investigation is extended to all the susceptible population. In this scenario, the performance of the system in terms of sensitivity and specificity are measurable and less biased, and data provided by the LIMS may be useful for epidemiological considerations.

However, a LIMS may also play a key role in disease monitoring and surveillance. In this case, the system is designed to collect data not only related to the specimens sampled and their origin, but also other data of epidemiological relevance and related to the disease under surveillance. In this case, the surveys are intentionally targeted and, even if not all the susceptible population is tested, however, the information provided may be considered as representative of the disease under study. Indeed to collect data useful for epidemiological studies is necessary to clearly identify the aims of surveillance and define which data should be collected in which population.

An example of the application of LIMS to collect data concerning epidemiological surveillance is provided by the West Nile Virus (WNV) Italian surveillance program. The program includes operative

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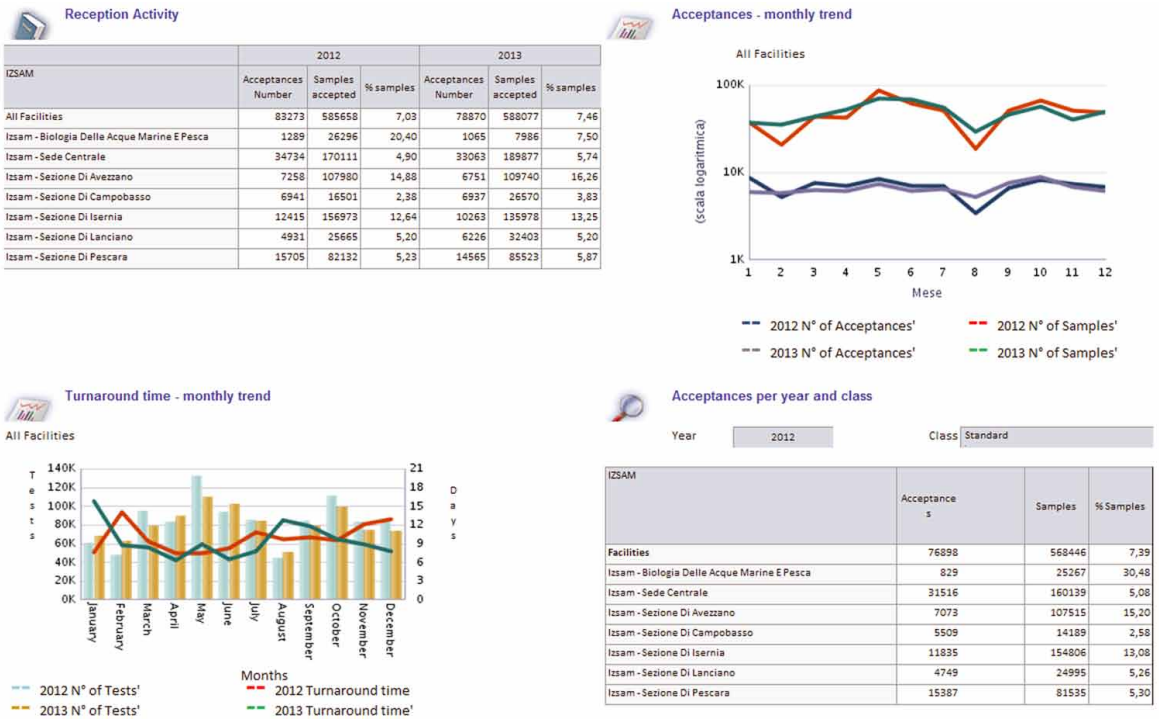
Figure 2. Reception activity trend: reports and graphs 2012-2013 (© copyright 2013, Patrizia Colangeli, used with permission)



IZSAM	2012			2013		
	Acceptances Number	Samples accepted	% samples	Acceptances Number	Samples accepted	% samples
All Facilities	83273	585658	7,03	78870	588077	7,46
Izsam - Biologia Delle Acque Marine E Pesca	1289	26296	20,40	1065	7986	7,50
Izsam - Sede Centrale	34734	170111	4,90	33063	189877	5,74
Izsam - Sezione Di Avezzano	7258	107980	14,88	6751	109740	16,26
Izsam - Sezione Di Campobasso	6941	16501	2,38	6937	26570	3,83
Izsam - Sezione Di Isernia	12415	156973	12,64	10263	135978	13,25
Izsam - Sezione Di Lanciano	4931	25665	5,20	6226	32403	5,20
Izsam - Sezione Di Pescara	15705	82132	5,23	14565	85523	5,87

IZSAM	Acceptances	Samples	% Samples
Facilities	76898	568446	7,39
Izsam - Biologia Delle Acque Marine E Pesca	829	25267	30,48
Izsam - Sede Centrale	31516	160139	5,08
Izsam - Sezione Di Avezzano	7073	107515	15,20
Izsam - Sezione Di Campobasso	5509	14189	2,58
Izsam - Sezione Di Isernia	11835	154806	13,08
Izsam - Sezione Di Lanciano	4749	24995	5,26
Izsam - Sezione Di Pescara	15387	81535	5,30

procedures for collection of human, veterinary and entomological data, with the purpose to provide a surveillance system for early detection and monitoring of WNV circulation. The Italian national surveillance system for WNV includes data coming from active surveillance and data coming from passive surveillance. In particular, it collects data coming from:

- Screening of blood and hematopoietic stem cells donations in affected areas and screening of solid organ donations in the surveillance areas;
- Periodic blood testing of sentinel horses and chickens to check for seroconversion;
- Mosquito trapping;
- The collection of dead wild birds
- Periodic sampling of migratory birds found in humid areas.

In this context, the LIMS collects both laboratory data (as date of arrival of samples, type of samples, date of analysis, results of the analysis, analytical details) as well as epidemiological data as geographical coordinates of the sampling site, and relevant data concerning the animals (identification and age of the sampled animal, presence or absence of clinical signs etc.). In addition, in Italy, the information system for animal disease outbreaks notification called Animal Disease Notification System (SIMAN) is used to collect and dispatch to the competent Authorities data and information related to the WND outbreaks and to the surveillance activities (Colangeli, P., Iannetti, S., Cerella, A., Ippoliti, C., Di Lorenzo, A., Santucci, U., Simonetti, P., Calistri, P., & Lelli, R. 2011). SIMAN has useful epidemiological reporting

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tools to monitor, manage and analyze data generated by West Nile Disease (WND) surveillance activities. In particular, the section "Report West Nile Disease" allows downloading the list of registered sentinel farms and animals, as well as the sampling activities performed and the laboratory results. The data stored into the SIMAN WND database, together with the data on human cases weekly provided by the Ministry of Health, are the source of information for the weekly National Epidemiological bulletin on WND published by the National Reference Centre for Exotic Diseases (CESME) on the official national website dedicated to WND (http://sorveglianza.izs.it/emergenze/west_nile/emergenze_en.html [17/02/2014]).

Less timely and incomplete reporting of diseases may result in reduced ability in rapidly detect and monitoring outbreaks, which may cause delays in implementing action on conditions that may affect large numbers of people. Enhancing the capabilities of LIMS systems would provide a valuable tool making possible the electronic report of data and thus their timely availability. In the context of disease surveillance system, LIMS represents a powerful tool to identify and monitor the occurrence of infectious diseases and other conditions of public health importance.

- A tool to increase data quality, since a LIMS activates both formal checks (*i.e.* on dates) and, especially, controls on business rules (temporal progression of dates, check on the correctness of combination of tests-methods-matrix-species-department). For this reason, the system should supply tables containing parameters and truth tables, manageable through software only by authorized users with a appropriate role. A LIMS should be able to suggest default values for sample compliance (like "Negative" or "Absent", or "< 10", etc.), standard operative procedures, unit of measurement, and so on. The application should offer an extensive use of drop down lists to reduce data entry mistakes and minimize transcription errors. Integration with laboratory instruments increase data quality and reduce time necessary for typing results and their validation. In addition, the user obtains standardized reporting of laboratory data.
- Interconnection between LIMS and other applications (internal or external to laboratory) to allow information exchange. Through web services, a LIMS is able to obtain data from different veterinary information systems both public and private and automatically store them. In the context of animal health, information about breeding farms (code, address, owner, etc.) can be read directly from the National Farm Identification and Registration Animal Database (I&R system). The procedure also allows verifying the information about a single animal at sampling stage like ear-tag, age or sex. The same interconnection should be possible in the context of food safety where a "Food Business Operators (FBO) register" exists. This feature allows providing, in real time, the validated results of diagnostic tests to the connected information systems.

In this way, a LIMS may thoroughly satisfy information needs that the Ministry of Health and other body (National Reference Centers, an international organization) require for a public laboratory. The term "information needs" concerns the periodic demand to supply aggregated or single data about specific diseases, control plans or contaminants (for example, monthly dispatch of data on GMO or rabies, annual data on pesticides, daily data on West Nile Disease, Bluetongue, etc.). To share these information is, therefore, necessary to map codes of different systems and ensure that the exchanged data have the same meaning ("semantic interoperability").

Each information system should be always seen as part of a more complex system with which it should exchange data (Figure 3).

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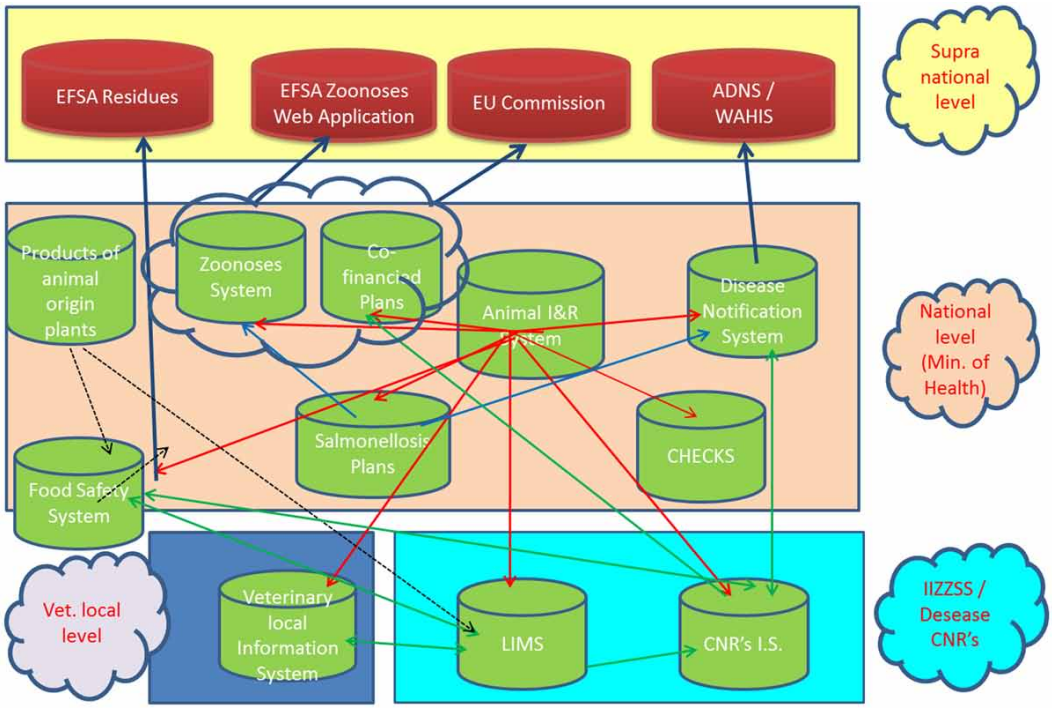
Figure 3. Italian integrate veterinary information system (© copyright 2013, Patrizia Colangeli, used with permission)



In addition, an "ideal" LIMS should allow automatically and independently adding specific information about each disease surveillance plan or for other purpose. These additional data are important for different actors in the context of Animal Health Information System, like the National Reference Centers.

- As a Thesaurus: The pillar for an efficient system cooperation is the use of unique data encoding as much as possible approved and shared at national/international level like, in the context of animal health, OIE codes for diseases. A centralized and unique I&R system exists in Italy; it collects and univocally identifies each farm of main livestock species and each animal in the holding (only for cattle). A similar database, named "FBO register" is in progress for all other structures of interest (such as dairy factories, dealers, canteens, etc.). In the context of human medicine, standard terminology already exist (such as Logical Observation Identifiers Names and Codes (LOINC) and Systematized Nomenclature of Medicine - Clinical Terms (SNOMED-CT). The European Food Safety Authority (EFSA) is making the effort to unify and codify the variables involved in the food and feed sample identification (Standard Sample Description, currently at ver. 2.0) (http://www.efsa.europa.eu/en/efsajournal/pub/3424.htm [17/02/2014]) but the complete definition of a shared semantic and categorization in the veterinary field represent an effort to be still. The use of a thesaurus, starting from the necessity of the dialog among heterogeneous information systems allows managing the "knowledge" and simplifies its divulgation; moreover, it complies with the requirement to manage and maintain a set of sanitary codes aimed to allow all involved operators to use the same terms.

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- As a tool for dematerialization. LIMS also may be a "paper-less" system, thus reducing paper and space needed for storing, as well as reducing fire risks. This means to remove sample reception register, all the paper support used to record raw data (register, technical notebook, worksheet, etc.), as well as test reports. Test reports are replaced by pdf files with digital signature, sent by e-mail and available also on line. Specimens are labeled with a bar code; paper working sheets are replaced by lists of specimens associated with tests to be performed by each department. These lists are visualized on computer screens, and digital models for registration of raw data are also available in all diagnostic departments.

The advantages of the system are based on the reliability of specimen identification and simplified access, through code readers, to specimen identification data. Writing and reading of the bar code take place automatically, eliminating possible errors. Furthermore, the labeling system allows the immediate traceability of all documents related to the specimen and the prompt availability of raw data.

The implementation of the system makes possible the simplification of many procedures, contributing to cut direct and indirect costs (paper handling and storing, document storage rooms, etc.) and improve efficiency in reporting (Colangeli, P., Ruggieri, E., Mercante, M.T., Ricci, L.,2013).

- As a support for the accreditation process: there is a worldwide trend for the progressive development of national and international veterinary laboratory networks. Central to this networking is the development of test standardization and harmonization, to ensure that test results from the participating laboratories are comparable.

A laboratory's fulfillment of the requirements of ISO/IEC 17025:2005 means that the laboratory meets both the technical competence requirements and management system requirements that are necessary to consistently deliver technically valid test results.

The need, for official laboratories, to respond to the requirements of ISO 17025, was determined by the obligation to implement the EEC Directive 93/99 and Regulation (EC) 882/2004. Then the public laboratories, like that of the Istituto Zooprofilattico Sperimentale, in order to meet the requirements of Community legislation have had to provide a quality management system. This system has to be structured in such a way as to make it possible to track the whole process concerning the sample, from its arrival in the laboratory to the production of test results on a sample analyzed and the issuing of the related test report.

The ISO 17025 standard allows ensuring that results are provided using competent personnel and official test methods or otherwise methods developed to the laboratory, in this second case the methods must be completely validated. In this area, the implementation of information systems is crucial to support technical activities, by means of software that would allow to have samples tracked at any time, also highlighting what you were doing on the same process.

It is in this sense important to develop an information system that could solve the problems relating to the identification of the sample, identifying them univocally, and also at the same time keeping track of all the operations related to the process, demonstrating not only the reliability of the result, but also the traceability of each step of the analysis process, including the different operators which have carried out each single step. For this reason the LIMS is a tool for traceability of sample and traceability of actions made on it ("who acted, how and when"), aspects which should be very difficult to keep under control

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only with a paper recording system. Moreover, the information system supports the sample activities, allowing you to keep all documentation for each sample and all the results relating to the tests carried out on a sample.

Solutions and Recommendations

LIMS is a fundamental component of lab management; however, there are major challenges to face in order to correctly implement it:

- Lack of funding to purchase and maintain a LIMS (commercial or developed), and/or the hardware and network necessary to run it;
- Reluctance to improve knowledge in managing the LIMS, in particular by staff with low computer literacy;
- The frequent requests for customization made by the different users;
- Availability of skilled, motivated and trained personnel to manage the development and maintenance of LIMS.

The transitions to using a LIMS requires a highly-motivated staff, able to change old habits and accept a radical change in the methodological approach. The receptionist role becomes crucial to check sample conditions and to ensure the correct insertion of all data relating to accepted samples, pre-requisite of the entire flow of information. Indeed, an error in reception step has an impact on the whole process with effects that in some cases can have serious repercussions (management of disease outbreaks, incorrect billing etc.). For this reason, the interface between the LIMS and users should be as user-friendly as possible, in order to decrease the probability of input errors by operators.

An ideal LIMS should be web based to be accessible from different users at the same time, multi-language to avoid language barriers, and should offer a simple and intuitive user interface. Since different laboratories may not all operate in the same way, it is important that a LIMS matches the laboratory flow and has the flexibility to accommodate future changes in laboratory activities.

Appropriate network security policies are necessary to ensure that only authorized personnel have access to computing resources. These policies should encompass both users who work connected by local area network, as well as those who may be connected remotely. The ultimate purpose is to prevent unauthorized changes, deletions, or additions to customer data, as well as to prevent unauthorized disclosure of information.

Data integrity policies and procedures are important to ensure that the software that manages the data related to test and results of the laboratory would perform as expected and that changes are performed in a controlled and tested environment. The software should also record and track the changes made to the data by the operating laboratory personnel.

Frequent communications and engagement of end-users are very important not only during start-up, but also during LIMS's use. User manuals, available also on-line and provided with FAQ and suggestions, may obviously be useful, but also training could be important in order to increase trust and confidence in the software. In this context the role of a leader is also important that should be the referent for the management both of the technical and organizational aspects. Finally, the delivering of some incentives for the staff involved (money, awards, etc.) should not be excluded.

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FUTURE RESEARCH DIRECTIONS

Since technological solutions are now available, the next efforts will all be geared up to improve the quality of data collected. The main objective is to limit the manual data entry; therefore the following steps may be necessary:

- Interoperability over a network with other application systems in order to read and capture what is already present in other systems (the same data is inserted only once);
- Interface with equipment used for analysis;
- Use of digital on-line forms to collect raw data;
- Use of standard data encodings and bar-code labels;
- Use of checks and rules about syntactic and semantic meanings (truth tables);
- Use of a Thesaurus for standard codes.

CONCLUSION

A LIMS enables laboratories to track samples from submission to reporting and can facilitate the linkage between diagnostic results and response in the field. This would strengthen diagnostic capacities when these are directly related to the ability of the laboratory to report results rapidly.

Moreover, there is a direct temporary correlation among the celerity of the diagnosis, the beginning of the therapy and the possibility of limit the disease spread, with a consequent reduction of money loss.

LIMS is now a fair mature IT technology; however the active role in supporting disease detection, surveillance and response to disease outbreaks is the target to be reached in the near future.

With the decreasing hardware and software costs (using open tools) and the growing availability of internet connections and LAN, the pre-conditions for laboratories to leave the paper tracking systems are today fulfilled. While implementing a LIMS is not a short-term investment, however, it could produce a long-term effect on the vitality of the laboratory for many years following installation.

A LIMS can be a powerful tool that gives the laboratory a competitive advantage over other laboratories, saving time and money. Benefits of LIMS implementation include faster turnaround times, automation, increased productivity, higher quality of data, electronic reporting, and integration with other enterprise databases. In addition, you obtain standardized reporting of laboratory data.

Although it is recognized that epidemiology and Laboratory Information Management Systems may play a central role in monitoring animal diseases having public health importance, unfortunately not all countries are in a position to have enough resources available to implement complex disease surveillance programs involving LIMS.

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KEY TERMS AND DEFINITIONS

Animal Disease Surveillance: Aims to improve disease analysis, early warning and predicting disease emergence and spread. As a preventive measure, disease surveillance is aimed at reducing animal health-related risks and major consequences of disease outbreaks on food production and livelihoods.

Information System: The tool used to collect, filter, process, create, and distribute data. It consists of hardware, software, networks and operators.

Interconnection: Many organizations use multiple software systems for management. Different software systems often need to exchange data with each other. Interconnection is to link different systems to allows to exchange this data.

Laboratory Management System: A software-based laboratory and information management system that offers a set of key features that support a modern laboratory's operations.

Monitoring: Is the making of routine observations on health, productivity and environmental factors and the recording and transmission of these observations.

"Paper-Less" System: Is the work environment in which the use of paper is eliminated or greatly reduced. This is done by converting documents and other papers into digital form. Proponents claim that "going paperless" can save money, boost productivity, save space, make documentation and information sharing easier, keep personal information more secure, and help the environment. The concept can be extended to communications outside the office, as well.

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Veterinary Epidemiology: Is principally concerned with the study of disease within populations (although it may also be used for investigation of issues such as animal welfare and productivity). Put simply, it involves the investigation of patterns of disease within a population, in relation to which animals are affected, the spatial distribution (i.e. location) of affected animals, and the temporal distribution of affected animals (i.e. animal disease surveillance patterns of disease through time).

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Chapter 16
Developing SMS Health Messages for Pregnant Indigenous Australians Using Persuasive Technology

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ABSTRACT

While developed nations search for solutions to pay for the increasing financial burden of healthcare, developing nations provide a way forward in the deployment of innovative healthcare. Mobile SMS programs are low-cost and effective in supporting health services. Having been successfully used to address lifestyle factors directly affecting maternal outcomes, such as: smoking, physical activity, nutrition, substance use and psychological stressors. Of primary importance in the development of SMS behavior change programs to support the maternal healthcare of Indigenous Australian women, is cultural appropriateness; specifically, the cultural notion of 'women's business'. In traditional Indigenous Australian culture, it is senior women who teach young women about maternal health and it is considered offensive for anyone other than a senior woman to instruct women on such matters. This discussion will consider the challenges in developing maternal healthcare SMS messages that aim to satisfy both the culturally sensitive requirements in addition to the medical requirements.

INTRODUCTION

While medical science has made some remarkable discoveries over the past two centuries, the cost of healthcare for most developed nations has been growing faster than GDP and is therefore unsustainable (World Economic Forum 2013). Over the past two decades, the economics indicate the long-term sustainability of the healthcare industry by government funding is not achievable using the current models of healthcare delivery. In most developed nations, healthcare costs are increasing faster than national income to a point where the healthcare industry is considered by some to be amongst the most wasteful

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sectors in the world (Harvard University, 2014; World Health Organisation [WHO], 2010; PricewaterhouseCoopers Health Research Institute, 2008). To pay for this increasing financial burden governments must deny funding to education, roads, and public safety, or eventually resort to increasing taxes.

There are also concerns for many people in developed nations being excluded from healthcare systems due to poverty, communication, ignorance and distance. Populations have increased, life expectancy has improved and the numbers of physicians and specialists have decreased (Sanabria, 2014). At the same time, the healthcare industry is reluctant to look outside its traditional approach to service delivery as such change undermines the power structures in governments, pharmaceutical companies, physician services and nursing systems (Thompson, 2012).

This is not a new problem; healthcare is not the first industry needing to improve quality and convenience while reducing costs. Neither is the health industry the first to resist change. In developing nations, where healthcare resources are low, innovative new models of healthcare are succeeding. These new models provide a way forward for developed nations in the healthcare delivery of tomorrow.

One such area needing improvement in Australia is Indigenous maternal healthcare. While much progress has been made in regards to Indigenous healthcare, it is essential that the Australia healthcare system continue to leverage existing technologies to reach people in need of care. In order to maximize the potential of mobile technology in the field of Indigenous maternal health, both cultural and medical requirements need to be integrated into the design methodology of the system. Specifically, this discussion will outline the issues surrounding a proposed low-cost SMS behavior change program, intended to inform and motivate Indigenous Australian women for positive pregnancy outcomes. This low-cost innovative healthcare model has proven effective in both developing and developed nations.

BACKGROUND

Healthcare Innovation

In Australia, Indigenous health expenditure was estimated to be $4.55 billion in 2010–11, 3.7% of the total Australian health expenditure (Australian Institute of Health and Welfare [AIHW], 2013a). The average health expenditure per Indigenous Australian was $7,995, compared with $5,437 per non-Indigenous Australian (AIHW, 2013b). The Australian Government (44.8%) and the state and territory governments (46.6%) combined, funded 91.4% of the total health expenditure for Indigenous Australians in 2010–11. The non-government sector, which includes out-of-pocket payments by individuals, funded 8.6% (AIHW, 2013b). Health expenditure estimates for Indigenous maternal conditions in 2010–11 were $144 million (AIHW, 2013a).

The cost of healthcare for Indigenous Australians compared to non-Indigenous Australians is not only more expensive but also the maternal health outcomes for Indigenous Australians are significantly worse than for non-Indigenous Australians (see next Section 'Antenatal Care For Indigenous Australian Women'). An innovative system built on the principles of Indigenous methodologies may be well suited to the Indigenous Australian maternal healthcare setting.

In terms of cost savings to healthcare, Cannon et al. (2013) estimate the costs of inadequate antenatal care to remote Western Australian Indigenous communities. Their study modeled pregnancy events with adequate and inadequate care to reflect different outcomes. They reported the mean cost of pregnancy to be AUD$8985. For adequate care, the costs were AUD$7635 and for inadequate care AUD$10,216. They

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further estimated that for a rural community with "150 births per year, up to AUD$123,082 may be spent to improve access to care at no extra cost to the total current expenditure" (Cannon et al., 2013, p. 313).

The cost of implementing SMS programs favors economies of scale. A study by Zurovac, Larson, Sudoi and Snow (2013) examined the costs and cost-effectiveness of a text message intervention in Kenya, which improved health worker adherence to malaria guidelines. While the application of the SMS intervention was different to one proposed here, the associated cost of setting up and running an SMS system is similar. They found that the intervention was both effective and inexpensive. Table 1 provides costs associated with scaling to regional and national coverage and outlines the reduced cost of each additional patient managed.

While healthcare systems in developed economies are grappling to find answers to their mounting financial issues, the future has seemingly overtaken them. Innovative delivery models designed and developed in resource-constrained environments, such as India, Africa and parts of Asia, demonstrated that it is feasible to improve access to quality healthcare at a fraction of the cost seen in the conventional healthcare delivery systems (World Economic Forum, 2010a). For example, the Aravind Eye Care System:

delivers quality eye care in India at a fraction of the cost through the use of focused 'factories' that eliminate any waste in the system, increase the productivity of expensive assets and trained work-force and focus on straightforward standardized procedures including cataract surgery and spectacle fitting. They have reached ~12 million in India (10% of total blind), and costs are only 1% of the equivalent service in the UK (albeit not adjusted for country specific factors) with surveys showing outcome quality is higher in India (World Economic Forum, 2010b, p.2).

After adjusting for purchasing power, so the figures are comparable, the Aravind Eye Care System in India performs at one-sixth of the cost of the NHS in the UK (World Economic Forum, 2013).

Bill Gates (2008), the founder of Microsoft and Co-chair of the Bill & Melinda Gates Foundation provided further insight into the way forward for the future of healthcare innovation;

Table 1. Cost-Effectiveness of Text Message Intervention, Under Three Implementation Scenarios, in Kenya, Africa.

Test Condition	Cost To Implement	Cost Per Additional Child Managed
As implemented under study conditions in study areas.	Intervention costs were 19,342 USD, of which 45% were for developing and pretesting text messages, 12% for developing text-message distribution system, 29% for collecting health workers' phone numbers, and 13% were costs of sending text-messages and monitoring of the system.	0.50 USD
If the intervention was routinely implemented by the Ministry of Health (MoH) in the same areas.	Costs would be 28% lower (13,920 USD) due to lower costs of collecting health workers' numbers.	0.36 USD
If the intervention was scaled up nationally.	97,350 USD, and the majority of these costs (66%) would be for sending text-messages.	0.03 USD (If the cost on the national scale was 400% higher than estimated, the cost per additional child correctly managed would be only 0.16 USD)

(*Adapted from:* Zurovac, Larson, Sudoi, & Snow, 2013, p. 52045)

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Philanthropy and government aid channel our caring for those who can't pay, but the resources run out before they meet the need. But to provide rapid improvement for the poor we need a system that draws in innovators and businesses in a far better way than we do today. Such a system would have a twin mission: making profits and also improving lives for those who don't fully benefit from market forces (para. 31-32).

This notion of a 'twin mission' is partly observed in the Mobile Alliance for Maternal Action (MAMA) program in Bangladesh, known locally as Aponjon, meaning 'the dear one' in Bangla. Aponjon is an innovative public-private partnership that delivers maternal and infant health messages to mobile phones through the use of SMS and 60-second voice messages. MAMA Bangladesh (2014) reports that, "Aponjon is poised to become the first financially sustainable health information service utilizing mobile phones to improve health outcomes at national scale in a developing country" (p. 23).

To achieve this goal, 88% of Aponjon is currently financed by USAID, 7% by corporate social responsibility (CSR) funding at local and global levels, 4% by the Sponsor-a-Ma campaign and slightly less than 1% from user fees and advertising. For the long-term financial sustainability, the Aponjon project is planning to derive 40% of its funding from user fees, 20% from development agencies and the remaining from CSR, advertising and the Sponsor-a-Ma campaign (MAMA Bangladesh, 2014).

Innovation is simply defined by Anthony (2012) as "[s]omething different that has impact" (as cited in Harvard Business Review, 2012 para. 3). For the healthcare industry the opportunity exists for 'doing something different' within maternal health services which care for Indigenous Australian women. Yet, the challenge is implementation within an industry that is reluctant to embrace innovation. According to the World Economic Forum this is not a problem specific to the Australian healthcare industry but for developed nations in general. They report that, "the fundamental structure of healthcare systems – acute hospitals and physician offices – has barely altered in at least a century" (World Economic Forum, 2013, p. 13).

Others voice similar concerns. Topol, for example, describes the healthcare industry as:

remarkably conservative to the point of being properly characterized as sclerotic, even ossified. Beyond the reluctance and resistance of physicians to change, the life science industry (companies that develop and commercialize drugs, devices, or diagnostic tests) and government regulatory agencies are in a near paralyzed state, unable to break out of a broken model of how their products are developed or commercially approved (Topol, 2012, Introduction, para. 3).

Cultural Requirements

One cultural requirement discussed by Kendall, Sunderland, Barnett, Nalder and Matthews (2011) has a significant impact on the current study. They describe the insidious nature of "culturally insensitive research designs and methodologies that fail to match the needs, customs, and standards of Aboriginal communities" (p. 2). Kendal et al. refer to the "ample examples of contemporary research that has inappropriately required Aboriginal people to discuss sensitive topics that violate culturally determined gender roles or community structures of authority" (2011, p. 2).

Maher (1999) provided a summation of indigenous health beliefs, with a view "to aiding understanding by health professionals of their present attitudes and behaviors in regard to health care" (p. 229). Mayer explains one concept of traditional Aboriginal health beliefs, known as 'men's business/women's business',

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In Aboriginal culture, there are clear-cut divisions between men's and women's role in society. Women's business includes all aspects of reproduction: menstruation, pregnancy, childbirth, contraception, abortion and female ceremonial business. Food taboos are still prevalent, especially during mourning, pregnancy, lactation and menstruation. Men's business involves hunting, conflicts, the land, male anatomy and male ceremonial business.

Breaches of these traditional divisions (e.g. female nurse washing elderly initiated male Aboriginal, a female nurse teaching an Aboriginal man self-catheterisation or a male doctor undertaking a vaginal inspection) is likely to cause great distress and 'shame'. Shame is a complex concept that is difficult to translate into non-Aboriginal English (Maher, 1999, p. 232).

A complementary view of 'women's business' connects traditional Indigenous Australian women's birthing practices with Aboriginal Law (Lore) and the Dreamtime. The *Dreamtime* is a spiritual belief system. Overstepping these traditions shows disrespect to Indigenous Australian culture at many levels:

Traditionally, Aboriginal women gave birth in the place where they were born, 'on country' with other women by their side. Young women learn about borning and the Grandmothers Law from the older women during their first labour. Birthing is 'women's business' and intricately related to 'Aboriginal Law' and the 'Dreamtime'. The dreamtime explains creation and many of the rules and symbols are expressed in the myths and stories that are passed from generation to generation. The process of borning is a process where the spirit of the land and the people come together, and the place where a person is born establishes their relationship to the land (Kildea, Wardaguga & Dawumal, 2004, The Centre, para. 2).

Understandably, some Indigenous Australian women "are no longer prepared to accept the affront imposed on their culture and personal dignity by conventional Western systems of managing childbirth" (Barclay Andre & Glover, 1989, p. 123). Knowledge about Indigenous Australian birthing belongs in the domain of Indigenous Australian women. It is not open knowledge. Researchers do not have the cultural qualifications to investigate or seek such knowledge without permission from senior Indigenous Australian women. This recognition respects the role of senior women within Aboriginal and Torres Strait Islander cultures (Shehan & Walker, 2001) and is critical in the success of an effective behavior change program.

A recent study by Bar-Zeev et al. (2014) reported that midwives experience a tension between their professional responsibilities and the cultural limitations of the women they care for. Midwives chose not to follow certain healthcare guidelines out of concern it would threaten the ongoing relationship with women. Had midwives discussed certain subjects, they were concerned women may not have returned for further treatment. One midwife reported:

Domestic violence, grog (alcohol) use and smoking are real big problems... but we (non-Aboriginal midwives) can't be the one trying to talk to them (pregnant women) about this... it needs to be health workers, the old ladies (Elders) doing all the talking… I feel like it always comes across like your shaming (embarrassing, humiliating) them if you bring it up... like pointing fingers... (Bar-Zeev et al., 2014, p. 293).

While this behavior may be viewed by healthcare as denying women appropriate care, from an Indigenous perspective these midwives are intuitively acting in a culturally correct manner. In traditional

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Indigenous Australian culture, it is the senior women, including breeding women, Law-women and healing women, who teach young women about maternal healthcare (Bell, 1998), not healthcare services.

In an attempt to overcome this cultural dynamic, the current project proposes, firstly, to seek permission from senior Indigenous Australian women to proceed with the project, and, secondly, to include senior Indigenous Australian women as the major component of the SMS message writing process. In addition to having each message clinically approved by healthcare, the intention is to make each of the SMS messages appear as if they were written by a senior Indigenous Australian woman. The wording of the messages in this way aims to satisfy the cultural notion of 'women's business', while upholding the medical standards of healthcare.

The complete development and deployment of the SMS system is outside the scope of this project. Instead, the current focus is on the writing and testing of the SMS messages themselves for cultural appropriateness. There are significant cultural challenges that require careful planning if the project is to succeed. From initial consultations with Indigenous Australian women, health professionals, IT professionals, educators and reviewers, the possible system weaknesses, in terms of cultural issues, are outlined in Table 2.

Antenatal Care for Indigenous Australian Women

In a developed nation such as Australia, which boasts one of the most efficient healthcare systems in the world (Bloomberg, 2013), why is it still necessary to emphasize the importance of caring for Indigenous women during pregnancy, after decades of priority status?

In Australia during 2011 there were 17,621 births registered where one or both parents identified as Indigenous Australian (Clarke & Boyle, 2014). Census data from the ABS (2011b) reported the number of people identifying as Indigenous Australian in NSW was 172,624, which represents 31.4% of the total Indigenous Australian population in Australia. From this total, 5,600 births were recorded in NSW, which was the highest number of registered Indigenous Australian births by any state (ABS 2011).

The birth outcomes for Indigenous Australians are significantly different compared to non-Indigenous Australians. There is a higher prevalence of smoking during pregnancy, hypertensive disorders, teenage pregnancy and gestational diabetes (Prime Minister's Science, Engineering and Innovation Council 2008). Sullivan, Hall and King (2008) reported the maternal mortality ratio for Indigenous Australian women between 2003-2005 was 21.5 deaths per 100,000; for non-Indigenous Australian women the ratio was 7.9

Table 2. Possible Obstacles and Solutions To System Success

Item	Obstacle Identified	Possible Solution
3.1	Rejection of the SMS messages due to their cultural inappropriateness.	Inclusion of Indigenous Australian women fully in the development of the health messages.
3.2	Indigenous Australian women will not subscribe voluntarily.	(Outside scope of current project) The aim is to integrate the subscription process into the first antenatal visit.
3.3	The frequent changing of mobile phones and telephone numbers by the target audience.	(Outside scope of current project) Providing subscribers with business card size instructions on how to re-subscribe, if they change their phone number.
3.4	Indigenous Australian healthcare services may not ready for mobile health adoption.	(Outside scope of current project) Seek out innovative maternal health services, interstate if necessary.

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per 100,000. This maternal mortality ratio is more than two and a half times higher among Indigenous Australian women and known to be underestimated (Kildea, 2008 in Bar-Zeev et al., 2014). In addition, the perinatal death rate is twice as high for Indigenous Australian infants (17.3 per 1000 births) compared to non-Indigenous Australian infants (9.7 per 1000 births), as is preterm birth (13.3% v. 8.0%) and low birth weight (12.4% v. 5.9%) (Li, Zeki, Hilder, & Sullivan, 2012, in Bar-Zeev et al., 2014).

While many of the solutions to manage maternal health conditions require direct medical attention by healthcare services, implementing behavior change and educational programs via SMS can address lifestyle factors that directly impact on maternal outcomes. For example, Bar-Zeev et al. (2014) identified "that most perinatal deaths among Indigenous infants were attributed to antenatal factors that could be addressed though targeted primary healthcare interventions such as smoking cessation programs, to reduce the prevalence of low birth weight and preterm birth" (p. 294). However, it must be emphasized that such interventions are not intended to be stand-alone programs but are integrated into existing maternal health services.

The literature reports widely (Table 3) on successful SMS lifestyle change programs which parallel with many of the life-style issues reportedly impacting the health of Indigenous Australian women, including: lack of physical activity, poor nutrition, harmful levels of alcohol intake, substance use and higher psychological stressors (deaths in families, family violence, serious illness, financial pressures, contact with the justice system) (Bar-Zeev et al., 2014, Clarke & Boyle, 2014). By addressing such behavior issues via SMS, the project intends to empower pregnant Indigenous Australian women to make positive healthy choices.

Table 3. Lifestyle Factors Impacting Birth Outcomes Which Can Be Modified Using SMS Programs

Life-Style Change	Positive Results Reported From SMS Behaviour Change Research
Increasing Physical Activity	Fjeldsoe, Miller and Marshall, 2010; Sirriyeh, Lawton and Ward, 2010.
Weight Control	Haapala, Barengo, Biggs, Surakka and Manninen, 2009; Joo and Kim, 2007.
Diet Control	Soureti et al. 2012.
Management Of Anxiety Symptoms	Riva, Preziosa, Grassi and Villani, 2006.
Smoking Cessation	Rodgers et al. 2005; Brendryen and Kraft, 2008; Brendryen, Drozd and Kraft, 2008.
Alcohol Consumption Monitoring	Kuntsche and Robert, 2009; Weitzel, Bernhardt, Usdan, Mays and Glanz, 2007; Ríos-Bedoya and Hay, 2013.
Illicit Substance Abuse Monitoring	Maher et al. 2010; Muench, Weiss, Kuerbis and Morgenstern, 2012; McClure, Acquavita, Harding and Stitzer, 2013.
Therapeutic Communication For Emotional Disorders	Gerber, Stolley, Thompson, Sharp and Fitzgibbon, 2009; Haapala et al. 2009; Hazelwood, 2008; Kharbanda, Stockwell, Fox and Rickert, 2009; Leong et al. 2006; Prestwich, Perugini and Hurling, 2009.
Reminders To Take Medications	Mao, Zhang and Zhai, 2008; Strandbygaard, Thomsen and Backer, 2010; Miloh et al. 2009; Franklin, Waller, Pagliari and Greene, 2006; Vilella et al. 2004; Cocosila, Archer, Haynes and Yuan, 2009.
Appointment Reminders	Downer, Meara, Da Costa and Sethuraman, 2006; da Costa, Salomao, Martha, Pisa and Sigulem, 2010; Koshy, Car and Majeed, 2008.
Sexual Health Education	Perry et al. 2003; Lim et al. 2012; Levine, McCright, Dobkin, Woodruff and Klausner, 2008; Gold et al. 2011; Mitchell, Bull, Kiwanuka and Ybarra, 2011.
Contraception Adherence	Castano, Bynum, Andres, Lara and Westhoff, 2012; Hou, Hurwitz, Kavanagh, Fortin and Goldberg, 2010.
Family Violence Management	Howard, Friend, Parker and Streker, 2010.

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SOLUTIONS AND RECOMMENDATIONS

The current project reports on the proposed adoption of a successful innovative healthcare model being implemented widely in developing nations. The model is low cost, does not require investment in expensive infrastructure and is effective in supporting existing maternal health services (Gazmararian, Elon, Yang, Graham, & Parker, 2013; Hoff, Nunez-Alvarez, Martínez, & Yvette, 2012; Kaleka, Olsen & Sweet, 2012; Evans, Wallace & Snider, 2012; Ding, Euler, Kennedy, & Greby, 2012; California State University, 2011). This relatively simple model sends three SMS messages per week to the mobile phones of pregnant women, with the intention of educating and motivating them towards improved birth outcomes.

The deliverable of this project is approximately 150 SMS behavior change messages intended to be sent to Indigenous Australian women during pregnancy. The message set will cover a time period from week 5 to week 42 of pregnancy. Messages are to be developed using established behavioral theory models, derived from Captology, a discipline within human-computer interaction (Fogg, 2003). As a part of the message writing process, healthcare experts approve the message content for clinical accuracy. In addition, senior Indigenous Australian women, the traditional owners of 'borning' knowledge, are involved in the adaptation of each message, to make content more culturally appropriate.

The messages are to be written with the intention of being sent via Short Messaging Service (SMS). This reduces the length of each message to a maximum of 160 characters. SMS provides a simple and cost-effective solution for healthcare services to reach pregnant Indigenous Australian women. Mobile phone coverage is far more extensive than face-to-face medical facilities, which partly reduces healthcare delivery factors such as distance, communication, ignorance and lack of appropriate services. Furthermore, SMS is push technology, so women will not need to install new software on their phones to receive messages; the SMS is delivered to the mobile phone without any effort on behalf of the recipient. Neither do pregnant Indigenous women require new mobile phones with Internet access to receive messages; even outdated mobile phones can receive SMS.

In addition to specific behavior change messages, content includes information that medical professionals want women to know, for example, low-cost telephone numbers that link to free and low-cost services associated with the message topic, based on the mother's location. Message topics include information on antenatal visits, nutrition, exercise, smoking, alcohol, drug abuse, medical conditions associated with pregnancy, labour, delivery, intimate partner violence, oral health, hygiene, baby development and other issues specific to Indigenous Australian women during pregnancy.

The development of the actual messages is viewed as the critical step in delivering effective behavior change (Fogg, 2009b). Once the messages are developed, low-cost 3rd party cloud services provide complete SMS management. A *cloud service* is any resource which is provided over the Internet. In other words, there are services available on the Internet to manage the storage and sending of scheduled SMS.

Example of SMS for Supporting Healthy Pregnancies

The following SMS examples have been made available by the Mobile Alliance for Maternal Action. MAMA's adaptable messages are based on WHO and UNICEF guidelines and have been developed in close collaboration with a group of global health experts to reflect the most up-to-date, evidence-based global standards. One important feature about the MAMA messages is that they are 'adaptable'. The generic messages are intended to be adapted to specific audiences and healthcare systems (MAMA, 2014).

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As pregnancy is a nine-month cycle, MAMA message delivery is intended to parallel with the corresponding stages of pregnancy. For example, in week 5 of pregnancy the following message about morning sickness is sent, "Are you feeling sick? Most women do in early pregnancy. Try having some ginger, mint or lemon tea, and rest if you can" (MAMA, 2013, p. 1), in week 38 the following message is sent, "Low back pain is a sign that the baby is low down, ready to get born. Make sure you can get to the clinic in time" (MAMA, 2013, p. 44-5). The available SMS management software allows this type of message scheduling without specialised technical personnel.

Generally, the Australia healthcare system does not offer maternal services Indigenous women will accept, leading women to present later in their pregnancy for midwifery/obstetric care (56% in first trimester), attend fewer antenatal appointments and are less likely to have received health screening during pregnancy (Hunt, 2006; Panaretto et al., 2005; Rumbold & Cunningham, 2008, Australian Health Ministers' Advisory Council, 2012). The MAMA (2013) core pregnancy SMS messages provide an example of a thoughtfully designed reminder message that not only 'reminds' but also 'motivates', saying "Going to the clinic will help make sure that you and your baby stay healthy. Find out where your nearest clinic is today" (p. 2). After adapting the wording to Australian culture, i.e., changing the word 'clinic' to 'Doctor' or 'Dr', such messages may also be effective in increasing antenatal appointments for Indigenous Australian women.

The California State University (2011) found that sending SMS medical warnings to American women was effective. While this effectiveness has not been tested on Indigenous Australian women, messages will include symptoms that a woman may not be familiar with. For example, a warning messages about the symptoms associated with pre-eclampsia are scheduled in week 27, saying, "Slightly swollen hands and feet are common in pregnancy. But if you have sudden swelling and headaches, go to the clinic" (MAMA, 2013, p. 30). Again in week 34, a second message on symptoms associated with pre-eclampsia is scheduled, saying "Sudden swelling of hands, face and feet is a sign of a problem. Tell your family, and ask them to take you to the clinic if they see this" (MAMA, 2013, p. 39). Such warning messages can be tailored to target the specific regional or community health needs.

Message content may also include concrete strategies to engage in healthy behaviour changes. To encourage a nutritious diet during pregnancy, for example, a message can include examples of nutritious food, "Eat well, so your baby will grow well. Try to eat some meat, eggs, bean or lentils every day and green vegetables and milk, yoghurt or soya" (MAMA, 2013, p. 3). The following type of message can be sent to discourage smoking, "Smoking harms you and your baby. If you smoke, your baby could be born weak and catch infections easily. Stop smoking and avoid smoky places" (MAMA, 2013, p. 11). To discourage alcohol consumption during pregnancy, "Drinking alcohol is bad for you and your baby. It could make your baby weak and ill. Don't drink in pregnancy" (MAMA, 2013, p. 9).

While these messages examples may appear short and simple, a study on SMS pregnancy health intervention by the California State University (2011) reported, "women like receiving health information via text messages, and will act upon the knowledge they receive" (p. 2).

Additional message examples are available from Text4Baby, a US-based free text messaging service reportedly based on behavioural theory. Text4Baby has a large subscriber base with more than 320,000 people enrolling between February 2010 and March 2012 (Whittaker et al., 2012). Messages cover the period from early pregnancy through to the baby's first birthday. The text messages are very generic but provide helpful advice on maternal health options and alternatives. For example the following messages were made available by the Healthy Babies Coalition (2012, para. 11) on the text4baby.org website:

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- "Have you visited a Dr. or midwife (CNM/CM)? If not, make an appointment now. Call your health plan. Or 800-311-2229 to connect to low-cost care".
- "Your baby is growing a lot! Baby is now the size of a lime & can open its mouth & move its tiny hands".
- "If you have any signs of preterm labour--cramps, belly tightening, low back pain, bleeding, or watery, pink/brown discharge--call your Dr. right away".
- "A seat belt protects you & your baby. Shoulder belt goes between your breasts & lap strap goes under your belly (not on or above). Wear it every time".
- "Are you really in labour? Real labour won't stop when you lie down or walk around. In real labour, the pains get worse & happen more often".

A randomized evaluation provided evidence that specific health beliefs are changed by sending text messages to pregnant American women (Evans, Wallace and Snider 2012). Those exposed to Text4Baby messages were in agreement with the attitude statement 'I am prepared to be a new mother' (OR = 2.73, CI = 1.04, 7.18, p = 0.042) between baseline and follow-up. For those who had attained a high school education or greater, we observed a significantly higher overall agreement to attitudes against alcohol consumption during pregnancy (OR = 2.80, CI = 1.13, 6.90, p = 0.026). We also observed a significant improvement of attitudes toward alcohol consumption from baseline to follow-up (OR = 3.57, CI = 1.13 - 11.24, p = 0.029) (p. 1031).

The study highlighted that mothers were nearly three times more likely to believe that they were prepared to be new mothers compared to those in the no exposure control group. Commenting further on this study, William Evans, Professor of Prevention and Community Health at the School of Public Health and Health Services said "in addition to being more prepared for the arrival of a new baby, the pregnant women seemed more likely to understand the value of habits such as eating healthy foods or regular visits to a health provider or clinic" (The National Healthy Mother Healthy Babies Coalition, 2012, para. 5)

Another study by the National Latino Research Centre and the Department of Reproductive Medicine, at the University of California, investigated the satisfaction of 1,171 Text4Baby subscribers (912 English and 259 Spanish) in the San Diego area. The results indicated high satisfaction, improved interaction and increased access to health resources (California State University, 2011). More specifically, findings indicated that:

- Spanish speaking women reporting higher satisfaction scores than English speaking women.
- 63.1% of women reported that text4baby helped them remember an appointment or immunization that they or their child needed.
- 75.4% reported that text4baby messages informed them of medical warning signs they did not know.
- 71.3% reported talking to their doctor about a topic that they read on a text4baby message.

Martinez and Uekusa (2013) found that 44% of the Spanish-language participants lived in a zip code where over 25% of families live in poverty. Jordan, Ray, Johnson and Evans (2011) concluded in their paper, "Text4baby seems to be an excellent way to communicate with low-income women and new mothers who have limited access to critical prenatal and newborn information" (p. 210). This finding

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may be an indication of parallel effectiveness with Indigenous Australian women in similar socioeconomic circumstances.

A recent systematic review of the literature by Poorman et al. (2014) focused on the use of SMS for maternal and infant health. A total of 48 studies included '… 30 randomized controlled trials; two non-randomized or partially randomized controlled trials; two cohort studies; three uncontrolled trials; five cross-sectional or ecological studies; three pilot studies; two historical case controls; and one focus group' (Poorman et al. 2014, p. 2). The evidence presented in this study concluded;

The use of text messages to promote maternal health has tremendous potential to reach pregnant women and new mothers, particularly those with fewer resources. As we have shown, these women are more likely to use text messaging and to be at risk for poor birth outcomes that may be modified through appropriate text message interventions. These women are traditionally more difficult to outreach to with traditional communication methods, and thus this technology may be particularly valuable for this population (Poorman et al. 2014, p. 19).

Other evidence supporting this type of system is the investment of significant financial resources at various locations around the world. For example, the Mobile Alliance for Maternal Action (MAMA) is a public private partnership between USAID, Johnson & Johnson, the United Nations Foundation and BabyCenter, who have invested $10m into similar SMS maternal health systems in Bangledesh, South Africa and India. The success of these programs has resulted in MAMA being included on the Annual Nominet Trust 100 (NT100) list, a global list of 100 inspiring ventures from around the world. Other projects included on the NT100 list include '… Freecycle, Random Hacks of Kindness and Google's self-driving car, alongside initiatives from emerging economies, including eCompliance, a revolutionary use of fingertip-readers to record tuberculosis treatment in India; philanthropic food-photo sharing app Feedie from South Africa and HarassMap, an anonymous crowd-mapping platform for sexual harassment in Egypt' (MAMA 2014b, para. 4).

Operational Hardware and Software

The computer hardware required to run the SMS delivery system is available as an Internet service, often termed *Infrastructure as a service (IaaS)*, which displaces the need for on-premises servers, air-conditioned server rooms, backup and storage systems, and networks, not to mention the IT staff necessary to maintain them. Via the Internet, IaaS services provide the required hardware infrastructure within minutes (Rosen, 2010). See the textit.in example below.

The software required to manage SMS is also available in the cloud. This is known as *Software as a service* (*SaaS*), which "refers to applications running on cloud infrastructures, typically delivered to the end user via a web browser" (Rosen, 2010, p. 26). The healthcare industry is not required to develop proprietary software or understand the underlying infrastructure or platform details. These systems require no programming knowledge to set up and costs are based on actual usage. The software collects and securely stores end-user registration data, can auto-reply to end-user messages and send feedback customised to the end-user's current situation. For such SMS systems, Klasnja and Pratt (2012) conclude, the "diversity of these interactions provides evidence for just how flexible text messaging can be as a system for delivering health interventions" (p. 186).

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By way of example, the textit.in service will reliably send 1,000 messages per hour from any global location with mobile phone coverage. Textit.in requires the additional purchase of an inexpensive Android phone and SIM card from a local carrier dedicated to this purpose. The mobile phone also requires Internet access via Wi-Fi or GSM data connection, or both. If one of the Internet connections drops out, the phone will switch to the alternative. To maximise reliability, the phone is placed geographically in an area with a strong network signal and a reliable power source (Nyaruka LTD, 2013).

Women subscribe to the system by sending an SMS text message containing 'Baby' to a mobile phone number. Upon receipt, the system automatically sends SMS prompts the mother to enter the baby's expected due date and postal code. The system then automatically sends SMS messages timed to the corresponding stages of her pregnancy.

Privacy

In NSW, privacy laws are regulated by the *Health Records and Information Privacy Act 2002* (NSW) (the 'HRIP Act'), which regulates health privacy, and the *Privacy and Personal Information Protection Act 1998* (NSW)(the 'PPIP Act'), which remains applicable to non-health information. As privacy policy is set by legislation, compliance with the HRIP Act is mandatory for the proposed SMS system (NSW Department of Health 2005).

Personal information is defined in Section 6 of the *PPIP Act* as:

If a person's identity cannot be ascertained from the information it will NOT be personal information, and the privacy laws will not apply. Unique identifying information such as name and address, photographs, biometric information including fingerprints and genetic characteristics will always be "personal information". A range of other information can also become personal information, if it is viewed in combination with other information, which together is sufficient to allow a person's identity to be "reasonably ascertained". (NSW Department of Health 2005, p. 11)

Legislative obligations are imposed on the health system by the HRIP Act. It applies to all people who work within the NSW public health system, who, in the course of their work, have access to personal health information. The HRIP Act covers all types of dealings with personal health information, including collection, storage, security, use, disclosure, access, transfer and linkage of records (See Table 4). They apply to personal health information in any format, including electronic and online formats as well as paper-based records. While different formats will require different approaches and procedures, the underlying principles remain the same.

While all reputable projects integrate strong privacy principles, it may not be strictly necessary for the current project to be subject to the PPIP Act because the identity of a person is not reasonably ascertainable from the information collected from each individual. This is due to the simplicity of the stored data set. Data input includes recipient's mobile phone number, expected due date and postcode. While the mobile phone number is assumed to be registered to a pregnant woman, there is also the possibility of the phone number being registered to someone else, such as another member of her household, as is often the case with teenagers. This lack of certainty protects the privacy of the individual. In other words, pregnancy health messages are probably being sent to the owner of the mobile phone but one cannot be certain.

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Table 4. Summary of the Health Privacy Principles for Public Health Services in NSW, Relevant to the Current Project.

Principle	Description	Application to Current Project
Collection	Personal health information must be collected by lawful means and for a lawful purpose. The purpose must be directly related to, and reasonably necessary for, an organisation's functions or activities (NSW DoH 2005, p. 6).	Information is collected during the first antenatal visit. Personal information includes 1) mobile phone number, 2) expected delivery date, and 3) post code.
Security	Personal health information held by public health agencies must be securely housed and protected against loss or misuse. Information must be kept only as long as is necessary for the purpose (or as required by a law), and must be disposed of securely (NSW DoH 2005, p. 6).	Any SMS messages transmitted may be accessible by certain third-party organizations, such as cellular networks and SMS gateway services, which are used to transmit the messages. These organizations have their own rules, policies, and security measures controlling who has access to messages transmitted through their services. Data are retained until week 42 of pregnancy and then deleted from the database.
Access and Amendment	Organisations that hold personal health information must allow individuals to find out if they hold information about that individual, and, if so, what kind of information they hold, what it is used for, and whether and how the individual can access it. Individuals may request that their personal health information be amended to ensure that it is accurate, relevant, up-to-date, complete and not misleading (NSW DoH 2005, p. 6-7).	Due to the frequent changing of telephone numbers, individuals are provided with instruction on how to access and update their own information.
Accuracy	Organisations must take reasonable steps to ensure that the personal health information they hold is relevant, up-to-date, complete and not misleading (NSW DoH 2005, p. 7).	Personal health information is entered by the end-user.
Use	Personal health information can be used for the purpose for which it was collected, or for other purposes recognised by the Act. These include "secondary purposes" such as where there is consent for the use, the use is a "directly related purpose", for management, training and research activities, for investigation and law enforcement, or where there are serious and imminent threats to individuals or the public (NSW DoH 2005, p. 7).	The *telephone number* is relevant to the delivery of the SMS message, *delivery date* is relevant to the stage based messages, and *postal code* is relevant to customising messages to specific language groups and research activities.
Disclosure	The provisions for disclosure of personal health information are the same as those for use of this information (NSW DoH 2005, p. 7).	Full disclosure of privacy and security policies before subscribing to the system.
Anonymity	Provided that it is lawful and practicable, individuals should be given the option of not identifying themselves when dealing with health organisations (NSW DoH 2005, p. 7).	Individuals are not required to provide their names and addresses to use the system.
Trans-border data flows and data flows to Commonwealth agencies	As a general principle, personal health information must not be transferred to a Commonwealth agency or an organization in another state jurisdiction unless the receiving agency applies personal health information privacy policies and procedures substantially similar to those of NSW (NSW DoH 2005, p. 7).	This may become relevant if the project expands nationwide.

(*Adapted from:* NSW Department of Health 2005)

In regard to the end-user, a study by Häkkilä and Chatfield (2005) suggests that existing SMS etiquette treats messages as private, and people expect the receiver to understand the level of privacy from the message context. This phenomenon is quite interesting, as SMS is technically insecure: anybody can read them if they get your phone. However, this finding highlights a novel aspect on mobile culture, the support for the use of encryption or for visual privacy information to be sent as part of a text message was rejected by many respondents in favour of the social norms that currently preserve user privacy.

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Persuasive Technology

In very general terms, 'persuasive technology' refers to technology designed to change attitudes or behaviours of specific audiences, through persuasion and social influence, but not through coercion. Persuasive technology is defined in the *Proceedings in First International Conference on Persuasive Technology* (2006) as:

Persuasive technology is the general class of technology that has the explicit purpose of changing human attitudes and behaviors. Persuasive technologies apply principles of social psychology in influencing people; principles of credibility, trust, reciprocity, authority and the like. … The scope of technologies that hold persuasive potential is broader than ICT alone, and includes persuasive product design and architectural design, yet the interactive nature of computers uniquely enables user-sensitive and user-adaptive responding, allowing persuasive messages to be tailored to the specific user in question, presented at the right place and at the right time, thereby heightening their likely persuasive impact (Ijsselsteijn 2006, p. v).

The following behavior grid (Table 5) illustrates the psychological strategies most suited for use in persuasive technology via mobile phones. This table was prepared by B.J. Fogg, based on his experience in the field of mobile persuasion. In his paper, Fogg stresses that this work is preliminary and is not intended as a final map for mobile persuasion but as a generative tool, to highlight the potential of designing mobile persuasive experiences. (Fogg, 2009a) The current project intends to maximize the possibility of success by focusing on the types of behavior changes that have been identified in the grid as most suitable.

Row 1, 'behavior for a period of time' indicates a behavior change that extends for a fixed period of time. The change is not done once, neither is it a permanent change, it can last for three weeks, nine months, or two years. The period of time is irrelevant. The target audience knows the behavior has an end date. An example of this may be to ask women to stretch for five minutes a day, from week 20 until birth, in order to manage stress. Row 2, 'behavior on a predictable schedule' refers to a behavior change

Table 5. Behavior Grid Indicating Types Of Behavior Change Most Suited To Mobile Devices

		What Type Of Behavior Change?	
		A: perform *existing* behavior (familiar behavior)	**B: *increase* behaviour (frequency, intensity, or duration)**
On What Schedule?	**1: behavior for a *period of time*** (X has a duration)	*Exercise for 30 minutes*	*Floss longer for two weeks*
	2: behavior on a *predictable schedule* (X gets repeated periodically)	*Gamble online each morning at 10am*	*Exercise with higher heart-rate each morning*
	3: behavior is *on cue* (X is cued irregularly; it's a change in habitual response)	*Drink water at each fountain you see*	*Write a longer thank you note after a dinner party*
	4: behavior is *at will* (can perform x at any moment)	*Check computer for viruses*	*Check for computer viruses more often*
	5: behavior is *always performed* (X means change in habit, in way of being)	*Maintain good posture*	*Think thoughts of appreciation*

(*Adapted from:*Fogg, 2009a, p. 4)

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that is repeated periodically on a schedule. The time period between performing the tasks is consistent; it can be daily, weekly or yearly. An example of this may be to ask women to visit their doctor every two months for antenatal check-ups. Row 3, 'behavior is on cue' refers to a behavior change that is performed on an irregular time schedule, as a habitual response, for example, washing hands before preparing meals. Row 4, 'behavior is at will', is a behavior that can be performed at any moment in time. Row 5, 'behavior is always performed' indicates a change of habit.

Column A, 'perform existing behavior' is behaviors which are already familiar to the target audience. The end-user knows the behavior, it's been achieved before. There are no surprises in performing this behavior, outcomes are known in terms of cost (in time, money, effort, and so on). Column B, 'increase behavior' are behaviors which are also familiar, however they are changing by increasing intensity or duration.

FUTURE RESEARCH DIRECTIONS

While this discussion may provide a novel and innovative idea for assisting Indigenous maternal health services, the bottom line to widespread adoption within healthcare is the evidence base. This is the first project of its type targeting the maternal healthcare of Indigenous Australians. As this is the preliminary stage of the project, no formal research has been completed other than the literature review. This is a proposal, not the verification of validation of a proven solution. While proven solutions may be preferred before implementation, proof should be readily achieved once implementation is realized.

The literature reports extensively on the successful outcomes of SMS in maternal health, however, the author has no direct evidence that this will be successful in an Indigenous Australian maternal health setting. Regardless of this significant fact, the reader can still retain confidence in the methodology employed by this project, to maximise the probability of success.

The coincidence of high adoption of mobile phones among the Indigenous Australian population and poor maternal health is considered by the author as a significant factor worthy of further investigation. Specifically, this technology approach has become possible due to a number of studies reporting on the rapid adoption of mobile phones, by Indigenous Australian communities (Taylor, 2012; Kral, 2010; Dyson & Brady, 2009; Department of Broadband, Communications and the Digital Economy, 2008; Tangentyere Council Research Hub and Central Land Council, 2007; James, 2006; Young, Robertson, Sawyer, & Guenther, 2005; Tiwi Land Council, 2004).

What Fjeldso and others (2012) noted in their study, is the widespread omission of details used in the development of behavior change messages, within the healthcare literature. This is a serious issue for those wanting to replicate successful behavior change projects. In the health sciences the end results are understandably the primary focus; in human-computer interaction (HCI) it could be argued that the method used to develop the system is of primary concern. Even when the outcome of a project is not favorable, when the process details are provided, it becomes possible to improve on the process itself. Granted, the application of this study is in the field of healthcare but it remains a technology project requiring a HCI methodology, not a healthcare approach. It is the intention of the current study to provide the process details.

Often, healthcare studies recommend a 'pre-testing' phase, requiring the target audience to receive health messages for an extended period. For example, Fjeldsoe et al. (2012) based their methodology

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on the sequential multiple assignment randomized trial (SMART) method (Collins, Murphy & Stretcher 2007). Participation involved a one-on-one interview before and after the message testing period. While this method produces data on such things as the acceptable frequency of message delivery and the clarity of message content, it does not provide any data on whether the messages affected behavior, which is critical, before moving on to collecting scientific data (Fogg 2009b).

Instead, after the initial messages have been written, the next logical research direction is to test the messages to see if they affect behavior. The development of these behavior change messages is an iterative prototyping process not a scientific experiment. It allows the observation of how the target audience reacts to the messages. To achieve this type of behavior change test, after writing the initial messages, the messages are tested using variations, preferably the easiest and fastest variations first. Such tests may take two hours to set up, with a further two hours to put the test in motion. The results are then reviewed and new tests are prepared. It is at the completion of this stage that the SMS messages are ready for use in clinical trials. Yet, even at this stage, positive behavior change is not guaranteed, the messages have merely been developed to a point where they have the maximum possibility of success. (Fogg 2009b)

With the messages developed, formal scientific pilot testing can now proceed. However, the use of Randomised Controlled Trials (RCTs) at this stage is premature because '… RCTs often reveal little about *why* the technology under evaluation is or is not effective' (Klasnja, Consolvo & Pratt 2011, p. 3066). Field studies, such as those used in HCI are recommended for testing technology systems designed for health behavior change, even short studies that contain a significant qualitative component uncover bugs in the system that can go undetected, even in lab-based usability testing (Rogers et al. 2007). Employing field studies to discover why the system worked or why it didn't work is the way HCI researchers determine how to advance the system (Klasnja, Consolvo & Pratt 2011). In other words, during pilot testing, we are still optimizing variables affecting behavior change for the target audience. Only after the system has matured, an RCT becomes necessary to demonstrate that the new technology is effective.

In a practical sense, the researcher is also aware that no matter how impressive a new idea may be, it still requires a sustainable financial model. While this proposal presents an innovative solution, further research into a realistic financial model is required. There are a number of possible financial directions that can be explored. For example, financial support by individual hospitals, maternal healthcare services and state run maternal health programs. The program may also be distributed directly to consumers for free or low-cost, supported by advertisements and possible partnerships. It may also be possible to partner with the developers of medical sensors to combine SMS behaviour change programs with their products or developing our own wearable sensor device.

CONCLUSION

The primary issue to overcome in the development of a maternal health behavior change program for Indigenous Australians, is the cultural notion of 'women's business'. The clear-cut divisions between men's and women's role in Indigenous Australian culture needs to be incorporated directly into the design methodology i.e. Indigenous research methodologies. The voice of Senior Indigenous Australian women needs to be evident in the message content, in addition to the medical requirements. The other main barrier to implementation is the Australian healthcare industry itself, which is reluctant to embrace innovation.

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SMS provides a stable and elegant solution, which can address lifestyle factors that directly impact on maternal outcomes. Captology, a discipline within Human Computer Interaction provides an established foundation for potential behavior changes that are most suited to mobile phones. Mobile phone coverage is far more extensive than face-to-face medical facilities and every mobile phone is SMS-capable. Furthermore, the Indigenous Australian community has a high rate of mobile phone adoption.

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KEY TERMS AND DEFINITIONS

Antenatal: "Means 'before the birth', or during pregnancy" (Government of South Australia, 2007, para. 1).

Captology: "Is the study of computers as persuasive technologies. This includes the design, research, and analysis of interactive computing products (computers, mobile phones, websites, wireless technologies, mobile applications, video games, etc.) created for the purpose of changing people's attitudes or behaviours. BJ Fogg derived the term *captology* in 1996 from an acronym: Computers As Persuasive Technologies = CAPT" (Persuasive Technology Lab, 2010, para. 1).

Cloud Services: "Means services made available to users on demand via the Internet from a cloud computing provider's servers as opposed to being provided from a company's own on-premises servers. Cloud services are designed to provide easy, scalable access to applications, resources and services, and are fully managed by a cloud services provider" (Webopedia, 2014, para. 1).

Human Computer Interaction (HCI): Dix offers this simple underlying principle for HCI, "the study of interaction between people and computers" (2004, p. 5).

Indigenous Australians: Are the Indigenous peoples of Australia.

Innovation: Is simply defined as "Something different that has impact" (Anthony, 2012, as cited in Harvard Business Review, 2012 papa. 3).

Maternal Healthcare: "Is the health of women during pregnancy, childbirth, and the postpartum period. It encompasses the health care dimensions of family planning, preconception, prenatal, and postnatal care in order to reduce maternal morbidity and mortality" (Wikipedia™, 2014, para. 1).

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SMS: "Stands for 'short message service' and is also called texting or text messaging. SMS messages or 'texts' are usually sent from one mobile phone to another, but can also be sent from some home phones. It is a quick and convenient way of sending a short message to someone" (BBC, 2014).

Wearable Sensors: Are small electronic devices that are worn on the user's body for an extended period of time, significantly enhancing the user's experience as a result of the product being worn. They contain advanced circuitry, wireless connectivity and at least a minimal level of independent processing capability. For healthcare and medical applications, devices require FDA or equivalent approval. They are used in monitoring of vital signs, as well as for augmenting senses (IHS Inc., 2013).

Women's Business: "In Aboriginal culture, 'women's business' includes all aspects of reproduction: menstruation, pregnancy, childbirth, contraception, abortion and female ceremonial business. The knowledge about Indigenous Australian birthing belongs in the domain of Indigenous Australian women. Breaches of these traditional divisions is likely to cause great distress" (Maher, 1999, p. 232).

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Chapter 17
Health Information Technology and Quality Management

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ABSTRACT

Even in healthcare and health information technology change will not vanish or disperse. Technology, civilization, and creative thought will drive this force increasingly forward. Health care managers will continue being judged on their ability to efficiently and effectively manage (Patton & James, 2000). The arena of Health Services Research (HSR) is trusted on by judgment deciders and the public is the principal basis of data on how thriving health systems are meeting this task (Steinwachs & Hughes, 2008). The goal of HSR is to deliver material that will ultimately lead to advances in the health of the community. HSR evaluation of quality of care has demonstrated it is an unspecified science and multifaceted, even though its description is comparatively simple (Steinwachs & Hughes, 2008). This article is to investigate the background, controversies, and problems surrounding Health Information Technology (HIT) Change and Quality Management including an overview of current changes and benefits of implementation. This will be coupled with solutions and recommendations, further research, and conclusion. This will enhance the field of research in leadership, change management, quality management, and health care.

INTRODUCTION

One of the most widely discussed areas in the health care field is improving the quality of patient-centered care within Health Information Technology (HIT). HIT allows for the all-inclusive management of medical information and the protected exchange between health care consumers and providers (U.S. Department of Health & Human Services, 2008). Health care comprises of the use and management of a profusion of information that must be collected, managed, reviewed, processed, and mined (McHaney, n. d.). With this in mind, HIT is proclaimed to be the solution to improve patient-centered health care and quality, while reducing cost within the medical industry (Hersh & Wright, 2008). There is an emergent agreement in the health policy community that cognizant and involved patients have a dynamic role to play in refining the quality of care that the United States (U.S.) health system delivers (Robert

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Wood Foundation, 2007). A rising frame of research is commencing to offer solutions to that question, but there are also considerable holes in the research (Robert Wood Foundation, 2007). The foundation, content, and circulation of the health quality information that is currently available to consumers all vary widely. For instance, proportional evidence on quality performance for health plans has been accessible for some time in the form of the Health Plan Employer Data and Information Set (HEDIS) measures (Robert Wood Foundation, 2007). It is imperative to postulate relational characteristics of high quality care and ask patients to describe those involvements (e-Source Behavioral & Social Sciences Research, n. d.). It may also be useful to rate the extent to which care met patient expectations, but it is important to recognize that high satisfaction does not necessarily imply high quality (e-Source Behavioral & Social Sciences Research, n. d.). Even though HIT has the potential to transform the delivery of health care effectively and efficiently, health organizations continue to lack in this area.

A health organization has often been treated like a manufacturer who is advised that using cheaper materials can reduce manufacturing costs. The end result is that the manufacturer saves money on manufacturing costs but at the same time defects are accumulating and the results are subpar products. As we relate this to health organizations the ill effects of these short cuts are not externally evident, the health organization gives poor service or makes errors. Ultimately, health organizations fail in any of the countless ways in which organizations fail when they are poorly sustained. When health organizations operate inefficiently without proper funding, the odds become stacked against them.

Stakeholders will be described as individuals, affected continually in the health care administration, processes, and accompanying actions associated with its realism (Li, 2015). The effects may be through providers, employers, patients, and payers either in direct or indirect, including the populations where the health care facilities are located (Li, 2015). Those in the health care arena have a duty to cogitate the desires and anticipations of its stakeholders (Li, 2015). Managing stakeholder expectations is a method perturbed with cultivating project performance by sustaining the requirement of all stakeholders with applicable communiqué for every stakeholder requirements and problem perseverance when required (Project Management Lexicon, 2015).

Several other studies suggest that the adoption of HIT remains limited in certain functions (Poon, Jha, Christino, Honour, Fernandopulle, Middleton, & Kaushal, 2006). There have been limited studies conducted to determine which functionalities of HITs need implementation. Most studies concentrated on certain functionalities such as Computer Provider Order Entry (CPOE) or Electronic Health Record (EHR). CPOE is a set of clinical processes that incorporate technology to optimize physician ordering of medication and other required laboratory testing (Ormond, 2005). During a study by Minnesota Orthopedics Specialist, it was realized that vendor and local support during implementation was critical for success (O'Neill, 2007).

EHR is "related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization" (U.S. Department of Health and Human Services, 2008, p. 17). This definition has been updated to include a digital collection of patient health information compiled at one or more meetings in any care delivery setting and is often used to refer to the software platform that manages patient records maintained by a hospital or medical practice (Health IT News, 2013).

This leads us to look at the internal and external change. This is imperative for the change process and implementation of HIT. The internal reaction to change is the key point of discovery that requires learning something new, not just the acquisition of knowledge (Cameron & Green, 2004). Over time health organization management has avoided mentioning patient care and patient-related quality issues in either

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a positive or a negative framework. Many administrators appeared to focus more on central management than on clinical operations. In doing so, they have missed opportunities to engage patients and families as allies, document patient satisfaction and positive social work outcomes, and identify systemic patient care problems. The Greek Philosopher Heraclitus said that "no man ever steps in the same river twice, for it's not the same river and he's not the same man" (BrainyMedia.com, 2009, para. 1). Some interpret that the river is the external world. The external world is ever changing; the "river" is never the same. Another way to interpret this is that the "man" who stepped in the river today is not the same "man" that steps in the river tomorrow due to change, evolution, or experience that relate to external facts and figures (Cameron & Green, 2004). Technology changes rapidly and maintaining the status quo, actually means falling behind, and health organizations cannot afford to do that in our technology-driven world.

Change will not vanish or disperse. Technology, civilization, and creative thought will maintain an increasing force forward. The pace of change has significantly increased since the days of the cave dweller who walked the earth until the "technology convergence" to the ox and horse. The world may not be spinning faster, however the people are (Patton & James, 2000). This article will investigate the background, controversies, and problems surrounding Health Information Technology Change and Quality Management, including an overview of benefits of implementation and strategies. This will be coupled with solutions and recommendations, further research and a conclusion.

BACKGROUND

Information Technology (IT) is a term that denotes the processing of data using a computer; the use of technologies electronically from computing, telecommunications, and the allocation of information in digital and other forms (Encarta® World English Dictionary, 2007). Specifically, it refers to the products, methods, inventions, and principles that are used to produce information (Kroenke, 2008). Information Systems (IS) is a term that denotes gathering of hardware, software, data, procedures, and masses that produce information (Kroenke, 2008). The American Hospital Association in 2006 conducted a survey acknowledging numerous barriers to HIT adoption. Initial costs (94%) and continuing costs (87%) were the most commonly reported barriers. Clinician acceptance (82%) and lack of interoperability with current systems (79%) also ranked lofty. To tackle the issue of interoperability, the U.S. Department of Health and Human Services (HHS) contracted with the Certification Commission for HealthCare Information Technology to certify HIT systems that meet standards for interoperability, functionality and security (Certification Commission for Health Information Technology, 2013).

The intricacy in measuring quality derives from cracks in our understanding concerning diagnosis plans, for which patients, which really increase the probability of anticipated health outcomes. Additionally, patients do not have to have the same anticipated health outcomes, resulting in changes in care for identical health problem, supplementary obscuring the measurement of quality of care. Quality measurement has progressed significantly, but it rests primary in its early development stage. The conceptual framework commonly pragmatic in evaluating quality derives from eons of research and the insightful analysis of Avedis Donabedian (Steinwachs & Hughes, 2008). The Doanbedian conceptual model for describing, analyzing, and evaluating the quality of care using three dimensions: (1) structure, (2) process, and (3) outcome (Steinwachs & Hughes, 2008). This model is useful in the assessment of health services and the accreditation of health care providers and organizations. HSR research tools can be useful in

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scientific settings to increase clinical preparation and patient outcomes. These tools are used as part of quality improvement programs in hospitals, clinics, and health plans (Steinwachs & Hughes, 2008).

According to Nelson (2014) the ethical framework for Quality Improvement (QI) is based on the premise "to protect patients and foster the integrity of the organization" (p. 2) ensured by health care leaders. This ethical framework is very broad and leaves a lot to be desired. For example, foster the integrity of the organization can come down to a moral or ethical decision of the individual health organization. It is known that administrators must admit their part in affecting organizational ethics and grasp this chance to generate an environment that can reinforce the relationships and reputations on which their health organization exist (Paine, 1994). QI involves methodical and continuous activities that lead to calculable progression in health care services and the health status of targeted patient sets (U.S. Department of Health and Human Services Health Resources and Service Administration [HRSA], n.d.) The Institute of Medicine's (IOM) expresses quality in health care as an uninterrupted connection among the level of improved health services and the sought after health outcomes of individuals and populations (HRSA, n.d.).

HEALTH INFORMATION TECHNOLOGY AND QUALITY MANAGEMENT CONTROVERSIES AND PROBLEMS

Medical errors are an enormous cause of the defective medical model in use today needing a frantic renovation (Shanafelt, Boone, Tan, Dyrbye, Sotile, Satele, West, Sloan, & Oreskovich, 2012). According to Shanafelt, Boone, Tan, et al., (2012) the bulk of health care givers witnessing errors made by their peers, seldom do anything to contest them. The field of health care is tremendously meaningful and the same time difficult and nerve-racking. An extensive percentage of American health care providers undergo burnout on the job, according to a 2012 study published in the Archives of Internal Medicine (Shanafelt, Boone, Tan, et al., 2012). Specialists appear to be at the utmost risk, when function in front line care (Shanafelt, Boone, Tan, et al., 2012). Shanafelt, Boone, Tan, et al. (2012) suggest burnout may wear down professionalism, effect quality of care, and escalate the risk of medical errors.

The countless estimates on medical errors point out numerous failures of the U. S. Health Care System (Andel, Davidow, Hollander, & Moreno, 2012). Quality and patient safety have traditionally been an ancillary issue for the majority of the nation's hospitals (Andel, Davidow, Hollander, & Moreno, 2012). Life cycles for equipment are being prolonged as health organizations try to limit or cancel plans to purchase costly new technology. As health organizations look to cut cost with bulk medication, new purchasing processes denote acquiring of multi-dose medications instead of single dose vials and syringes. This has enlarged the number of medication errors (Andel, Davidow, Hollander, & Moreno, 2012). The Medicare program is paying for services health care providers charge, including the provider errors (Andel, Davidow, Hollander, & Moreno, 2012). Although there is no conclusive confirmation that the recent recession is having an influence on health care quality and patient safety, it may be having a negative effect (Andel, Davidow, Hollander, & Moreno, 2012).

The advantages of involuntary reporting include direct surveillance of providers and chart evaluation using initiate tools (Agency for Healthcare Research and Quality [AHRQ], 2014). Involuntary reporting remains a prominent foundation of information because they are normally readily accessible; it is frequently probable to attain thorough accounts of what went wrong (Murff, Patel, Hripcsak, & Bateset,

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2003). The limitations of voluntary reporting are there not set procedures to review records. For example, in the studies the data was provided by a two-step review process (Murff, Patel, Hripcsak, & Bateset, 2003). If the health care provider's reviewers differ on if an adverse event occurred, the health care providers will try to come to an agreement or involve a third party (Murff, Patel, Hripcsak, & Bateset, 2003). Typically, only a minute portion of the charts are reviewed independently by two health care providers (Murff et al., 2003). Notwithstanding the effectiveness of voluntary reporting systems in other industries, voluntary reporting in health care has been relatively ineffective (Murff, Patel, Hripcsak, & Bateset, 2003).

Is it possible the medical industry has adopted HIT for financial gain through organizational efficiency more so than with patient-centered HITs being the secondary factor? There is some evidence that health organization fiscal accountability's "survival" mentality has the potential to compromise medical treatment and commitment to organizational efficiency at the expense of patients and their families (Mizrahi & Berger, 2005). Management is not exclusively looking for ways of maximizing production and transaction costs. Some organizations want to ensure they remain competitive and survive in the long term.

In their struggle to obtain legitimacy, organizations adjust to society according to a collective rationalization. As a result, institutionalized activities are durable, socially accepted, unwilling to change, and their survival is not directly linked to rewards or control (Ouedraogo, 2007). In a motionless flow organizations have a tendency to become complacent (Elearn Limited, Pergamon Flexible Learning, 2005). The need to confront this organizational complacency can be one of the major triggers for change. Working any length of time has shown the rate of change is increasing. For example, the huge change of Health Organizations in 2001 was compressed in a shorter amount of time. Table 1 is from Elearn Limited, Pergamon Flexible Learning (2005). Credit is also given to Grundy (1995) for the source of the information.

Organizations base change strategies on the past three to five years. The important issue is to base change strategies on the future and new recipes to combat change. Adapted from *Change Management,* by Elearn Limited, Pergamon Flexible Learning, 2005; and from *Breakthrough for Growth,* by A. N. Grundy, 2005. Table 2 illustrates how much organizations change over time in sweeping environments (Elearn Limited, Pergamon Flexible Learning, 2005). Credit is also given to Lynch (2000) from which the information was adapted.

The worst thing that organization's management can do is allow their ego to step into the driver's seat and dictate their responses by clinging to old methods without considering new ones. Not only will they be ineffective, they will look irrational in the process or weaken the organization (Nicholson, 2009). When it comes to managing change, research is the best solution. Do not manipulate the data to fit an

Table 1. Change recipes: Recipes refers to the established ways an organization anticipates and responds to change

Time	Past	Old markets, receipts, and competition
	Change	
	Present	Current markets, receipts, and competition
	Change	
	Future	Unfolding markets, new recipes, and future competition

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Table 2. Heatlh organzations objectives and strategies shift. Adapted from Change Management, by Elearn Limited, Pergamon Flexible Learning, 2005; and adapted from Corporate Strategy, by R. Lynch, 2000.

Period	Company Objectives	Management Priorities
Early to mid 1990s	Grow and maintain market dominance in health markets	Invest in Health Organization brand Increase service levels Launch regular new practices
Late 1980s to early 1990s	Survive the threat from competitors	Major cutbacks in cost base Divest nonessential parts of the organization
Mid 1990s and future	Restart growth	Acquire new Heath Organizations Diversify into software and services, leading to HIT

intended agenda. The point is to work with the research data as objectively as possible. One approach by Katie Delahaye Paine describes the steps of effective research measurement as redefining measures of success: experiment, listen, measure, and learn (Nicholson, 2009).

According to Clarke and Donaldson (n.d.) a system overload is unavoidable. Restrained demand from those waiting for a promise of "free" or heavily subsidized services is expected. Health care professionals want to help people in need, but the sheer logistics of extended care delivery, the current and growing shortage of personnel, and limited resources will challenge the intentions of the policymakers who constructed the national health law. Reports have begun documenting a new, unprecedented shortage of nurses linked to growing demand for services, as well as drops in graduations from nursing education programs (Clarke & Donaldson, n.d.).

The "transformational" changes touted by the law's champions will likely complicate and negatively affect health care workers and their ability to provide care. These changes will increase regulatory burdens, increase already heavy workloads, reduce payments, impose new penalties, and disregard personal preferences and values (Anderson, 2014). Change does not happen overnight and there will be some tremulous times.

The effect of managed care on quality of care has been problematic to assess, at least in part, because of the difficulty in reaching a common understanding of how quality should be measured. Quality has been defined as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge (Silberman & James, 2000). The definition of quality varies based on personal perspective, background, culture, and individual need. Regardless of definition, quality is demanded and oftentimes not provided. Many view quality health care as the predominant authority under which patient safety resides. For example, the IOM considers patient safety "indistinguishable from the delivery of quality health care." Ancient philosophers such as Aristotle and Plato considered quality and its attributes (Mitchel, n.d.).

At first, IOM defined quality as the point at which health services for the society increase the likelihood of desired health outcomes and are consistent with professional knowledge (Mitchel, n.d.). This was transformed into to a definition of quality that appeared to be listings of quality indicators, which are terminologies of the standards. These standards are not necessarily in terms of the possibilities or conceptual clusters for these indicators. These clusters of quality indicators were and often continue to be comprised of the 5D's, which are death, disease, disability, discomfort, and dissatisfaction, rather than more positive components of quality (Mitchel, n.d.). This is a starting part and the 5 D's are better than nothing at all. This definition will be transformed again in the future.

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A framework accentuates analysis of the voluntary reporting and detailing progression improvements ascending from analysis, rather than inspiring voluntary reporting for its own sake (AHRQ, 2014). When there is no data and metrics, there is no reference point to know how the health care organization is doing, not knowing how health care organizations compare to each other (Healthcare IT News, 2014). There is no way to judge whether health care organizations strategies are making a difference (Healthcare IT News, 2014).

OVERVIEW OF CURRENT CHANGES

The iron triangle of health care includes access, cost, and quality. All of them are dependent on each other. Likewise, altering one variable affects the remaining two. Computers had a parallel start progressing from a product only available to a few (due to cost and difficulty of the systems) to where computers are affordable, universal, simple to use, and of even better quality than the past (Liu, 2012). The important issue is that it took many years before computers became more affordable, powerful, and accessible (Liu, 2012). Now they have evolved in the forms of laptops, netbooks, and now smartphones and tablets. In the future health care will break the iron triangle and demonstrate that it is not a law but an observation (Liu, 2012). If a debate is started over which one is more important, there is no gain. When one is altered, it inevitably alters the others. The health care triangle is a series of relationship that exist together such as doctor, nurse, and clerical. One cannot function or complete their task without the other. Hopefully, in years to come these computer programs will lead to affordable, universal, and quality for HIT and health care overall.

BENEFITS OF IMPLEMENTATION

Health care expenditures have amplified dramatically during the past fifty years, mutually in total terms and as a share of Gross Domestic Product (GDP) (White House ERP, 2013). Expenditures in the U.S. health care segment computed over $2.7 trillion in 2011, increasing from up the $698.3 billion expended in 1980, increasing by a factor of 3.9. Health care expenditure in 2011 attributed for 17.9 percent of GDP, resulting in doubling of the shares from 1980 (White House ERP, 2013). These expenditures have led to Quality Management for Health Care System to make available a structure to aid health organizations in, communicating, monitoring, and incessantly advancing the whole health care delivery system (James, n.d.). At this point the nationwide atmosphere must utilize an extremely designed method in the quest for quality management (James, n. d.). This has resulted in indications that back the suggestion that a systematized system to achieve high quality care can be front-runner to lower health care costs (James, n.d.).

Health care organizations as a whole spend vastly on information technology, nevertheless the declared progress in patient safety and efficiency have not been recognized (Healthcare IT News, 2014). One of the more substantial problems concerning medical errors encompasses wasted and late diagnoses (Healthcare IT News, 2014). For example, inadequate ordering of appropriate tests or initiate return visits (Healthcare IT News, 2014). One purpose of this chapter is to first discuss why preventable medical errors are still a problem in the U. S. almost 20 years later after a 1999 report titled *To Err is Human*, which estimated that between 44,000 and 98,000 Americans died in 1997 as a result of preventable medical errors (Institute of Medicine, 1999).

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SOLUTIONS AND RECOMMENDATIONS

Health Informatics (HIs) experts in a Delphi study ranked Business Process Reengineering (BPR) as one of the top research priorities for HI (Bliemel & Hassanein, 2004). The RAND Corporation developed the Delphi Method to forecast the impact of technology on business (RAND, 2014). The Delphi method surveys the opinions of "expert panels." The research is conducted in three rounds, where the information is gathered, refined, and then fed back to the expert participants. The feedback stage allows issues to be sharpened and helps to highlight the major issues involved. Round one involves an in-house panel that seeks to identify the research questions for the experts. It also conducts a pre-test of the survey. The second round involves an examination of the issues by the expert panel. At this stage, additional items are often suggested that may have been overlooked. The panel responses and additional items are combined to the original questionnaire. In the third round, the panel makes judgments on the items. This sometimes takes the form of a multiple-choice questionnaire.

The goal is to come up with an expert consensus by reducing the range of responses (RAND, 2014). The results showed a process-oriented healthcare industry would benefit from BPR. BPR involves several organizational improvements that are enabled by electronic patient records and an inter-operating system (Bliemel & Hassanein, 2004). In which the focus is on achieving specific performance targets such as specific profit margins, clinical outcomes, quality improvements, or customer satisfaction. A health organization's balanced-scorecard reports will indicate whether the organization is managing with acceptable results and provide a basis for assessing their managers' performances and their roles in the organization's success (Mizrahi & Berger, 2005). The growth and maturity of informatics has been a prime catalyst in positioning the health care industry for change. The Patient Protection and Affordable Care Act (PPACA) for instance, which puts in place comprehensive health insurance reforms that will roll out over four years and beyond (U.S. Department of Health and Human Services, 2013).

During the implementation of reform, informatics will serve as the foundation for all aspects of successful healthcare reform initiatives (Health IT News, 2013). Changeability addresses the positive question of what makes people and organizations good, and their ability to manage for the future. In tentative times, pressure for alteration is greater than ever (Cree, 2009). High performance health organizations compete on their ability to identify up-and-coming threats and opportunities, and to respond to them swiftly with well-informed decisions. The development of networks of longitudinal, comprehensive, and interoperable HIT offers opportunities for improving coordination of care and the usefulness of records, increasing competence of health care, and avoiding duplication of services (Leavitt, 2007).

These decisions must encompass business analytics. By understanding the process of analytics, healthcare providers have the insight necessary to make process adjustments in the future. To make excellent managerial decisions companies need access to information that encompasses not only company performance but also the broader competitive landscape (CFO Publishing Corporation, 2009). Informatics can increase options for treatments, reduce risks, improve processes, help with financial management, and ultimately improve patient care. It requires having the people, data, technologies, and processes necessary to mine the information and act upon it.

The Delphi study also identified electronic patient records and connected inter-operating systems as urgent research priorities (Bliemel & Hassanein, 2004). Having a physician or physicians who are passionate about the HIT is critical. The physicians who are salaried and committed to the HIT and clinical systems, is critical for success (Amatayakul & Hodges, 2006). The acquisition of new hardware and

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software has the possibility to enhance a health care organization's potential to provide high-quality, cost-effective patient care.

Management must commit to open and honest disclosures of facts that not only help people understand the rationale for change, but also how it affects and benefits the organization (Nicholson, 2009). It is important for administrators to function well at three levels: the hospital/macro level, the internal (department or program) level, and the external/community level. They need to cultivate other staff leaders, redesign functions, prioritize goals, and promote internal communication to create a sense of professional pride and collective ownership (Mizrahi & Berger, 2005). These leaders need support from other leaders and from the professional and academic resources of major institutions to make their case. They must develop mutually supportive staff-driven activities, mechanisms to share information, ideas, resources about best practices, survival models, and methods of reorganizing roles and functions within and between hospital systems (Mizrahi & Berger, 2005). To compete effectively, health organizations must look beyond improving operating efficiency to improving their processes for managing performance (CFO Publishing Corporation, 2009).

To maintain cost, accountability, and fairness there should be a national standard of rate by the National Association of Insurance Commissioners (NAIC) to look into areas such as:

1. A definition of "rate filing" that includes new and renewed premium rates, any proposed rating formula, classification of risks, or modification of any formula or classification of risks;
2. A standard of review that places the burden of proof on the health insurance issuer to demonstrate that the proposed;
3. Ensuring that rate filing is not unreasonable, unnecessary, inadequate, or unfairly discriminatory (National Association of Insurance Commissioners [NAIC], 2010).

While, America's Health Agenda focused on these areas of concern to maintain cost, accountability, and fairness:

1. The implementation of electronic health claims, premium payments, referral authorizations by 2016;
2. The formation of a National Prevention, Wellness, and Public Health Council charged with developing a national strategy to improve the nation's health;
3. The creation of a grant program to support the delivery of evidence-based and community-based prevention and wellness services aimed at strengthening prevention activities (America's Agenda: Health Care for All, n. d.).

Touting these changes as being instrumental in reducing chronic disease rates and addressing health disparities, especially in rural and border areas (America's Agenda: Health Care for All, n.d.). This funding will support primary care training and capacity building. The development of training programs that focuses on primary care models such as medical homes and team management of chronic diseases (America's Agenda: Health Care for All, n.d.).

Public Health Institutes (PHIs) are nonprofit organizations that increase the public's health by modernizing, leveraging resources, and building partnerships across sectors including government agencies, communities, the health care delivery system, media, and academia (National Network of Public Health Institutes, 2010). Health System Strengthening (HSS) has become a major focus of the U.S. (Bloland,

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Simone, Burkholder, Slutsker, & De Cock, 2012). The Role of Public Health Institutions in Global Health System Strengthening is critical for achieving major health goals in preventive care in the community.

The American Public Health Association (APHA) has created building blocks for the health infrastructure to gain funding for local, county, and city public health agencies to ensure that the health system is assessing and responding to public health needs for preventive care (American College of Physicians, 2012). Adequate, steady funding streams for the development and maintenance of local programs and activities are fundamental for the successful achievement of the goals of public health in the community. Funding by the government enables public health providers' access to resources that private clinicians may not have.

Health care can be provided through public and private providers. Public health care is usually provided by the government through national healthcare systems. Private health care can be provided through "for profit" hospitals and self-employed practitioners, and "not for profit" non-government providers including faith-based organizations (Basu, Andrews, Kishore, Panjabi, & Stuckler, 2012). Creating maintainable, operational linkages between the clinical and community settings can improve patients' access to preventive and chronic care amenities by developing partnerships between organizations that share a common goal of improving the health of people and the communities (AHRQ, 2014).

Table 3 is factors that lead to the requirement to implement health authorities' interconnection infrastructure. These factors may also be seen as the targets that are, and will be, accomplished. The table constitutes the functional requirements for the network infrastructure and evolving reformation and of current advances in the field of data communications. These factors include areas such as:

Table 3. Benefits of using information and communication technologies in the health care sector. From Implementation and Integration of Regional Health Care Data Networks in the Hellenic National Health Service, by Lampsas, Vidalis, Papanikolaou, & Vagelatos (2002).

Health Care Players	Benefits
Administration units	Policy development and decision-making are strongly supported by effective and on-time information gathering and distribution. Easier adaptation to eEurope challenges. Supply control; better budget monitoring. Overall improvement in the way citizens are served.
Hospitals	Increased efficiency in communication between hospitals, administration units, social security services, careers, physicians, and citizens. Personnel familiarization with information technologies through Internet-access operations. Patient-record traffic support. Reinforcement of the need to build Health Care Information Systems (HCISs) and local networks in hospitals. Utilization of the developed Intranets. Better information services for the citizens. Advanced telematics services (e.g., telemedicine applications in difficult-to-reach regions).
Health care personnel	Meets the increased need for telecommunications not only for medical, but also for compensation reasons. Participation in care chains and relevant coordination. Physicians' collaboration. Patients' history data retrieval. Continuing education services; familiarization with new technologies through special training programs. Interaction with patients to provide advice or prescriptions.
Citizens	Use of the Internet for health-related information retrieval. Information and communication technologies will increase interest in citizens' health-issues management. Creation of the appropriate infrastructure for future provision of special health services for specific population groups (e.g., in-house services for older people or patients with long-lasting attendance and nursing needs).

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1. The regional structure of the administration services;
2. The treelike managerial structure of the health care units;
3. The active participation of general practitioners in the new system;
4. The need for transmission of sensitive EHR information and for interconnection with private pharmacies and the insurance system in the years to come;
5. The successive advances in Internet technologies (Lampsas, Vidalis, Papanikolaou, & Vagelatos, 2002).

One of the fastest ways to prove the return on investment from Lean or Six Sigma is to place emphasis on the elimination of waste from operations. Six Sigma is about those "critical few" variables that drive process performance, Lean is about the "trivial many." Targeted initiatives such as the popular "5S" method have been credited with making significant improvements in the efficiency of the workplace by attacking the low hanging fruit or the trivial many in waste reduction (Lazarus, 2012). 5S is a method for organizing a workplace to maximize efficiency. The 5 steps, undertaken in order, according to Lazarus (2012):

1. **Sort:** Set aside all work-related tools for categorization and possible relocation;
2. **Set in Order:** Decide which tools are needed daily, weekly, monthly or less often. Organize the proximity of tools based on frequency of use;
3. **Shine:** Ensure workplace is sterile with adequate visual controls to support rapid identification of where resources are and how they are to be used;
4. **Standardize:** Leverage this work across the entire workspace. Use one workstation as a prototype, replicate, or expand. Use this as an opportunity to standardize all supplies and tools;
5. **Sustain:** Delegate ongoing responsibility for maintaining order. Post pictures to support rapid identification if any aspect of the organization effort has been compromised (Para 8).

Many healthcare organizations have added a 6th "S" for member "Safety" (Lazarus, 2012). Table 4 is a checklist for the prescription of a Robust Lean/Six Sigma Program, this shows what is needed to make Lean/Six Sigma Program successful, information.

Table 4. Checklist: Prescription for a robust lean/six sigma program, obtained from Lazarus (2012) para 6

Staff trained in both Lean and Six Sigma methods
Establish Return On Investment (ROI) expectations from portfolio of projects
Sponsor training for senior management
Visibility across enterprise for program and its achievements
Celebration and recognition for completed projects and project leaders
Implement formal handoff from project leader to process owner
Continue running control charts on all completed projects
Implement specification limits that identify if performance has regressed
Create governance for program to approve new projects
Communicate expectations for staff to complete at least one project annually (more if the staff are dedicated to performance improvement)

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FURTHER RESEARCH

There should be further research on health organization in other countries such as the Canadian Health Care System, which is increasing their use of health technology assessment organizations including the Canadian Agency for Drugs and Technologies in Health (CADTH, a national body) and specialized provincial agencies in Alberta, Ontario, and Quebec. The organizations support and inform purchasing decisions, service management, and clinical practice (Thomson, Osborn, Squires, & Jun, 2013). The Danish Health Care System's 2007 structural reform centralized the administration of hospital care in order to enhance the coordination of service delivery and to improve quality and efficiency. They merged 14 counties to create five regions and reduced the number of municipalities from 275 to 98. The regions are currently reorganizing their hospital systems, closing or combining small hospitals, and building new hospital infrastructures (Thomson, Osborn, Squires, & Jun 2013).

The English Health Care System Clinical Commissioning Groups (CCGs) are replacing Primary Care Trusts as local health care purchasing organizations, introducing the National Health Service (NHS) Health and Social Care Act 2012. This allowed the NHS in England to take over day-to-day responsibility, and expanding the NHS into a role of Monitor to act as the economic regulator of public and private providers. The National Institute for Health and Clinical Excellence (NICE) sets guidelines for the NHS on clinically effective treatments, and appraises new health technologies for their efficacy and cost-effectiveness (Thomson, Osborn, Squires, & Jun 2013).

In the French Health Care System, the National Support Agency for the Performance of Health and Medico-Social Facilities provides guidance to institutions in need of structural changes and performance audits, and publishes dashboard indicators such as length of stay, occupancy, patient satisfaction, and incidence of bedsores. That is classified by category and type of medical activity. It is the only such public body in Europe. The Biomedicine Agency operates in four key areas:

1. Assisted reproductive technologies;
2. Prenatal and genetic diagnosis;
3. Embryo and stem cell research;
4. Procurement and transplant of organs, tissues, and cells (Thomson, Osborn, Squires, & Jun, 2013).

Moreover, research should be continued in the area of informatics. For example, the Supporting LIFE Project cultivates a low-cost implementation with extraordinary impact on the control of infectious diseases in Malawi (Department of Informatics, 2014). This is example of ongoing research projects by the Department of Informatics Lund University School of Economics and Management. This type of research will determine if informatics has the ability for organizations to understand their risk and cost profiles while ensuring the best care for patients. In conjunction with this research there should be a focus on health organizations' inequities, such as geographies and finances.

Computer networking opens many avenues to effective communication and collaboration amongst health care providers and organizations in the coordination and delivery of patient care (Ponemon Institute, 2014). For example, the increasing use of smartphones of today's society and the advancement of the Accountable Care Organization (ACO) model allows for the chance to update and revolutionize outdated communication in health care (Ponemon Institute, 2014).

Ponemon Institute (2014) study found three areas of opportunity that can be improved with communication and collaboration:

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1. **Patient Admission:** Admitting one patient takes about 51 minutes, of which an average of 33 minutes (65 percent) is wasted due to inefficient communications. This translates into an annual loss of about $728,000 per U.S. hospital;
2. **Emergency Response Coordination:** Coordinating an emergency response team takes an average of 93 minutes per patient. Of this time, an average of 40 minutes (43 percent) is wasted due to inefficient communications. This equates to an annual loss of more than $265,000 per U.S. hospital;
3. **Patient Transfer:** Transferring a patient to another facility or home care/hospice takes about 56 minutes, of which an average of 35 minutes (63 percent) is wasted due to inefficient communications. The total annual cost of this waste is about $754,000 per U.S. hospital (p. 2).

CONCLUSION

This article investigated the background, controversies, and problems surrounding Health Information Technology and Quality Management. An overview of current changes, benefits of implementation, solutions and recommendations, and further research rounded out the article. One universally accepted truth in organizations is the unavoidability of change. Another is that few organizations achieve the benefits they should due to not adequately planning change. This leads to the old adage organizations do not plan to fail, they fail to plan for change. Hospital boards approve millions of dollars for software, hardware, and consultants, but frequently the new positions required to build an effective team are not included in the approved budget. Numerous reports have indicated the importance of HIT. The question still remains as to how implementation will happen on a consistent level.

Change management, process and workflow improvement, comprehensive training, user support, and system ownership are all perilously important to HIT success, and therefore require funding. Informatics will allow organizations to understand their risk and cost profiles while ensuring the best care for patients. Informatics can be used across the broad spectrum of healthcare and is not limited to decision support functions. Management tools and techniques will help health organizations, if they hold their managers accountable for achieving targeted results. Effective communication of a well-deliberated plan is at the foundation of the management of employees during times of change.

Quality is a topic of concern among all health care organizations. Patients expect a high quality of care. Providers are scrutinized for the level of care offered. Health care professionals such as physicians take the Hippocratic Oath, swearing to uphold specific ethical standards. This includes treating the ill to the best of one's ability, preserving patient's privacy, and teaching the secrets of medicine to the next generation (Medical Net.com, 2014). However, as with most cases, money becomes a driving force with the marketing and targeting of the pharmaceutical companies to market their medications. It is easy for a health care professional to forget the main focus of quality care. Even payers are assessing the levels of quality present (or absent) among health care organizations.

An integrated program of change that allows for the incorporation Business Informatics (BI) or Health Business Informatics (HBI), Health Informatics (HI), Nursing Informatics, or simply "Informatics" is essential. Renovating care into quality care is the core of the clinical environment, and nurse leaders need to recognize the importance of emerging technologies (McHaney, n. d.). Nurse leaders should become involved in planning, designing, developing, implementing, and evaluating networks that will be used by nurses. This has led to a specialty area that integrates sciences of nursing, computer, and information called Nursing Informatics (McHaney, n. d.). This specialty area provides expertise in developing and

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implementing Information Management Systems (IMSs) that can be used by nurses to enhance daily tasks and integrate various aspects of patient care. These techniques are used to seamlessly integrate technology and information that may be located within a geographical area or even across international boundaries (McHaney, n.d.).

Reforms have the ability to save money and lives in the long run. The future is dependent on programs such as the Inner City Health Clinics (ICHC), launched by the Patient Protection and Affordable Care Act (PPACA) (Frykholm & Kennel-Shank, 2014). The Act included $11 billion in new funds for clinics that serve neighborhoods where access to medical care is limited and many people are uninsured or underinsured. The expansion of community health centers is especially important in the 25 states that have accepted the expansion of Medicaid to people with incomes up to 133% of the federal poverty income level. The new term that will be used is "conduit to care." When someone is identified through a screening as having a health problem, that person may be reluctant to follow up with a doctor. ICHC's outreach workers provide the follow up contact (Frykholm & Kennel-Shank, 2014). This approach is crucial to reaching people before their health problems get out of control. This is the kind of life-saving and cost-saving method that healthcare reform needs to thrive in the future. Telemedicine is also on the rise and has the opportunity to provide new cost-effective and efficient methods of delivering health care across geographical distances (Gupta & Saot, 2011). The overall benefit is tremendous; many consumers who never had insurance finally have access to it, or better coverage. The question that remains is whether the changes by the PPACA will force acute care organizations to integrate vertically with post-acute care providers (Shay & Mick, 2013).

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Chapter 18
Twitter and Its Role in Health Information Dissemination:
Analysis of the Micro-Blog Posts of Health-Related Organisations

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ABSTRACT

The utilization of micro-blog-based systems for the dissemination of health-related information offers a number of potential benefits. In this chapter, the authors describe a study of such micro-blog-based dissemination of health information by Australian health-related organisations through the manual categorization of over 4,700 tweets posted during a defined sample period. These tweets were analysed in relation to the sector of the tweeting organisation, health condition area, type of information in the micro-blog post, and level of retweeting. The particular category of public health-related tweets is also analysed in greater detail. This chapter differs from previous health and Twitter-related studies in that it: 1) seeks to characterize the overall and relative Twitter activity of health-related organisations for the sector across a whole nation, rather than collecting a sample matching a specific keyword or health condition; and 2) carries out a more semantically deep analysis of the content of those tweets, hence the manual analysis-based methodology adopted.

INTRODUCTION

Health information dissemination has undergone significant changes due to various technological advances. From originally being delivered through the use of posters, bulletin boards and newspaper articles as public health announcements, to dissemination via current traditional mass media (e.g. television, radio) and increasingly now by online means with the rapid uptake of the Internet. Contemporarily, with

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the introduction and mass-adoption of social networking services (SNSs) by a significant proportion of online users, there are now additional and potentially powerful means of health information dissemination (Steele, 2011).

Twitter, a micro-blogging-based SNS with approximately 240 million active global users, contains useful features and characteristics such as: one-to-many interactions, 'up-to-the-minute' information dissemination, the ability of users to select accounts relevant for them to follow, and the capability of users to generate, receive and share information amongst themselves. This provides an efficient platform for potential Web-based information sharing and retrieval and Twitter can thus potentially aid in achieving the dissemination of health information. Recent reports by social media and marketing-based companies have found that Twitter currently has approximately 2.5 million monthly unique Australian visitors, and this number is rising rapidly (SocialMediaNews.com.au, 2014). The growing proportion of Internet users adopting Twitter, as well as the already widespread uptake of SNSs in Australia, indicates the significance of exploring this medium as a potential tool for health information dissemination.

This chapter will present a detailed overview of how Twitter is currently being used by health-related organisations in Australia, and the health conditions and types of health-related information that are being posted by different organisational sectors. Categorised health information mined from the sample of tweets is also further analysed for the purpose of exploring relationships between the types of disseminators and receivers of health information. The study aims to provide initial empirical data relevant to health organisation utilisation of social media for the health sector on a national scale, rather than necessarily across the entire 'Twittersphere'.

RELATED WORK

Due to the relatively recent introduction of health information-related micro-blogging, and the recent widespread national and global uptake of Twitter in general, the exploration of health and Twitter is still an emerging area of research. A previous health organisation-related study had found that of those public health department accounts within the US using social media, 86.7% had Twitter accounts (Thackeray, Neiger, Smith & Wagenen, 2012). The researchers of the study categorised tweets based on information presented, however they did not follow any links embedded within the tweets and thus did not analyse the information provided in the linked-to Web pages. This chapter will attempt to provide a deeper semantic analysis whereby micro-blog posts and the specific health conditions and types of information being conveyed will be explored and categorised according to both information presented in the tweet and the linked-to page indicated by any embedded URLs.

The tweeting and sharing of information on specific health conditions has also been explored in a number of works. Sullivan et al. (2012) analysed concussion-related tweets to investigate different themes (e.g. 'news', 'personal situation', 'inferred management') as well as to whom these types of information were being disseminated. Epilepsy-related information dissemination via Twitter has also been studied (Mcneil, Gordon & Brna, 2012), where researchers analysed and coded tweets into specific categories to describe the types of epilepsy-related information that was being tweeted. These studies added support that health information could be effectively disseminated via Twitter, but also found a minority of tweets sampled were actually informative in terms of health information. Other research articles have also examined Twitter and smoking cessation (Prochaska, Pechmann, Kim & Leonhardt, 2011), dental pain (Heaivilin, Gerbert, Page & Gibbs, 2011) and pharmaco-surveillance (Bian, Topaloglu & Yu,

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2012) - this again demonstrates that previous studies have tended to focus on specific health condition or health areas.

A previous cross-sectional study of SNS use amongst the Society for Assisted Reproductive Technology highlighted the growing influence of social media in relation to health-related issues and communication (Omurtag, Jimenez, Ratts, Odem & Cooper, 2012). Various clinics within the organisation had their online Websites evaluated and it was found that rather than consumers asking for information, health-related bodies were 'pushing' information through SNSs. This research also demonstrated that in addition to providing clinically relevant health information, SNSs included many other types of information such as 'advertising' (28%), 'support' (19%) and 'irrelevant chatter' (17%). Therefore it would be of interest to carry out similar categorisation and analysis on a more widespread social media platform, such as Twitter, to see if these information types are proportionally consistent.

The idea of influence or scale of dissemination on Twitter can be represented by the measure of how many times a tweet is retweeted, as well as the quantity of audience reached. Cha, Benevenuto and Gummandi (2010) found that Twitter accounts with large numbers of followers had many one-to-one interactions (i.e. mentions and replies), and retweeting was a more suitable way of representing influence of a user beyond a one-to-one interaction domain (i.e. broader community interaction and dissemination). Therefore, they suggested that the most influential users were those who had more of their tweets retweeted and mentioned, rather than judging the influence of an account based on the number of followers.

As mentioned, measuring the reach or dissemination of a micro-blog post or tweet can also involve identifying the retweeting accounts and their numbers of followers. Kwak, Lee, Park and Moon (2010) found from their dataset of 41.7 million user profiles and 106 million tweets, that any retweeted tweet reached an average of 1,000 users – regardless of the number of followers of the original tweeting account.

Whilst some of the studies mentioned have been carried out with non-health-related datasets, or were limited to specific health areas, our work will analyse health-related Twitter usage on a nation-wide basis and across all health topics. This work can be differentiated from previous work in that it analyses the use of micro-blogging across a whole sector (health in this case) for a country rather than selecting a particular narrower health area or topic and retrieving data corresponding to keywords matching that narrower area.

METHODOLOGY

Identifying Relevant Accounts

Accounts relevant to the study were found via a three-step method. With each step, identified accounts were examined to see if they met the inclusion criteria for our study (Table 1). First a search was conducted through the search function on the Twitter website (www.twitter.com) utilising health-related and appropriate keywords such as 'health', 'nutrition', 'cancer', 'Australia' etc. to find relevant accounts. The second step involved utilising the search engine Google (www.google.com) to identify additional relevant Twitter accounts that were not found from step one. Searches were performed using a combination of health-related keywords, for example the search 'dementia Australia Twitter' was entered into Google in an attempt to either uncover dementia-related Twitter accounts that were originally overlooked, or to ensure the search for relevant accounts was exhausted. In the third step, already identified accounts had their Twitter feeds and followers examined to uncover further relevant users that met the inclusion criteria.

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Table 1. Inclusion criteria

Inclusion Criteria	Definition
Nationality	Self declared home location is Australia or is a known or deducible to be Australian-based
Representativeness	Accounts represent government health bodies or other health organizations (with the link to a relevant website provided in account description)
Topic of account	The account pertains to health information, either generically or in relation to a specific condition
Content of tweets	Accounts must have at least one health-related tweet or provide links to health articles
Activity	Accounts are currently active, as we defined as having tweeted in the month of February 2012
Number of followers	The number of Twitter followers for any given account was set to a minimum of 150

When considering the various factors required for the identification and inclusion of Twitter accounts, the following factors were considered:

- The specific details of accounts to be identified (according to inclusion criteria),
- Broad topic areas of accounts (i.e. health-related),
- The owner of the account (i.e. what organisational sector they came from).

Categorising Health Tweets

Individual tweets were grouped and generalized according to similarities for 1) specific health-related conditions (Table 2) and 2) type of tweet identified (Table 3). The first form of categorisation undertaken was in relation to health condition areas - for example, condition-specific tweets about 'skin cancer advice' and 'breast cancer research' were categorised under the umbrella health condition area of 'cancer'. To provide another dimensional view of the collected data, health-related tweets were also categorised according to the type of tweet, independent of health condition area, that the tweet pertained to. Referring to the above example, tweets about 'skin cancer advice' were categorised as 'public health advice' and tweets about 'breast cancer research' were categorised as 'research and project' type tweets.

Requirement for Manual Tweet Analysis within Methodology

It was deemed that various Twitter analytics tools (e.g. Twitonomy, TweetStats) did not have capabilities that would fulfil the required account identification process (nor the subsequent data collection and deep semantic analysis requirements of collected tweets), and hence a manual approach was adopted throughout the data mining and analysis of this study (Dumbrell & Steele, 2013). The three-step manual methodology provided the process whereby a substantive sample of the current health-related organisational Twitter users meeting these criteria in Australia were identified and compiled.

We identified that current Twitter analytics tools did not provide the capabilities of categorising and semantically-analysing tweets based on complex concepts such as 'public health advice', 'infectious diseases-related' or 'fundraising' and as such, manual categorisation and analysis by a researcher was required. In general, current Twitter analytics tools cannot provide analysis of tweet content based on

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Table 2. Proportion of health condition-related areas of sector tweeting

	Gov (% of 388 Health Tweets)	FP (% of 1,071 Health Tweets)	NFP (% of 2,331 Health Tweets)	All Sectors (% of 3,790 Health Tweets)
Addictive substances	4.1%	2.4%	2.0%	2.3%
Allergies	0.0%	0.3%	0.1%	0.1%
Cancer	1.3%	5.0%	6.2%	5.4%
Children	0.0%	0.7%	0.2%	0.3%
Dental	0.8%	1.9%	0.3%	0.8%
Diabetes	1.0%	0.8%	2.6%	2.0%
Disability	0.0%	0.0%	2.1%	1.3%
Elderly	0.3%	1.0%	0.3%	0.5%
Gender				
Male	0.3%	0.1%	0.1%	0.1%
Female	0.0%	0.3%	0.0%	0.1%
Heart	0.3%	2.1%	1.2%	1.3%
Indigenous (general)	0.3%	0.7%	3.4%	2.3%
Infectious diseases	3.1%	1.0%	0.4%	0.8%
Injury	0.8%	1.1%	0.0%	0.4%
Lifestyle				
Fitness	3.9%	1.4%	0.4%	1.1%
Nutrition	11.6%	8.5%	3.7%	5.9%
Maternity	0.8%	2.8%	0.3%	1.1%
Mental health	7.5%	6.4%	9.4%	8.3%
Neurology / Geneology	0.0%	0.7%	0.4%	0.4%
Non-condition specific	59.5%	53.3%	58.1%	56.9%
Obesity	0.0%	0.8%	0.4%	0.5%
Organ donation	3.6%	0.5%	0.5%	0.8%
Osteoporosis / arthritis	0.0%	0.1%	0.9%	0.6%
Pharmaceutical	0.3%	4.5%	0.4%	1.6%
Renal / Kidney	0.0%	0.1%	0.9%	0.6%
Respiratory	0.0%	0.1%	0.3%	0.2%
Sexual	0.5%	1.1%	1.1%	1.1%
Sleep-related health	0.0%	0.7%	0.4%	0.4%
Vaccine	0.3%	1.3%	2.8%	2.1%
Vision	0.0%	0.1%	0.9%	0.6%
Total	100.0%	100.0%	100.0%	100.0%

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Table 3. Proportion of sector tweeting type

	Gov (% of 388 Health Tweets)	FP (% of 1,071 Health Tweets)	NFP (% of 2,331 Health Tweets)	All Sectors (% of 3,790 Health Tweets)
Advertising	0.0%	1.0%	0.5%	0.6%
Ambulance updates	19.3%	0.0%	0.0%	2.0%
Awareness	11.3%	22.3%	23.6%	22.0%
Competitions	4.1%	0.3%	2.0%	1.7%
Conferences & events	3.1%	3.5%	7.0%	5.6%
Fundraising	1.0%	2.1%	15.5%	10.2%
Funding	1.0%	0.7%	0.9%	0.9%
Insurance	0.8%	2.6%	1.8%	1.9%
Jobs & Career	1.8%	4.5%	3.6%	3.6%
Medical workforce	1.3%	6.1%	1.7%	2.9%
Motivation & support	2.1%	0.8%	1.8%	1.6%
Organisational news	6.7%	21.7%	17.0%	17.3%
Policy	3.9%	3.0%	0.9%	1.8%
Promotional	0.5%	3.5%	2.4%	2.5%
Public Health Advice	36.9%	21.1%	17.3%	20.4%
Research & Project	6.2%	6.6%	4.0%	5.0%
Total % contribution	10.2%	28.3%	61.5%	100.0%

concepts and semantics within the text of tweets. These analytics tools also do not contain the functionality to examine the Web pages linked-to by hyperlinks present in tweets, hence further necessitating the manual approach adopted.

GENERAL SECTOR CHARACTERISTICS

A total of 114 health-related Australian organisation Twitter accounts, meeting the inclusion criteria, were identified via the three-step process as described above. Three distinguishable organisational sectors were observed during the account identification process: government Twitter accounts, for-profit (FP) organisational accounts, and accounts that represented not-for-profit (NFP) organisations. The 114 identified accounts in the sample were thus categorised into these three sectors - it was found that there were 16 government, 27 FP and 71 NFP Twitter accounts present in the substantiative national sample for this study (Figure 1).

The characteristics of each Twitter account were also collected – such as the number of tweets, accounts followed and following accounts. For comparative purposes, these characteristics were analysed proportionate to the number of Twitter accounts identified for a certain sector (e.g. the mean number of followers for accounts in a sector was the total number of followers divided by the number of accounts identified in that sector). When taking this into consideration, it was found that government health-related accounts had 2,347-followers on average per account, the highest of the three sectors. NFP accounts had

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Figure 1. Proportion of different Australian health-related Twitter accounts identified

on average 1,975 followers per account, which was still a much higher average than compared to their FP counterparts that had the lowest number of followers on average, with a mean of 1,153 per account.

This low number of followers for FP accounts may be explained by a previous study (Sillence, Briggs, Harris & Fishwick, 2004) that had found Internet users to be more likely to reject sites they considered promotional or sales-based. Therefore, the reputation that FP organisations have (e.g. commercial, product-promotion) may make consumers less trusting of the information on their websites. . This may potentially be why FP Twitter accounts have a lower average number of followers than other sectors. In the sample of the 27 health-related FP organisation accounts, only 4.5% of tweets in the month of February were considered advertising or promotional-related. However, this was still the largest proportion of these tweet types when comparing to the NFP and government subsets

TWEETING CHARACTERISTICS BY ORGANISATIONAL SECTOR

A total of 4,787 tweets were found to have been posted from across the 114 identified accounts in the month of February 2012. Of these 4,787 tweets, 3,790 (79.2%) were categorised as health-related whilst the remaining 997 (20.8%) were non health-related. This is similar to results found for public health department Twitter accounts in the USA (Thackery et al., 2012). The tables below (Table 2 & 3) represent data that is the proportion of health-related tweets, and thus the analysis does not include the 997 non-health related tweets. As stated in the methodology section, these health-related tweets were looked at according to two separate dimensions and categorised into two separate tables – by health condition area (Table 2) and tweet type (Table 3).

When looking at health condition-related areas identified for the February 2012 sample period, it can be seen that a large proportion of these tweets were categorised under non-condition specific (i.e. developments in the particular health-related sectors without reference to a specific health condition, such as for example the progress of federal health reform). In absolute numbers there were 2,157 identified

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tweets from the sample that dealt with such health information in a general sense, rather than relating to a specific health condition. Tweets categorised under this group made up more than half (56.9%) of all health-related tweets in the sample.

Outside of the non condition-specific tweets, the top 3 largest contributions to the health-related tweet sample by far were those of mental health (8.3%), nutrition (5.9%) and cancer-related (5.4%) areas. In fact, the next highest represented health-related areas (addictive substances and Indigenous health, both at 2.3% each) were much lower in percentage than these top three health-specific areas.

When comparing the three sectors, we also found that there were differences in the amount of tweeting of certain health areas within each sector. Government accounts tweeted most frequently about lifestyle-related topics (nutrition: 11.6% and fitness: 3.9%), addictive substances (4.1%), organ donation (3.6%) and infectious diseases (3.1%). Interestingly, nutrition-related information was by far the highest specific health area tweeted about by government accounts, and was also the highest proportion when compared to other sectors. The relatively high dissemination of addictive substance-related tweets might be expected as government bodies are frequently rolling out national campaigns for awareness of issues such as binge drinking, drunk driving and the effects of illegal drug use. With regards to the area of infectious diseases, the government also undertakes initiatives to educate and warn people about new or rapidly spreading diseases (e.g. the swine flu pandemics). However in the case of the organ donation-related tweets, the tweet dataset was taken during DonateLife week, which occurs in February. This provides an example of how even samples taken from over a month may potentially still be influenced by specific events occurring at that time which may cause sampling bias.

Similarly to government accounts, FP organisational Twitter accounts tweeted significantly about nutrition (8.5%) and mental health (6.4%) related areas. FP organisations also tweeted a larger proportion of cancer-related tweets than government accounts (5.0%). Also interestingly when comparing to the other two sectors, FP accounts had by far the largest proportion of tweets in health areas that could be considered to have commercial and profitable aspects. One of the most tweeted about health-specific topics from FP accounts were those related to the pharmaceutical area, which comprised 4.5% of total health-related tweets by this sector. This far outweighed the proportion of pharmaceutical-related tweets posted by government (0.3%) and NFP (0.4%) organisations, thus showing that FP organisations may possibly be tweeting about health-related areas more specific to their business goals (e.g. advertising, sales, etc.).

NFP organisations had the highest proportion of mental health and cancer-related tweets, at 9.4% and 6.2% respectively. This sector also tweeted proportionately more about Indigenous health, as 3.4% of their health-related tweets came from this area. This percentage was much higher when compared to FP (0.7%) and government (0.3%) Twitter accounts. These results may suggest that government accounts could tweet more about Indigenous health as government bodies both recognise initiatives and often provide funding in this area. Another significant area of tweeting based around a target group from NFP accounts is the dissemination of disability-related information. This category appears to be under-represented when considering tweets from government and FP accounts (both 0.0%), however when examining NFP organisations it was found that tweets about the disability health-area made up 2.1% of the total health-related tweets from NFP accounts.

There were a relatively small number of tweets for some widespread and significant health conditions affecting Australia. The National Health Priority Areas (NHPAs) is an initiative by the Australian government that aims to identify health areas contributing significantly to the morbidity and mortality rates of the population. Asthma, arthritis and musculoskeletal conditions, injury prevention and control

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and obesity are four of the nine current NHPAs (Australian Institute of Health and Welfare, 2013) that are under-represented in the identified sample of health-related tweets. Asthma and respiratory disorders ranked as the lowest Twitter communicated NHPA representing only 0.2% of the entire health-related tweet sample, whilst arthritis and musculoskeletal conditions, the most active of these under-represented categories comprised only 0.6% of the total health-related tweets in the sample.

The four mentioned under-represented NHPAs had a total of 65 identified tweets in February 2012. Combined, these conditions contributed to only 1.7% of health-related tweets. Considering that these areas are considered of national importance, these numbers were notably low especially when compared to other NHPAs: cardiovascular health (51 tweets or 1.3%), diabetes (74 or 2.0%), cancer (204 or 5.4%) and dementia and mental health-related tweets (316 or 8.3%). Tweets in these more prominently identified NHPAs accounted for approximately one-sixth (17.0%) of the 3,790 health-related tweets identified in February 2012.

Table 3 was compiled from the same sample of 3,790 health-related tweets collected/analysed for the study (and also used to compile Table 2). This table however provides another dimension to view various proportions of tweet numbers by separating the identified tweets into the type of health information being provided.

FP accounts had 21.7% of their health-related tweets dedicated to providing 'organisational news' (news about the activities of that organisation), whereas NFP organisations tweeted a slightly lower percentage of organisational news as a proportion of their health-related tweets (17.0%). Governmental accounts tweeted significantly lower proportions for organizational news (6.7%) and promotion (0.5%). This suggests that FP accounts are particularly active in promoting developments within their organisations, and suggests an opportunity for government and NFP accounts to provide further organisational news-related tweets to potentially encourage further engagement between their organisations and health consumers.

Fundraising-related tweets alone contributed to approximately 10.2% of the total number of health-related tweets identified in February. Unsurprisingly, many of these tweets (361) came from NFP organisations. Throughout the analysis, Twitter was identified to be a frequent way for NFP accounts to communicate about fundraising, with 15.5% of their health tweets categorised under this type. This medium can potentially be a cost-effective method for NFP organisations to fundraise, especially when considering the costs of developing, promoting and advertising through various traditional media. In addition, the use of Twitter or social media for fundraising has the advantage of potentially reaching a more interested and targeted audience for the specific health area of fundraising.

One of the more interesting findings is that Twitter is already being widely used for 'public health advice' dissemination. Such tweets were defined as health information the consumer could use to potentially change relevant aspects of their current health behaviours. In our sample, 772 or one-fifth (20.4%) of health-related tweets in February fell under this category type. This was an anticipated beneficial function for micro-blog postings. In terms of proportion for a sector, government tweets are most dominated by public health advice with more than one-third (36.9%) of their health-related tweets being categorised under this type, indicating the current frequent use of government Twitter accounts to deliver health advice to consumers. It should be noted that both FP and NFP accounts also had substantial numbers of public health advice-related posts, with 21.1% and 17.3% respectively. Public health advice tweets were considered an interesting sub-sample of the overall sample to further analyse, given that this was a significant category in terms of number of tweets in addition to the high impact application of micro-blogging in relation to the communication of public health information.

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PUBLIC HEALTH TWEETS AND THEIR DISSEMINATION

The dissemination, or sharing, of micro-blog postings on Twitter is done by a user-driven process referred to as retweeting. Retweeting is the act in which a user shares a tweet posted by another user to their followers, much like somebody forwarding an email to their entire address book. Dissemination of public health information is an interesting concept that has been examined in previous research (Dumbrell & Steele, 2012). The open nature of the medium by which this information is shared, as well as the interface characteristics of Twitter, allows for quantitative measures to be observed. These measures can include how many times a certain type of health information is retweeted, how many end-users this information reaches – and if these factors have any relation to the nature of information being shared or the initial poster of the information. This novel idea and practice of members of the public being involved in health information dissemination allows for users to not only share particular health information with others, but also pass subjective evaluation on that specific piece of information (i.e. is it worth sharing?). Figure 2 shows the frequency with which public health-related tweets from the sample were retweeted, whereas Table 4 compares absolute and proportionate retweeting frequencies throughout the sectors.

A total of 359 of the 772 public health-related tweets identified were retweeted. NFP accounts had more than two-fifths of their public health-related tweets (176 out of 403, or 43.7%) retweeted by

Figure 2. Retweeting frequency

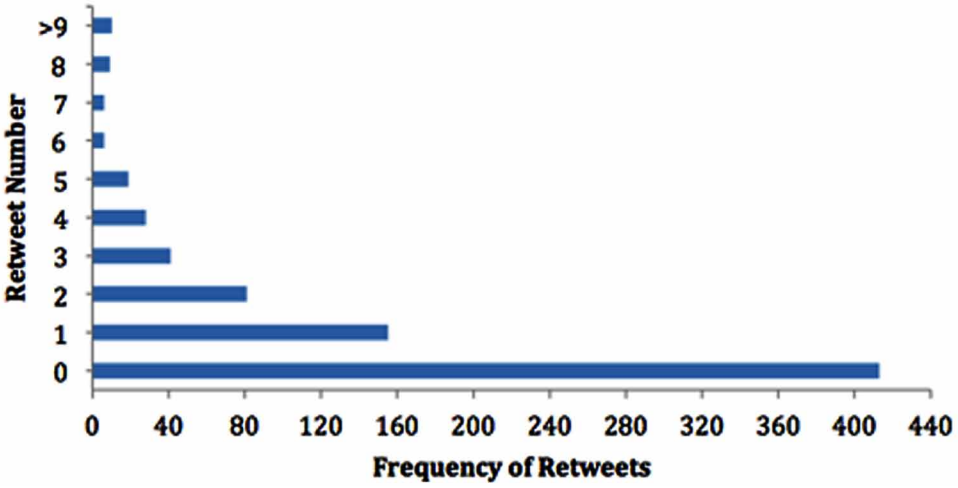

Table 4. Retweeting frequency between sectors

	Government	FP	NFP
Number of Public Health Tweets	143	226	403
Proportion of Public Health Tweets in Total Sample (% of 3,790)	3.7%	6.0%	10.6%
Proportion of Public Health Tweets within Sector	36.9%	21.1%	17.3%
Number of Public Health Tweets Retweeted	99	84	176
Percentage of Retweeted Public Health Tweets / Number of Public Health Tweets within Sector	69.2%	37.2%	43.7%

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other users. FP health-related organisations had the smallest raw number (84) as well as the smallest proportion of retweeted public health advice (37.2%) out of all three sectors, considering 226 of their tweets in February 2012 were public health-related. The government health-related Twitter accounts we identified were found to be the most successful in disseminating health information to the public. Of the 143 government posted public health-related tweets identified in February 2012, 99 were retweeted (approximately 70%). In fact, if taking into consideration the number of Twitter accounts per sector, it could be seen that government accounts had recorded on average a higher reach with their public health information (i.e. due to higher retweet rates and the smaller number of accounts found within this sector).

For this study we also considered the level of dissemination, or the "reach", as an absolute measure of: the number of followers that would receive a certain piece of information, as well as the number of followers of an account that would retweet that piece of information. For example, if an account with 1,000 followers tweeted an article on dementia, and this article was retweeted four times by different accounts, then the reach of this information would be 1,000 plus the sum of followers of the four retweeting accounts (overlap between the followers of accounts not considered).

Table 5 outlines the number of users reached by retweeted public health tweets in our sample. As can be seen, NFP accounts had a larger total reach (283,302) when compared with government (241,320) and FP (223,444) accounts. When taking into account the average reach per account however, it can be seen that retweeted tweets of NFP accounts actually reached approximately three times less users per account (6,555) than both government (20,110) and FP accounts (17,188). Furthermore, when looking at the average number of users reached per retweeted public health-related tweet, it could be seen that FP accounts had a higher number of average users reached per tweet (2,725) with government accounts at the next highest (2,462) and NFP accounts having approximately 1,000 less average users reached per tweet than both the other two sectors at 1,610.

One of the issues found however was that there were a few retweeting accounts with an exceptionally high number of followers that could impact overall calculations of reach (i.e. outliers). For example, the Twitter account "Dr. Karl" had 147,971 followers at the time of data collection, and even though the account had only retweeted one tweet from a FP account, this increased the reach (total, average per account and average per tweet) of FP accounts by approximately three-fold (as shown in Table 6). Therefore it can be seen how outliers can have a significant impact, as one user with many followers can influence how many users will receive the tweet and the corresponding information presented in this tweet. This also raises the aspect of social media-based information dissemination being influenced by a small set of high-follower accounts and the implications of this for strategies to effectively and widely disseminate public health information via social media.

Table 5. Followers reached by retweeted public health tweets

	Government	FP	NFP
Total Reach	241,320	223,444	283,302
Average Reach per Account	20,110	17,188	6,555
Average Reach per Tweet	2,462	2,725	1,610

Table 6. Followers reached by retweeted tweets (minus outliers)

	FP	FP (Minus Outliers)
Total Reach	223,444	75,473
Average Reach per Account	17,188	5,806
Average Reach per Tweet	2,725	932

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Table 7 represents the categorisation of accounts that had disseminated any of the 359 retweeted public health advice tweets. Government accounts did the least retweeting of public health advice tweets when compared to other account types with only 44 of the 890 (or 4.9%) retweeting accounts from the government sector. In addition, more than half of the retweets made by government accounts (23) were actually of public health tweets from other health-related government Twitter accounts identified. These numbers show how government accounts have low retweet numbers (potentially due to selectiveness), which may be because they tend to retweet information from other government bodies rather than information from other sectors.

On the other hand, accounts that represented various individual users (i.e. not organisation-based bodies) recorded the highest proportion of the 890 retweeting accounts; with 561 or 63.0% of identified public health information retweets being from individual users. FP organisations had the second highest amount of retweeting activity by organisations at 125 identified accounts, and NFP accounts had retweeted public health tweets only 88 times. The remaining 72 retweeting accounts were ambiguous as to whether they were associated with organisations or individuals, and hence were classified as 'other'. These numbers are interesting, as they show low activity of government Twitter accounts when it comes to retweeting public health advice – but illustrate higher proportions of interaction by individual users who disseminate organisation-generated health information.

Table 8 outlines the differences between the number of links (URLs) present in public health-related retweeted and non-retweeted tweets. Government accounts had links present in all their retweeted tweets, however this proportion dropped to 87% when considering the links present in non-retweeted tweets. To a lesser extent, this was also found in NFP organisations, with only a 6.9% difference in link presence when comparing retweeted and non-retweeted public health tweets. FP organisation had links present in every one of their public health-related tweets (both retweeted and non-retweeted). It is also interesting to note that the amount of links present in public health-related tweets is two to three times greater than found in non health-related datasets in previous studies (Poblete, Garcia, Mendoza & Jaimes, 2011).

Table 7. Retweeting accounts

	Government Tweets	FP Tweets	NFP Tweets	Total
Retweeting Accounts				
Government	23	3	18	44
FP	38	26	61	125
NFP	29	4	55	88
Individual	146	104	311	561
Other	23	11	38	72
Total	259	148	483	890

Table 8. Percentage of links present in tweets

	Government	FP	NFP
Retweeted	100%	100%	91.9%
Non-retweeted	87.0%	100%	85.0%

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The authoritativeness of online documents can be quantified to some extent by the Google PageRank function, which is an algorithm that calculates the importance of Web pages by considering both the number of incoming hyperlinks and the importance of the pages from which they are coming from. As can be seen in Table 9, the PageRank of public health-related tweets by Government accounts for both linked-to and the site home Web pages of linked-to pages are the highest when compared to those of FP and NFP organisations. The average PageRank of site home pages of linked-to pages from Government and NFP organisations were similar (6.8 vs. 6.3); with the average of site home Web page PageRank of public health-related FP tweets being the lowest of the three sectors (5.1). FP accounts actually had the lowest average overall PageRank counts of the three sectors, especially when looking at the average PageRank number of their linked-to Web pages (1.5). This may mean that FP organisations tweet links to pages that have generally less authoritative information than government and NFP organisations, and hence may explain why lower proportions of public health tweets are retweeted and to less users (Table 4 & 6). In addition it should be noted that even though FP accounts have links in 100% of their tweets (Table 8), with regards to public health information, this linked-to information is less authoritative than other sectors.

IMPLICATIONS

Our work found that the information being tweeted by health organisations was largely health-related, with only one-fifth of the data mined categorised as non health-related. On the contrary to the findings by Omurtag et al. (2012), the types of information provided by the sample of organisations identified throughout Twitter were minimally advertising or 'irrelevant chatter'. With regards to influence, it was seen in our sample that government accounts were most influential as they had not only on average more followers, but also more reach (when removing outliers). This also highlights the impact of individuals with large followings on SNSs, as well as the growing role of the public in the dissemination and propagation of health information. As the population of online users grows, this also presents a further consideration in relation to privacy issues via the use of this medium for the retrieving and sharing of health information.

There are a number of implications for both government and private health organisations. In relation to government health services that generate online information, this work demonstrates areas where further micro-blog dissemination could occur (e.g. the four underrepresented NHPAs and general Indigenous health). Government organisations could utilise the availability of SNSs to further fill these gaps for health information. In addition, due to the influential and authoritative aspects of government accounts and Web documents, they can be harnessed more so as to act as powerful communicators of high quality health information. The policy implications that arise due to these possible changes will involve actions,

Table 9. PageRank of public health tweet web-links by sector

	Government	FP	NFP
PageRank of Linked-to Web Page	4.5	1.5	4.1
PageRank of Site Home Page of Linked-to Web Page	6.8	5.1	6.3

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such as the reassessment of online responsibilities, quality filters and privacy controls for all entities involved. This is also important due to the greater involvement of the public in public health information dissemination, as appropriate policy procedures would potentially lead to greater community awareness and engagement in the use of SNSs for health information.

In relation to NFP health organisations, the usage for fundraising was demonstrated with our results. The use of SNSs for these purposes would not only be an additional method of raising funds through a more targeted and engaged audience, but also a more cost-effective approach for these organizations. Private health practices can also potentially increase community engagement by mirroring government account strategies, such as disseminating more important (or authoritative) Web documents. Our results also show that the presence of URLs in health-related tweets generally resulted in higher levels of dissemination than tweets without URLs. Health companies and organisations that want to increase their information reach can use this for potential future strategies for effective social media-based dissemination.

This work is also a step towards the further understanding of dissemination for the development of software tools and applications (Steele & Lo, 2009) to improve or optimize the coverage and targeting of public health information sharing and dissemination across a community, nationally or internationally.

LIMITATIONS

The limitations of such a study come from potential issues in sampling and analysis of Twitter accounts and tweets. Whilst manual methods were utilised to identify relevant accounts according to criteria, some organisation accounts may have been missed. Although our sample is substantive, we cannot claim to have an absolute representation of all Australian health-related bodies and organisations on Twitter, due to the limitations of the search functions themselves. As mentioned in previous sections, there is also a potential risk of bias when collecting tweets over a specific time period when certain health-related campaigns are occurring, thus increasing the prevalence of information related to this area and potentially skewing results. There is also the issue of verification of specific accounts on Twitter, as anybody in the world can create a Twitter account under an available name. Thus other third parties could potentially misrepresent organisations and government bodies that are not verified on Twitter, although this would have been detected during the identification of accounts in our study.

A difficulty in the categorisation of specific health areas was the complexity and factors of various conditions that could relate to more than one category. For example, tweets pertaining to the aged were generally categorized instead under the specific condition they related to (if they were about a specific condition). As shown in Table 2, there were a small proportion of aged-related tweets that were generically health-related (0.5% are classified under ‘elderly’). However when taking into account specific categories that may be affected by age (i.e. chronic conditions such as osteoporosis and some cancers) it can be seen that the overall proportion of age-relevant tweets would be substantially higher. Nevertheless, there had to be a distinction within the categorisation process, whereby the information contained in the tweet was categorised according to whether the emphasise was semantically addressing the ageing population, or whether information was provided about the condition in general.

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CONCLUSION

This chapter describes and analyses the Twitter activity of various Australian-based health-related organisation accounts during the month of February 2012. Specific criteria were utilised to identify and include active accounts that represented government, FP and NFP accounts based in Australia. The analysis and categorisation of tweets was carried out in two dimensions, and these were health condition and the type of information that was being tweeted. Further analysis was carried out on the specific subsample of public health advice tweets. The analysis in this chapter provides a step to understanding the overall dissemination by health organisations in the Australian context of health information via Twitter.

Future research may examine and analyse further aspects of health information dissemination via social media such as: whether relevant health messages reach the relevant target groups; the number and frequency of such messages; and the nature of dissemination and sharing of these messages by participating members. These issues can be explored throughout various population groups, such as looking at Australia as well as international comparisons to uncover similarities and differences.

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KEY TERMS AND DEFINITIONS

Micro-Blog: A system with a blog-like nature, where incremental updates are provided over time, but for which the text updates are typically shorter.

PageRank: An algorithm introduced by Google that provides a search query-independent quantitative measure of a Web page's 'authority'.

Public Health Campaign: A type of media campaign where information which can include educational material is communicated to a population or sub-population to positively affect health behaviours, awareness or preventative actions.

Social Networking Service (SNS): A (typically online) service that allows the representation of an individual's profile information and the capturing of the links between individuals and their respective profiles.

Tweeting: The act of sending a micro-blog post (limited to 140 characters) within the Twitter system.

Twitter: A widely used micro-blogging application.

Twittersphere: The overall set of postings and communications within the Twitter micro-blog system.

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Chapter 19
Health Information Technology and Change

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ABSTRACT

Even in in health healthcare and health information technology change will not vanish or disperse. Technology, civilization, and creative thought will drive this force increasingly forward. Health care managers will continue being judged on their ability to efficiently and effectively manage (Patton & James, 2000). The pace of change has significantly increased since the days of the cave dweller who walked the earth until the "technology convergence" of using the ox and horse as tools. This article is to investigate the background, controversies, and problems surrounding Health Information Technology and change, and will include an overview of current changes. This will be coupled with solutions and recommendations, further research, and conclusion.

INTRODUCTION

One of the most widely discussed areas in the health care field is improving the quality of patient-centered care within Health Information Technology (HIT). HIT allows for the all-inclusive management of medical information and the protected exchange between health care consumers and providers (U.S. Department of Health & Human Services, 2008). Health care comprises of the use and management of a profusion of information that must be collected, managed, reviewed, processed, and mined (McHaney, n.d.). With this in mind, HIT is proclaimed to be the solution to improve patient-centered health care and quality, while reducing cost within the medical industry (Hersh & Wright, 2008). It was not until 1994; the United States healthcare industry established information systems capable of handling a universal delivery system (Accenture, 2001). These Information Technology Systems (ITS) operated along enterprise and system boundaries in the Health care Delivery System (HDS). However, they fragmented by the proprietary business benefits of large vendors that wanted to control patient information (Accenture, 2001). Practical tools, especially computers, continue to be created and rapidly placed in

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industry, the ability of organizations to accept, accommodate, and even embrace technology is moving at a varied pace (McHaney, n.d.). The health care industry has been one of the unhurried organizations to embrace the computer revolution in regards to patient care. However, health organizations have been using computers for years in business departments. Research has indicated that HITs represent tools or functions that help patients maintain their health through management of health information (Hudak & Sharkley, 2007). Even though HIT has the potential to transform the delivery of health care effectively and efficiently, health organizations continue to lack in this area.

A health organization has often been treated like a manufacturer who is advised that using cheaper materials can reduce manufacturing costs. The end result is that the manufacturer saves money on manufacturing costs but at the same time defects are accumulating and the results are subpar products. As we relate this to health organizations the ill effects of these short cuts are not externally evident, the health organization gives poor service or makes errors. Ultimately, health organizations fail in any of the countless ways in which organizations fail when they are poorly sustained (English, 1994). When health organizations operate inefficiently without proper funding, the odds become stacked against them.

Several other studies suggest that the adoption of HIT remains limited in certain functions (Poon et al., 2006). There have been limited studies conducted to determine which functionalities of HITs need implementation. Most studies concentrated on certain functionalities such as Computer Provider Order Entry (CPOE) or Electronic Health Record (EHR). CPOE is a set of clinical processes that incorporate technology to optimize physician ordering of medication and other required laboratory testing (Ormond, 2005). During a study by Minnesota Orthopedics Specialist, it was realized that vendor and local support during implementation was critical for success (O'Neill, 2007).

EHR is "related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization" (U.S. Department of Health and Human Services, 2008, p. 17). This definition has been updated to include a digital collection of patient health information compiled at one or more meetings in any care delivery setting and is often used to refer to the software platform that manages patient records maintained by a hospital or medical practice (Health IT News 2013).

This leads us to look at the internal and external change. This is imperative for the change process and implementation of HIT. The internal reaction to change is the key point of discovery that requires learning something new, not just the acquisition of knowledge (Cameron & Green, 2004). Over time health organization management has avoided mentioning patient care and patient-related quality issues in either a positive or a negative framework. Many administrators appeared to focus more on central management than on clinical operations. In doing so, they have missed opportunities to engage patients and families as allies, document patient satisfaction and positive social work outcomes, and identify systemic patient care problems. The Greek Philosopher Heraclitus said that "no man ever steps in the same river twice, for it's not the same river and he's not the same man" (BrainyMedia.com, 2009, para. 1). Some interpret that the river is the external world. The external world is ever changing; the "river" is never the same. Another way to interpret this is that the "man" who stepped in the river today is not the same "man" that steps in the river tomorrow due to change, evolution, or experience that relate to external facts and figures (Cameron & Green, 2004). Technology changes rapidly and maintaining the status quo, actually means falling behind, and health organizations cannot afford to do that in our technology-driven world (Rutsky, 1999).

Change management is a multidisciplinary group activity to provide optimum solutions to health care organization. Those responsible must have to access a wide range of skills and resources to change

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the process of how an organization does business. The goal is to transform the organization efficiently with organizational change (Patton & James, 2000). Traditional change management emphasizes the significance of reinforcing and embedding desired changes in structures, processes, systems, target settings, and incentives. To be effective, these mechanisms are required to take into consideration that people do not always behave realistically (Aiken & Keller, 2009). Within the setting of a workshop, several parties involved (management consultants, business professionals, and managers) try to think of favorable alternatives to the business process as a whole or in parts. Information Technology (IT) specialists, change management experts, and other specialists then use the resulting process design to implement the new layout of the process within the organization.

Change will not vanish or disperse. Technology, civilization, and creative thought will maintain an increasing force forward. Health care Managers will continue to be judged on their ability to efficiently and effectively manage (Patton & James, 2000). The pace of change has significantly increased since the days of the cave dweller who walked the earth until the "technology convergence" to the ox and horse. The world may not be spinning faster, however the people are (Patton & James, 2000). This article will investigate the background, controversies, and problems surrounding Health Information Technology and change, including an overview of current changes. This will be coupled with solutions and recommendations, further research and a conclusion.

BACKGROUND

Information Technology (IT) is a term that denotes the processing of data using a computer; the use of technologies electronically from computing, telecommunications, and the allocation of information in digital and other forms (Encarta® World English Dictionary, 2007). Specifically it refers to the products, methods, inventions, and principles that are used to produce information (Kroenke, 2008). Information Systems (IS) is a term that denotes gathering of hardware, software, data, procedures, and masses that produce information (Kroenke, 2008). The American Hospital Association in 2006 conducted a survey acknowledging numerous barriers to HIT adoption. Initial costs (94%) and continuing costs (87%) were the most commonly reported barriers. Clinician acceptance (82%) and lack of interoperability with current systems (79%) also ranked lofty. To tackle the issue of interoperability, the United States (U.S.) Department of Health and Human Services (HHS) contracted with the Certification Commission for HealthCare Information Technology to certify HIT systems that meet standards for interoperability, functionality and security (Certification Commission for Health Information Technology 2008).

Networks are the infrastructure of the electronic world and are the platform for the transfer of information from one location to another. Networks can be any electronic device that is attached to computer system, providing a channel for information to be passed. There are two main types of computer networks: Local Area Networks (LANs) and Wide Area Networks (WANs). LANs are "computers connected in a common geographical location and have a common owner" (McHaney, n.d. p. 434). A WAN is "two or more over a large geographical area from each other and they are connected by leased telecommunications equipment" (McHaney, n.d. p. 434). Designing networks is a critical part of the design, development, and implementation of any health care information system. Organization size, needs, account budget and spending need to be considered (McHaney, n.d.). Injudiciously, many health organizations spend less money and end up with undesirable systems and the need to spend more money. Besides financial concerns, health organizations need to take into account growth of the company, future needs, the type

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Healthcare Information Systems (HISs) to be implemented, number of employees using the system, and the amount of data to be stored, retrieved, and transferred (McHaney, n.d.). There have been many studies on the relevancy between the application of IT and organizational efficiency or firm performance. The results have shown a positive correlation between IT and firm performance (Albadvi, Keramati, & Razmi, 2007). Meanwhile, other researchers have not been able to find such a correlation. This is called a productivity paradox in the literature of IT and productivity. One way suggested of explaining the paradox is to consider intervening variables such as total quality management, reengineering of processes, and organizational infrastructures on the relations between IT and performance (Brynjolfsson, 2003). The highest productivity of IT will be realized when IT investment is integrated with complementary investments; new strategies, new business processes, new working practices, and new organizations all appear to be important. These changes will require a period of time-consuming reengineering and redesign of an organization in order to best utilize their IT investment.

Historically the level of the development of Information Technology (IT) systems has not been clearly known in relationship to HER implementation. Supporters of IT goals in their use of HIT use the objectives of the organization to achieve operational efficiency. The Institute of Medicine report key capabilities of an EHR System that identified a set of eight core care delivery functions that electronic health records systems should be capable of performing in order to promote greater safety, quality, and efficiency in health care delivery. These were reported by Key (2003) as follows:

1. **Health Information and Data:** Having immediate access to key information such as patients' diagnoses, allergies, lab test results, and medications would improve caregivers' ability to make sound clinical decisions in a timely manner.
2. **Result Management:** The ability for all providers participating in the care of a patient in multiple settings to quickly access new and past test results would increase patient safety and the effectiveness of care.
3. **Order Management:** The ability to enter and store orders for prescriptions, tests, and other services in a computer-based system should enhance legibility, reduce duplication, and improve the speed with which orders are executed.
4. **Decision Support:** Using reminder prompts and alerts, computerized decision-support systems would help improve compliance with best clinical practices, ensure regular screenings and other preventive practices, identify possible drug interactions, facilitate diagnoses, and treatments.
5. **Electronic Communication and Connectivity:** Efficient, secure, and readily accessible communication among providers and patients would improve the continuity of care, increase the timeliness of diagnoses and treatments, and reduce the frequency of adverse events.
6. **Patient Support:** Tools that give patients access to their health records, provide interactive patient education, and help them carry out home-monitoring and self-testing can improve control of chronic conditions, such as diabetes.
7. **Administrative Processes:** Computerized administrative tools, such as scheduling systems, would greatly improve hospitals' and clinics' efficiency, and provide more timely service to patients.
8. **Reporting:** Electronic data storage that employs uniform data standards would enable health care organizations to respond more quickly to federal, state, and private reporting requirements, including those that support patient safety and disease surveillance (Key, 2003).

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This poses questions about the current level of HIT adoption and the operational effectiveness of HIT in a multiple health organization settings. Business Process Automation (BPA) involves the process of supplementing the manual process with the goal of decreasing costs and increasing efficiency (Pharmaceutical-Technology.com, 2009). There have been some negative connotations to technology-centered approaches to automation, which has led to the development of human-centered automation (Kaber & Endsley, 2004). Two proposed approaches dispute the traditional division of human automation task responsibility in complex systems. These approaches redefine the transfer of functions to people and automation in terms of a further integrated group approach. The first approach seeks to pass control back and forth between the human and the automation. The second keeps both the human and the automation involved in systems operations.

This allows the assigning of systematic functions to the human, computer, or both. This has spawned the Levels of Automation (LOA), which refers to the level of task preparation, routine interaction maintained between a human operator, and a computer in controlling a complex system. Below are the names of the 10 LOAs and a brief description:

1. **Manual:** The human performs all responsibilities as well as monitoring the state of the system.
2. **Action Support:** The system assists the operator with performance of the selected action, although some human control actions are required.
3. **Batch Processing:** The human generates and selects the options to be performed; they then are turned over to the system to be carried out without human intervention.
4. **Shared Controls:** Both the human and the computer generate possible decision options.
5. **Decision Support:** The computer generates a list of decision options, which the human can select from or the operator may generate his or her own options.
6. **Blended Decision-Making:** The computer generates a list of decision options, which it selects from and carries out if the human consents.
7. **Rigid System:** The system presents only a limited set of actions to the operator.
8. **Automated Decision Making:** The system selects the best option to implement and carries out that action based upon a list of alternatives it generates (augmented by alternatives suggested by the human operator).
9. **Supervisory Control:** The system generates options, selects the option to implement, and carries out that action.
10. **Full Automation:** The system carries out all actions (Kaber & Endsley, 2004).

Process automation is driven by either innovation or necessity. An example of the innovation in process automation was the implementation of the automatic transplanting machines during the growth period of the farming industry. This created expanding sales in the area of plug growing techniques. In spite of lower labor costs and only 12 to 16 weeks per year of useful production, the return on investment for first-generation transplanting was excellent for growers benefiting from good product margins on growing sales.

This also illustrates the domino effect of process innovation. A gain in productivity in one area necessitates changes in other areas in order to realize a net gain in volume of data or material handled. Incremental process changes are implemented by the necessity to control production costs in a rapidly changing market (Kanczak, 2008). As the use of IT in health care operations has matured, the need to

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integrate software applications has become increasingly important. However, interoperability among these IT applications is hindered because the applications use different terminology and representations of the domain.

Business managers now face vibrant and multifaceted operating environments. Technologies and services, along with the organizations they sustain and provide for, are converging. As organizations and services converge, there is a growing realization that a holistic approach to the services is required (Patton & James, 2000). The packaging of what separates services into effective "consumer solutions" will continue for the near future (Patton & James, 2000).

HEALTH INFORMATION TECHNOLOGY ISSUES, CONTROVERSIES, AND PROBLEMS

Is it possible the medical industry has adopted HIT for financial gain through organizational efficiency more so than with patient-centered HITs being the secondary factor? There is some evidence that health organization fiscal accountability's "survival" mentality has the potential to compromise medical treatment and commitment to organizational efficiency at the expense of patients and their families (Mizrahi & Berger, 2005). Management is not exclusively looking for ways of maximizing production and transaction costs. Some organizations want to ensure they remain competitive and survive in the long term.

In their struggle to obtain legitimacy, organizations adjust to society according to a collective rationalization. As a result, institutionalized activities are durable, socially accepted, unwilling to change, and their survival is not directly linked to rewards or control (Ouedraogo, 2007). In a motionless flow organizations have a tendency to become complacent (Elearn Limited, Pergamon Flexible Learning, 2005). The need to confront this organizational complacency can be one of the major triggers for change. Working any length of time has shown the rate of change is increasing. For example, the huge change of Health Organizations in 2001 was compressed in a shorter amount of time. Table 1 is from Elearn Limited, Pergamon Flexible Learning (2005). Credit is also given to Grundy (1995) for the source of the information.

Organizations base change strategies on the past three to five years. The important issue is to base change strategies on the future and new recipes to combat change. Adapted from *Change Management,* by Elearn Limited, Pergamon Flexible Learning, 2005; and from *Breakthrough for Growth,* by A. N. Grundy, 2005. Table 2 illustrates how much organizations change over time in sweeping environments (Elearn Limited, Pergamon Flexible Learning, 2005). Credit is also given to Lynch (2000) from which the information was adapted.

Table 1. Change recipes; recipes refers to the established ways an organization anticipates and responds to change.

Time	Past	Old markets, receipts, and competition
	Change	
	Present	Current markets, receipts, and competition
	Change	
	Future	Unfolding markets, new recipes, and future competition

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Table 2. Health organizations objectives and strategies shift

Period	Company Objectives	Management Priorities
Early to mid 1990s	Grow and maintain market dominance in health markets	Invest in Health Organization brand Increase service levels Launch regular new practices
Late 1980s to early 1990s	Survive the threat from competitors	Major cutbacks in cost base Divest nonessential parts of the organization
Mid 1990s and future	Restart growth	Acquire new Heath Organizations Diversify into software and services, leading to HIT

Adapted from *Change Management,* by Elearn Limited, Pergamon Flexible Learning, 2005; and adapted from *Corporate Strategy,* by R. Lynch, 2000.

The American Hospital Association in 2006 conducted a survey acknowledging numerous barriers to HIT adoption. Initial costs (94%) and continuing costs (87%) were the most commonly reported barriers. Clinician acceptance (82%) and lack of interoperability with current systems (79%) also ranked lofty. To tackle the issue of interoperability, the HHS has contracted with the Certification Commission for HealthCare Information Technology to certify HIT systems that meet standards for interoperability, functionality, and security (Certification Commission for Health Information Technology 2008).

As the use of information technology operations has matured, the need to integrate software applications has become increasingly important. However, interoperability among these applications is hindered because the applications use different terminology and representations of the domain. These problems arise most highly for systems that must manage the heterogeneity inherent in diverse domains and integrate models of different domains into coherent frameworks (Gruninger & Menzel, 2003). For example, such integration occurs in business-process reengineering, where enterprise models integrate processes, organizations, goals, and customers.

Even when applications use the same terminology, they often associate different semantics with the terms. This clash over the meaning of terms prevents the seamless exchange of information among the applications (Gruninger & Menzel, 2003). Typically, point-to-point translation programs are written to enable communication from one specific application to another. However, as the number of applications has increased and the information has become more complex it has been more difficult for software developers to provide translators between every pair of applications that must cooperate during interaction. What is needed is some way of plainly specifying the terminology of the applications in a clear-cut fashion (Gruninger & Menzel, 2003).

Most industries in America have used IT to produce organizations that were more cost effective, efficient, and productive. Health care executives understood that to capitalize on these sources of funds their organizations required information systems that could mechanize the patient billing process and facilitate accurate cost reporting (Glaser & Wager, 2005). However, the truth of the matter is that health care has not reached this echelon (Dejack, 2005). Studies have shown the most frequent barrier to the customer's use of interactive health IT across studies was the lack of a perceived benefit. The lack of convenience was a significant barrier. In particular, patients were less likely to use systems requiring access to equipment or technology that did not fit flawlessly into their normal daily routines (Agency for Healthcare Research and Quality, 2008).

Correspondingly, overly burdensome data entry was perceived as a barrier. Several studies found that the level and timeliness of clinician involvement with the system was directly connected with patient

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use; low clinician participation lead to low patient use (Agency for Healthcare Research and Quality, 2008). Technical issues often prevented consistent use of health IT systems, especially among studies conducted on early system prototypes. Although subjects were often provided with the technology for a research trial, several studies have identified that costs and access to the technology would serve as barriers to use of health IT beyond the study interval (Agency for Healthcare Research and Quality, 2008).

Paper records were used because of their simplicity, low implementation costs, and wide spread acceptance. According to Bates et al., the factors listed below necessitate change to HIT:

1. Current records are limited as to availability and can only be viewed by one person at a time.
2. Staff and other medical professionals are illegible to view medical records.
3. Medical records can increase to two or three volumes.
4. Inherent in the use of medical records are evaluation problems, low utility, and large overhead.
5. The use of medical records can impede decision making process (Bates, Ebell, Edward, John, & Mullins, 2003).

The fact is that without fail human beings think they are better than they are, an occurrence referred to in psychology as self-serving. For example, because frontline managers perceived changes as unfair to the customer, a significant number of them vocally bad-mouthed the merchant's policies to customers, and used price overrides to show their good faith even though it meant they were less likely to achieve individual sales goals. The results were customer attrition, price overrides sharply increased, and significant value was destroyed by the effort. In the pricing example described above the outcome was inherently fair and therefore the downward spiral described could have been avoided by carefully tending to employees' perceptions of fairness in the communications and training surrounding the changes.

The question is universal. It is hard to gather followers behind any idea that does not make logical sense, let alone one with undesirable consequences. If the masses are not buying the story perhaps it warrants a second look. Furthermore, the choice of language used to explain any change has to be well thought out at the beginning to gain trust and minimize doubt (Baylor, 2009). All new leaders, whether they are taking charge of a small partnership or a sprawling public corporation, want to know how to change the ineffective parts of the organization without undermining the parts of the organization that are working (Welch & Welch, 2009).

As boards and senior leaders realized some of the major holes in staffing, they rapidly moved to get approval to hire on the fly, and fill the holes with expensive consultants and vendor staff. In the meantime, everyone struggled to make these systems work. These projects had time delays while a team was assembled. The results was that organizations recognized that not having the right players in leadership positions was a restricted view for a critical, complex undertaking such as filling major roles in staffing. As a result, several senior positions have emerged that require unique skills.

The worst thing that organization's management can do is allow their ego to step into the driver's seat and dictate their responses by clinging to old methods without considering new ones. Not only will they be ineffective, they will look irrational in the process or weaken the organization (Nicholson, 2009). When it comes to managing change, research is your best friend. Do not manipulate the data to fit with your agenda. The point is to work with the research data as objectively as possible. One approach by Katie Delahaye Paine describes the steps of effective research measurement as redefining measures of success: experiment, listen, measure, and learn (Nicholson, 2009).

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According to Clarke and Donaldson (n.d.) a system overload is unavoidable. Restrained demand from those waiting for a promise of "free" or heavily subsidized services is expected. Health care professionals want to help people in need, but the sheer logistics of extended care delivery, the current and growing shortage of personnel, and limited resources will challenge the intentions of the policymakers who constructed the national health law. Reports have begun documenting a new, unprecedented shortage of nurses linked to growing demand for services, as well as drops in graduations from nursing education programs (Clarke & Donaldson, n.d.).

The "transformational" changes touted by the law's champions will likely complicate and negatively affect health care workers and their ability to provide care. These changes will increase regulatory burdens, increase already heavy workloads, reduce payments, impose new penalties, and disregard personal preferences and values (Anderson, 2014). Change does not happen overnight and there will be some tremulous times.

Quality is a topic of concern among all health care organizations. Patients expect a high quality of care. Providers are scrutinized for the level of care offered. Health care professionals such as physicians take the Hippocratic Oath, swearing to uphold specific ethical standards. This includes treating the ill to the best of one's ability, preserving patient's privacy, and teaching the secrets of medicine to the next generation (Medical Net.com, 2014). However, as with most cases, money becomes a driving force with the marketing and targeting of the pharmaceutical companies to market their medications. It is easy for a health care professional to forget the main focus of quality care. Even payers are assessing the levels of quality present (or absent) among health care organizations.

The effect of managed care on quality of care has been problematic to assess, at least in part, because of the difficulty in reaching a common understanding of how quality should be measured. Quality has been defined as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge (Silberman & James, 2000). The definition of quality varies based on personal perspective, background, culture, and individual need. Regardless of definition, quality is demanded and oftentimes not provided. Many view quality health care as the predominant authority under which patient safety resides. For example, the Institute of Medicine (IOM) considers patient safety "indistinguishable from the delivery of quality health care." Ancient philosophers such as Aristotle and Plato considered quality and its attributes (Mitchel, n.d.).

At first, the Institute of Medicine (IOM) defined quality as the point at which health services for the society increase the likelihood of desired health outcomes and are consistent with professional knowledge (Mitchel, n.d.). This was transformed into to a definition of quality that appeared to be listings of quality indicators, which are terminologies of the standards. These standards are not necessarily in terms of the possibilities or conceptual clusters for these indicators. These clusters of quality indicators were and often continue to be comprised of the 5D's, which are death, disease, disability, discomfort, and dissatisfaction, rather than more positive components of quality (Mitchel, n.d.). This is a starting part and the 5 D's are better than nothing at all. This definition will be transformed again in the future.

Even though there is a better understanding, availability of technology, and preeminent minds working on the concerns of better access and lower cost for health insurance (Liu, 2012). This has given hope that rising concerns over connectivity can be dealt with at the same time by these preeminent minds. However, many Americans lack health insurance coverage at some point during any given year (Executive Summary, 2014). Health care quality fluctuates widely, even after controlling for cost, source of payment, and patient preferences. This demonstrates the distinct connection between access, cost, and quality.

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UNDERSTANDING THE LEGAL SYSTEM AS IT RELATES TO CHANGE IN HEALTH ORGANIZATIONS AND HIT

The American legal system, although complex, was developed to establish order in society. This same system impacts health care organizations, which must adhere to various rules, regulations, laws, and statutes. The complexity occurs because these terms that can be intermingled and are confusing. When it relates to health care they can also be called health care reforms. An example is the Patient Protection and Affordable Care Act (PPACA), which is the most extensive change of the United States healthcare system since the passage of the Medicare and Medicaid in the mid-1960's (Altman, 1994). The goal of these reforms are to improve patient care and protection of patient rights (Panning, 2014). That is the same goal as the legal system: to enforce, improve, and protect the rights of citizens. As we move forward there will be a brief description of the terms rules, regulations, laws, statutes, and policy development and how they relate to health organizations and change.

Rules

In the American legal system a rule is a procedure or controlling conduct (Meriam Webster.com, 2014a). For example, the rules of the PPACA prohibit insurance companies from discriminating against anyone with a pre-existing condition, dropping your coverage if you get sick, billing you into bankruptcy because of an illness or injury, and limiting your annual or lifetime benefits (whitehouse.gov, 2014). If you look at rules that relates to health care they govern the ability for Americans to access and buy insurance. Within this context the PPACA relates to the law; however, within the law are rules.

Regulations

Regulations are orders prescribed by authority to regulate conduct (Meriam Webster.com, 2014b). For example the Health Information for Economic and Clinical Health (HITEACH) Act gives HHS the authority to write regulations (U.S. Department of Health & Human Services, 2014a). The purpose of the regulations is to regulate the development of a national health information technology infrastructure. The HHS has a Regulatory Agenda that is published each fall and spring. In the fall the HHS has a regulatory plan that condenses the main concerns for the year. The HHS has regulatory authority over a few areas, including: the Affordable Care Act, Health Information Privacy (HIPPA), and Human Research protection regulations (U.S. Department of Health & Human Services, 2014a).

Laws

The legal system refers to a law as a rule, which, if broken, can be enforced with criminal punishment or civil liability. These laws can be made by federal, state, and local legislatures, judges, the president, state governors, and administrative agencies (Meriam Webster.com, 2014c). In health organizations an example of this would be the Emergency Medical Treatment and Labor Act (EMTALA), which is a federal law mandating that anyone with an urgent medical need in an emergency situation is to be stabilized and treated, regardless of their insurance status or ability to pay (American College of Emergency

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Physicians, 2014). EMTALA was enacted by Congress in 1986 as part of the Consolidated Omnibus Budget Reconciliation Act (COBRA) of 1985 (American College of Emergency Physicians, 2014).

Statutes

A statute begins as bill proposed by a legislator. It is referred to as a legislative act or a formal enactment by a legislature to forbid, direct, make declaration of an act or set forth governmental mechanisms (Meriam Webster.com, 2014d). For example, in healthcare HIPPA was an act amended to the "Internal Revenue Code of 1986 to improve portability and continuity of health insurance coverage in the group and individual markets" (U.S. Department of Health & Human Services, 2014b para 1). This was done to "combat waste, fraud, and abuse in health insurance and health care delivery, to promote the use of medical savings accounts, to improve access to long-term care services and coverage, to simplify the administration of health insurance, and for other purposes" (U.S. Department of Health & Human Services, 2014b para 1).

Policy Development

Governments, societies, and actions with the major intent to endorse, renovate, or uphold health as defined by the World Health Organization (WHO) is a health system (Bloland et al., 2012). Public health is a perilous part of the grander concept of health systems and has been defined as "what we as a culture do collectively to assure the conditions in which our society can be healthy (Committee for the Study of the Future of Public Health IoM, 1988). The United States health care system can be said to have numerous systems that operate independently and collaboratively at times (Rice, 2013). It is imperative to understand the United States public health infrastructure, which includes 3 key goals: improvement of health, creation of environments that promote good health, and promotion of healthy development and behaviors (Healthy People.gov, 2010).

OVERVIEW OF CURRENT CHANGES

The iron triangle of health care includes access, cost, and quality. All of them are dependent on each other. Likewise, altering one variable affects the remaining two. Computers had a parallel start progressing from a product only available to a few (due to cost and difficulty of the systems) to where computers are affordable, universal, simple to use, and of even better quality than the past (Liu, 2012). The important issue is that it took many years before computers became more affordable, powerful, and accessible (Liu, 2012). Now they have evolved in the forms of laptops, netbooks, and now smartphones and tablets. In the future health care will break the iron triangle and demonstrate that it is not a law but an observation (Liu, 2012). If you start the debate over which one is more important there is no gain. When you alter one it inevitably alters the others. The health care triangle is a series of relationship that exist together such as doctor, nurse, and clerical. One cannot function or complete their task without the other. This section will address two of the changes that have been seen in recent years to deal with HIT change and implementation of health care for all Americans. Hopefully, in years to come these computer programs will lead to affordable, universal, and quality for HIT and health care overall.

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Health Information Technology for Economic and Clinical Health

Policies, health, and regulations affect various health care organizations. This section will discuss the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009. According to Bloom (2010) the HITECH Act of 2009 is an attempt to improve the performance of health care systems through the use of technology, such as EHRs. The HITECH Act is focused on health organizations using certified EHRs. The HITECH Act was touted to expand the federal government ability to establish a national electronic patient records system by 2014 (APA Practice Organization, 2014). This allowed the HHS the authority to institute programs to improve health care quality, safety, and efficiency through the advancement of HIT innovations and implementations (HealthIT.gov, 2014). The HITECH Act provides for enforcement, and penalties for violation, of privacy and security standards; including permitting enforcement through state attorneys general (APA Practice Organization, 2014). The following is a brief overview of implications to health care organizations, providers, and patients.

Implications to Health Organizations

As we move into 2015 the implication facing health organizations is substantial pressure to implement the HIT systems that have "certified" EHR applications and that fulfill the federal government's definition of "meaningful use," or risk significant financial penalties in the near future (Ford, Menachemi, Huerta, & Yu, 2010). To offset the pressure and cost, every hospital in the United States are eligible for a minimum of $2 million with larger hospitals eligible for more funds to purchase and incorporate EHRs (Bau, 2011). With this in mind, health organizations such as larger hospitals located in urban areas and teaching hospitals are implementing EHRs at a quicker rate (Jha et al., 2009). In 2014 research found approximately 38% of possibly eligible hospitals achieved meaningful EHR implementation by the end of 2012 (Diana, Harle, Huerta, Ford, & Menachemi, 2014). The (HITECH) Act of 2009 is driving fundamental market and industry changes that health organizations need to be strategically poised to deal with and implement.

Implications to Providers

An implication of the HITECH Act of 2009 for providers is the requirement of certified EHRs. This requires providers to commit continued use of EHR technology over a period of years. There are no measurable thresholds and programmatic timelines (Joseph, Sow, Furukawa, Posnack, & Chaffee, 2014). However, the certification process for EHR vendors has reduced provider uncertainty by establishing an unbiased validation service to ensure that certain functionality is available. To ease this transition providers are eligible for payments ranging from $44,000 to $63,000 to use certified EHRs. However, providers have to meet certain criteria of "meaningful use." To an extent that has put the market, and not the federal government, in the position of determining the vendors that will meet the providers needs with the financial incentives (Jospeh et al., 2014). This forces training on operating these systems and in some cases has caused many providers to go into partnership and Limited Liability Corporation (LLC) practices, while others are being engulfed by bigger medial organizations.

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Implications to Patients

Patient implications include reduced cost and better quality of care. The HITECH Act of 2009 supports health care quality improvement and cost reductions. This falls in line with the Patient Protection and Affordable Care Act. An example is the required functions of EHRs being aligned with "requirements for emerging models of health care delivery improvement, including 'patient-centered medical homes,' a term for health care providers who emphasize partnerships between patients and their physicians, and Accountable Care Organizations (ACO)" (Bau, 2011 p 1). The HITECH Act of 2009 has the ability to involve patients and health consumers in their own self-care, even rally entire communities into more patient self-awareness.

Patient Protection and Affordable Care Act

The PPACA was designed to reduce the large number of under and uninsured people in the United States by mandating that individuals obtain health insurance. This section will discuss strengths, weaknesses, opportunities, threats, and possibilities of this policy for the general population and for private businesses. The section will allow for engagement in future discussions and act as an eye-opener to the many areas of importance that are involved with the PPACA.

Strengths of the Patient Protection and Affordable Care Act

The intent of the legislation for the PPRCA was to escalate the availability of health care in the United States of America. The Act increases regulation of the health care industry, incentivizes the development of generic medicines (Public Law 2010, 111th Congress Public Law 148 2010, sec.7001), controls drug costs for Medicare patients by increasing government funding of pharmaceuticals (Public Law, 2010, 111th Congress Public Law 148 2010, sec.2501), and restricts the ability of insurance companies to refuse coverage on health grounds (Public, Law, 2010, 111th Congress Public Law 148 2010, sec.2705). It also mandates minimum coverage requirements for health insurance plans (Public Law, 2010, 111th Congress Public Law 148 2010, sec.1302 (b) (1)). The range of society qualified for government assistance has been enlarged so that more people at the lesser end of the economic scale will have access to health care (Public Law, 2010 111th Congress Public Law 148 2010, sec.2001). While taxation will improve funding of health coverage for those living near the poverty line, and for seniors through Medicaid and Medicare services. The overall strength of the Act is treating healthcare funding as a public service rather than a commodity to trade and purchase, allowing for essential medical service to society as a whole (Schoen, Osbom, Squire, Dotty, & Applebum, 2001).

Through this United States health care system will remain a predominantly private system (West-Oram, 2013). The world's employers are strongly committed to creating a workplace culture of health to boost individual engagement and organizational performance. These have included a brand identity for their employee wellness programs and reduction in health insurance premiums (Rizzo, 2014).

Weakness of the Patient Protection and Affordable Care Act

Religious assemblies have complained about certain requirements of the Act. For example, the objection to the requirement that employer sponsored health insurance provide contraception is a demand

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that Catholic organizations claims ''violate consciences'' (Dolan, 2012). Oppositions were raised to the mandate to purchase insurance, claiming that it will ultimately contribute to the funding of services such as abortion, which they deem immoral; violating their right to freedom of conscience (Bandow, 2012). For example the Amish community opposes vaccination, while the Jehovah's Witnesses or Christian Scientists typically oppose ''biomedical care'' (West-Oram, 2013). Their argument seems to be based on the distinction that the church is separate from the state.

These weaknesses have a continued impact on the Act, and have been raising court cases. Petitioners have filed suits to the U.S. Supreme Court arguing that the requirement to purchase insurance violates the right to practice religion freely (United States Department of Justice, 2012). This could be seen as a weakness or a threat; however, since the PPRCA does include provisions for religious exemption from the purchase of insurance that has stood up in court. This is more of weakness that can be analyzed and dealt with during the growth of the Act.

Opportunities of the Patient Protection and Affordable Care Act

Health organizations and plans have reached a defining moment in the industry and their success depends on how they choose to proceed. Consciously implementing new tools and approaches, such as analytics and Electronic Health Records (EHR) integration, have the ability to craft balance within plans, and inform decision making and the use of resources as they seek to improve the health and well-being of their enrollees (Rizzo, 2014). Opportunities arise because powerful analytics serve as an informatics catalyst that can convert risk scores from a vulnerability to strength, drawing from multiple data sources such as EHRs (Rizzo, 2014).

As noted earlier the PPRCA gives the option to expand Medicaid to most people earning at or below 133% of the Federal Poverty Level (FPL) of the state. Those experiencing homelessness will greatly benefit from this policy change because most nondisabled adults were previously ineligible for Medicaid (DiPietro & Klingenmaier, 2013). Of the over eight hundred thousand patients seen in 2012 at federally funded Health Care for the Homeless clinics, approximately 60% were uninsured (DiPietro & Klingenmaier, 2013). This is an opportunity to increase the overall health care of Americans and lower long-term care in the future.

Threats of the Patient Protection and Affordable Care Act

The author believes the true threat to the PPACA is the buy in from the American public and private business. This has been evidenced on the federal HealthCare.gov exchange website with consumers facing problems getting needed information (Threats to reform growing, 2013). Due to these delays, and technology problems, it is projected that premiums will "go through the roof in 2015" due to the fact that the plan did not enroll enough young and healthy adults in the first year (Threats to reform growing, 2013). Many consumers that did enroll and purchased from the health exchanges have complained the cost of individual coverage is too high. This raises a question as to whether it is possible for all individuals to come together and get a corporate discount as they would receive in a business setting. This may not come to fruition; however, it is imperative that we understand that before health care can get better prices will have to rise. It refers back to the old saying: to make money, you have to spend money.

It has been publicized in the news that many companies like Wal-Mart issued statements that layoffs have been due to raises in health care cost. Franchise owners of chains like Papa John's, KFC, Taco Bell,

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Red Lobster, Olive Garden, Denny's, Longhorn Steakhouse, the Capital Grille, and Applebee's are laying off fulltime employees or cutting hours, blaming it on their inability to afford health insurance or to pay the fines for fulltime employees (Obama Care Facts, 2014). There should be more briefing and media coverage on Fox News and other resources such as crossroads GPS, Forbes, and Heritage Foundation to revitalize and persuade public view on the PPACA. This threat is real even though the PPACA assists small business with the ability to purchase benefits, and forces bigger businesses who don't want to provide benefits to treat their workers with respect (Obama Care Facts, 2014).

Possible Trends of the Patient Protection and Affordable Care Act

Data is quickly being archived; however, there is not much historical health data on enrollees. As the situation becomes more challenging to health organizations and plans, there is the possibility of inundating the health care system right when it gives the opportunity for benchmarking and procedural change. There are similarities and differences between the National Institute for Health and Clinical Excellence (NICE) found in the United Kingdom and the Independent Payment Advisory Board (IPAB) that was developed under the PPACA. The IPAB was created as provision under the PPACA as an instrument for controlling health care costs outside the influence of political procedures and forces. Establishing a 15-member IPAB to extend Medicare solvency and reduce spending growth through the use of a spending target system and fast track legislative approval process. The members are appointed by the President with the advice and consent of the Senate.

SOLUTIONS AND RECOMMENDATIONS

Health Informatics (HIs) experts in a Delphi study ranked Business Process Reengineering (BPR) as one of the top research priorities for HI (Bliemel & Hassanein, 2004). The RAND Corporation developed the Delphi Method to forecast the impact of technology on business (RAND, 2014). The Delphi method surveys the opinions of "expert panels." The research is conducted in three rounds, where the information is gathered, refined, and then fed back to the expert participants. The feedback stage allows issues to be sharpened and helps to highlight the major issues involved. Round one involves an in-house panel that seeks to identify the research questions for the experts. It also conducts a pre-test of the survey. The second round involves an examination of the issues by the expert panel. At this stage, additional items are often suggested that may have been overlooked. The panel responses and additional items are combined to the original questionnaire. In the third round, the panel makes judgments on the items. This sometimes takes the form of a multiple-choice questionnaire. The goal is come up with an expert consensus by reducing the range of responses (RAND, 2014). The results showed a process-oriented healthcare industry would benefit from BPR. BPR involves several organizational improvements that are enabled by electronic patient records and an inter-operating system (Bliemel & Hassanein, 2004). In which the focus is on achieving specific performance targets such as specific profit margins, clinical outcomes, quality improvements, or customer satisfaction. A health organization's balanced-scorecard reports will indicate whether the organization is managing with acceptable results and provide a basis for assessing their managers' performances and their roles in the organization's success (Berger, 2002).

The growth and maturity of informatics has been a prime catalyst in positioning the health care industry for change. The PPACA for instance, which puts in place comprehensive health insurance reforms that

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will roll out over four years and beyond (U.S. Department of Health and Human Services 2013). During the implementation of reform, informatics will serve as the foundation for all aspects of successful healthcare reform initiatives (Health IT News, 2013). Changeability addresses the positive question of what makes people and organizations good, and their ability to manage for the future. In tentative times, pressure for alteration is greater than ever (Cree, 2009). High performance health organizations compete on their ability to identify up-and-coming threats and opportunities, and to respond to them swiftly with well-informed decisions. The development of networks of longitudinal, comprehensive, and interoperable HIT offers opportunities for improving coordination of care and the usefulness of records, increasing competence of health care, and avoiding duplication of services (Leavitt, 2007).

These decisions must encompass business analytics. By understanding the process of analytics, healthcare providers have the insight necessary to make process adjustments in the future. To make excellent managerial decisions companies need access to information that encompasses not only company performance but also the broader competitive landscape (CFO Publishing Corporation, 2009). Informatics can increase options for treatments, reduce risks, improve processes, help with financial management, and ultimately improve patient care. It requires having the people, data, technologies, and processes necessary to mine the information and act upon it.

The Delphi study also identified electronic patient records and connected inter-operating systems as urgent research priorities (Bliemel & Hassanein, 2004). Having a physician or physicians who are passionate about the HIT, who are salaried and committed to the HIT and clinical systems, is critical for success (Amatayakul & Hodges, 2006). The acquisition of new hardware and software has the possibility to enhance a health care organization's potential to provide high-quality, cost-effective patient care.

Management must commit to open and honest disclosures of facts that not only help people understand the rationale for change, but also how it affects and benefits the organization (Nicholson, 2009). It is important for administrators to function well at three levels: the hospital/macro level, the internal (department or program) level, and the external/community level. They need to cultivate other staff leaders, redesign functions, prioritize goals, and promote internal communication to create a sense of professional pride and collective ownership (Mizrahi & Berger, 2005). These leaders need support from other leaders and from the professional and academic resources of major institutions to make their case. They must develop mutually supportive staff-driven activities, mechanisms to share information, ideas, resources about best practices, survival models, and methods of reorganizing roles and functions within and between hospital systems (Mizrahi & Berger, 2005). To compete effectively, health organizations must look beyond improving operating efficiency to improving their processes for managing performance (CFO Publishing Corporation, 2009).

To maintain cost, accountability, and fairness there should be a national standard of rate by the National Association of Insurance Commissioners (NAIC) to look into areas such as:

1. A definition of "rate filing" that includes new and renewed premium rates, any proposed rating formula, classification of risks, or modification of any formula or classification of risks.
2. A standard of review that places the burden of proof on the health insurance issuer to demonstrate that the proposed.
3. Ensuring that rate filing is not unreasonable, unnecessary, inadequate, or unfairly discriminatory (NAIC, 2010).

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While, America's Health Agenda focused on these areas of concern to maintain cost, accountability, and fairness:

1. The Implementation of electronic health claims, premium payments, referral authorizations by 2016.
2. The formation of a National Prevention, Wellness, and Public Health Council charged with developing a national strategy to improve the nation's health.
3. The creation of a grant program to support the delivery of evidence-based and community-based prevention and wellness services aimed at strengthening prevention activities (America's Agenda: Health Care for All, n.d.).

Touting these changes as being instrumental in reducing chronic disease rates and addressing health disparities, especially in rural and border areas (America's Agenda: Health Care for All, n.d.). This funding will support primary care training and capacity building. The development of training programs that focuses on primary care models such as medical homes and team management of chronic diseases (America's Agenda: Health Care for All, n.d.).

Public health institutes (PHIs) are nonprofit organizations that increase the public's health by modernizing, leveraging resources, and building partnerships across sectors including government agencies, communities, the health care delivery system, media, and academia (National Network of Public Health Institutes, 2010). Health System Strengthening (HSS) has become a major focus of the United States (Bloland et al., 2012). The Role of Public Health Institutions in Global Health System Strengthening is critical for achieving major health goals in preventive care in the community.

The American Public Health Association (APHA) has created building blocks for the health infrastructure to gain funding for local, county, and city public health agencies to ensure that the health system is assessing and responding to public health needs for preventive care (American College of Physicians, 2012). Adequate, steady funding streams for the development and maintenance of local programs and activities are fundamental for the successful achievement of the goals of public health in the community. Funding by the government enables public health providers' access to resources that private clinicians may not have.

Health care can be provided through public and private providers. Public health care is usually provided by the government through national healthcare systems. Private health care can be provided through "for profit" hospitals and self-employed practitioners, and "not for profit" non-government providers including faith-based organizations (Basu et al., 2012). Creating maintainable, operational linkages between the clinical and community settings can improve patients' access to preventive and chronic care amenities by developing partnerships between organizations that share a common goal of improving the health of people and the communities (Agency for Healthcare Research and Quality, 2014).

Table 3 shows factors that lead to the requirement to implement health-authorities interconnection infrastructure. These factors may also be seen as the targets that are, and will be, accomplished. The Table constitutes the functional requirements for the network infrastructure and evolving reformation and of current advances in the field of data communications. These factors include areas such as:

1. The regional structure of the administration services.
2. The treelike managerial structure of the health care units

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Table 3. Benefits of using information and communication technologies in the health care sector

Health Care Players	Benefits
Administration units	• Policy development and decision-making are strongly supported by effective and on-time information gathering and distribution. • Easier adaptation to eEurope challenges. • Supply control; better budget monitoring. • Overall improvement in the way citizens are served.
Hospitals	• Increased efficiency in communication between hospitals, administration units, social security services, careers, physicians, and citizens. • Personnel familiarization with information technologies through Internet-access operations. • Patient-record traffic support. • Reinforcement of the need to build health care information systems (HCISs) and local networks in hospitals. • Utilization of the developed Intranets. • Better information services for the citizens. • Advanced telematics services (e.g., telemedicine applications in difficult-to-reach regions).
Health care personnel	• Meets the increased need for telecommunications not only for medical, but also for compensation reasons. • Participation in care chains and relevant coordination. • Physicians' collaboration. • Patients' history data retrieval. • Continuing education services; familiarization with new technologies through special training programs. • Interaction with patients to provide advice or prescriptions.
Citizens	• Use of the Internet for health-related information retrieval. • Information and communication technologies will increase interest in citizens' health-issues management. • Creation of the appropriate infrastructure for future provision of special health services for specific population groups (e.g., in-house services for older people or patients with long-lasting attendance and nursing needs).

From *Implementation and Integration of Regional Health Care Data Networks in the Hellenic National Health Service,* by Lampsas, Vidalis, Papanikolaou, & Vagelatos (2002).

3. The active participation of general practitioners in the new system.
4. The need for transmission of sensitive electronic health record (EHR) information and for interconnection with private pharmacies and the insurance system in the years to come.
5. The successive advances in Internet technologies (Lampsas, Vidalis, Papanikolaou, & Vagelatos, 2002).

FURTHER RESEARCH DIRECTIONS

There should be further research on health organization in other countries such as the Canada Health Care System, which is increasing their use of health technology assessment organizations including the Canadian Agency for Drugs and Technologies in Health (CADTH, a national body) and specialized provincial agencies in Alberta, Ontario, and Quebec. The organizations support and inform purchasing decisions, service management, and clinical practice (Thomson, Osborn, Squires, & Jun, 2013). The Danish Health Care System's 2007 structural reform centralized the administration of hospital care in order to enhance the coordination of service delivery and to improve quality and efficiency. They merged 14 counties to create five regions and reduced the number of municipalities from 275 to 98. The regions are currently reorganizing their hospital systems, closing or combining small hospitals, and building new hospital infrastructures (Thomson, Osborn, Squires, & Jun 2013).

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The English Health Care System Clinical Commissioning Groups (CCGs) are replacing Primary Care Trusts as local health care purchasing organizations, introducing the National Health Service (NHS) Health and Social Care Act 2012. This allowed the NHS in England to take over day-to-day responsibility, and expanding the NHS into a role of Monitor to act as the economic regulator of public and private providers. The National Institute for Health and Clinical Excellence (NICE) sets guidelines for the NHS on clinically effective treatments, and appraises new health technologies for their efficacy and cost-effectiveness (Thomson, Osborn, Squires, & Jun 2013).

In the French Heath Care System, the National Support Agency for the Performance of Health and Medico-Social Facilities provides guidance to institutions in need of structural changes and performance audits, and publishes dashboard indicators such as length of stay, occupancy, patient satisfaction, and incidence of bedsores, which are classified by category and type of medical activity. It is the only such public body in Europe. The Biomedicine Agency operates in four key areas:

1. Assisted reproductive technologies.
2. Prenatal and genetic diagnosis.
3. Embryo and stem cell research.
4. Procurement and transplant of organs, tissues, and cells (Thomson, Osborn, Squires, & Jun, 2013).

Moreover, research should be continued in the area of informatics. For example the Supporting LIFE Project cultivates a low-cost implementation with extraordinary impact on the control of infectious diseases in Malawi (Department of Informatics, 2014). This is example of ongoing research projects by the Department of Informatics Lund University School of Economics and Management. This type of research will determine if informatics has the ability for organizations to understand their risk and cost profiles while ensuring the best care for patients. In conjunction with this research there should be a focus on health organizations' inequities, such as geographic and financial.

Computer networking opens many avenues to effective communication and collaboration amongst health care providers and organizations in the coordination and delivery of patient care (Ponemon Institute, 2014). For example, the increasing use of smartphones of today's society and the advancement of the Accountable Care Organization (ACO) model allows for the chance to update and revolutionize outdated communication in health care (Ponemon Institute, 2014).

Ponemon Institute (2014) study found three areas of opportunity that can be improved with communication and collaboration:

1. **Patient Admission:** Admitting one patient takes about 51 minutes, of which an average of 33 minutes (65 percent) is wasted due to inefficient communications. This translates into an annual loss of about $728,000 per U.S. hospital.
2. **Emergency Response Coordination:** Coordinating an emergency response team takes an average of 93 minutes per patient. Of this time, an average of 40 minutes (43 percent) is wasted due to inefficient communications. This equates to an annual loss of more than $265,000 per U.S. hospital.
3. **Patient Transfer:** Transferring a patient to another facility or home care/hospice takes about 56 minutes, of which an average of 35 minutes (63 percent) is wasted due to inefficient communications. The total annual cost of this waste is about $754,000 per U.S. hospital (p. 2).

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CONCLUSION

This article investigated the background, controversies, and problems surrounding Health Information Technology. An overview of current changes, recommendations and solutions, further research, and a conclusion rounded out the article. One universally accepted truth in organizations is the unavoidability of change. Another is that few organizations achieve the benefits they should due to not adequately planning change. This leads to the old adage organizations do not plan to fail, they fail to plan for change. Hospital boards approve millions of dollars for software, hardware, and consultants, but frequently the new positions required to build an effective team are not included in the approved budget. Numerous reports have indicated the important of HIT. The question still remains as to how implementation will happen on a consistent level.

Change management, process and workflow improvement, comprehensive training, user support, and system ownership are all perilously important to HIT success, and therefore require funding. Informatics will allow organizations to understand their risk and cost profiles while ensuring the best care for patients. Informatics can be used across the broad spectrum of healthcare and is not limited to decision support functions. Management tools and techniques will help health organizations, if they hold their managers accountable for achieving targeted results. Effective communication of a well-deliberated plan is at the foundation of the management of employees during times of change.

An integrated program of change that allows for the incorporation Business Informatics (BI) or Health Business Informatics (HBI), Health Informatics (HI), Nursing Informatics, or simply "Informatics" is essential. Renovating care into quality care is the core of the clinical environment, and nurse leaders need to recognize the importance of emerging technologies (McHaney, n.d.). Nurse leaders should become involved in planning, designing, developing, implementing, and evaluating networks that will be used by nurses. This has led to a specialty area that integrates sciences of nursing, computer, and information called Nursing Informatics (McHaney, n.d.). This specialty area provides expertise in developing and implementing Information Management Systems (IMSs) that can be used by nurses to enhance daily tasks and integrate various aspects of patient care. These techniques are used to seamlessly integrate technology and information that may be located within a geographical area or even across international boundaries (McHaney, n.d.).

Reforms have the ability to save money and lives in the long run. The future is dependent on programs such as the Inner City health Clinics (ICHC), launched by PPACA (Frykholm & Kennel-Shank, 2014). The Act included $11 billion in new funds for clinics that serve neighborhoods where access to medical care is limited and many people are uninsured or underinsured. The expansion of community health centers is especially important in the 25 states that have accepted the expansion of Medicaid to people with incomes up to 133% of the federal poverty income level. The new term that will be used is "conduit to care." When someone is identified through a screening as having a health problem, that person may be reluctant to follow up with a doctor. ICHC's outreach workers provide the follow up contact (Frykholm & Kennel-Shank, 2014). This approach is crucial to reaching people before their health problems get out of control. This is the kind of life-saving and cost-saving method that healthcare reform needs to thrive in the future. Telemedicine is also on the rise and has the opportunity to provide new cost-effective and efficient methods of delivering health care across geographical distances (Gupta & Saot, 2011). The overall benefit is tremendous; many consumers who never had insurance finally have access to it, or better coverage. The question that remains is whether the changes by the PPACA will force acute care organizations to integrate vertically with post-acute care providers (Shay & Mick, 2013).

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KEY TERMS AND DEFINITIONS

Accountable Care Organizations (ACO): Groups of doctors, hospitals, and other health care providers, who come together voluntarily to give coordinated high quality care to their Medicare patients (Center for Medicine & Medicaid Services.gov, n.d. para. 1).

Business Process Reengineering (BPR): Originated in the 1950s as large firms began to explore the potential impact of computers on the efficiency and effectiveness of their business processes. Different approaches, methods, and techniques have since appeared and constitute the foundations of BPR as it is presently known.

Change Management: A multidisciplinary group activity to provide optimum solutions to change the process of how an organization does business to transform efficiently with organizational change (Patton & James, 2000).

Electronic Health Record (EHR): Also known as Electronic Medical Records (EMR). Certification Commission for Healthcare Information Technology Commissioner meeting minutes of April 15, 2008 related that the work group addressing the terms EMR, EHR, and PHR would like to retire the term EMR and take the definition of EHR to present future vision (Certification Commission for Healthcare Information Technology, 2008).

Health in All Policies: A policy or reform designed to secure healthier communities, by integrating public health actions with primary care and by pursuing healthy public policies across sectors (The World Health Report, 2008).

Health Informatics: As defined by the U.S. National Library of Medicine, health informatics "is the interdisciplinary study of the design, development, adoption, and application of IT-based innovations in healthcare services delivery, management, and planning" (Ong, 2014 para 1).

Health Information Technology (HIT): The all-inclusive management of medical information and the protected exchange between health care consumers and providers.

Health Information Technology Interoperability: Defined as the "principal difference between an EHR, which can exchange information interoperably, and an EMR, which cannot" (U.S. Department of Health & Human Services, 2008, p. 14).

Health Sector Reform: An effort aimed at reconfiguring health services, dominant in the 90s in the framework of the New Public Management, typically including the following components: separating the roles of financing and provision and the possible introduction of a managed market; developing alternative financing mechanisms, particularly user charges and health insurance; decentralization; limiting the public sector and encouraging a greater role for the private sector; prioritizing the use of cost-effectiveness techniques (Collins, Green, & Newell, 2002).

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Health Service: Any service (i.e. not limited to medical or clinical services) intended to contribute to enhancement of health or to the diagnosis, treatment and rehabilitation of sick people (World Health Organization, 1998).

Health System Strengthening (HSS): Any range of initiatives and strategies that improves one or more of the functions of the health system and that leads to improved health through improvements in access, coverage, quality, or efficiency (Islam, 2007).

Informatics: "Studies the representation, processing, and communication of information in natural and engineered systems. It has computational, cognitive and social aspects. The central notion is the transformation of information whether by computation or communication, whether by organisms or artifacts" (University of Edinburgh Informatics, n.d. p. 1).

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Chapter 20
On Piloting Web-Based Rabies Surveillance System for Humans and Animals: Web-Based Rabies Surveillance System

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ABSTRACT

Rabies is a neurodegerative viral zoonotic disease that affects all warm blooded animals. It is estimated that about 99% of human rabies cases are caused by dog bites. High prevalence of rabies has been reported in different parts of Tanzania. The disease has continued to cause public health threat to the communities due to weak passive and active surveillance systems. The data piloted in this study was based on the information gathered from Kilosa district. The geo information collected was used to develop a geospatial based system that can easily show the hotspots of rabies. The use of WEB GIS is likely to strengthen disease surveillance in Kilosa and other Districts of Tanzania. This approach offers a model for sharing both human and animal diseases surveillance information. Adoption of this approach is likely to increase awareness and timely response to rabies incidences.

INTRODUCTION

Rabies is a viral neurodegenerative zoonotic disease that affects all warm blooded animals (Fitzpatrick et al., 2012). The rabies virus belongs to the Lyssavirus genus of the family Rhabdoviridae, and order Mononegavirales (Swai et al., 2010). The disease affect not only human being and dogs, but also other domestic and wild animals such as: cattle, goats, cats, horses, pigs, hyenas, jackals, lions, wild dogs, mongoose, primates and bats (Sambo, 2012; Swai et al., 2010; Swai et al., 2011). Rabies is endemic and has challenged the health systems in different developing countries; pausing a big challenge in both

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human and animal health systems thus calling for one health approach to manage the disease in both human and animal (Mazet et al., 2009; Rweyemamu et al., 2013). From a global public health perspective, the domestic dogs are considered to be the main target for rabies control and principal reservoir for transmission of the virus to humans and domestic livestock (Mazigo, 2011).

Poorly coordinated rabies incidences reporting system to timely identify, prevent and respond to such cases remains one of the major challenge in establishing a sustainable surveillance system in Tanzania (Mazigo, 2011, Rweyemamu et al., 2013). Certainly, human deaths due to rabies can be prevented through delivery of prompt post-exposure prophylaxis (PEP) to bite victims (Cleaveland et al, 2002). Furthermore, the transmission cycle between humans and domestic dogs can be reduced through sustained mass vaccination programs of domestic dogs, strengthening the reporting system, detection of rabid animals, mapping of endemic areas and prompt response to treatment and prevention strategies (Blanton et al., 2006; Cleaveland et al., 2001; Cleaveland et al., 2013).

The application of ICT in rabies surveillance system in Kilosa district and other parts of Tanzania is very limited (Mboera and Rumisha, 2008). However advances in ICT observed in recent years increased possibilities for community members' involvement in rabies case identification, detection, alerting, monitoring, controlling and surveillance to reduce human deaths and hence minimize its socio-economic impact (Knobel et al., 2005). Application of ICT based rabies surveillance systems is likely assist the Veterinarians to sustain mass vaccination of domestic dogs, to keep records of vaccinated domestic animals and incidences of rabies in domestic animals; to enable public health workers, to create awareness on the magnitude of risks and steps to be taken upon exposure.

Thus, the overall objective of this study was to develop an effective, efficient and cost effective real time web based surveillance system for identifying, reporting, controlling and monitoring rabies incidences in Kilosa district, Morogoro, Tanzania. Specifically the study assessed the appropriateness of the real time rabies surveillance system for instant incidence identification, reporting, control, monitoring and surveillance. Ultimately the development of web based rabies surveillance system would enhance the capacity for; identifying, collecting and reporting of incidences to a central institution, aggregating and sharing data related to national rabies control using geographic web services and social media in appropriate combinations of traditional and novel media (including Internet based Google Maps, local radio and TV); livestock based organizations and the general public (Georgiadou et al, 2011).

SITUATION ANALYSIS

Rabies is one of major public health problems in different parts of Tanzania (Mwisongo et al., 2001). In Kilosa district, rabies has remained endemic for many years despite efforts to control it in domestic dogs (Bardosh et al., 2014). The district boarders Mikumi national park thus allows interactions between humans, domestic dogs and wild animals. The presence of a human-dog-wildlife interphase in the district offers a unique environment for the persistence of the disease in the area (Sambo, 2012). In addition,lack of timely communication during vaccination campaigns has remained to be the major setback in such a way that many people especially in rural areas of Kilosa do not vaccinate their dogs on annual basis as required because such information do not reach them timely. Lack of awareness is also a problem; most people have limited knowledge on handling rabies cases and often they do not know what to do if their animals get infected (Mazigo, 2011). This is attributed to the traditional methods that are used in rabies surveillance in Kilosa District (Bardosh et al., 2014).

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i. Dogs Vaccination against Rabies

Coordinated massive vaccination of domestic dogs against rabies is one of the most effect strategy for controlling the disease in communities with large dogs populations. Vaccination breaks the transmission cycle of the disease between dogs, other domestic animals and humans. Dog bites are the cause of almost all human rabies' deaths, with much smaller number of cases occurring each year from other domestic and wild animals (Hiby, 2012). Low vaccination success rate has been reported in different parts of Tanzania due to the fact that few people are aware of the vaccination campaigns thus on the day of vaccinating dogs only a small number of community members vaccinate their dogs while the majority remains un-vaccinated. This is partly caused by under reporting of the rabies incidences and lack of awareness of control measures (Mazigo, 2011).

ii. Post Exposure Prophylaxis

In humans the rabies is entirely preventable, by timely administration of Post exposure prophylaxis (PEP) to dog bite victims. Modern cell culture vaccines used in combination with rabies immunoglobulin's has been reported to be virtually 100% effective in preventing human deaths if administered promptly to rabies-exposed patients (Hampson et al, 2008). Availability of PEP in most health centers has remained a big challenge in Tanzania. For example in Kilosa district there are few health centers with PEP stocks for treating the affected dog bite victims (Mboera et al., 2001). In most cases bite victims have to travel long distances to the hospital to access PEP. This results to delayed administration of PEP and failure to adhere to treatment regimens. According to WHO guidelines, PEP is an emergency and as a general rule should not be delayed or deferred; does not have contraindications if purified rabies immunoglobulin and vaccine are used; must be applied using vaccine regimens and routes of administration that have been proven to be safe and effective. The 5 dose intramuscular regime is the most commonly used: one dose of the vaccine should be administered on days 0, 3, 7, 14 and 28 in deltoid region or, in small children, into the antero-lateral area of the thigh muscle. The 2-1-1 regimen may also be used whereby; two doses are given on day 0 in the deltoid muscle, right and left arm. In addition, one dose in the deltoid muscle on day 7 and one on day 21.

iii. Application of ICT Facilities in Diseases Surveillance Systems

For prompt detection and response to any disease outbreak, a sensitive surveillance system is indispensable. A well established communication system is the 'heart' of the surveillance system. The speed of communication which is most critical to contain or stamp out an outbreak, save lives, and prevent or minimize detrimental effect to the communities. It is challenging, however, to set up an effective communication system, and even more so in poorly established infrastructure in the developing countries like Tanzania.

Radios and Television

The media of communication to disseminate information on rabies to community members that is used in Kilosa district include the use of community radio. Kilosa community radio has played an important role in disseminating information on rabies outbreak and public health education to increase awareness

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of people on the disease. Despite of the use of radio and television still the disease has continued to be a public health threat. One of the reason causing difficulties to control the disease include presence of a poor link between the Veterinary and humans healthcare departments resulting to un-timely communication of the rabies incidences (Mazigo, 2011; Mboera et al., 2001; Sambo, 2012).

Mobile Phone

In recent years mobile phones usage in Tanzania has expanded so much with almost every household owning a handset. Mobile phones are very useful means of communication (Sanga et al., 2014; Pascoe et al, 2012). This technology has been used in South Africa for monitoring and surveillance of rabies outbreaks, farmers phone or send messages to the State Veterinary offices to report any rabies case and Veterinarian or Animal Health Technician gives feedback to the farmer through the mobile phone (McCrindle and Masipa, 2010). This means of communication is rarely used in Kilosa. However, it is a very useful tool such that a diversity of users have the ability to call a medical practitioner or Veterinarian to communicate rabies incidences and this reduces the cost of farmers to travel to the Veterinary office to report diseases and deaths in either livestock or human being. The challenges for this technology in Kilosa district is poverty which hinder farmers to be able to own the mobile phones and pay for the service. However, the technology has some disadvantage such as illiterate farmers cannot use; if the farmer is illiterate would find it difficult to use the technology and for poor farmers it is difficult to afford buying a mobile phone (McCrindle and Masipa, 2010). Establishment and implementation of a web based rabies surveillance system which will be more efficient and effective in commutating and disseminating rabies related information is likely to improve rabies surveillance in the country.

RABIES SURVEILLANCE SYSTEMS

The majority of animal and human exposure to rabies virus can be prevented by raising public awareness about the rabies virus and how it is transmitted and prevented (Sambo, 2012). In case there is a person or animal which has been affected by the virus then appropriate Veterinary and health care personnel should be consulted. The Veterinary and human health Departments are responsible for giving education to people through seminars, newspaper, books, articles, journals and different mass media (Mazigo, 2011). Mazigo (2011) reported increasing trend in the number of reported cases in recent years at Bugando Hospital in Tanzania that was explained as an outcome of increases awareness on the consequences of rabies which has been conducted through different stakeholders; ultimately this has raised people's level of knowledge on the disease.

According to the World Health Organization (WHO) disease surveillance is defined as the continuous, systematic collection, analysis and interpretation of health-related data needed for the planning, implementation, and evaluation of public health practice (McNabb et al., 2002; Nsubuga et al, 2002; Kimaro and Nhampossa, 2005. Recent studies have shown that the human population boom in Africa appears to correlate well with the increase in the number of domestic dogs, and by conservative estimates, however the prevalence of human rabies is considered to be under-reported due to a weak surveillance system in place (Mazigo, 2011). In Tanzania, the under-reporting is largely attributed to poor surveillance systems and people's tendency not to report human and animal cases of rabies. Furthermore, there

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is over-dependency on clinical diagnosis (in animals and/ or humans) that downgrade the reliability of rabies-surveillance systems. Certainly, these weaknesses have translated to poor planning of surveillance programs, resulting in shortage PEP and even when available may be accompanied with inappropriate administration, as well as delays in its administration (Mboera et al., 2001; Sambo, 2012). Although not as frequent as the inability to afford treatment, such scenarios have built a lack of trust in health facilities, as well as poor compliance with PEP regimens leading to human deaths that would otherwise be prevented.

IMPORTANCE OF RABIES SURVEILLANCE SYSTEM

Systematic collection, analysis and aggregation of quality rabies-related data is paramount to the success of all public health initiatives to fight against the disease (Cleaveland et al., 2013). This will consequently require a sound monitoring system of trends of rabies incidences and well established reporting system. The absence of correct and up-to-date data on incidences of rabies or in cases of a poor reporting system lead to futile prevention and control programs. The presence of reliable and functioning surveillance systems is necessary for the success of global health initiatives to fight against the rabies (Knobel et al., 2005). However, surveillance systems that collect useful and representative data in developing countries like Tanzania are not functioning well due to limited available resources, lack of knowledgeable staff, disorganization, and poor infrastructure for finding and reporting cases (Cleaveland et al., 2013). Furthermore, in Tanzania it has been estimated that around 23,709 humans sustained dog-bite injuries between 1990 and 1996, whereas 42,669 human dog-bite injuries were reported for the year 2000 (Mazigo, 2010; 2011; Bardosh et al., 2014). These reports suggest that there was either an increase in the number of cases or the extent of the problem was being underestimated in previous studies. However, untimely reporting and response due to poor communication networks remain to be the major obstacle for and effective and functional surveillance system (Table 1).

THE APPLICATION OF ICT IN RABIES SURVEILLANCE

In order to overcome the weaknesses of the traditional rabies surveillance system, there is a need to use the Information and Communication Technologies (ICTs) in the surveillance process. It is possible to reach a large number of people to create awareness about rabies through the use of mass communication medias such as Internet, face book, television, radios and other means of communication (Blanton et al., 2005). The ICT based rabies surveillance systems support easy awareness creation (i.e. sensitization) and a more rapid and timely reporting and response to zoonotic outbreaks (Thinyane and Foster, 2010). Furthermore, ICT facilitates communication between veterinary and human health services by making both Departments aware of rabies surveillance data. Zoonoses are certainly the most prominent example of diseases which require compulsory interaction between human and animal health Departments because of their dual affect on both livestock and humans (Zinsstag and Tanner, 2008). Introducing ICT will also be useful in determining vaccination schedules and tracking purpose.. Additionally the application of Geographical Information System (GIS) allows mapping of rabies hotspots so that the livestock Department can easily track implement control programmes (Blanton et al., 2005). It also can present rabies data

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Table 1. National Roadmap on Rabies Identification, Detection, Control, Monitoring and Surveillance System

Ministry of Livestock and Fisheries Development	• Purchase and distribute rabies vaccine • Check vaccine viability • Check vaccination coverage and certification • Ensure cold chain for storage of vaccines • Diagnosis – sample collection, submission, testing and characterization of viruses isolates • Review policy, laws regulations, guidelines, checklist and standards • Reinforce information network system from community to National level • Organize and supervise dogs population census • Law enforcement • Monitor and evaluate implementation of the rabies control strategy
Ministry of Health and Social Welfare	• Purchase and distribute human rabies vaccine • Annual supervision • Public awareness • Human rabies diagnosis • Active surveillance • Heightened awareness and training of front line workers • Policy review
Prime Minister's Office Regional Administration and Local Government	• Public awareness campaigns • Stray dog control • Support procurement of vaccines • Implement rabies vaccination campaigns • Support training of extension staff and farmers • Supervise establishment and maintenance of the Livestock Development Fund (LDF) by • Local Government Authorities • Monitor and evaluate implementation of the rabies control strategy at district level • Raise awareness on the importance of the disease to the public by LGAs • Formulate by laws, which will be used as a tool for control of the disease • Conduct regular active surveillance of the disease at village level • Involve the Standing Committee at ward level on Education, Health and Water on rabies • control • Collaborate with other stakeholders in implementing rabies control strategy
Ministry of Natural Resources and Tourism	• Improve knowledge on rabies • Capacity building at all levels • Vaccination vs rabies in interface areas (annual) • Awareness on rabies • Improve diagnostic capabilities of wildlife laboratories • Improve linkages neighbours and community • Formulation and reinforcement of Policy and Legislations • Undertaking collaborative research
Ministry of Justice and Constitutional Affairs	• Provide legal assistance in drafting by-laws and regulations regarding rabies control • Legal advice on issues related to rabies control strategy
Institutions	• Carry out operational research on rabies • Collaborate with other stakeholders in designing and implanting the rabies control strategy • Provide technical advice on rabies control • Develop and disseminate research findings • Train students in fields of rabies
Private Sector and Non Governmental Organizations	• Collaborate with other stakeholders in designing and implementing the rabies control • strategy • Support procurement of vaccines

historically, which means the spread of rabies can be tracked not only based on region but also on time series (Hampson et al, 2008; Sita and Laksmita, 2012).The use of modern ICT especially GIS provide a platform for investigating the use of web GIS in supporting the report of Veterinary information during outbreaks. Such web GIS can help different stakeholders from public health and animal health as well as

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law enforcement agents to visualize the cases of rabies on map in real time. The idea behind Web GIS is to provide a common platform of collaboration for all entities that are significant in dealing with rabies. The importance of early awareness and response measures when dealing with rabies incidences is very important. Rabies still poses a public health threat and quick communication and collaboration between various stakeholders is an important aspect in reducing the disease burden. Example of a project which implemented Web GIS is from South Africa where it aims at improving reporting and communication mechanisms through an ICT web based system (Thinyane and Foster, 2010).

Web based application is the best option than mobile based application because early study by Steinfield and Wyche (2013) argue that even though mobile phones have potential to improve the access of agricultural information and knowledge to farmers but still there are problems which hinder its effectiveness and efficiency. According to Steinfield and Wyche (2013), these problems are:

1. Farmers lack appropriate competence in using mobile phones.
2. Many farmers speak different native language while mobile based systems are in English or Swahili and this limit comprehension of messages by end users.
3. Low levels of literacy hinder successful use of mobile based systems.
4. Some rural areas have no access to electricity to keep phones charged and also, some remote areas have not telecommunication network, thereby reducing its availability for use with mobile based system.
5. Many farmers are reluctant to use the limited airtime credit they have to access mobile based systems.
6. Some culture and norms deny women to calling or texting strangers of the opposite gender, limiting their ability to benefit from mobile based systems.

A web-based GIS application of rabies provides a new resource for the rapid mapping and displays the dissemination of data on rabies cases in order to show information about any rabies infected area. Rabies cases are shown in the points form (markers) on the map based on the coordinates of locations. Each region is being displayed in different colors according to the number of rabies cases that occurred. This application can support relevant Government authorities to make informed decisions focusing on areas which have high rabies incidences. Also it is useful in determining vaccination schedules so that the Veterinary Department can easily track and determine priority areas for controlling the disease. It also allows retrospective review of data, which means the spread of rabies can also be tracked based spatial temporal patterns (Sita and Laksmita, 2012).

The emergence of modern technologies that support geospatial information gathering is of great use now. The use of open data kit that incorporates geoinformation has brought great advancements in geo sciences. For example, geoODK application (http://geoodk.com/ accessed on 20-March-2015) can be used to collect georefenced information and update of the data can be done instantly while at the field.

Thus, the developed Web GIS improves the functionality of the existing manual systems by developing an interactive and user friendly system that aims at improving reporting and communication through web. It can also help to create awareness to the people on areas where there is an outbreak of the disease. Furthermore, it can help to provide public education on rabies in an easy way. The system can be used by people to give information on rabies incidences. The information can include animal bites, cases of animal rabies, and cases of human rabies.

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PILOTING WEB BASED RABIES SURVEILLANCE SYSTEM IN KILOSA DISTRICT

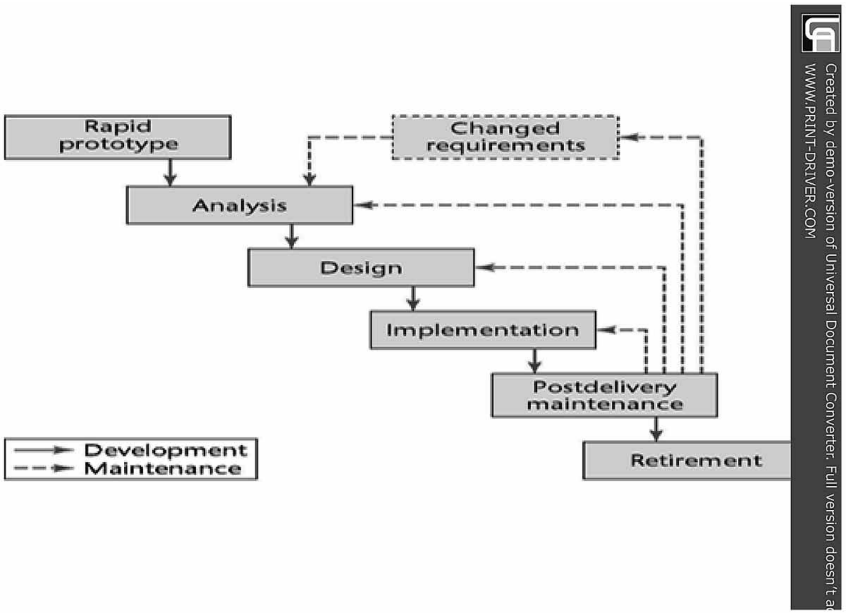
This study employed a mixed research approach as well as rapid prototype technique in development web based rabies surveillance system. The study was conducted in Kilosa district which is one of the six districts of Morogoro region in Tanzania. It is bordered to the north by Manyara Region, to the northeast by the Tanga Region, to the east by Mvomero District, to the southeast by Morogoro Rural District, to the south by Kilombero District, to the southwest by the Iringa Region and to the west by the Dodoma Region. According to the 2012 national census, Kilosa district had a total population of 438,175 whereby females were 219,797 while 218,278 were males (URT, 2013). Kilosa district is divided into wards and it has 35 wards (URT, 2013). Kilosa District has climatic conditions and fertile soil that provide conducive environment for agriculture activities such as food crop production and livestock keeping. It's in this district where Mikumi National Park is allocated as described in previous sections.

REQUIREMENTS FOR DEVELOPMENT OF ICT BASED RABIES SURVEILLANCE SYSTEM

Requirements were gathered from the users first by using interviews. Interviews are a good way to collect perception data from people particularly if there are small numbers of people whose views are to be captured. Key informants in Kilosa district were interviewed focusing role of ICT in diseases surveillance and questions were probing on necessary information on the rabies in the district.

The interview was used to collect information from village executive officers from villages around Mikumi National park. Other key informants who were interviewed were: in charge for District health

Figure 1. Requirements for development of ICT based rabies surveillance system



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department, n charge for District veterinary health department, researcher from SUA Faculty of Veterinary Medicine researching on ecohealth (http://tanzaniaecohealth.com/index.html), Agricultural extension Officer from Kilosa District, Owner of rural Telecentre in Kilosa (KIRSEC) (http://www.kilosaruralservices.net/) and administrator of Kilosa Community radio. In addition semi-structured interviews were also conducted consisting of several key questions that helped to define the areas to be explored. Thus it allowed both the interviewer and interviewee to diverge in order to pursue necessary information on rabies in the district. For instance how people are aware of the disease, how is it transmitted, how is it prevented and rabies records keeping and transmission to different authorities within the district and beyond.

Also since the rapid prototype model was adopted to develop the web based rabies surveillance system thus the requirements that were missing from the prototype that was developed, both developers and the users used the prototype and determine what functionality that the prototype missed and what user and system requirements were to be added.

Interviews with key informants were used to probe the systems and user requirements which needed to be re-engineered in the prototype system during all phases of software development life cycle. The phases consist of analysis, design and implementation.

REQUIREMENT ANALYSIS

The requirements gathered from users by using interview and the prototype were analyzed to establish exactly what the system should do to solve the problem and gaps that were available within the district in respect to the disease. Thus from the analysis that was done then software requirement specification (SRS) document was prepared. Table 2 shows the data collected from secondary sources and were used to develop the system.

SYSTEM DESIGN

From the analysis above the system was designed in a way that it should answers the problems specified by the SRS document. System design comprised of architectural and detailed description of the design. Architectural or high level design aims to identify the modules that should be in the system, the specifications of these modules, and the interaction between the modules in order to produce the desired results. The specifications were carefully analyzed and a module structure that has the desired functionality was produced.

Detailed design involved going deep into specific modules of the system. The system design was broken down into 3 major modules (3-tier application), namely;

1. **Front–End Design:** This comprise of the user interface which links users and the system. Users can interact with the system using the series of interactive web pages as displayed through the web browser.

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Table 2. Rabies Vaccination status in Kilosa District in 2012

Ward	Village	Human Population	Number of Dogs	Number of Dogs Vaccinated (% in Brackets)	Dog Bite Cases Reported	Suspected Rabid Dogs Killed
Kimamba	Kimamba "A"	7,249	177	171	12	2
	Kimamba "B"	6,271	165	0	0	0
Rudewa	Twatwatwa	2,704	905	50	9	3
Madoto	Mbwade	1,869	127	50	0	0
Tindiga	Malangali	4,247	70	0	0	0
	Tindiga	5,833	81	0	0	0
Kilangali	Kilangali	2,723	131	0	0	0
	Kiduhi	563	151	0	3	7
	Kivungu	4,179	102	0	0	0
Ulaya	Ulaya Kibaoni	3,673	189	40	0	0
	Mhenda	4,138	263	0	0	0
Mikumi	Mikumi	15,166	333	120	0	0
	Ihombwe	1,773	116	0	0	0
Kilosa town	Kilosa town	34,236	637	440	6	1
Ruhembe	Kidogobasi	4,562	227	0	0	0
Total		**99,186**	**3574**	**871**	**30**	**13**

2. **Application Design:** This is meant to provide communication between client and server. PHP scripting language (4 or higher) was used to fetch user queries from the browser into the database and retrieve the relevant rabies information back to the user on the web page.
3. **Back–End Design:** This comprises of the database. Database is where information about rabies is stored so that users can access them through front-end's user interface. The database was implemented using MySQL which is an open source relational database management system. It is based on the structure query language (SQL) and it is consistent, fast performance, high reliability and ease to use. ***The locations were called using postGIS technology that calls georeferenced information from the MySQL database.***

SYSTEM IMPLEMENTATION

After the design of the system then it was implemented by using the MySQL database server in the back-end while JavaScript, CSS and HTML were used in the development of user interface. In order for the user interface to connect with database, PHP scripting language was used. In the front-end of the system JavaScript and CSS were used to create an interactive user interface. Google maps API capabilities were manipulated and used to locate the interactive information using Google maps and Javascripts. AJAX technology was incorporated to improve the interactivity of the maps through the browser. Some Google API classes where used to make easy the implementation of the technology.

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DESCRIPTION OF USER INTERFACE AND THE SYSTEM IN GENERAL

The web based rabies surveillance system allows users to update information that relate with rabies incidences such as reporting of areas that were affected by rabies, reporting if there was any rabid animal like dogs, etc. and viewing information on rabies. Figure 2 shows the interface of a web based rabies surveillance system.

From the interface (Figure 2), the user could view affected areas in map layer; this would let the user know which areas in Kilosa were mostly affected by rabies. These areas were identified by a green marker and by placing a cursor on it, the user could know the village name of the area. The Figure 3 below shows the snapshot for this.

From the interface (Figure 3), the user could view the number of dogs on map layer. This would let the user know how many dogs were available in a certain village. These areas were identified by a green marker and by placing a cursor on it the user could know the name of the area and by clicking the marker the number of dogs in the area would be displayed. The information displayed on Figure 3 relate to data collected from Kilosa presented in Table 2.

From the interface (Figure 4), the user could click the button of dog vaccination in map layer; this would let the user to know how many dogs were vaccinated in a certain village. These areas were identified by a green marker and by placing a cursor on it the user could know the name of the area and by clicking the marker the number of dogs that were vaccinated in the area would be displayed. The information displayed on Figure 4 relate to data collected from Kilosa presented in Table 2.

Figure 2. The interface of the Rabies Surveillance System

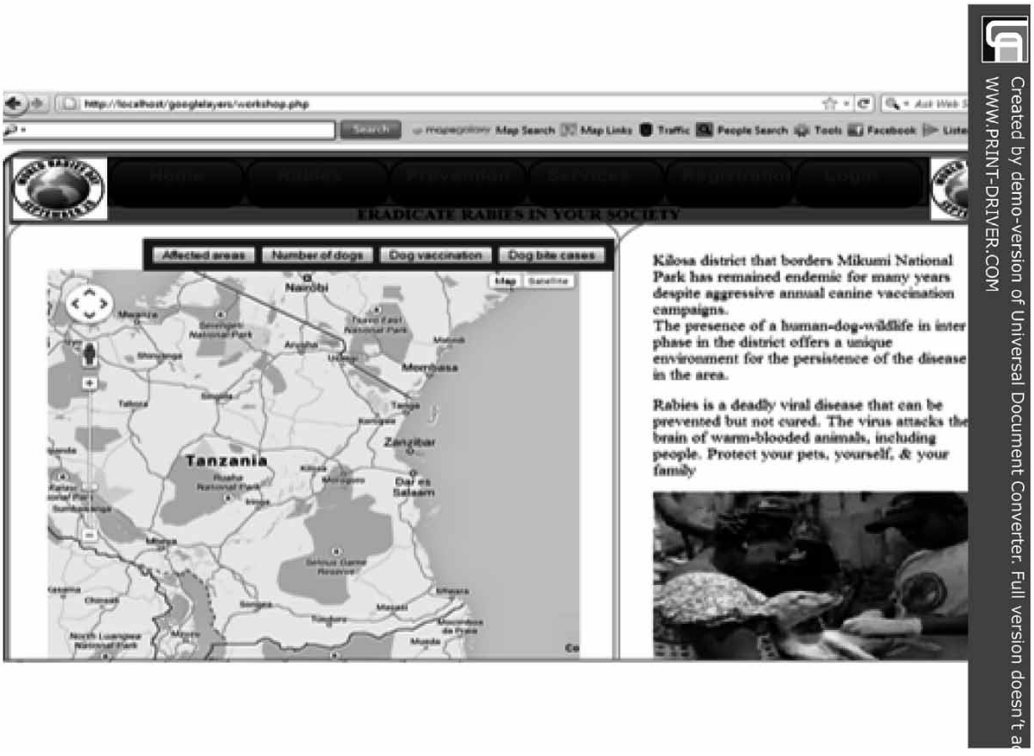

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Figure 3. The highly affected areas by rabies in Kilosa

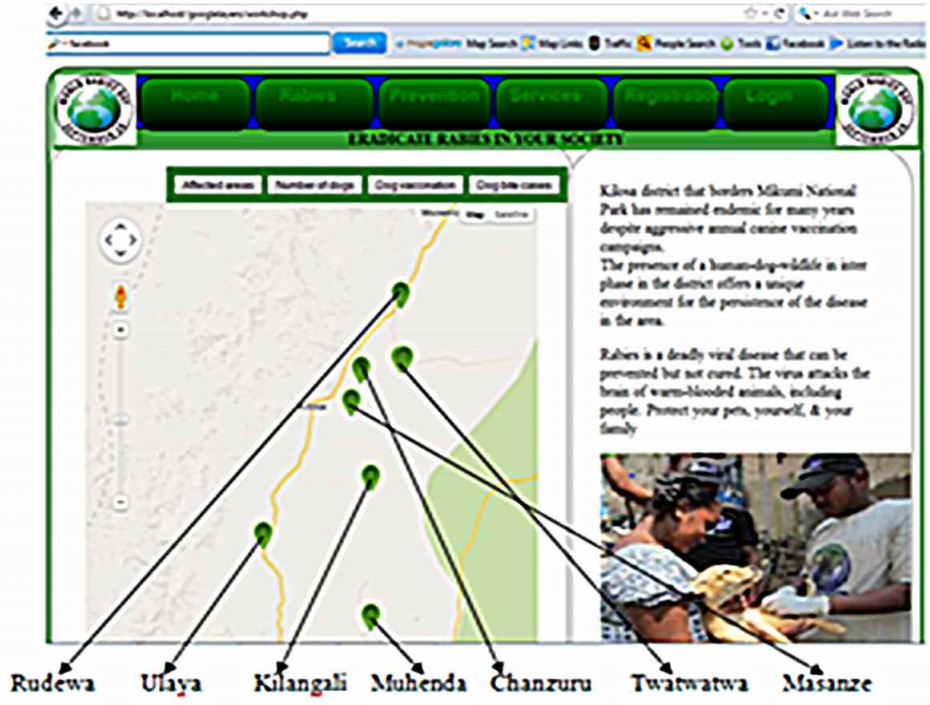
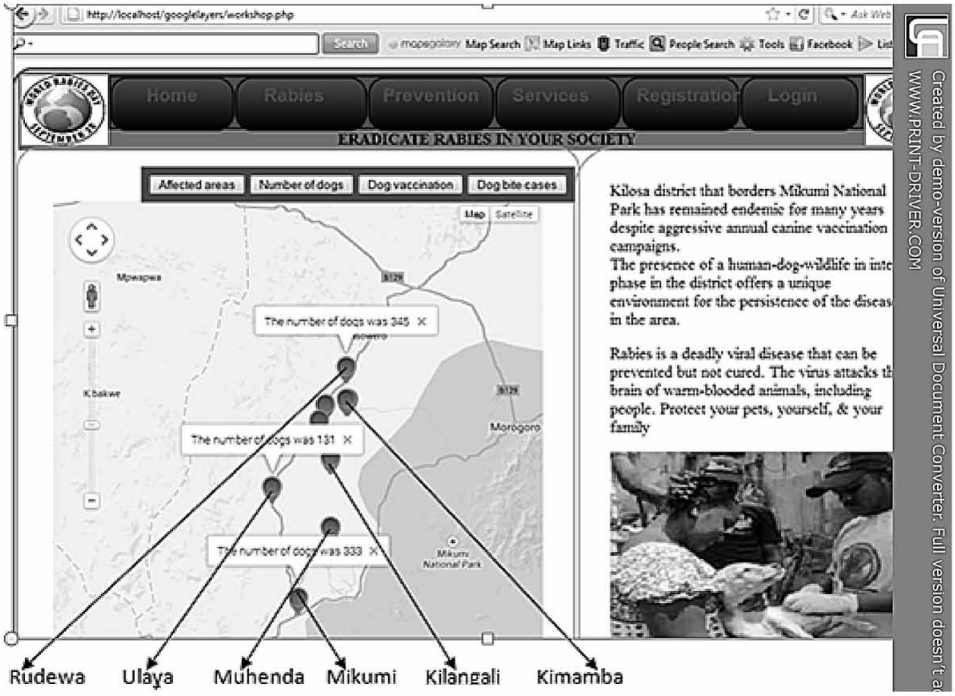


Figure 4. The number of dogs within the village



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Also from the interface (Figure 5) the user could click the button of dog bite cases in map layer; this would let the user know how many dog bite cases were reported in a certain village. These areas were identified by a green marker and by placing a cursor on it the user could know the name of the area and by clicking the marker the number of dog bite cases reported in the area would be displayed. The information displayed on Figure 5 relate to data collected from Kilosa presented in Table 2.

Thus, from these different maps (Figure 2, Figure 3, Figure 4, Figure 5 and Figure 6) a user could make analysis on which areas were affected by rabies and determine the reasons why certain areas were highly affected. Is it due to lack of dog vaccination program or is it because of poor reporting on rabies cases such as dog bite cases?

Even though the web based surveillance system for rabies is not a new field but what has been piloted here is the applicability of web based rabies surveillance system in identification, detecting, monitoring and controlling it in Tanzania (Mwabukusi et al., 2014). The preliminary results from this pilot research carried out in Kilosa District shows promising findings which have been reported in this book chapter. Thus, it is anticipated that new knowledge has been contributed in the areas of community informatics, health informatics and their applicability in both human and animal health (i.e. one health concept (Rock et al., 2009; Mazet et al., 2009). The developed system is different from other surveillance system for either animal health or human health which does not put human being at the centre of intervention (Brownstein et al., 2008; Rumisha et al., 2007; Mghamba et al.,2008; Mboera et al., 2001; Kimaro and Nhampossa, 2007 ; Waidyanatha and Prashant, 2010; Mwabukusi et al., 2014).

Figure 5. The villages showing the number of vaccinated dogs

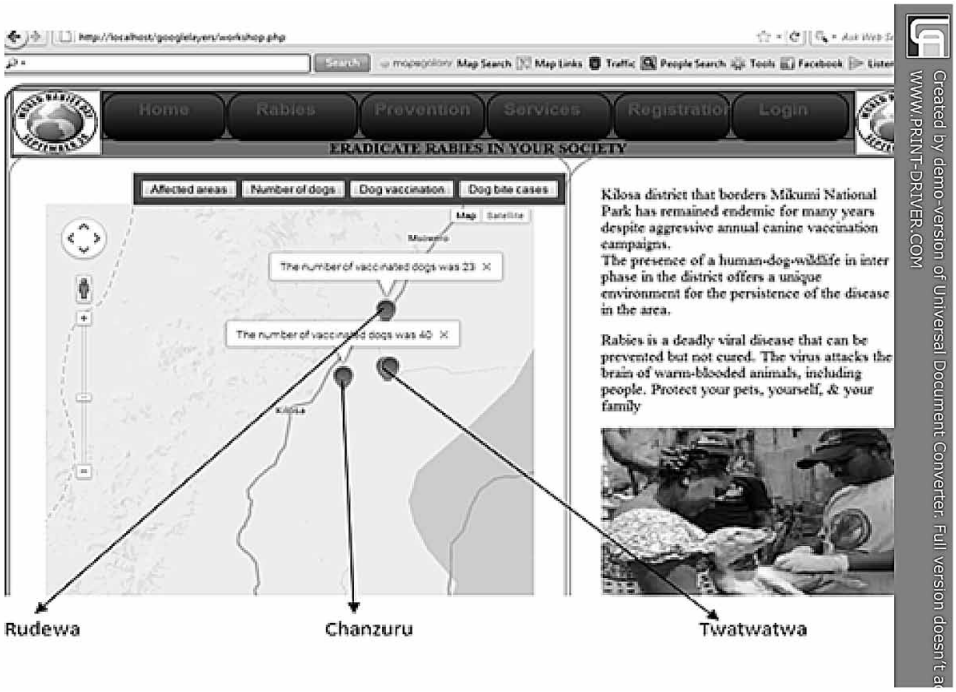

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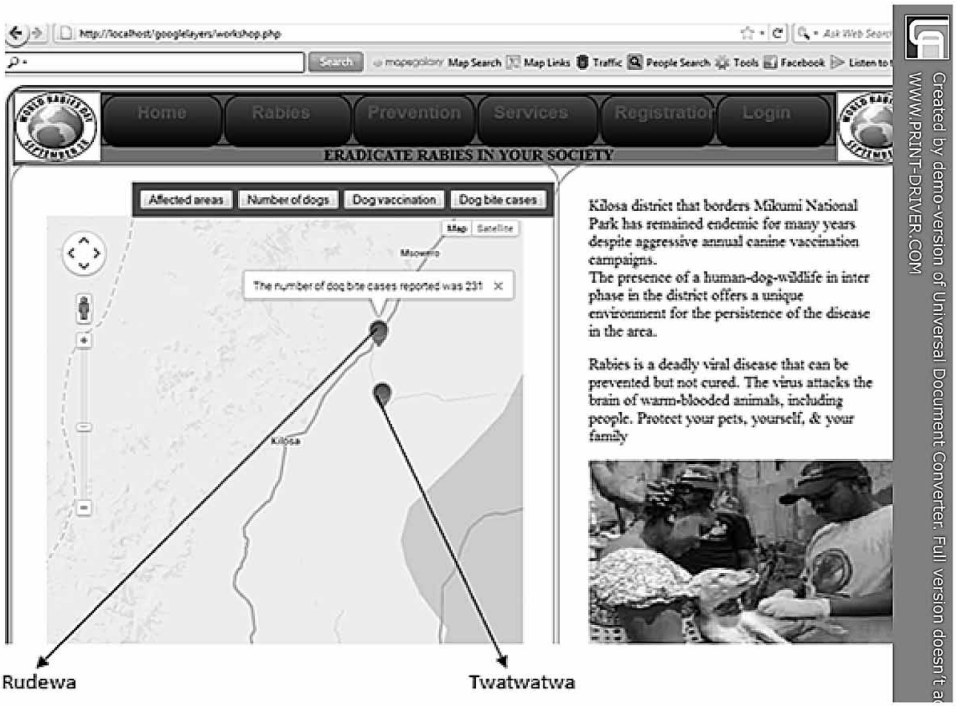
Figure 6. The number of dog bite cases reported



CONCLUSION

This study quantified and mapped the spatial and temporal dynamics in rabies incidences in Kilosa district, Morogoro region. Thus, the system provides rapid communication on rabies cases and it helps to increase awareness to the communities on the disease since literature shows that many people die due to rabies because of lack awareness of the disease and steps need to be followed upon encounters. The system described here allows quick communication and collaboration between Veterinary and medical Departments in Kilosa district which is very important in managing rabies at community level. Also from the web based rabies surveillance system has more unique features that includes layered maps whereby a user can navigate smoothly and make the geo-analysis of the affected areas by the disease and determine the reasons behind high infections. Also, the system administrator can use data from the database such as the village location data and the village details information to do geo-analysis of the disease impact in Kilosa. The areas with high rabies outbreak can be mapped and openly be viewed so that livestock department can easily track and set priorities for the control of the disease. The authors of this book chapter recommend that all line ministries should improve the identification, detection, alerting, monitoring, controlling and surveillance of rabies through the use of the developed web based system. The line ministries to be involved are Ministry of Livestock and Fisheries Development, Ministry of Health and Social Welfare, Ministry of Natural Resources and Tourism, Ministry of Justice and Constitutional Affairs and Prime Minister's Office - Regional Administration and Local Government as well as Private sectors and Non Governmental Organizations. Without unifying the efforts from different sectors (inter-sectoral) and disciplines (inter-disciplinary) it is difficult to address the problem of

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rabies (http://tanzaniaecohealth.com/index.html). Future study will focus on evaluating the adoption of the developed system in Kilosa District. The evaluation of the system will base on technology, culture related values, competence and personal values.

Another area for future research study should be on improving the performance of web based rabies surveillance system by using openlayers instead of Google layers. Google maps are too slow for real time reporting (Waidyanatha and Prashant, 2010).

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KEY TERMS AND DEFINITIONS

Disease Surveillance: Is an epidemiological practice by which the spread of disease is monitored in order to establish patterns of progression (http://en.wikipedia.org/wiki/Disease_surveillance).

Information and Communications Technology (ICT): Refers to all types of technology used to handle telecommunications, broadcast media, intelligent building management systems, audiovisual processing and transmission systems, and network-based control and monitoring functions (http://en.wikipedia.org/wiki/Information_and_communications_technology).

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"Stakeholder" or "User" or "Actor": Refers generically to organizations or or community or individuals who use or exploit web based rabies surveillance system. While these types of users / stakeholders may have some different interests and perhaps different concerns based on scale of data involved, generally a corporate / organization and an individual user are going to have different expectations and concerns related to web based rabies surveillance system.

Surveillance: Is the monitoring of the behavior, activities, or other changing information, usually of people for the purpose of influencing, managing, directing, or protecting them (http://en.wikipedia.org/wiki/Surveillance).

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Chapter 21
Social Media and Alcohol Use: Adverse Impact of Facebook and Twitter on College Students

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ABSTRACT

The use of Social Networking Sites (SNSs) has become an integral part of daily life, particularly for adolescents. The chapter examines the negative impact of social networking sites and how they may expose alcohol-related consumption and behavior to young adults, especially college students. In particular, the focus is on the use of two specific social networking sites, Facebook and Twitter, and their association with alcohol use. The review of existing literature reveals that the depiction of alcohol use on social networking sites has a deleterious effect on alcohol use through the creation of positive social norms toward use and abuse. Further, the chapter looks at the Theory of Differential Association to explain the use of SNS as a pivot to increased alcohol use by adolescents and young adults.

INTRODUCTION

This chapter examines the use of SNSs by young adults, specifically college students, and further describes how these platforms might shape alcohol use amongst this age group, and in turn negatively impact social and academic aspects of their lives. Based on a systematic review of most recent studies conducted in the United States and elsewhere, the thrust is on synthesizing the manner in which SNSs facilitate underage drinking. The chapter offers comprehensive conceptual, theoretical, and empirical bases of association between use of SNSs and use of alcohol in adolescence and early adulthood. The chapter focuses on Edwin Sutherland's Theory of Differential Association (TDA) to explain the manner

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in which interaction and socialization with peers in virtual communities facilitates formation of alcohol-identities and peer influence grouping. The TDA also explains why some adolescents are impacted by social media use negatively whereas others might experience socially desirable outcomes.

BACKGROUND

The alcohol culture in the United States has significantly increased in the past 25 years (Newport, 2010). Large amounts of alcohol consumption, or "binge" drinking, is connected to immediate fatalities and long-term health outcomes. While alcohol consumption varies between colleges (Lorant, Nicaise, Soto, & D'Hoore, 2013), on average four out five students drink alcohol, and about a half of college students who drink, consume four or more drinks in one sitting (Fact Sheets- Binge Drinking, 2012). The risk-taking behavior is developed through the positive outlook that is modeled from a direct or indirect encouragement of popular activities, alcohol consumption (Santor, Messervey, & Kusumakar, 2000). In addition, this deleterious culture is further amplified by print and media marketing. In one study, adolescents' exposure to alcohol marketing increased their likeliness of drinking, and further increased consumption level for those already drinking (Bruijn, Angus, Gordon, & Hastings, 2009). With the new digital age, alcohol marketing has expended to various SNSs. This new environment allows for an additional source of exposure to alcohol, and builds the hypothesis of increased likelihood of alcohol consumption and abuse amongst young adults, especially college students.

SOCIAL NETWORKING SITES AND ALCOHOL CONSUMPTION

In recent years, the use of SNSs has become inescapable. As of May 2013, 72 percent of Americans use SNSs, a 5 percent increase from 2012; and amongst young adults ages 18-29, SNS use is 89 percent (Duggan & Brenner, 2013). There are many methods of using these platforms: entertainment, information sharing, socializing, etc. College students use SNS to extensively communicate: given that it allows them to connect and efficiently interact with their peers and instructors. These academic needs may involve sharing information related to group projects, brainstorming on common assignments, and organizing meetings with study groups. Unfortunately, they also allow creation of virtual meeting space to display shared interests relating to drinking behavior (e.g. parties, sporting events, games, etc.). Whilst there are many social networking sites used by young adults; for the focus of this study Facebook and Twitter have been analyzed.

The first platform, Facebook, was developed in 2004 for users at participating colleges and universities across the United States. Its exclusivity grew its popularity to a larger audience of users across the globe. Facebook users develop profiles to connect with friends, relatives, and other networks. Facebook functionalities range from photo-sharing, story-telling format for information sharing, and private messaging. As of recent, 86 percent of those in the 18-29-age bracket are Facebook users (Duggan & Brenner, 2013). Students in this age bracket may use Facebook to create open and private Facebook groups to share updates with their fellow peers on various academic related or social related events. Regrettably, in addition to many positive functions that Facebook's platform can provide to college students, it can also allow students and other youth to interact and virtually connect for purposes other than academic.

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A supportive evidence of increased drinking behavior, as a result of Facebook use by college students, is a study conducted collecting data on Facebook use by college students. In this study, the Alcohol Use Disorder Identification Test (AUDIT) scale was used as a screening tool to measure Facebook alcohol references. The study surveyed undergraduate students, ages 18-20 years, at two universities with public Facebook profiles. Researchers categorized the profiles into three categories: non-displayers, alcohol displayers, and intoxication/problem (I/PD) drinking displayers. The results of the study showed that those Facebook accounts whose profile owners displayed I/PD were more likely to face drinking problems on the AUDIT scale (Moreno, Christakis, Egan, Brockman, & Becker, 2012).

The second platform, Twitter, is an online micro-blogging platform that allows users to send 140-character messages, or tweets in real-time. Twitter has many functions for information sharing and encourages the use of hashtags (#), mentions (@), and retweets (RT) to its users. Hashtags are used to create conversations or information sharing around a specific topic. Popular and widely used hashtags often make the Twitter list of trending topics for users of a specific geographic location. The use of hashtags not only elevates the marketing of the user's tweet but also connects the user with other users of similar interest. The practice of mentions in tweets is to indicate a message to a specific user, which can include replying directly to that user (e.g., @johnsmith). The retweet function on Twitter is used to re-share what another user has tweeted.

According to recent data, about three out of ten (30%) young adults (18-29 year olds) use Twitter (Duggan & Brenner, 2013). Twitter is used for various academic purposes by college students and young-adults. Most evidently, in one study, Twitter was found to increase a number of positive academic outcomes, including: higher grades, positive engagement between instructor and student, and overall increased academic engagement (Junco, Heiberger, & Loken, 2011). However, similar to Facebook, whereas Twitter has its benefits for improved academic outcomes for students, it also is a platform that exposes students to alcoholic brands and behaviors. Researchers from the University of Western Sydney's School of Business studied the promotion of seven popular alcohol brands on Twitter over the course of six months. They discovered that these companies' tweets reached to a broader secondary audience through the retweets of their followers; an audience that could be under the drinking age. Indeed, the study showed hashtags were also effective in popularizing drinking during social events such as concerts or sporting events (Burton, Dadich, & Soboleva, 2013). This study is one example of ways Twitter may stimulate a positive display for alcohol consumption and exposure for both college students and young adults.

CONNECTION BETWEEN SOCIAL MEDIA AND DRINKING: THE THEORETICAL EXPLANATIONS

Studies have used many explanations to reason why young adults get involved in socially undesirable behaviors. Tickle, Hull, Sargent, Dalton, & Heatherton (2006) used Ajzen and Fishbein's (1980) Theory of Reasoned Action to explain how social influences, such as portrayal of influential characters smoking cigarettes and smoking by family members, predict adolescent smoking. A classic theory of deviance, Edwin Sutherland's Theory of Differential Association (TDA) offers the best explanation for linkage between increased use of social media and socially undesirable behaviors such as smoking and drinking. Some criticisms of Sutherland's theory (Akers, 1988; Matsueda, 1988; Warr & Stafford, 1991) might suggest TDA is less relevant due to new realities created by social media. Social media, and virtual

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reality created with its help, play a decisive role in creating hyperreality (Baudrillard, 2012) for those living in the virtual reality. Consequently, young adults' responsibility to conform to mainstream societal norms weakens, because some youth are able to forget realities of the mainstream culture in favor of a simulation of reality created by sub-group norms, such as desirability of underage drinking, pre-marital sex, etc. Social media can facilitate seamless blending of reality and hyperrealist.

With increasing use of social media, parental control over adolescents is diminishing. Parents held much more control over adolescents in the absence of virtual meeting spaces. Who they met and were influenced by could be controlled by manipulating situations, so negative influence could be avoided. With social media facilitating togetherness and communications independent of physical presence, strict control is not possible. Even when parents and guardians are aware of associations causing negative influences, they are helpless in preventing networking. With virtual meeting places, parents can be deceived about the identities of others in the network. To complicate the matter, easily created fake identities can severely hamper efforts to prevent negative influences. Much like the real world, identity and impression management (Goffman, 1959) by hiding the undesirable characteristics and exaggerating more desirable characteristics also characterizes the cyber communities (Zweir, Araujo, Boukes, & Willemsen, 2011).

Theory-Based Explanations of Influence of Use of SNSs on Alcohol Use in Adolescence: Theory of Differential Association

Use of main propositions in Sutherland's theory helps understand the phenomenon in question relatively well. Sutherland would suggest that deviation from mainstream norms is a learned behavior. The primary learning about smoking and alcohol use often happens as youngsters learn these behaviors from their parents. Research on etiology of alcohol use shows that youth behavior is heavily shaped by parents' drinking habits; parents who are heavy alcohol consumers have children who are more likely to be involved in underage drinking (Armstrong, Ruttle, Burk, Costanzo, Strauman, & Essex, 2013). Perhaps more important is the influence of the secondary socialization of youth with their peers. Birds of feather flock together is true when it comes to underage drinking. Having friends who were deviant in general also increased the odds of underage drinking among youth (Armstrong, et al., 2013). Adolescent peer group identification is often clearly captured in their names making it easy for distinguishing self from others. Sussman, Pokhrel, Ashmore, and Brown (2007), through an exhaustive review of 44 peer reviewed studies on adolescent peer group identification in offline environments (e.g., school) showed that discrete peer group identities can be categorized into five life style categories; deviant group of adolescents was one of those five categories. This group was categories separately in 37 of the deviants 44 studies. The deviant group reported caring least about school work, school-related extra-curricular activities and preparation for career. Their engagement into tobacco alcohol, drug use was much higher in deviant group (Sussman et al., 2007). Risky behaviors are not really inherited and adolescents with no one to teach them about these behaviors cannot really invent them. Social media and networking created through this becomes a major source of learning.

The premise of the Differential Association Theory that humans learn deviant behavior through interaction and communications with others is perhaps most relevant in explaining the linkage between social media and youth behaviors like smoking and drinking. Social media as communication landscape is ever more popular and is maturing fast, offering diverse functions to facilitate communication (Kietzmann, Hermkens, McCarthy, & Silvestre, 2011). The communication landscape of SNSs works much like regular communication in that it results in social bonding and adherence to the "virtual" norms (Garas, Garcia,

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Skowron, & Schweitzer, 2012). Consistent with Berger and Luckmann's theory of social construction of reality (Berger & Luckmann, 1966), norms evolve for social media users through frequent interactions and communications, gradually becoming routinized and leading to construction of their realities. Such communications facilitated by SNS may also play a latent function of learning of otherwise deviant behaviors like drinking and smoking by the youth. Social context, particularly availability of other underage drinkers to participate in drinking has been shown by research to increase underage drinking (Reboussin, Song & Wolfson, 2012).

The premise of the TDA proposes that the core of the deviant behavior learning happens within intimate personal groups. Subrahmanyam, Reich, Waechter, and Espinoza (2008), found that the online social networks of communications, particularly MySpace and Facebook, are not just popular means for connecting with other "emerging adults," the core of online communication networks is made up of intimate friends and family. Through online social interactions, participants co-construct the spheres of their virtual existence, but due to major overlap with the circle of off-line friends, psychological connections and social bonds are constructed through shared online and offline experiences. Online social networks are not only helpful in maintaining offline relationships; they are also used by some subgroups to find friends and romantic partners (DeHaan, Kuper, Magee, Bigelow, & Mustanski, 2013). Empirical evidence shows that online networking and instant messaging is done primarily with offline friends to converse about offline events being planned for the day or week. Social media, therefore, can be argued as a catalyst in promoting deviant behaviors through intimate circle of friends maintained by youth. Prior to the popularity of social media, tobacco industry and alcoholic beverages industry pushed the imagery of tobacco and alcoholic beverages through television and movies adds various other means (Arora, Mathur, Gupta, Nazar, Reddy, & Sargent, 2013). The imagery of smoking and alcohol use portrayed in movies can influence adolescents' attitudes, intentions, and behaviors towards initiating smoking and drinking as well as increased use. Positive imagery, such as drinking and smoking by credible lead characters holding prestigious social positions, particularly those portrayed as heroes gives a sense of social desirability of these otherwise socially undesirable behaviors. Tickle et al. (2006) used the theory of reasoned action to conceptualize their research by using data from 150 schools from New Hampshire and Vermont to examine the impact of smoking imagery in movies on adolescent smoking behavior. Viewing smoking in movies was among the most important predictors of underage smoking intentions and behavior. The increasing regulations against targeting of minors and underage individuals in cigarette and alcohol advertisements may have protected youth from aggressive targeting by these industries. However, the increased use of social media over the past decade or so, have created an alternative source of alcohol and cigarette imagery displays. By Sutherland's theory, indirect influences such as mass media might not have much influence in promoting deviant behavior.

For acting out deviance, association with deviant friends alone is insufficient. One must also have skills required to perform the deviant acts. For instance, for cigarette smoking or alcohol consumption, children and youth not permitted to buy cigarettes and alcohol through legal means need to have skills to acquire them through other means. Thus, the learning of deviant behaviors means having skills of committing the deviant acts, as well as justification and rationalization for those acts. The etiology of alcohol use among underage college students is complex, but SNS communications can be private enough to organize underage smoking and drinking occasions, thus, the skills can be obtained through online circle of friends to perform offline acts of deviance. Factors that affect student drinking include: student expectations and social pressure (National Institute on Alcohol Abuse and Alcoholism (NIAAA), 2013), particularly during freshman year, social factors, such as, involvement in fraternities or sororities

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and peer behavior (Borsari & Carey, 2001; NIAAA, 2013; Testa, Kearns & Livingston, 2009), culture, e.g., race/ethnicity (Borsari & Carey, 2001; Metlife Foundation, 2013), and biological and psychological factors (Schulte, Ramo, & Brown, 2009). Location might also play an important role in underage alcohol consumption, with youth in rural areas reporting more frequent use and problematic use (Atav & Spencer, 2002; Borders & Booth, 2007).

Sutherland's theory would suggest that the specific direction of the motives and drives for alcohol use is learned from definitions of proscriptive and prescriptive norms about alcohol use. One factor that consistently predicts underage alcohol consumption is social norms, more specifically the misperception that peers are using alcohol at high rates (when compared to self-reported use) (Litt & Stock, 2011; Perkins, Meilman, Leichliter, Cashin, & Presley, 1999).Young adults who consume alcohol might subscribe to subgroup norms with alcohol use, even binge drinking, as socially desirable behavior (Ridout, Campbell, & Ellis, 2012). Young adults also consistently misjudge the frequency of alcohol use by their peers, which leads to increased beliefs that underage alcohol use is a normative behavior and increased alcohol consumption (Litt & Stock, 2011; Perkins et al., 1999) SNSs such as Facebook provide a unique platform for the development and maintenance of alcohol use social norms among college students. Adolescents with self-reported alcohol displays reported greater willingness to use alcohol, more positive attitudes toward alcohol use, and lower vulnerability to the consequences of alcohol consumption (Litt & Stock, 2011). Through sharing of alcohol-related images, comments, and videos and supporting alcohol related-advertisements (Anderson, De, Angus, Gordon, Hastings, 2009), young adults create and maintain intoxigenic social identities as well as intoxigenic digital spaces that further contribute to the normalization of underage alcohol consumption (Griffiths & Casswell, 2010).

The principal of differential association, the central premise of Sutherland's theory, demonstrates how social media might be more crucial facilitator of underage drinking and smoking than any other factors. The primary assumption is that a person's capability to perform deviant acts without worrying about violation of values, mores, norms, and laws depends on availability of a subculture or a counter culture often found among teenagers that will reinforce the non-conformity to mainstream cultural norms, and values as not only something normal but desirable. Peer influences in digital space enable youth create a hyperreality (Baudrillard, 2012), that blurs the line between what is desirable by mainstream culture and what is considered desirable by the simulation of social desirability within the closed circles of youth. Young adults who consume alcohol might represent a counter-culture with alcohol use as socially desirable behavior. Young adults also consistently misjudge the frequency of alcohol use by their peers, which leads to increased beliefs that underage alcohol use is a normative behavior and increased alcohol consumption (Litt & Stock, 2011; Perkins et al., 1999). SNSs such as Facebook provide a unique platform for the development and maintenance of alcohol use social norms among college students.

The premise that differential association may vary in frequency, duration, priority, and intensity is equally applicable to association through SNSs. Studies have shown that the frequency and intensity of alcohol use displays differ across users. For instance, Fournier and Clarke (2011) found that profiles of Facebook users varied considerably for percent of alcohol-related content, ranging from 0% to 29%. Variation was also found in motives for use of SNSs (Yang & Brown, 2013).

Learning of deviant behavior through association with other deviants and non-deviants comprises processes involved in form of learning. Those adolescents who belong to online peer groups involved in activities more in line with broader cultural norms can lead to socially desirable outcomes. For instance, adolescents who also include their parents in their social networking not only have stronger bonding with parents, their use of SNSs leads to better behavioral outcomes, improved pro-social behavior, and

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reduced relational aggression (Coyne, Padilla-Walker, Day, Harper, & Stockdale, 2013). Also, social media specially designed for the young adults who are mentally impaired are known provide many positive functions for their leaning needs (Gowen, Deschaine, Gruttadara, & Markey, 2012). Social media is expected to actually help young adults to deal with their mental health problems through positive peer reinforcement (O'Dea & Campbell, 2011).

Social media can be also a deterrent to underage smoking and drinking. Just as social media can promote underage smoking and drinking, it can also be used as prevention. Social media can be used by those concerned with population health to post anti-smoking and anti-drinking messages. Twitter, Facebook, YouTube and other social media has increasingly been used by public health geneses to perform efficient monitoring using generated contents and educating fellow Tobacco control population education against to prevent smoking (Myslín, Zhu, Chapman, & Conway, 2013).Twitter offers large amounts of user centric information for public health professionals, reflecting perspective not available from surveys. Twitter data can be harvested with minimal effort on real–time basis (Myslín et al., 2013).

SOCIAL MEDIA, ALCOHOL USE, AND SOCIAL OUTCOMES

Research on college students suggests that references to and display of alcohol use (i.e., pictures of intoxication, alcohol brand images, comments regarding alcohol use) on SNSs are associated with self-reported alcohol use, perceptions of friends' alcohol use (Fournier & Clarke, 2011; Westgate, Neighbors, Heppner, Jahn & Lindgren, 2014), and increased risk for problematic drinking (Hoffman, Pinkleton, Austin & Reyes-Velázquez, 2014; Moreno et al., 2009; Westgate et al., 2014). Studies suggesting absence of relationship between alcohol use displays and alcohol use are rare, if any. On the other hand, the impact of imagery of drinking on youth attitudes and behaviors towards these habits is documented globally. Such imagery often glorifies and, in turn, promotes tendencies to engage in smoking and drinking, even though mainstream social norms are increasingly proscriptive of both underage smoking and drinking (Davey & Zhao, 2012).

The transition from childhood into adolescence involves interactions that are beyond small groups. In this age group, larger peer groups are involved, and the peer pressure tends to overshadow the parental controls and guidance. Even before the predominance of digital space in our lives, peer group pressures tended to have profound impacts on adolescents' attitudes and behaviors. Membership of one or more peer influence group is desirable for a multitude of functions associated with it. Such membership helps adolescents with finding emotional/instrumental support, foster friendships and social interactions (Brown, Eicher & Petrie, 1986). Peer influences are different in pre-adolescence than in adolescence, in that in the former, peer groups are defined on the basis of common activity, whereas in adolescence, peer group influence is global and far reaching, affecting attitudes, behaviors and engagement in illicit acts (O'Brien & Bierman, 1988). Peer influences are documented by many recent studies, particularly showing that alcohol use during adolescence is significantly a function of peer pressure and use of alcohol by peer groups (Becker & Curry, 2013; Boyd-Ball, Veronneau, Dishion, & Kavanagh, 2013; Huang et al., 2013; Mundt, Mercken & Zakletskaia, 2012; Visser, Winter, Veenstra, Verhulst, & Reijneveld, 2013).

Social media can enable youth to share their drinking stories online and photos of alcohol-use during parties. McCreanor et al., (2012) found that SNSs can create conducive environments for encouraging underage drinking. Virtual norms are constructed through online interaction and social construction of shared understanding of prescriptive and prospective principles of online behaviors. However, research

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supports the premise that online behaviors and attitude are governed by same broader social norms prevalent in physical social world. This implies that in relationships built and maintained in virtual social environment, the group norms might be equally applicable in both social and virtual situations. By the same token, the youth norms formed through interactions at SNSs that govern drinking intentions, can lead to actual consumption of alcohol.

Alcohol use displays allow SNS users to explicitly declare their alcohol-identity, which is argued to be a crucial component of identity exploration for adolescents and young adults. Exaggerated alcohol identities, e.g. self-labeling "binge drinker", are also a means of persuading others with similar identities to reach out for planning and acting out these identities (Ridout et al., 2012). Persuasive alcohol advertisement has been found to not only influence initiation of underage drinking but also to increase the risk of regular alcohol use, resulting in alcohol-related problems later in adolescence (Grenard, Dent & Stacy, 2013; Moreno, Briner, Williams, Brockman, Walker & Christakis, D.A., 2010).

Studies suggest that substantial amounts of alcohol-related content are found on SNSs (Fournier & Clarke, 2011). Alcohol-related content revealing alcohol identities significantly predicts underage alcohol consumption (Ridout et al., 2012). Empirical evidence supporting deleterious effects of adolescents' networking in virtual communities with deviant peers is mounting. A large scale study of 1,563 10th-grade students showed that online connection with friends who display pictures of partying or drinking significantly increased the risk of both smoking and alcohol use in adolescence. The impact of alcohol displays on underage drinking was compounded when adolescents had social media connections with other adolescents who were also involved in drinking. In other words, independent of the influence of alcohol displays, the risk for alcohol use grew in the virtual company of other alcohol users, implying that friendships facilitated and maintained online had substantial peer influence (Huang et al., 2012). In one of the largest studies of young adults (*N*-3,448) in the United States, the quantity of alcohol content on social media websites was found to be a significantly predictor of alcohol and marijuana use (Stoddard, Bauermeister, Gorden-Messer, Johns, & Zimmerman, 2012).

Facebook users' modalities of and attitudes toward alcohol consumption, and perceived vulnerability is impacted significantly by the norms about alcohol use posted on Facebook profiles. Litt and Stock (2011) found that young adults who are frequently exposed to alcohol use displays were likely to internalize the subjective norm about desirability of alcohol consumption, which increased their risk of actual alcohol consumption compared to adolescents less frequently exposed to alcohol use displays on Facebook. Studies indicate that social media presents a digital space that can be used by young people to communicate messages created for marketing of alcohol, thus, presenting an intoxigenic social environment (i.e., an environment that promote alcohol use and abuse). The online networking can be used in other ways conducive to underage drinking, including to decide safe meeting places for drinking, communicate ways to consume alcohol, convey positive features of certain alcohol products, and to create a value system that is supportive of alcohol use. The communications can be accomplished through a variety of means, including digital photographs, short personal messaging, and online status titles (Griffiths & Casswell, 2010).

The prevalence of underage drinking is high enough to be considered a public health issue. Alcohol use among youth aged 12 to 20 years of age is common, with 10.4 million reporting that they drank alcohol beyond "just a few sips" in the past month (NIAAA, 2013). Roughly one-fifth of college students meet the criteria for alcohol abuse or dependence; however, seeking treatment is uncommon (i.e., 5%) (NIAAA, 2013). The rates are higher in some ethnic and age groups than others (Johnston, O'Malley, Bachman, Schulenberg, 2013; Nishimura, Hishinuma, & Goebert, 2013). Since initiation of drinking

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in very early age increases the span of alcohol use during their life course and increases the risk for subsequent abuse of prescription opioids (Fiellin, Tetrault, Becker, Fiellin, & Hoff, 2012), the initiation in early teens is even more disconcerting. Empirical evidence indicates the percentage of students in 8th grade who have experienced alcohol is alarmingly at 30 percent in the US, whereas in 10th and 12th graders it is 54 percent and 69 percent respectively. The current use of alcohol within past 30 days is also of note. In 2012, respectively 5 percent, 6 percent, and 24 percent of 8th, 10th, 12th graders reported such heavy drinking (Johnston et al., 2013).

Unfortunately, alcohol related harms (i.e., negative outcomes related to alcohol use) are prevalent as well. According to NIAAA (2013), 1,825 young adults die in the United States alone from unintentional injuries each year. Further, 97,000 young adults report alcohol-related sexual assault or date rape each year (NIAAA, 2013). The ill effects of drinking are major public health concern even among adult populations, but increasingly among youth (Maimon & Browning, 2012). Underage drinking can lead to memory disorders and risk of such disorders is increased for individuals with family history of alcoholism (Silveri, 2012). Studies have also shown elevated risks of morbidity and mortality due to alcohol consumption by American youth and young adults. The negative consequences of underage drinking range from academic problems to intentional and unintentional injuries, and raised risk of mortality. It is imperative to prevent or delay the initiation of drinking, both from individual and public health point of views (Jones & Waite, 2013).

The use of social media and mobile internet offers many advantages but also ill-effects including cyber-bullying (Tokunaga, 2010) and use of alcohol, drugs and tobacco. Peer pressure resulting in alcohol use can lead to other undesirable social outcomes, particularly a decline in subjective well-being among young adults. (Kross et al., 2013) used several scales such as SWLS (Satisfaction with Life Questionnaire), Beck depression Inventory, the Rosenberg self-esteem scale and social provision scale to assess subjective well-being of adolescents, concluding that Facebook had negative impact on two aspects of subjective well-being:

1. How the participating adolescents felt moment-to-moment, and
2. Their level of satisfaction with life.

This study, therefore, concluded that rather than improving well-being, Facebook undermines it. In contrast, an earlier study presented slightly different findings. Kim and Lee (2011) studied 391 college students and found that for users with larger numbers of Facebook friends, use of Facebook led to improved subjective well-being. Kalpidou, Costin, and Marris (2011) had mixed results compared to the other two studies. Among first year college students, larger number of Facebook friends led to diminished academic adjustments, and lower self-esteem. Among students in their later years at college, this effect of Facebook on self-esteem and academic adjustment became positive, suggesting that younger adults are more vulnerable to negative consequences of Facebook.

Apparently conflicting evidence from the aforementioned studies may not be inexplicable. Since users' intensity of Facebook and other social media might differ, studies drilling down into details found that variation in how social media use impacts self-esteem might be attributable to intensity of both the use of social media and that of relationships (e.g., number of Facebook friends). To illustrate, a study of students at a large Northeastern university revealed that students with frequent visits of their Facebook scored better on Rosenberg Self-Esteemed Scale, indicating that they had higher objective self-esteem. This study also suggested that "selective self-presentation … leads to intensified relationship forma-

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tion" which influences impression of self-esteem in a negative manner (Gonzalez & Hancock, 2011, p. 79). In addition, although Facebook and other social media are used for relationship forming, the impact of connecting with friends through SNSs is also not the same for all because of differences in self-esteem independent of online relationships. Adolescents with low self-esteem who participate in online networking tend to consider it safer for self-expression, but end up antagonizing online friends and losing online peer support (Forest, & Wood, 2012). The principle of relative depreciation equally governs the cyber communities and peer groups in that communicating with or just looking at people with impressive profile attributes (e.g., pictures) can lead to negative self-evaluations (Haferkamp & Kramer, 2011). Also, the peer group is not always homogenous. Instead, an individual might have membership of multiple peer groups. For instance, Dolcini and Adler (1994) found that in their study, students had four different peer groups in the offline social world – Elite popular Black, Elite Smart, Elite Floaters, and Elite Outsiders, and there was a substantial membership overlap. Alcohol use varied significantly by type of peer group affiliation in this study.

Use of Facebook and other social media does not affect all youth in the same manner also due to variation in motives for use. Individuals' motives for the use of certain social media are a product of their primary upbringing and socialization as well as secondary socialization influences, including peer pressure. These motives, in turn, predict the type of activities for which the use occurs, the nature of social adjustments adults and adolescents make, and effectiveness in accomplishing level of positive social adaptation. Research shows that Facebook is used by late adolescents (college students) for two primary purposes:

1. Relationship formation, and
2. Relationship maintenance (Yang & Brown, 2013).

Motives for use can include finding out more about someone the user had recently met, knowing with whom the other users maintain friendship, checking out possibilities for potential future friendships, developing romantic relationship, and finding more interesting people than offline friends. Relationship maintenance encompassed motives such as staying connected with college friends, and other acquaintances, maintain social ties rather than attempting to find new friends (Yang & Brown, 2013).

The connection between social media and underage risky behaviors is crucial to assess and consider in public policy because the use of SNSs has grown dramatically over the past decade, with a 233% increase from 2010 to 2011 in Facebook usage among college students alone (Alacron-del-Amo, Lorenzo-Romero, & Gomez-Borja,2011; Corbett, 2011). Most (80%) college students use at least one SNS (Peluchette & Karl, 2008). Approximately half of those with SNS accounts log in to their site at least once per day (Peluchette & Karl, 2008), with roughly 34% spending more than an hour on their site (Espinoza & Juvonen, 2011) Young adults' use of SNSs provides an avenue for communicating with friends, with young adults reporting an average of 196 contacts ('friends') (Espinoza & Juvonen, 2011; Ross et al., 2009). Most smart phones have apps that allow 24/7 access to social media sites, updates, postings, etc. Many people don't logout, allowing alerts and messages to come straight to their phones at all times. Most young adult Facebook profiles are set to public (i.e., information is shared with the public – not just friends) (Lewis, Kaufman & Christakis, 2008), leaving open the possibility of negative outcomes related to public content.

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CONCLUSION

SNSs play an important role in college students' lives, hence the development of Facebook for college students (Yang & Brown, 2013). Often, the literal moving away from parents and other family and friends, college students, particularly freshman, use SNSs to stay in touch with existing friends while connecting with new friends on campus (Yang & Brown, 2013). SNSs have come to play a vital role in adolescent peer group formation and dynamics. Adolescents of all ages use social networking to maintain connections with their peers and to make new connections to enhance their social networks (Yang & Brown, 2013). Social networking enables college students to maintain relationships, development new peer relationships, and manage social activities within their peer group (Lampe, Ellison, & Steinfield, 2006; Pempek, Yermolayeva, & Calvert, 2009; Subrahmanyam et al., 2008; Urista, Dong, & Day, 2009). Overall, SNSs serve an organizational function that allows college students to effectively manage their social networks (Yang & Brown, 2013). Females in particular use SNSs such as Facebook to manage friendships (Yang & Brown, 2013). However, SNSs might be even more important to adolescent males, who report greater sense of belonging as a result of SNS than do girls (Quinn & Oldmeadow, 2013).

Existing evidence on peer group formation supports the use of SNSs as a means to increasing interactions that extend beyond small groups, which results in increased opportunities for peer pressure. Peer pressure in virtual environments is evident through the posting of alcohol use displays (i.e., images including videos), endorsement of alcohol advertisements, and comments regarding alcohol use and alcohol-related events. Identifying oneself as a 'drinker' is considered by many young adults to be a socially desirable component of identity in a social networking environment (Ridout et al., 2012). Being known as a 'drinker' might be particularly important to young adult males, as evidence suggests males were more likely than females to post self-promoting pictures or comments involving alcohol (Peluchette & Karl, 2008). Overall, alcohol use displays on SNSs play a key role in the expression of identity for many adolescents and young adults, particularly during the college years.

Alcohol related displays are common on SNSs (Fournier & Clarke, 2011) and predict underage alcohol consumption (Ridout et al., 2012). Alcohol use displays create an environment in which youth misperceive the frequency of alcohol use among their peers (i.e., social norms theory), which results in increased use and abuse (Litt & Stock, 2011). Thus, based on their role in alcohol use among youth and young adults, available evidence suggests that use of SNSs contributes to the public health problem of underage drinking. Prevalence studies suggest that alcohol use is common among 12 to 20 year olds, with approximately 10 million reporting that they consumed alcohol within the past month. Additional public health problems related to alcohol consumption, such as driving under the influence and related unintentional injuries, sexual assault, and alcohol abuse and addiction, are prevalent among youth and young adults. Thus, the relationship between social media and underage alcohol use is ripe for consideration in the public policy arena, especially given the tremendous increase in social networking site use in recent years.

Research supports relationships between high rates of underage drinking in the United States and prevalence of alcohol harms among college students. Unfortunately, the control of virtual environments by parents is quite limited. Policy changes and legal implications cannot promise the prevention of using SNSs as forms of display for alcohol abuse amongst college students and young adults. Several theories give the benefit of understanding the linkages between increased use of SNSs and negative behaviors.

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The strongest supporting theory in this study is TDA. The theory supports that deviant behavior occurs most often within intimate and personal networks (Sutherland, 1939). While SNSs also can be promising for prevention of poor health behaviors, further research and application is needed to guide its use for positive behavioral changes in alcohol attenuation.

Future Research Directions

Whereas existing evidence suggests a strong relationship between alcohol use displays on SNSs and positive attitudes toward underage alcohol use and related behaviors, little is known about the dynamics or mechanisms that underlie the relationships. For example, our review located no studies that extended the offline investigation of adolescent subcultures into the virtual world. Adolescent peer group formation has been studied extensively offline (Brown, Eicher, & Petrie, 1986; Dolcini & Adler, 1994; O'Brien, & Bierman, 1988; Sussman et al., 2007); however, studies on peer group formation in online environments are virtually nonexistent. SNSs naturally enhance adolescents' tendency to form social groups based on social similarities in social needs and behaviors. Our literature search found research on nature of peer group formation in offline interactions (Dolcini & Adler, 1994). Future research should use qualitative approach to explore the possible existence of adolescent subgroups in virtual environments and their perceived relationships with alcohol-related intentions and behaviors. Once possible subgroups are identified, segmentation (i.e., identification of unique subgroups) research using chi-squared interaction detection (CHAID) (Alfonso & Kaur, 2013) or cluster analysis techniques such as those used in the classification of social networking site uses in Alarcon-del-Amo et al. (2011) can be used to verify the continuation of offline peer groups into online communities. Cluster analysis techniques would allow for the identification of unique subgroups of young adults who use social networking sites. For example, cluster analysis could be used to test whether the concept of 'deviant' subgroups identified offline persists in virtual environments.

Most studies have used quantitative approaches to looking at the influence of SNSs on alcohol use. Qualitative methods are useful in exploration and identification of the mechanisms behind relationships (Creswell, 2009), such as the relationship between SNS use and underage drinking. Qualitative studies that look at the nature of online interactions and alcohol use are needed. Qualitative research methods such as focus group discussions or in-depth interviews could be used to gather young adults' perceptions of the influence of SNSs on their behavior and perceived relationships between online behavior and future outcomes. Currently there is no firm explanation of how alcohol use displays affect behavior. Specifically, future research should use qualitative research methods to identify risk and protective factors at play in the virtual world that might be associated with underage alcohol use. Quantitative research could then be used to verify the risk and protective factors identified using qualitative research and identify levers of change to target in intervention research.

Perhaps most important to address is the lack of theoretical frameworks used so far in the literature. The use of theoretical constructs is vital in the explanation of human behavior. Theories such as the one discussed herein (i.e., Edwin Sutherland's Theory of Differential Association) could be used to identify key constructs to measure in the exploration of mechanisms that explain relationships between alcohol use displays on SNSs and alcohol-related behavior and to interpret the results of both qualitative and quantitative research studies in this area. For example, quantitative studies could test the theoretical premise that young adults learn alcohol use related behaviors and skills through interaction and communication with their peers through social networking use. In turn, qualitative research could be used to explore the

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principal of differential association in relation to alcohol-related displays on SNS and related behavior. More specifically, future research could explore values, mores, and norms expressed through SNS and their perceived relationships with alcohol-related beliefs, attitudes, and behavior.

Finally, there is a real need for intervention research in the area of social networking and alcohol-related related behavior. As stated earlier, social media can be also a deterrent to underage drinking. There is very little research in the area of using social media to combat underage drinking. Future research should address this dearth through the identification of levers of change to target with social media interventions. Theoretically driven, mixed method research (Creswell, 2009) could be used to identify strategies that could be effective in changing online behavior and social norms. For example, qualitative research could investigate strategies for using social media to change social norms among youth and young adults, while quantitative research could be used to identify the most significant predictors of social norms to address with interventions. Further, media literacy could be effective in alerting youth and young adults to the influence of alcohol related imagery and behaviors and the virtual world that may influence their behavior (Bergsma & Carney, 2008). Media literacy could be used to educate youth on the role of SNS use and their behaviors. Strategies similar to those used in anti-tobacco prevention campaigns could be used to inform youth of the influence, for example, of virtual alcohol advertisements on their behavior. The potential for differential response to interventions based on gender should be explored in future intervention research, as males report higher rates of alcohol use displays on their SNSs (Peluchette & Karl, 2008) and also report a greater sense of belonging from social networking activities (Quinn & Oldmeadow, 2013). In light of this, gender specific intervention strategies might be required. Future research should seek to confirm this possibility.

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KEY TERMS AND DEFINITIONS

Deviation: Deviation or deviance refers to departure from acceptable standards for behaviors, beliefs, and values.

Norm: Formal or informal rules created by a society or a subgroup through ongoing interactions that are used for determining appropriateness of behaviors, attitudes, beliefs, and values.

Peer Group: A social group of individual that are homogenous with respect to one or more socio-demographic characteristics such as age, education, occupation, etc.

Social Media: Web-based applications or platforms such as Facebook, Twitter, LinkedIn, MySpace, and Instagram, that are easily accessible by user, to allow interactive creation and sharing of contents.

Social Networking Sites: Web-based services that enable users to create public profiles and share contents with other users whose connections/profiles are made available within the same Website.

Social Outcomes: Positive or negative consequences for or changes in statuses, roles, and accomplishments that are important within the norms of a group.

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Chapter 22
The Philippine Health Care Delivery System and Health Expenditure

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ABSTRACT

Health is recognized by the Philippine constitution as a basic human right. The Philippines, compared to most Asian countries, produces more and better human resources for health. However, the Philippines are challenged by attracting and retaining staff in the under-served areas of the country. Philippine allotted 4.2-4.4% of its GDP to health from 2009 to 2011. Furthermore, considerable inequities in health care access and outcomes between Socio-economic groups remain. The Phil Health's limited breadth and depth of coverage has resulted in high levels of out of pocket payments. The implementation of the reforms in financing, service delivery and regulation which are aimed to tackle the inefficiencies and inequalities in the health system has been challenged by the decentralized environment and the presence of private sector, often creating fragmentation and variation in the quality of health services across the country.

INTRODUCTION

The Philippines is the second largest archipelago on earth with 7,107 islands. It is positioned on the western edge of the Pacific Ocean on the South-eastern rim of Asia (PHSDP, 2012). It is a member of the Association of South-East Asian Nations or ASEAN. The country is made up of three major geographical regions namely: Luzon, Visayas and Mindanao. It has a total of 80 provinces, 138 cities and 1,496 municipalities. In 2010, the population of the Philippines was 92.3 million, with a growth rate of

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1.9% per year. Half of the population lives in the urban areas and of that, 44% live in slums (PHSDP, 2012). Christians make up the majority of the population and there is a Muslim minority concentrated in the southern part of the country. Additionally, the country is a home of 180 ethnic groups. Malays make up the majority and there are tribes of indigenous peoples in mountainous areas throughout the country (PHSDP, 2012).

Economically, the Philippines is considered as a developing country and is a lower middle-income economy in the South East Asia. Per capita Gross Domestic Product (GDP) is 2,918.13 US Dollars in the third quarter of 2013. The GDP growth rate is 7.025 in the same year. The annual per capital poverty threshold is P9,385 in 2012, slightly higher than that in 2009 which was P8,448. Average annual family income reached P206,000 in 2012, it is also higher than that of P173,000 in the year 2006. Unemployment rate in 2013 is 7.3% with a 0.3% increase from the 7.0% in 2012. Underemployment rate has decreased from 22.8% in 2012 to 19.2% in 2013 (NSCB, 2013).

The Philippines has had seven constitutions since 1897. In effect now, the one ratified by referendum in 1987, established a republican government patterned after that of the United States with a strong executive branch, a bicameral legislature, and an independent judiciary under a supreme court. It has had seven constitutions since 1897. In effect now, the one ratified by referendum in 1987, established a republican government patterned after that of the United States with a strong executive branch, a bi-cameral legislature, and an independent judiciary under a supreme court (PHSR, 2011).

Health service delivery is based on a Western biomedical model of health initially introduced during the Spanish colonial era and strengthened during American colonization. This Western system is superimposed on a pre-existing alternative model of health care based on a mix of folk and herbal medicines, religious beliefs, and traditional practices that has persisted throughout the country. Indicators of health status have steadily improved since the 1970s. The analysis of the country's demographic and health aspects show that it is going through a demographic and epidemiological transition, characterized by a decrease in fertility, increase in life expectancy and a substantial change in risk factors (PHSR, 2011). However, there is a high inequality in many health outcomes between socio-economic classes and disparities between geographical regions. The top five causes of death include heart and cerebrovascular diseases, malignant neoplasm, pneumonia, and tuberculosis. The top five causes of morbidity include acute respiratory infection, ALRTI and pneumonia, bronchitis, hypertension and acute watery diarrhoea (PHSDP, 2012).

THE PHILIPPINE HEALTH CARE DELIVERY SYSTEM

The Philippine health system has undergone changes and trends to meet the timely demand for it. In fact, there have been many legislative actions undertaken by the government to form the regulatory framework for the health system and public health in the country. Example of these are the Local Government code of 1991, National Health Insurance Act of 1995, Organ Donation Act (1991), Hospital Licensure Act, Pharmacy Act, Dangerous Drugs Act and many others.

Organization of the Health Care System

The Philippines provides recognition of health as a basic human right. Protection and promotion of the right to health of the people and instilling health consciousness among them have been guaranteed in the

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Article II, Section 15 of the Philippine Constitution. The Philippine health system consists of the public and private sector. The public sector consists of the Department of Health (DOH), Local Government Units (LGUs) and other national government agencies providing health services.

The Department of Health is the country's lead agency in health. The major mandate of DOH is provide national policy direction & develop national plans, technical standards & guidelines on health. It has a regional field office in every region and maintains specialty hospitals, regional hospitals and medical centers. It also maintains provincial health teams made up of DOH representatives to the local health boards and personnel involved in communicable disease control (NOH, 2005-2010).

With the devolution of health services under the 1991 Local Government Code, provision of direct health services, particularly at the primary and secondary levels of health care, is the mandate of LGUs. Under this set-up, provincial and district hospitals are under the provincial government while the municipal government manages the rural health units (RHUs) and barangay health stations (BHSs). In every province, city or municipality, there is a local advisory body to the local executive and the sanggunian or local legislative council on health-related matters (NOH, 2005-2010).

The passage of the 1995 National Health Insurance Act expanded the coverage of the national health insurance program to include not only the formal sector but also the informal and indigent sectors of the population. The program founded under the principle of social solidarity where the healthy subsidizes the sick and those who can afford to pay subsidize those who cannot. PhilHealth, a government-owned and controlled corporation attached to the DOH, is the agency mandated to administer the national health insurance program and ensure that Filipinos will have financial access to health services (NOH, 2005- 2010).

The private sector includes for-profit and non-profit health providers whose involvement in maintaining the people's health is enormous. Their involvement include providing health services in clinics and hospitals, health insurance, manufacture and distribution of medicines, vaccines, medical supplies, equipment, other health and nutrition products, research and development, human resource development other and other health-related services (NOH, 2005-2010).

Health Facilities and Services

The total number of hospital is 1,795. The 721 of this belongs to the government while 1,074 as private hospitals. The number of beds per 1000 population was 1.04 in 2008. The number of Barangay Health Stations (BHSs) was 17, 018 in 2008. And the Rural Health Units (RHUs) numbered 2,266 in 2005. In terms of government hospital beds, National Capital Region (NCR) has the most number of 27,779 beds followed by Region IV-A and Central Luzon at 9,459 and 8, 218 beds respectively. The regions with the least number of government hospital beds are Autonomous Region of Muslim Mindanao (ARMM) at 586 beds, CARAGA at 1,718 beds and Region IV-B at 2, 093 beds. The government hospital bed to population ratio is worst in ARMM with 0.17 per 1000 population while it is best in NCR with 2.47 per 1000 population. There is increasing trend in the number of BHSs from 15,343 in 2002 to 17,018 in 2008 and also an increased in the number of RHUs in the country from 1,879 in 2001 to 2,266 in 2005. NCR has the most number of RHUs while the Central Mindanao has the least number of RHUs. On the other hand, Region IV-A and Region IV-B have the most number of BHSs while NCR has the least (PSY 2004). On the average, each RHU serves around 41,000 people while each BHS serves around 5,100 people (PSY, 2004 & NOH, 2005-2010). Table 1 shows the number of beds and rate per 1000 population by region in 2008.

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Table 1. Numbers of beds and rate per 1000 population by region, Philippines, 2008

Region	Number of Beds	Rate per 1000 Population
I Ilocos	4,163	0.84
II Cagayan Valley	2,779	0.86
III Central Luzon	8,218	0.84
IV-A CALABRAZON	9,459	8.83
IV-B MIMAROPA	2,093	0.73
V Bicol	4,156	0.76
VI Western Visayas	5,114	0.78
VII Central Visayas	6,190	0.92
VIII Eastern Visayas	2,845	0.67
IX Zamboanga Peninsula	2,909	0.87
X Northern Mindanao	4,858	1.16
XI Southern M.	4,580	1.08
XII Central M.	3,180	0.94
NCR	27,779	2.47
CAR	2,472	1.52
ARMM	586	0.17
CARAGA	1,718	0.70
Philippines	**94,199**	**1.04**

Source: Department of Health

The DOH has existing policy to provide services under the National Mental Health Policy, the National Policy on Oral Health, including the Minimum Essential Oral Health Package of the DOH for children 2-6 years, and to overseas Filipino workers. However there is also a very limited dental and rehabilitative service in the public sector. The 7.76 million overseas Filipino workers face a wide range of occupational, mental, reproductive and sexual health-related problems, but currently receive almost no education or information and variable levels of insurance and support. Public facilities from both national and local governments provide free services including medicines and laboratory work up during outbreaks (e.g measles, dengue and flu) and other public health related events (PHSDP, 2012).

Health Information system including surveillance of diseases and other public health events are recorded and reported from the local surveillance units and through the Philippine Integrated Disease Surveillance and response to the DOH national surveillance unit. This serves as the data bank for the analysis of the health status of the local community as well as the national data for the health profile of the country especially those that will need immediate notification to WHO as a commitment for the implementation of International Health Regulation (2005).

In 2012 the DOH released a new classification system of hospitals and other health facilities with specific guidelines for scope of services and functional capacity for each classification, and overall operating standards. There is also an ongoing effort to upgrade government health facilities in line with the goal to achieve universal coverage (PHSD, 2012).

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Table 2. Classification and characteristics of health facilities and services in the Philippines, 2012

Facility	Number	Characteristics
Hospitals		
General Hospitals **Level 1 General Hospitals** **Level 2 General Hospitals** **Level 3 General Hospitals** **DOH Hospitals** **c. Specialty hospitals** **d. Other DOH Hospitals**	70 16 54	Most hospitals at all levels provide services for all kinds of illnesses, diseases, injuries or deformities. It has emergency and outpatient services primary care services, family medicine, pediatrics, internal medicine, obstetrics-gynecology, surgery including diagnostic and laboratory services, imaging facility and pharmacy. Hospitals Level 1 general hospitals also include: isolation facilities, maternity, dental clinics, 1 st level x-ray, secondary clinical laboratory with consulting pathologist, blood station, and pharmacy. Level 2 hospitals include level 1 services and departmentalized clinical services, respiratory units, ICU, NICU and HRPU, high risk pregnancy unit, tertiary clinical laboratory, and 2 nd level x-ray Level 3 hospitals include level 2 services and teaching/training, physical medicine and rehabilitation, ambulatory surgery, dialysis, tertiary laboratory, blood bank, 3 rd level x-ray A tertiary hospital which specializes in the treatment of patients suffering from a particular condition requiring a range of treatment (e.g. Phil. Orthopaedic Centre, National Centre for Mental Health); patients suffering from disease of a particular organ or groups of organ (e.g. Lung Centre of the Philippines, Phil. Heart Centre); or patients belonging to a particular group such as children, women, or elderly (National Children's Hospital, Dr. Jose Fabella Memorial Medical Centre). Tertiary care facilities located all over the country serving as referral hospitals in the different regions of the country and providing anticipated range of tertiary services.
Other Health Facilities		
Category A: Primary Care facility **Category B: Custodial care facility** **Category C: Diagnostic/ Therapeutic facility** **Category D: Specialized out-patient facility**		First contact facility offering basic services including emergency and normal delivery services. Includes: in-patient short-stay facilities, medical out-patients, overseas workers and seafarers facilities, and dental clinics. Provides long-term care for those with chronic or mental illness, substance/drug abuse treatment and rehabilitation, sanatorium/leprosarium, and nursing home facilities. Laboratory facilities, radiology including x-ray, and nuclear medicine facilities. Including for dialysis, ambulatory surgery, in-vitro fertilization, stem cell services, oncology and chemotherapy, radiation oncology, and physical medicine and rehabilitation. PNAC is a unit within the DOH responsible for promoting HIV/AIDs program and provides secretariat support to HIV/AIDs prevention and control, Diabetes Foundation, Heart Association and Philippine Coalition for the Prevention of NCDs are organizations with membership from the public and private sectors.

Source: Philippines Health Service Delivery Profile (PHSDP), 2012

Health Human Resource

Human resources for health are central to managing and delivering health services. They are crucial in improving health systems and health services and in meeting the desired health outcome targets. Human resources for health are enormous but unevenly distributed in the country. Most health practitioners are in Metro Manila and other urban centers. Compared to most Asian countries, the Philippines is producing more and better human resources for health (NOH, 2005-2010).

The number of physicians per 100,000 populations slightly increased from 123.8 in 1998 to 124.5 in 2000, which translates into one physician for every 803 people in 2000. The number of dentist per 100,000 populations almost remained unchanged at 54.2 in 1998 and 54.4 in 2000 or one dentist per 1,840 people in 2000. The number of pharmacists per 100,000 populations improved slightly from 55.8 in 1998 to 58.1 in 2000. This means one pharmacist for every 1,722 people in 2000. The number of

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Table 3. Summary of health services and providers in the Philippines, 2012

Health Services	Public Sector Provision	Private Sector Provision
Health promotion		
Health education Family planning Maternity care Child care Nutrition and food safety Lifestyle-related or non-communicable diseases Communicable diseases Environmental Health and sanitation	Health centres Barangay health stations National programs and agencies provide technical support Activities are highly variable and depend on the local government unit Community health teams provide education and information at family levels in the community. They also work with poor families to determine health needs, services available and receive PhilHealth benefits Hospitals conduct multi media health promotion activities in their waiting areas, lobbies and OPDs Some LGU-operated birthing facilities Include: Pre-natal care for mothers, Iron Anti-rabies for animal bite centres UHC/KP focuses on the 5Million poorest	Family and community practitioners, paediatricians, obstetricians, physicians and some subspecialists Some organized NGOs initiate activities Large-scale programs are rarely provided by the private sector
Disease Prevention		
Childhood immunization Tb, malaria, leprosy, filariasis, schistosomiasis, rabies, dengue fever, and SARS	Health centres Provincial hospital outpatient services and Animal Bite Treatment Centres National agencies provide technical support and supplies Support from the Global Fund for AIDS, Tuberculosis and Malaria Includes: Endemic areas are provided with anti- malaria drugs, schisto and filarial drugs, including soil-transmitted helminthiasis	Paediatricians clinics and private hospital outpatient services provide immunizations Private Animal Bite treatment Centres as stand alone clinics and those in private hospitals. Pulmonary specialists and some general practitioners participate in the DOTS program for
HIV and other Sexually Transmitted Infections (STI)	Display of IEC materials in some rural health units/ social hygiene clinics/city health offices; video showing in waiting areas	NGOs and Key Populations at higher risk for HIV Support Groups for Sex workers/Men having Sex with Men and People who inject drugs, and the young key populations conduct outreach work and peer education activities Some private hospitals display IEC materials; video showing in waiting areas
Environmental health and sanitation	Local governments, water districts, national agencies provide assistance in terms of water supply systems; sanitation systems; solid waste, hazardous waste, health care waste management systems; sewage and wastewater collection and treatment facilities; water and wastewater laboratories. DOH Environmental and Occupational Health Office provides technical support to LGUs.	Water utilities (e.g. Manila Water, Maynilad), NGOs for water and sanitation; water refilling stations, bottled water companies; solid waste and hazardous waste treatment and disposal services; septic tanks desludging services (e.g. Malabanan companies); sewage and wastewater treatment facilities; water and wastewater laboratories

Source: PHSDF, 2012

nurses per 100,000 populations almost remained constant from 442.7 in 1998 to 442.8 in 2000, a ratio of one nurse per 226 people for both 1998 and 2000 (SEAMIC, 2003 & NOH, 2005-2010).

In 2002, there are 3,021 doctors, 1,871 dentist, 4720 nurses and 16,534 midwives employed by LGUs. Other health personnel employed by LGUs consist of 3,271 engineers/sanitary inspectors, 303 nutritionist, 1,505 medical technologist, 977 dental aides and 2,808 non- technical staff. Assisting these health personnel at the grassroots are 195,928 volunteer barangay health workers and 54,557 birth attendants (FHSIS, 2002 & NOH, 2005-2010).

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Table 4. Summary of health services and providers in the Philippines, 2012

Health Services	Public Sector Provision	Private Sector Provision
Diabetes, hypertension, cancer and mental health	Health facilities at LGU levels National NCD program of the DOH provides technical support to local government units Hospitals at municipal/city, provincial and regional levels also provide disease-prevention related activities (e.g. smoking cessation advice, wellness clinic, etc.) The medicines program – Compack - for NCDs targets the 5 Million poorest as part of UHC/KP commodity support	Private general practitioners and Specialists in clinics and medical centres provide education and prevention programs. Some are linked to NGOs such as Diabetes Foundation, Philippine Heart Association, Philippine Coalition for the Prevention of NCDs, among others Private mental health facilities
Primary services		
Outpatient, dental and laboratory services Disease programs like TB, Malaria, Dengue	Health centres Primary care hospitals other DOH-supported commodities – eg TB drugs, vaccines (DPT, OPB, measles, BCG, Hep B), also flu vaccines for indigent senior citizens	Clinics Hospitals
Secondary and tertiary services		
Outpatient, Inpatient and hospital care Laboratory and special procedures Acute and emergency care Dental care Mental Health	Secondary and tertiary care hospitals, including very specialized care Hospitals Some health centres and hospitals Hospitals	Secondary and tertiary care hospitals, including very specialized care Hospitals Most dental care is by private practitioners in clinics and some hospitals Hospitals, Clinic/halfway homes
Rehabilitative services		
Acute inpatient rehabilitation Long term care for the elderly and disabled Programs for the disabled Palliative care	Tertiary hospitals with specialist physicians and physical, occupational and speech therapists A few tertiary hospitals provide house visits and palliative care Some community-based care National Commission Concerning Disabled Persons coordinates implementation and enforcement of legislation A few tertiary hospitals Services are variable, highly dependent on the local government	Tertiary hospitals Some home-based care Several NGOs and foundations provide assistance This should be filled up. There are more of private partners doing work here. Hospitals

Source: PHSDF, 2012

The Philippines has traditionally been a major source of health professionals to many countries because of their fluent English, skills and training, compassions, humaneness and patience in caring. The country is purportedly the leading exporter of nurses to the world (Aiken, 2004) and the second major exporter of physicians (Bach, 2003). Although the country is producing a surplus of health workers for overseas market since the 1960s, the large exodus of nurses in the last four years has been unparalleled in the migration history of the country. While Filipino physicians have been migrating to the United States since the 1960s and to the Middle East countries in the 1970s in steady outflows, the recent outflows are disturbing because they are no longer migrating as medical doctors but as nurses (NOH, 2005-2010).

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HEALTH EXPENDITURE

The Philippine health financing involves different financial sources, regulatory bodies and health services providers. Generally, the four main sources are government (national and local), Social insurance (government and private), user fees or out-of-pocket (OPP) and the donors. The sources coming from donors is also called grants are those that come from philanthropists and charity organizations. The Department of Health (DOH) and the National Health Insurance Program or PhilHealth. Health services providers as we know includes the hospitals, the doctors and nurses.

The total health expenditure per capita is 8.1% in 2011. It has an annual growth rate of 7.2% in the period of 2009 and 2011. The Philippine had allotted 4.2-4.4% of its domestic growth product (GDP) to health in the same period of time. This share rose slightly compared to 3.9% in 2007 (figure number), but remains relatively low compared with the WHO Western Pacific Region 2006 average of 6.1% this total health expenditure tallied an average annual growth rate of 9% in the period of 2009 and 2011.

The government total health expenditure on health amounted to 27% in 2011 from which 12.3% as a national government share and the remaining 14.7% by the local government share. From 2009 to 2011, the government expenditure on health has increased with an average annual growth rate of 14.6%. The government, as a whole, spent more on personal health care than the public health care each year from 2009 to 2011. More detailed expenditure accounts indicate that spending on hospitals dominated the government's personal health care expenditures.

Table 5. Number of government health workers, Philippines, 2008

Area	Doctors	Dentists	Nurses	Midwives
Philippines	2,838	1,891	4,576	17,437
NCR	590	498	723	1,135
CAR	89	40	131	637
I	159	105	259	1,014
II	97	65	196	839
III	278	176	441	1,662
IV-A	238	189	472	1,818
IV-B	83	68	142	555
V	157	85	273	1072
VI	234	123	401	1,775
VII	177	117	328	1,534
VIII	155	94	201	904
IX	100	44	203	697
X	138	74	241	1,052
XI	75	69	127	743
XII	113	56	194	876
ARMM	76	30	130	507
CARAGA	79	58	114	615

Source: Department of Health

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Table 6. Health expenditures by source, 2009-2011

Sources of Funds	AMOUNT (in million pesos, at current prices)	Growth Rate 2010-2011	Average Annual Growth Rate 2009-2011
	2009 2010 2011		
GOVERNMENT	**88,722 101,378 116,443**	**14.9**	**14.6**
National Government	36,949 43,375 53,069	22.3	19.8
Local Government	51,773 58,003 63,364	9.2	10.6
SOCIAL INSURANCE	**27,897 33,925 39,126**	**15.3**	**18.4**
National Health Insurance Program	27,791 33,799 39,022	15.5	18.5
Employee's Compensation	107 126 104	17.1	1.1
PRIVATE SOURCES	**217,865 239,139 272,009**	**13.7**	**11.7**
Private Out-Of-Pocket	182,370 199,983 227,215	13.6	11.6
Private Insurance	6,083 6,401 7,222	12.8	9.0
HMO	18,199 21,170 24,570	16.1	16.2
Private Establishments	7,809 7,937 9,297	17.1	9.1
Private Schools	3,404 3,649 3,706	1.6	4.3
REST OF THE WORLD	**7,681 6,384 3,478**	**45.5**	**32.7**
Grants	7,681 6,384 3,478	45.5	32.7
ALL SOURCES	**342,164 380,826 431,047**	**13.2**	**12.2**

Source: National Statistical Coordination Board, 2013

Table 7. Total Health Expenditure, 2009-2011

Item	2009	2010	2011
THE (in million Pesos, at current prices)	342,164	380,826	431,585
THE Growth Rate (in percent, at current prices)		11.3	13.2
THE (in million pesos, at 2000 constant prices)	209, 147	226, 144	248, 585
Total Health Expenditure Growth		8.1	9.9
Per Capita Health Expenditure (in pesos, at current prices)	3,759	4,112	4,577
Per Capita Health Expenditure (in pesos, at 2000 constant prices)	2,298	2,442	2,639
Per Capita Health Expenditure Growth Rate (in percent, at current prices)		9.4	11.3
THE Per Capita		6.3	8.1
THE (in billion pesos, at current prices)	342.2	380.8	431.0
Gross Domestic Product (GDP, in billion pesos, at current prices)	8,0261.1	9,003.5	9,735.5
Gross National Income (GNI, in billion pesos, at current prices)	10,652.5	11,996.1	12,878.1
Health Expenditure (% of GDP)	4.3	4.2	4.4
Health Expenditure (% of GNI)	3.2	3.2	3.3

Source: National Statistical Coordination Board, 2013

In 1995, the National Health Insurance Program (NHIP) managed by Philippine Health Insurance Corporation (PHIC or PhilHealth) signaled the movement towards a single-payer Premium-based financing or insurance system. However, the current system continues to maintain a dual financing system existing parallel to each other (NOH, 2011-2016). This Social health insurance program, known as PhilHealth, increased its share of total health spending at an average annual growth rate of 18.5% from

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2009 to 2011. Public funding through PhilHealth has been expected to set the incentive environment in order to have a greater leverage and drive forward health system performance. However, the share of 9.1% remains low in relation to the 30% target set by DOH in the 1999 health reform agenda to reduce out-of-pocket share of total health expenditure.

The private sector continues to be the dominant source of health care financing with financing with 63.1% share of the total health expenditure in 2011 and was slightly higher than the preceding year which was 62.8%. The private sector share on health spending has an annual growth rate of 11.7% from 2009 to 2011. Moreover, out-of-pocket or user fees continue to dominated the share of private sources and the total health expenditure as a whole with 57.2% and an annual growth rate of 11.6%. This trend of increased of OOP payments is quite alarming knowing that the Social insurance has been expanded in the recent years.

The high level of Out-Of-Pocket may lead to financial catastrophe and impoverishment. Table 5 validates the large contribution of OOP during confinement but it is significantly higher among patients confined in public facilities. Despite the safety nets, donations would still count as one of the major sources of financing.

Looking at the components of Out-Of-Pocket by quantile, more than half of the medical expenditure was spent on medicine. However, share of medicine on the total medical expenditure was consistently higher among the poor compared to their richer counterparts. Expenditure on contraceptives was also higher among the poor on household (Lavado & Ulep, 2011).

CONCLUSION

The health service delivery in the Philippines is based on a Western biomedical model. Health functions are generally devolved to provinces and municipalities. As stated above, health service has evolved into dual delivery systems of public and private provision, covering the entire range of interventions with varying degrees of emphasis at different health care levels. Health status has improved over the last decades. Among the indicators of this improvement are the decreased in the infant mortality rate, decreased prevalence of communicable diseases and the increased in the life expectancy of the Filipinos. However, there are still many problems and challenges the country has to solve. For the inequities

Table 8. Source of financing during impatient visits, Philippines, 2008

Source of Payment	Confined in Private Hospitals (%)	Confined in Public Facilities
Salary/income	48	51
Loan	17	23
Savings	37	32
Donation	17	23
PhilHealth	51	24
SSS/GSIS	4	2
HMO	6	1
Others	0.82	0.32

Source: Raw data from National Demographic & Health Survey, NSO 2008

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Table 9. Distribution of out-of–pocket expenditure by components and by socio- economic status, in percent, Philippines. 2000-2009

Components	Poorest				Richest				Philippines			
	2000	2003	2006	2009	2000	2003	2006	2009	2000	2003	2006	2009
Medicines	74.2	75.0	73.5	74.7	59.5	59.7	59.1	57.2	67.6	66.6	66.6	65.7
Hospital charges	1.8	2.1	2.2	2.1	7.2	6.7	6.9	7.0	4.4	4.4	4.6	4.7
Medical & dental	6.0	5.3	5.6	6.2	19.8	18.6	18.0	16.7	12.5	12.6	11.6	11.5
Other medical goods	9.0	8.4	8.7	8.9	11.7	13.7	10.3	10.9	10.8	11.6	10.1	10.6
Other medical services	8.8	1.1	1.7	2.0	1.3	0.4	0.8	0.9	4.4	1.0	1.6	1.7
Contraceptive	0.3	8.0	7.4	5.0	0.5	0.8	1.4	2.0	0.5	3.9	3.6	3.1
Food supplement	-	-	0.9	1.1	-	-	3.0	5.4	-	-	1.9	2.7

Source: Raw data Family Income and Expenditure Surveys, 2000-2009

in access to health care services and outcomes between Socio-economic groups remain. This has been generally caused by the high cost of access and use of health care. Also, the high level of out of pocket payments brought about by the limited breadth and depth coverage of the PhilHealth, the country's social health insurance, is a heavy burden to the poor Filipinos. Despite being a major exporter of health workers, some rural and poor areas of the Philippines still face shortage of professional health workers. Thus, the government has to exert efforts in attracting and retaining staff in the under-served areas of the country. Another key challenge is the inefficiency in service delivery. This I believed is the result of an ineffective referral system and gatekeeping of the health system. Finally, reform efforts in financing, service delivery and regulation have been done to resolve these problems. However, implementation has been challenged by the decentralized environment and the presence of a large private sector, often creating fragmentation and variation in the quality of services across the country.

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KEY TERMS AND DEFINITIONS

Department of Health: The Department of Health is the Philippine's lead agency in health. The major mandate of DOH is provide national policy direction & develop national plans, technical standards & guidelines on health.

Health: According to the World Health Organization (WHO), "health is more than just the absence of illness or disability, but also is physical, spiritual and social well-being."

Health Economics: Health economics can be defined as the application of the rules of economics to the health services. It can also be defined as the efficient use of the resources allocated to the health sector.

Health Expenditures: According to U.S. National Library of Medicine, health expenditures occurs the amounts spent by individuals, groups, nations, or private or public organizations for total health care and/or its various components. These amounts may or may not be equivalent to the actual costs (Health Care Costs) and may or may not be shared among the patient, insurers, and/or employers.

Health Care System: The World Health Organization defines health care systems as follows: "A health system consists of all organizations, people and actions whose primary intent is to promote, restore or maintain health. This includes efforts to influence determinants of health as well as more direct health-improving activities. A health system is therefore more than the pyramid of publicly owned facilities that deliver personal health services. It includes, for example, a mother caring for a sick child at home; private providers; behavior change programmes; vector-control campaigns; health insurance organizations; occupational health and safety legislation. It includes inter-sectorial action by health staff, for example, encouraging the ministry of education to promote female education, a well-known determinant of better health."

Out-Of-Pocket: OOP is defined as payments made for health care services by patients or households. In general, OOP cost refers health expenses that are not covered by insurance.

Philippine Health Insurance Corporation: Philippine's national health insurance program aiming to provide affordable health care for the population with site location, service and contact information.

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Chapter 23
Socio-Technical Systems on the Move:
Some Insights for Policy Activity

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ABSTRACT

Because of the advancements in Information Communication Technologies (ICTs), and notably the increased spreading of Web 2.0 Internet-based services and mobile computing, an increasingly information-rich environment is made available, where new types of Socio-Technical Systems (STS) can be established. Due to the pervasiveness of ICT, designing and developing Socio-Technical Systems is raising an increasing interest also from a policy point of view. They play a crucial role in the improvement of the so-called soft-infrastructures, a main asset for delivering social innovation. Raising the performance of such an infrastructure, in fact, turns out to be a major challenge to be addressed in order to meet EU requirements for smart growth. In this chapter, a concept of STS is suggested, and its ICT-enabled implications for policy activity are highlighted. As an example, the concept is used for designing a collaborative platform for health knowledge exchange at a regional level.

INTRODUCTION[1]

In everyday life, Information and Communication Technologies (ICT) and Internet access are progressively transforming the ways people gather information about their surrounding environment and interact with it (Atkinson & McKay, 2007; Castells, 2009; Horrigan & Rainie, 2002; Kwan, 2001; Dodge & Kitchin, 2004; Wellmann & Haythornthwaite, 2002; Townsend, 2001; Warf, 2001; Wilson & Corey eds., 2000).

These technologies alter the distance limits prescribed by social practices, thus allowing for a higher degree of accessibility. They are also time-adjusting as the time used in an activity can be freed for alternative ones. Furthermore, they affect the ways people perceive their surrounding environment and mediate human communication (Fuch, 2005). Finally, these features have an impact on activities which can be more easily segmented in tasks and spread out across space and time (Couclelis, 2009), although their ultimate effects cannot be easily explained.

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Lately, in spite of or because of the persistent, critical situations for most national and regional economies, the new generation of ICT, and notably mobile communications and web 2.0 Internet based services, are again stimulating an upsurge of interest, as new facets of ICT potential are gaining momentum, i.e. ubiquity, knowledge sharing, co-creation.

The recent emphasis on digital connectivity shows that Internet is not operating at the expenses of the real face-to-face relationships. Rather, it is an additional means of communication that is being integrated in everyday life (Wellman, Quan-Haase, Boase, & Chen, 2003), and likely to deliver new types of relationships and relation opportunities (Fuchs, 2005; Quitney Anderson & Rainie, 2010).

As the penetration of ICT creates an increasingly rich information environment, questions about the influences of the interaction of technical and social networks also arise: how does it encroach on existing organizations, by giving access to a globalized and information leaden society. Moreover, how does it enable the establishment of novel, more socially affordable types of systemic entities, herein called Socio Technical Systems (STS)?

Although the notion is already well established in the literature (Berra & Occelli, 2009; Morris, 2009; Sayer & Jarradi, 2013), the current features of STS, and namely those connected with the knowledge flux associated with the networks of interacting ICT enabled agents, raise a renewed interest to sharpen its underpinnings and investigate its functioning.

This chapter is a contribution to such an endeavour. First, in the next section, a conceptual framework is suggested which highlights the components and organizing mechanisms of STS.

Then, having this framework as a background, reference is made to the findings of some studies undertaken in the Piedmont region, where since 2005 the Piedmont ICT Observatory (PICTO) has been monitoring the spreading of ICT among citizens, firms and local governments. Arguments are provided that STS are not just intellectual constructs, useful for a better understanding of current organizational changes, but have also an impact in supporting their developmental process in a more inclusive and informed way. This turns out to be particularly relevant for delivering public services and in this direction, attention is turned to health care, a domain which besides accounting for the largest share of the regional public spending is undergoing a number of organizational reforms. An application of the STS notion is then outlined to help conceiving a collaborative platform for health knowledge exchange and support a regional soft infrastructure for health care delivery.

In the final section, some remarks are offered about the design potential of STS. We argue that, in the near future, applications of the concept of STS in policy practices will multiply and STS representations will be progressively refined. In this context, some most promising research topics are mentioned.

SOCIO-TECHNICAL SYSTEM: AN OLD CONCEPT FOR A NEW KIND OF SYSTEMS

Background

The concept of Socio Technical System (STS) is a longstanding one, loosely applied to describe any kind of organization that is composed of people and technology.

Originally introduced in the fifties, as computing and human requirements evolved, it has been progressively refined (Eason, 2008; Trist, 1981; Withworth, 2009). Notwithstanding, the term has been used with varied nuances in the literature (see among many others Ackerman, 2001; Berra, 2007; Castells,

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2004; Gallino, 2007; Geels, 2004; Graham & Marvin, 1997, 2001; Meyer, 2006; Kwan, 2001; Withworth & Withworth, 2010), underlying that the existing STS notions consist of two main principles:

1. The fact that the interaction of social and technical networks creates the conditions for successful (or unsuccessful) system organizational performance. This interaction can result partly from linear cause-effect relationships (such as those informed by design) and partly from non-linear, even unpredictable relationships. Whether designed or not, both types of interaction occur when socio and technical networks are made to work together;
2. The fact that, addressing each network alone (socio or technical), tends to amplify those network effects that are detrimental to the system's performance. A whole system approach is therefore needed to take into account the different wide-ranging effects.

In short, an STS is a comprehensive entity encompassing human and technological elements, communicating and interacting sometimes in non trivial ways by means of different social and technical (systems of) networks.

Although no supremacy is claimed by social and technological networks in shaping the STS system, each one plays a role insofar as their joint functioning must bridge the gap between two issues: social needs and technical performance, or between what human activity systems want and what the technology can offer (Ackerman, 2001).

Acknowledging the mutual constitution of the technological and social factors above described, requires uncovering the factors as well as the chain of events that underlie their co-evolution and ultimately drive system improvements or may cause failures.

First, an STS is grounded in multi-dimensional contexts which rest on historical, geographical and institutional aspects. An obvious, but often overlooked corollary is that for a situated human activity system, the existence of STS relies on the type of artefacts which, over time, technical progress makes available, and on the usages individuals and organizations make of those artefacts. Based on the fact that it depends on how technology is appropriate in social practices, aligning the operations of new technological functionalities and their usage by people and organization takes time (Orlikowski, 2002) and may create gaps among users.

Second, being embedded in socioeconomic processes, STS functioning results from the multiple network relationships which exist among its members and between those members and the external environments. The performance and reliability of technological networks (coverage, band-with, services) as well as the trustworthiness and responsiveness of the web of social networks are crucial features for the STS in order to operate and support its viability over time.

Finally, an STS requires forms of collective actions set up so that multiple parties who have a responsibility in managing the human activity system can pursue one of more shared goals. These goals are based on agents' own experience within the STS, they reflect the prevailing values belonging to the human activity system, and may result from a negotiation of agents' conflicting purposes.

A Conceptual Scheme of STS

When viewed through a time lens, it is evident that both technological and social profiles of an STS bear the unique prints produced by the development stage reached by the human activity system. In this respect, an overarching challenge raised by today globalized, multi-cultural, and networked society is

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what some scholars have called the "creation of patterns of consensual human interactions" (Banathy, 2000, p. 481). While calling for an increasing inclusiveness, it also raises the question about the type of enquiry systems an STS has to adopt for guiding its own developmental process.

Interestingly, this is just what the current progress on ICT promises to fulfil by using the drastic increase in communications and online social interactions. ICT progress in fact turns out to be pivotal for making human activity systems better capable of adapting and reconfiguring themselves (Whitworth, 2009). While changes in the technological supplies can be taken up rather straightforwardly, technology adjusted social transformations, as mentioned above, are more difficult. Indeed, the inertia and rigidities observed in the working of many organizations are often recognized as a main impediment. The creation of consensual patterns, however, goes beyond the simple removal of barriers. It requires us to investigate the evolution of the determinants underpinning social interaction, and how the resulting patterns of these interactions permit the production (and re-production) of human activity systems and ultimately of the whole society (Sayer, 2005; Poli, 2010). Although a full discussion of these topics is beyond the scope of this chapter, some implications as for the STS's profile are worth mentioning.

Worth noting is that an STS has an intrinsic capability of discerning what would be a desirable addition to the human activity system (Nelson, 2004). This is very different from that provided by truth or ideal seeking inquiring systems; the former being engaged into a search for what is true, the latter with what would be the ideal.

A salient aspect of this mode of enquire is the existence of an explicit relationship between those engaging into the enquiry and those who have to be served from the results of the enquiry process (Rawling, 2004; Umpleby, 2007).

To support that relationship, therefore, we need an approach, herein labelled as mode III, to single it out from the truth or ideal seeking inquiring systems, and which yields knowledge of what is desirable (the design of the inquiry-action pairing) on behalf of key stakeholders, who would benefit from the outcome of that approach (the realization of the inquiry-action pairing) (Nelson, 2004).

From this prospective, the following aspects of an STS, though not exhaustive, can be emphasised:

- **Guidance:** In order to sustain itself, an STS takes advantage from steering, and namely from that complex, mindful, reflective and projective oriented activity humans can undertake (Tsoukas, 2005).
- **Pro-Activity:** STS agents are prone to engage into actions pro-actively, as they do not just respond to changes, but take actions they feel will improve the organization's chances of moving towards the desired future (Withworth & Withworth, 2010).
- **Flexibility:** Any STS individual member is a reflexive and communicative agent who can modify his/her behaviour and knowledge, as a result of his/her participation in the network interactions[2]. These changes in their turn affect the web of network relationships, and modify the STS overall pattern, thus impacting on the everyday practices of the organization.

These aspects are not a novelty in the recent literature on organizations and organizational changes. For example, an organization dealing with a mode III approach has been called an homeopoietic system, a term coined ten years ago by Rowland (2004) to indicate a complex creative system, where both designers and recipients participate in making the organization through collaborative relationships.

The acknowledgment that interpretative frameworks agents can build up to make sense of the surrounding environment is central in the recent tenets of socio-cybernetics (Scott, 2008). As maintained

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by McIntyre (2003, p.7), in fact, the ways we understand the information about the world "shapes our perceptions about the world and our positions in interactions".

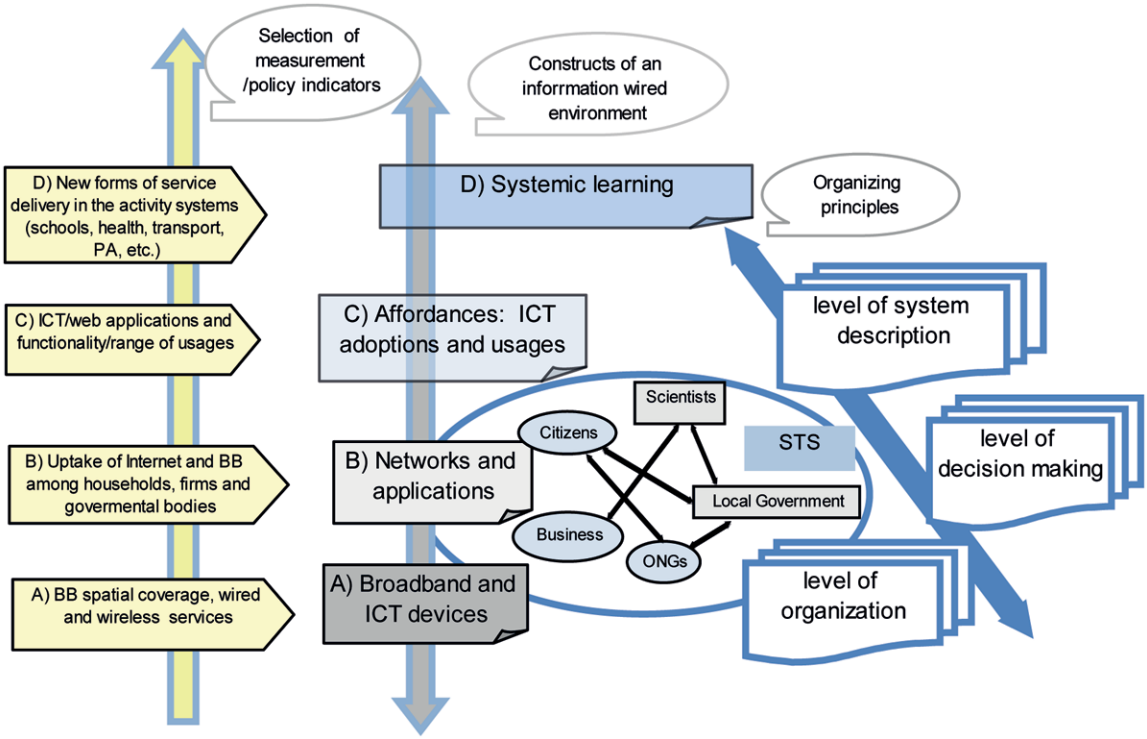
The joint consideration of the design and realization of the pairing inquiry-action, is at the core of meta-design (Fischer & Herrmann, 2011), an activity aimed at providing a framework where all stakeholders can contribute to the development of the functionality of an organization as well as to the evolution of its social and learning aspects.

When the generation process of the STS patterns is given primary attention, such an organization can also be understood as a Human Complex Adaptive System (HCAS), a system that, due to its interactions among the many elements of both socio and technical networks, can best adapt, evolve[3], and, learn, enhancing its transformative capability (Holland, 2006).

To sharpen the arguments discussed so far, a descriptive framework which sheds light on the constitutive components (constructs) and organizing principles of an STS is suggested. These principles are shown in the scheme of Figure 1, which also indicates the main stakeholders involved in an STS and some measurement indicators conventionally used for monitoring the roll out of ICT programmes[4].

In the diagram, the main components stem from a conceptual framework, which speculates that, in an information wired environment, STS consists of four interlinked constructs, related to: a) the technology, and namely the capacity of a vast array of different types of wired and wireless ICT and broadband technologies to interact with each other creating new efficiencies; b) the network effects, yielded when more usage of ICT services by any user increases the product's value for other users (and sometimes all

Figure 1. A diagram of socio technical system: components, organizing principles and examples of measurement indicators



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users); c) system affordances, which depend on the potentialities generated by the mediation role of ICT artefacts; d) systemic learning, which reflects a fundamental human activity rooted in humans' reflexive ability to make sense of their living experience (Occelli, 2006, 2008).

Two key dimensions underlie systemic learning: a) a human centred knowledge dimension, whose extremes are delimited by notions of completely transferable information (explicit knowledge) and non transferable information (tacit knowledge); and b) a technology centred knowledge dimension, which contrasts a notion of deliverable digital information and one which may be accessed as a result of the use of technological artefacts (computers, Internet, mobile phones, and so on).

How these two dimensions are related and co-evolve over time, while interacting with the other components of the information wired environment (technological artefacts, network effects and system affordances) is at the core of any STS. Indeed, as suggested, "Humans try to marshal the agency of machines to serve their own purposes, but cannot always anticipate or control the consequences. Outcomes are emergent from the interaction of both forms of agency, not from one alone" (Rose, Jones, & Trex, 2005, p. 147).

To make sense of STS organizing principles, one can adopt a multi-level system approach, in which the various system components and relationships are distinguished according to a threefold perspective[5], associated with system description, decision-making and organization, Table 1 (adapted from Mesarovic, Macko, & Takahara, 1970).

System description means defining the 'observation window' adopted by the observer/analyst when looking at the system. The selection of strata depends on the agent's point of view, as she/he/it might be directly engaged in STS operations (endocentric view) or only indirectly concerned as an 'external observer' of the STS overall functioning (exocentric view). Both endocentric and exocentric views are involved in developing and operating within a STS. Depending on how agents engage in STS, as a participant or observer, different descriptive strata are likely to be pertinent (i.e., local vs. global, strategic vs. operational, general vs. specific). The point to note here is that crossing the descriptive strata increases the awareness of the STS functioning: moving up on the hierarchy, one obtains a deeper understanding of its significance, while moving down, a more detailed explanation is provided.

In accordance with the Mode III approach, this involves a line of enquiry, in which the consistency's requirements commanded by a system approach are specified enough to put them into practice and accommodate the needs of those who have to take actions (Rhodes, Murphy, Muir, & Murray, 2011).

How agents commit their actions over time entails considering the decision-making process occurring in a STS's organization. In many real life situations, in fact, acting in a timely way and better

Table 1. Perspectives in multi-level system approach

Perspectives (Types of Level)	Main Issues Involved
a. Level of description (description by strata)	Selection of strata depends on the observer (i.e., strategic, tactical, operational)
b. Level of decision-making (description by layers)	Identification of the functional hierarchy entailed in a choice process (search, selection/adaptation, evaluation)
c. Level of organization (description by echelons)	Definition of the structure of an organization (elementary units and their arrangements)

(Adapted from Mesarovic, Macko, & Takahara, 1970).

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understanding a situation in order to cope with uncertainties are main motivations of decision-making. The communication flows enabled by STS networks provide agents with a unique support for meeting these needs.

First, at an individual level, feedback relationships across decision making functional hierarchy, are facilitated, thus improving the connections among the different decision layers, such as those related to the search and selection of alternatives, learning and adapting, and setting the performances and evaluation functions.

Second, at a system level, richer and faster communication flows help making system information more transparent and accessible, thus increasing the visibility and accountability of the functioning of the STS (Erikson & Kellogg, 2000), which over time enhance information trustworthiness and reliability and agents' intentions to engage into STS networks[6].

It is worth noting that evaluation can result from the joint articulation of the system description and decision making perspectives. As a part of agent's reflexive ability, individual evaluation activities can play a role in generating values, the latter being abstract entities that are relevant at STS higher organizational levels (Miceli & Castelfranchi, 2000).

Carrying out assessments such as monitoring and providing justification for actions, furthermore, are valuable activities in themselves as they assist STS in nurturing an appreciative setting, e.g. a setting characterized by knowledge openness, self-creation and responsibility in giving meaning to human processes (the definition is taken from the work by Vickers as discussed in Checkland, 2005).

The third perspective deals with the STS structuring, and is concerned with how the whole STS organizes itself as a result of multiple interactions occurring among the agents (as interacting decision-making units). Broadly speaking, this structuring can be regarded as some logically consistent clustering of its elements as the organization searches for consistency in its internal processes and consonance within its environments (Mintzberg, 1980).

When considering the extents to which the power of decision-making is dispersed among its members (decentralization)[7], different types of configurations can be observed. Although, as in the past, this structuring cannot occur independently of the contents dealt with in the other two perspectives, today ICT progress gives STS greater flexibility and makes the resulting configuration not easily accountable for by means of simple descriptive patterns (Sawyer, 2005). In this respect, the terms adhocracy (Mintzberg, 1980) and networked individualism (Wellman, 2002) have been suggested to account for this increased complexity in the organizational pattern. In the policy field, in particular, the terms network governments have been used to indicate the new possibilities to support innovation (such as the introduction of ICTs in government) and to personalize government-citizen relationships (van Dijk & Winters-van Beek, 2009).

On a conceptual ground, these configurations belong to a multi-dimensional space which, given certain conditions of ICT provision, is delimited by the articulation of the threefold organizing principles, and namely by the levels of system description, decision-making and organization. Although the limits of this are difficult to understand, some boundaries are likely to exist as a result of the traces produced by the paths the different agents may undertake as they take actions in the STS, e.g. they become problems' owners as they access/provide information and establish relationships and collaborate with other agents in order to address some of these problems.

To visualize the idea, diagram of Figure 2 shows how an STS configuration can evolve as changes occur along some selected axes of the multi-dimensional space, accounting for inclusiveness (one versus many problems' owners), type of interaction patterns (hierarchical versus networked) and information (siloed versus distributed).

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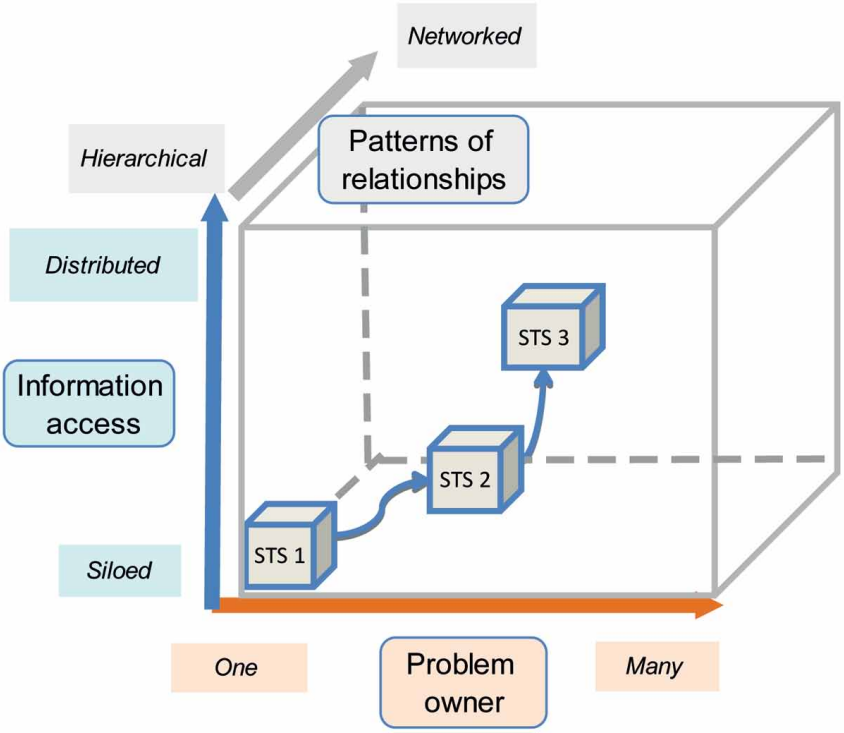
Figure 2. A view into the evolution path of an socio technical system



PROVIDING GROUND FOR DEVELOPING AN STS FOR REGIONAL HEALTH CARE

The STS issues are especially relevant for innovation oriented growth paths as well as for delivering more effective public services above all in education, transportation and health. Not unexpectedly, they permeate the bulk of the arguments addressed in a recent report by the European Commission (van Welsum, Overmeer, & van Ark, 2012), which calls for both new narratives about ICT leveraged development (e.g., linking pro-active initiatives with long term strategy) and action capability (e g., removing legal barriers, devising more open and flexible regulatory frameworks, and strengthening readiness to change) in order to collect the expected societal benefits of ICT impacts.

Indeed, over the last decade many facets of the STS components (see Figure 1) have been extensively investigated by several studies at national and regional levels, also spurred by the need to support ICT oriented policy initiatives (OECD, 2010). That was the case in the Piedmont region, where a five year policy program was put into place to roll out the regional broadband and an inter-institutional research team was created to monitor its progress (the Piedmont ICT Observatory).

As the program came to a completion in 2010, it can be said that some improvements were made in the establishment of an information based society. In spite of the distance which still separated Piedmont from the most advanced northern European areas, the regional achievements appeared very positive, above all, when regarded against the overall systemic profile of the region[8,9]. Lately, however, the turmoil in the economy and uncertainties in the regional climate severely curtailed ICT uptakes and the gaps between Piedmont and the leading European regions re-opened (IRES, 2014).

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In spite of, or maybe because of, the persistent socioeconomic difficulties, by this time a new stage in ICT development has been reached. A greater awareness about ICT potential exists, encouraged by the use opportunity offered by the latest ICT devices, such as apps, and wireless and mobile applications. More noticeably, evidence is mounting about the opportunity to lever ICT in driving regional development paths out of the current stagnating situation (PICTO, 2013). As a result, on the one hand, more tailored analyses are demanded to investigate how benefits of ICT use can be accrued to the different regional organizations. On the other one, it is apparent that conventional analyses of ICT diffusion processes have to be broadened to include additional STS components, such as systemic learning, and the application of STS organizing principles.

The health sector represents a domain where such an effort is most wanted. To date some work has already been done in order to study the diffusion of ICT in the Italian health sector at regional and national level (Osservatorio ICT in Sanità, 2014). The e-health issues however are still largely untapped. Attention has been primarily focused on the technological components and their uptake in the health practices only scantily addressed[10].

As pioneered in a study more than ten years ago (Eysenbach, 2001), e-health encompasses more than a simple technological development. It is an emerging domain at the crossroad of medical informatics, public health and business. It refers to health services and information delivered or enhanced through ICT and the use of broadband connections[11]. Underlying the term there is a far-reaching meaning which entails a state-of-mind, and a commitment for a networked purposeful mind-set, to improve health care locally, regionally, and worldwide by using ICT.

Overlooking this definition is likely to severely hamper the possibilities for e-health to deliver its benefits. In fact, as the recent report by the e-Health Stakeholder Group of the European Commission (2014)[12] highlights, disparities in both accessing to and providing services through the Internet can worsen already existing health inequalities.

The latter issue is of particular concern for the Piedmont region where, apart from the public spending constraints imposed by the austerity measures, the import of an ageing population is putting new strain on the health care system. According to the Italian National Bureau of Statistics, in 2011, population older than 65 in Piedmont accounts for 24% of the total population, compared with 21% in the whole of Italy and 18% in Europe 27, and is expected to reach 30% by 2040. Associated with ageing are chronic diseases which, as a shown in Figure 3, in Piedmont are affecting an increasingly large shares of population, and the process is even faster than in the rest of the country.

The tension in the regional health system is augmented by the raising expectations about the quality of health and welfare services, which, in the recent time, have been seriously stifled. As shown in Figure 4, the share of Piedmont citizens who valued positively the performance of these services reduced palpably between 2011 and 2014, while those who gave a negative assessment grew substantially.

In this situation, it is expected that applying an STS notion might contribute to sharpen the regional e-health issues, and enhance the action capability of the different stakeholders. As graphically represented in Figure 2, the basic idea is that, the undertaking might enable the regional health system to move from STS1 towards STS2 and STS3. It is assumed furthermore that in the course of action, a wider and collaboratively based information infrastructure might be progressively established, allowing the health regional system to cope more effectively with health disparities and emergent priorities.

A number of works, which offer valuable insights about how an STS concept can inspire ICT applications in health care systems, already exist and they help tackling those issues, see for example Sittig and Singh (2010); Munson, Cavusoglu and Frisch (2013). Here reference is made to a study by Hesse,

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Figure 3. Share of the population with chronic diseases in 2012 and variation between 2005 and 2012 in Piedmont and Italy
Source: Indagine Multiscopo ISTAT

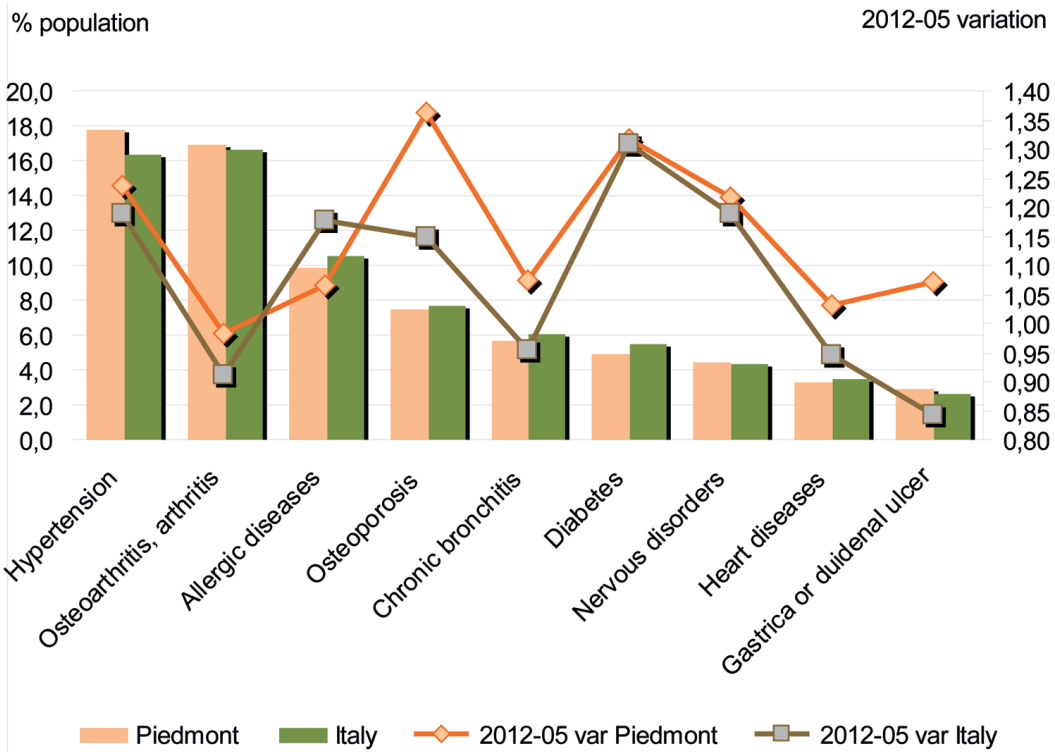
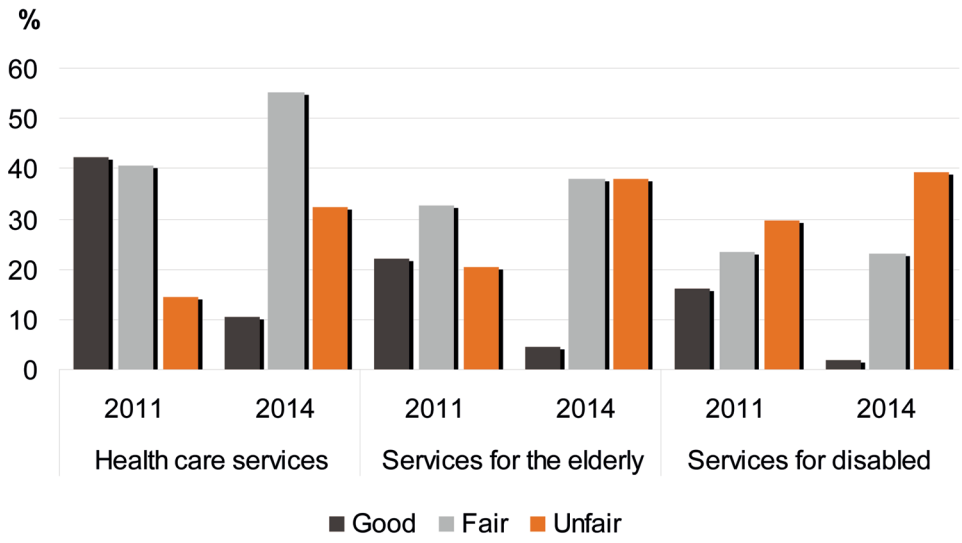


Figure 4. Appreciation of the services for health, for the elderly and disabled people by Piedmontese citizens in 2011 and 2014
Source: Indagine IRES sul clima di opinione dei cittadini piemontesi



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Hansen, Finholt, Munson, Kellogg and Thomas (2010). This study supports a specific point of view by examining how various knowledge contributions, such as those associated with clinical, patient and public health information, combine to develop technology-mediated social participation for health care provision.

When referring to the descriptive framework of Figure 1, this point of view obviously overlaps with what in the above diagram has been identified as systemic learning component, and it shares the focus of the system description perspective as a leading STS organizing principle. In the present case, the main purpose of taking this stance is to develop an STS, allowing a Collaborative Environment for Health Knowledge Interchange (CEHI) at a regional level to be put into place.

The opportunity to create this environment primarily stems from the necessity to help solving the financial and organizational problems currently affecting the regional health system[13]. Two additional reasons, however, motivate the effort.

The first is related to the contrasting findings of PICTO studies. On the one hand, they confirm the relatively robustness of the ICT endowment by the main regional stakeholders[14]. On the other, they show a latent weakness; above all in the capacity of governmental organizations to take advantage from ICT applications (IRES, 2014).

They provide evidence that, whereas, data about many socioeconomic phenomena and processes are growing dramatically, thanks to ICT pervasiveness, the aptitude to make sense of them and use the extracted knowledge for actions is still limited and in some cases even overwhelmed by data overload (Inguaggiato & Occelli, 2014).

By extending and empowering the perspective of observation of regional health stakeholders, CEHI can help enhancing the previously mentioned capability.

The second reason is suggested by the experience gained in some regional projects, and namely in that dealing with road safety (Boero, R., Grieco, A., Montaldo, C., Occelli S., & Tarditi, 2010; Occelli, 2012b). This project, in fact, has made it apparent how the interactions among ICT enabled policemen can deliver more consistent information flows about road crashes. The access to timelier and qualitatively better data, furthermore, has widened the possibilities for stakeholders to implement more effective countermeasures in the sub regional areas. Eventually, the establishment of a regional STS for road safety has created an environment where feedbacks from the different agents are more easily channelled and processed, and their outcome more timely inscribed in the policy domain concerning road safety.

Actually, developing a Collaborative Environment for Health Knowledge Interchange (CEHI) can be regarded as an application of meta-design at intermediate level (Fischer & Hermann, 2011). The latter being levels at which agents are aware of the possibility to become owners of health problems and engage in creating knowledge environment within which an STS can grow.

Of course, as mentioned earlier, such an endeavour builds upon some assumptions which, however, find evidence in existing studies about healthcare, and namely: a) the acknowledgement that a positive contribution to health care delivery can be brought about by improved partnership (Benson & Wright, 2006; Fauth & Mahdon, 2007); and b) The fact that stakeholder involvement and participation are indispensable for gathering the information evidence to document performance, better align health providers and engage service users in their care (Fauth & Mahdon, 2007).

Figure 5 sets out an attempt at outlining a stylized description of CEHI. Its purpose is simply to draw a framework for prompting the attention of health agents to make them participate in the project. The framework consists of three key components which are briefly outlined in the following.

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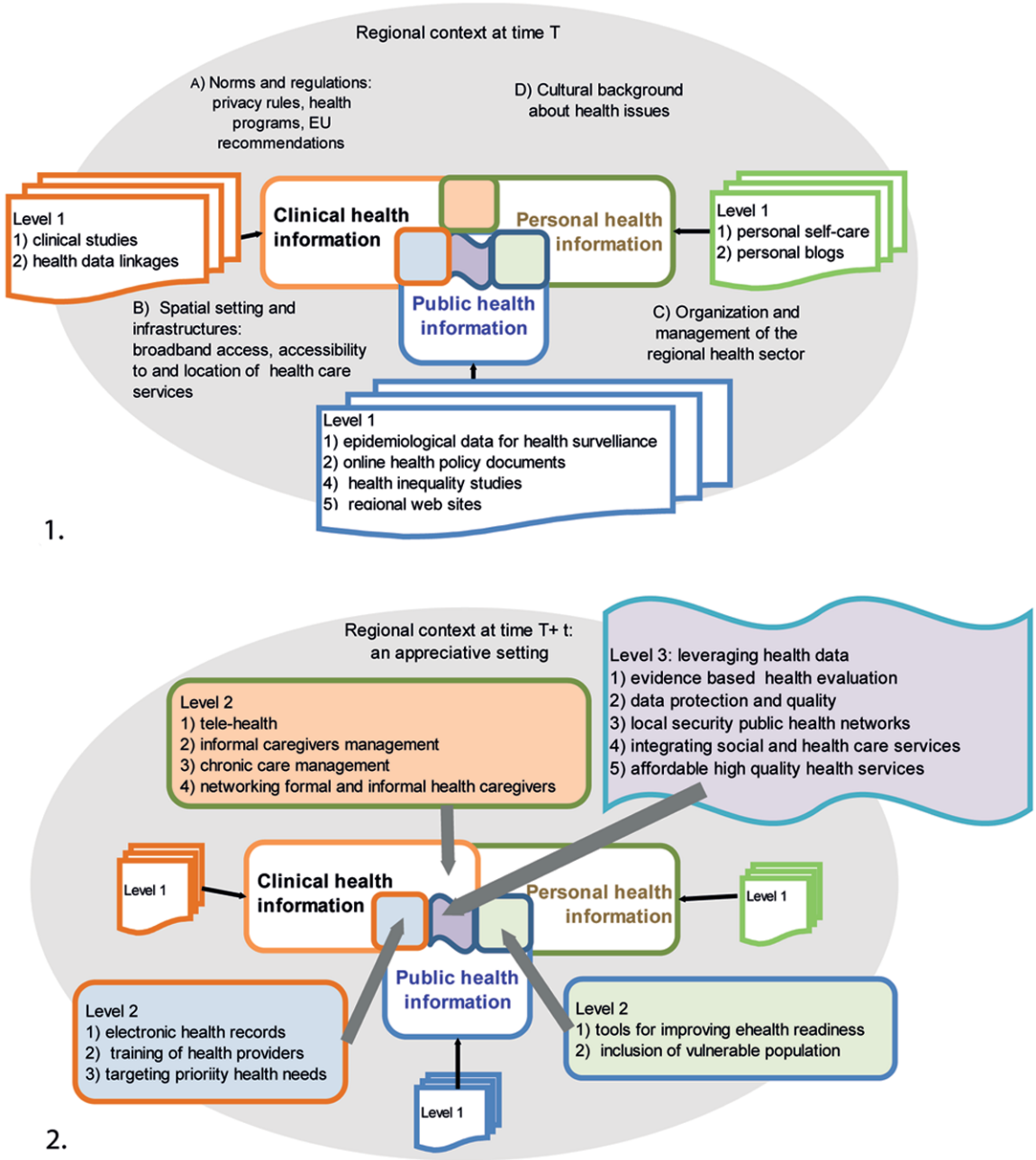
Figure 5. A diagram of a collaborative environment for health knowledge interchange; a) situation at time T, b) situation at time T+t



1. *The type of health information according to the problem owners*. In the diagram three main types of information concerning clinical, personal and public sides of health are mentioned, each of which is representative of a main group of health stakeholders. Of course each group (and its pertinent information basis) is not a monolithic organization but it is composed of many diverse agents, interacting with each other, e.g. an embedded STS which can stand alone. Each group, therefore,

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will have to be detailed further, in order to account for the agents' roles and competencies, e.g. doctor, nurse, caregiver, health providers, and so on, and for the window of observation a specific health knowledge requirement will call for, e.g., single patient, heath care department, hospital.

2. *The maturity level at which e-health information is made available within CEHI.* It is assumed that both the content and flows of health information evolve over time as technology progresses and organizations get hold of it. The hypothesis builds upon some results of PICTO studies which summon that the maturity level in ICT usage, (this being associated with ICT familiarity and awareness of the effects of ICT applications), is a crucial enabler in siding the technological with the social networks within organizations. In the case of the Piedmont health care system, such alignment has progressed rather slowly and been carried out separately by each organization. That is why in the diagram there is a distinction between three possible maturity levels for e-health information to develop. These ideally reflect progressively more integrated health-care services. Level 1 responds to the basic information needs as expressed in the activities singularly undertaken by each main health problem owner (the ST 1 in Figure 2)[15]. By and large, it reflects the current state of e-health uptaken by the Piedmont health care organizations, (and as shown in Figure 5a), its overall pattern being a patchy one, characterized by heterogeneous situations across the regional sub areas.

Level 2 e-health information recognizes the fact that increasingly the solution of certain health questions cuts across different domains of competence. A new kind of information is often wanted, which in most cases can be obtained by linking and processing data produced by the different health stakeholders in carrying out their regular activities. To distinguish Level 2 from Level 1 information, we use a large umbrella term and call it 'augmented information'. In Piedmont a number of projects have been launched which aim to provide and exploit this kind of information. This is the case of a tele-health pilot project implemented in a Piedmont province, which aims to give home care to people with chronic diseases[16] (in the diagram of Figure 5b this is represented in the link between clinical and personal health data). Another case is the pilot study for improving the road crash information system which, according to European recommendations, in the near future will have to be complemented with data about the health gravity of the people injured in these crashes. To meet this requirement road crash data, collected by policemen, have to be linked with the data of hospitalized people, recorded by health care professionals (in the-diagram of Figure 5b, this makes reference to the linking between clinical and public health data).

Finally, a major initiative, launched by the regional health plan, sets the foundations for connecting clinical, public and personal health data. Its goal is to develop a regional platform, supporting back-office data interchange among public health operators, a citizen web-portal about health care services and clinical data interchange for specialists and general practitioners[17].

Actually, the creation of health augmented information to improve health diagnosis, cares and prevention is a core challenge of big data analytics, a newly born computational field for analysing large data-sets. Intended to deal with the complexity, diversity and timeliness of data sets, the field has an untapped potential of value generation also for health care and it involves both the reduction of health cost pressure and the increase of health care quality (Groves, Kayyali, Knott, & van Kuiben, 2013; Institute for Health Technology Transformation, 2013).

Although the figures of Level 3 e-health information in Figure 5b are only indicative, nonetheless, they give a cue of what this highest information level could eventually mean for Piedmont health care system. First, they suggest that by enabling a cooperative environment, a trustworthy and reliable information health system can be set up, and a better integration among the different regional health stakeholders

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achieved. More specifically, this type of information is expected to yield a better understanding of the relationships between treatments, outcomes and patients (O'Reilly, Loukides, Steele, & Hill, 2012), thus enabling more effective patient centred medical practices to be carried out (Sturmberg, 2012). Furthermore, in a context where a governance strategy of health information is progressively more warranted (Cohasset Associates & AHIMA, 2014), the on-going relationships within the CEHI create an environment conducive to the development of sustainable information governance programmes.

3. *The development context of CEHI*. The STS outline we made in the previous paragraph, made it evident that the characteristics of the context play a decisive role in developing a CEHI. In Figure 5a a number of determinants are mentioned. They account for the situation of the institutional background (norms and regulation), the endowments of physical capital (spatial setting and infrastructures), the structure and management of health care regional systems and the level of awareness of health issues by the general public. These determinants may act as both barriers and incentives to CEHI's growth. They are (however) themselves subject to change as, over time, results of the works carried out by CEHI are inscribed in the regional context. As the setting is expected to become more and more appreciative (Figure 5b), feed-back loops among level 1, 2 and 3 health information are likely to be acted upon more easily and the time used to implement transformation and improvement may also be shortened. This means that, although organisations embark on change and upgrading of their programmes, for different reasons their ability to see how close they are to the desired end state will increase.

CONCLUDING REMARKS

One of the central topics of this chapter is that STS and namely the interaction between ICT and social networks and the resulting knowledge flows yielded from it, are a main (although not unique) vehicle for structuring, in a participatory way, more resilient organizations.

They play, indeed, a crucial role in the improvement of the so-called soft-infrastructures, a main asset for delivering social innovation. A soft-infrastructure can be loosely understood as a mix of institutions and services producing those intangible assets which make up the social and human capital and which are so crucial in fuelling the socio-economic resources of an area. Raising the performance of such an infrastructure, in fact, turns out to be a difficult challenge to be addressed in order to meet the EU requirements for a smart growth (SCF Associated, 2009).

This chapter tried to show that the notion of STS is not just an appealing intellectual concept, but can have a practical relevance for accompanying policy activity and introducing innovative actions. Eventually, as pointed out, it stimulates novel thinking about how we conceptualize human activity systems, and at the same time it urges us to pay greater attention to the system of relationships entailed in policy practices. When applied to these practices, STS, and the underlying Mode III system approach, provide an environment where individual agents, who are interacting with each other, can properly shape the relationships across system descriptions, decision making and organizations. They are also able to find ways to create plausible solutions to the problems they are facing. Such an environment, would give agents the opportunity to design result based hybrid strategies by combining competition; to upgrade their individual competencies and cooperative socialization; to evolve their social synergies (Whitworth & Sylla, 2011).

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Piedmont case studies, mentioned in the preceding section, provide evidence that STS concept, although still in an embryonic form, has an impact in the ways already existing regional governmental organizations work.

In most cases, however, the observed practices are primarily associated with the operations of ICT network and they mainly consist of mere substitutions of existing functionality with more cost-effective ones.

Indeed, so far an overall assessment is difficult to provide. On one hand, awareness about the opportunities likely to be associated with a region wide STS is increasing. On the other, it has been shown that for these opportunities to generate innovative transformations in service delivery and policy activities, the whole socio-informational linkages underpinning government organizations[18] should evolve.

The argument in OECD (2011) that ICT usage should extend from disseminating information to establishing relationships between outside and inside government, clearly highlights the need to have a comprehensive view of the change in public organizations.

It is expected that, in the near future, applications of the concept of STS in policy practices will multiply and STS representations, such as those in Figures 1 and 2, will be gradually refined. The types of connections among the different multi-level perspectives involved in STS, however, will raise challenging research and policy issues. In this respect, two points, which will be likely to get attention in future research, are mentioned.

The first is related to the role an STS can play in creating an environment where policy actions can be designed on a shared basis, experimented and progressively refined as the (social) system learn to build itself. The arguments made in discussing the framework for Collaborative Environment for Health Knowledge Interchange gave the idea, although cursory, of a range of possibilities. A crucial concern in this respect is how to ensure (by design?) that participants both give to and get something back from the collaborative environment (Chi, Manson, Fischer, Vieweg, & Parr, 2010). This is probably just another way through which the STS core issue of aligning technological and social networks shows itself, but it is by no means less challenging.

The second point deals with the pattern requirements the structure of an STS (when understood as a Human Complex Adaptive system) should exhibit in order to be open and flexible enough for adapting policy measures, while maintaining the prospect of their full implementation. This is a thorny issue, which raises questions about system resilience and viability. An even sharper aspect, so far still untapped, is the definition and measurement of the public value which is likely to be associated with an STS pattern and the outcomes of its functioning.

A contribution for addressing the question is offered for example by Talbot (2008) which acknowledges that multiple and, in certain cases, conflicting public values exist. They can be understood and measured by considering five dimensions, e.g., trust and legitimacy, collectivity, security, personal utility and autonomy, which clearly overlap with some key aspects of STS[19].

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KEY TERMS AND DEFINITIONS

E-Health: A domain at the crossroad of medical informatics, public health and business.

Homeopoietic System: A term coined ten years ago to indicate a complex creative system, where both designers and recipients participate in making the organization through collaborative relationships.

ICT Diffusion: The process of ICT spreading in society at different organizational and spatial levels.

Multi-Level System: The acknowledgement that a system is not a monolithic whole but results from the interaction of components working at different organizational and spatial levels.

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Policy Innovation: The process meant to foster and support improvements in the whole policy life-cycle.

Socio-Technical Systems: Organizations resulting from the dynamic intertwine of social and technical networks.

Soft-Infrastructure: A term highlighting the structuring role of human activities in supporting the functioning of a service.

ENDNOTES

1 This chapter builds on the article by Occelli (2012a) and considerably extends some parts of the original version.

2 The ICT component is considered as an agent too. Its definition is associated with a technology, information and functionality level.

3 As pointed out in Landini and Occelli (2010), HCAS is one of the most outstanding concepts which have emerged in the literature of the last 20 years. It is in fact a core idea that ties together most of the research domains converging under the large umbrella of complexity science. Its popularity across different fields may be ascribed to several reasons such as the capability of (a) metaphorically expressing a descriptive view, which eclectically embraces a number of aspects of a study system; and (b) instantiating that view in a methodological platform allowing for the operational implementation of a new 'species' of (MAS) models.

4 The definition of these indicators is based on the experience gained by the Piedmont ICT Observatory in monitoring the five year regional broadband program (PICTO, 2012, 2013). Over time they have been progressively refined to account for the efforts made by Piedmont's organizations to catch up with the development trends in the European information society triggered by the Lisbon Strategy.

5 Of course other perspectives can be proposed depending on how a STS is conceived. For example, in discussing the designing of organizations, Mintzberg (1980) argues that the elements in organizational structuring tend to appear in 5.

6 As a result, coordination among agents is facilitated, and the co-ordinability (governance) of the whole STS networks can be improved. This has several implications: both social, i.e. the issues of deliberative democracy, and economic, such as the needs to improve the network efficiency by the administrative costs.

7 Decentralization itself can have different forms depending on the extent to which: a) the formal decision making power is delegated down the chain of line authority; b) power flows informally outside this chain and c) power is dispersed to different places for different decision processes or the power over various decisions is dispersed to the same place (Mintzberg, 1980).

8 The distinctiveness of ICT diffusion in Piedmont is highly dependent on the features of the regional system which deeply affected the speed and facets of the diffusion processes. These features are related to: a) the morphology of the regional territory, 2/3 of which is mountainous or hilly; b) a large number of local authorities (1206 municipalities); c) a polycentric urban system, consisting of a few larger cities (the province head cities) and a majority of small and very small municipalities (80% has less than 5000 inhabitants); d) an aging and low educated profile of the regional popu-

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lation; e) a legacy to the car-based industrial sectors; f) the transition towards a more diversified economy in which technological and ICT based sectors are expected to play an important role.

[9] As for ICT uptake in the regional system, a synthetic overview is provided in the following (Occelli, 2012a). When considering the target indicators of the European Digital Agenda on a comparative basis, Piedmont performs relatively better than Italy although it is still far from the most advanced North European regions. In 2013, broadband coverage and diffusion among households and firms are similar to those observed in Europe. E-commerce among citizens is lower than the European average, but as high as the European value among enterprises. As for inclusion, Internet users and diffusion among disadvantaged people in the region are approaching the target values. Access to transactional e-government services is still modest, although progress in delivering e-government services by local governments has been remarkable. Recently, more diversified dynamics of ICT adoption/appropriation by the different actors have been taking place also as a result of the economic downturn. For firms and local governments, weak positive changes have been observed as these mainly depend on adaptation requirements and resource constraints. Between 2010 and 2011, however, citizens showed a significant growth in ICT appropriation, which has never occurred in earlier periods. Progress in the regional sub-areas was also conspicuous. Between 2009 and 2011, ICT appropriation rates raised considerably in the lagging behind areas, thus reducing the digital gaps in the region. An acceleration of ICT take up has been observed in the metropolitan area, thus suggesting that a new cycle of ICT services (those related to web 2.0, social networks, mobile APs and cloud computing) is being triggered off in the area. Contrasting features in the regional profile are revealed when considering the measurement frameworks recommended by the Innovation Union and Youth on the Move initiatives. When exposed to the national hindrance in technological development and ICT diffusion, Piedmont situation reveals some positive albeit weak signals. The regional indicators of R&S spending in public sector and of venture capital investments in Piedmont are relatively low, but those of patents and technological exchange with foreign countries perform slightly better. Compared with the overall production system, innovative sectors (ICT, Digital Contents, High Tech Manufacture and Knowledge Intensive Services) seem to be more resilient to the crisis. ICT adoption in local governments has been mainly compliant with the Italian public administration laws, and weakly sensitive to citizens' demand.

[10] Almost all municipalities and government offices in the region are now equipped with the basic ICT infrastructures and services (broadband, certified e-mail, digital signature and institutional websites). Although most office activities comply with e-government requirements, the interactivity level of online services is still under developed and limited to the provision of fill-in forms to prompt administrative procedures. The presence of ICT is the highest in the office procedures for core administrative services, such as taxes, demographics and financial services. These services are often managed independently within the administration. ICT applications are still limited in those services with fewer organizational requirements than services with greater organizational requirements. For a large number of municipalities, ICT equipments are perceived as expensive as they need investments, which can be afforded only by the larger administrations (PICTO, 2013). A considerable difficulty stems from the size of local governments where ICT competences are often missing (IRES, 2014).

[11] Findings by OECD (2010) show that the potential benefits that can result from ICT implementation in the health domain can be related to four broad categories of objectives: a) increasing quality

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of care and efficiency; b) reducing operating costs of clinical services c) reducing administrative costs and d) enabling entirely new modes of care.

[12] To contrast e-health inequalities, the European Commission (2014) has put forward key recommendations concerning: a) the integration of e-health into overall health and social care system policy; b) access improvement and involvement of all stakeholders; c) the accommodation of diverse needs and reduction of technological pressure; d) the improvement of digital health literacy and enhancement of user education at all levels.

[13] An overview of the Piedmont regional health system is available at http://www.regiotrend.piemonte.it/site/RESET2013_A4/RESET2013_cap5.5.pdf.

[14] See the synthetic account in note 9.

[15] As an example of level 1 health information by the public health organizations, we can mention the following websites: http://www.regione.piemonte.it/sanita/ep/relaz_san/salute.htmhttp://www.dors.it/el_focus.php?focus=Bhttp://www.cipespiemonte.it/.

[16] See: http://www.aslvco.it/Progetti.asp?id=13 and http://www.regione.piemonte.it/innovazione/images/stories/innovazione/dwd/robotti.pdf.

[17] This initiative is called "Sanità in Rete", http://www.sistemapiemonte.it/cms/pa/sanita/servizi/249-sanita-in-rete

[18] The issues are also part of the recent debate concerning the innovation possibility in the public sector (Gil-Garcia, 2012, Navarra & Cornford, 2007, Maier-Rabler & Huber, 2011, NESTA, 2008, OASIS, 2011, Talbot, 2008). Basically the current debate argues that innovation would ensue from an increased variety in the delivered services, whereby this would result from the inclusion of different and more pro-active types of actors as well as from a wider set of ICT-enabled service functionalities. The availability of more diversified and accessible service outputs therefore would help meeting people's increasingly differentiated needs, thus improving the rate of success in achieving government effectiveness and efficiency. While acknowledging the requisite variety requirement provides a rationale for innovation, the processes by which the forms and contents of variety come about, and their deployment time, deserve specific insights as they are themselves sources of innovative change.

[19] When referring to health, for example, Sturmberg (2010) makes a point that core values exist, e.g. the health of every patient, which remains unchanged in a changing world, that lead all the structural requirements and interactions of the healthcare system.

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Chapter 24
Online Spatial HIV/AIDS Surveillance and Monitoring System for Nigeria

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ABSTRACT

HIV/AIDS has now become a big threat to the world generally, most especially the Sub-Saharan Africa region as it continues to increase drastically in the region. This disease has increased the poverty level of the countries in the region. In Nigeria, millions of people infected with this deadly disease are in their productive years between 15 and 49. This surge is having a negative effect on Nigeria and other Sub-Saharan Africa countries as it lowers life expectancy, slows population growth and social and economic effect on the country. Presently, health officers in Nigeria primarily rely on monitoring HIV/AIDS prevalence only among women attending antenatal clinics as that is the only source of getting data from HIV/AIDS patients. In the country, there is no electronic HIV/AIDS database, no electronic means of capturing HIV/AIDS data and no electronic monitoring of HIV/AIDS patients. This chapter presents a prototypical HIV/AIDS surveillance and monitoring system and the prototype was developed using Dreamweaver, PHP and MySQL. With this system, users could spatially query the pattern and distribution of any HIV/AIDS disease using any known location. Also, queries based on occupation, level of education, and gender among other things are possible with this system. Though the system was developed for Nigeria, it can also be extended to other countries within Sub-Saharan Africa region.

INTRODUCTION

HIV/AIDS has remained a global catastrophe that continues to threaten several nations around the world. The prevalence rate of HIV/AIDS has continued to increase drastically since the disease was discovered in the early 1980s. HIV/AIDS is globally recognized as an international disease as it spreads explosively across Asia and Africa. It is estimated that "90 to 95 percent of AIDS infections occur in developing countries, primarily in Sub-Saharan Africa where some of the world's worst living conditions exist" (Enotes, 2012).

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Globally, 34 million people were living with HIV/AIDS at the end of 2011. An estimated 0.8% of adults between aged 15-49 years worldwide are living with HIV/AIDS. One out of twenty adults (4.9%) is living with HIV/AIDS in sub-Saharan Africa accounting for 69% of people living with HIV/AIDS worldwide. Sub-Saharan Africa accounted for 71% of the adults and children newly infected in 2011 (UNAIDS, 2012).

HIV/AIDS has become a major problem in developing countries due to the fact that poverty has blocked the development of adequate health care facilities including problems with purchasing of HIV/AIDS drugs. In most developed nations, the high spread of HIV/AIDS has reduced because of their healthcare development, affordability of HIV/AIDS drugs, treatment and vast implementation of its preventive measures. While the risk of HIV/AIDS transmission is being controlled in the developed nations, the spread is increasing and worsening in developing nations with their limited public education about HIV/AIDS and the inability to fight the deadly disease.

Due to the magnitude of HIV/AIDS, nations throughout the world have developed National AIDS Programs (NAPs) based on the specific needs of the country's population. The World Health Organization (WHO), a United Nations agency, founded a global HIV/AIDS trust fund in 1987 to help fund the NAP programs. The NAP program focuses on the prevention of the transmission of HIV/AIDS through sexual intercourse, blood and blood products and unsterilized objects such as injection needles. The initiative has supported programs that reduce the transmission of the disease from mother-to-child and also fought against the stigmatization of HIV/AIDS patients (Ruxin *et al*., 2005).

In Africa, the impact of HIV/AIDS is cumbersome on some of the poorest countries. Nine countries in Africa have about one tenth of their adult population infected with HIV/AIDS. At least one adult out of five is living with HIV/AIDS in three countries on the southern part of the African continent (Kembol *et al*, 2011). In the Sub-Saharan Africa region which is heavily affected by HIV/AIDS than any other region in the world, "an estimated 22.9 million people are living with HIV/AIDS in the region which is about two thirds of the global total. In 2010, over 1.2 million people died from AIDS in sub-Saharan Africa and 1.9 million people became infected with HIV/AIDS" (Avert, 2012).

The HIV/AIDS epidemic in sub-Saharan Africa has been both a cause and consequence of underdevelopment in many African countries. It is still one of the most significant health problems in many developing countries despite several control efforts. It remains a major cause of mortality in the region. The socio-economic problems of the HIV/AIDS epidemic are widely felt not just in the health sector, but also in the agricultural, educational, industrial and the economic sectors in general. The effects of the disease on the people have rolled back years of development progress achieved in the regions.

HIV/AIDS is a contributing factor to the level of poverty in some countries. The relationship between HIV/AIDS and poverty is most obvious when one looks across the countries; almost all the countries with the highest prevalence are poor. Africa, the poorest of all the continents, is the epicenter of the epidemic. The HIV/AIDS epidemic is often concentrated in marginalized populations and among people driven by economic need to engage in professions that increase the risk of the HIV/AIDS infection.

Poverty increases the vulnerability to HIV/AIDS and the denial of access to the antiretroviral therapy for those already infected with the disease. In affluent countries, most of those who need the treatment are receiving it, but in poor countries mostly in the sub-Saharan region, only a few who could afford to pay have received the treatment. As poverty fuels HIV/AIDS, so is the epidemic increasing poverty and threatening the economic growth and development of affected nations, thereby creating financial hardship for people, families, government and robbing the nation of people in their prime and most productive

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years (Kembol *et al*, 2011). The impact of HIV/AIDS on individuals and families is enormous and this will get worse before it can get any better, even where the prevalence rate is falling. Moreover, much of this burden falls mostly on the poor.

The Nigerian health care system is poorly developed, with no adequate and functional surveillance systems. Public health not only functions to provide adequate and timely medical care but also to track, monitor, and control disease outbreak. The Nigerian health care system has had to manage several infectious diseases such as HIV/AIDS, malaria, tuberculosis outbreaks year after year. For decades now, epidemic diseases have been a threat not only to the lives of individuals but also to the nation as a whole (USAIDS, 2002).

Lack of database-related surveillance systems is a major cause of the widespread of HIV/AIDS in most of the affected countries. In Nigeria, the health care system is degrading. The provision of health access to the Nigerian people is 43.3% (Pharmacy & Bioallied Science, 2011). This can be attributed to the peculiar demographics of the Nigerian populace. More than half of the Nigerian population live in the rural area. About 70% of the health care is provided by private vendors and only 30% by the government (Pharmacy & Bioallied Science, 2011). Over 70% of drugs dispensed are substandard. More than half of the Nigerian population live below the poverty line and cannot afford the cost of health care.

Despite the fact that Nigeria has one of the highest prevalence rates of HIV/AIDs in sub-Saharan Africa, the country has no HIV/AIDS database that can be used to monitor, analyze, manage and control the spread of the disease. Health decisions can only be made with epidemiological data that is accurate and consistent. The control and management of a disease in any country, requires that the spatial and temporal rates and trends of the disease must be determined in order to gain insight into the geographic coverage and prevalence rate of the disease (Idowu, 2009).

Presently, in the sub-Saharan Africa region, there is no country that has a fully fledged HIV/AIDS surveillance system and a reliable or efficient way of capturing HIV/AIDS related data. In Nigeria, the only HIV/AIDS epidemiological data available is that of pregnant women obtained during ante-natal visits, but presently there are more people living with HIV/AIDS whose data are not on record. Therefore, no national database on HIV/AIDS is available. There is an increasing number of HIV/AIDS carriers in Nigeria by the day and a major reason for this is the absence of a fully fledged HIV/AIDS surveillance system that can collect data, analyze, and forecast HIV/AIDS in Nigeria. In order to accurately and efficiently monitor the prevalence rate of HIV/AIDS in any area in Nigeria, there is the need for a reliable and effective national HIV/AIDS national database and surveillance system.

In order to solve this problem of inconsistent and patchy HIV/AIDS data in Nigeria, this chapter presents a fully-fledged, effective and efficient web-based Geographical Information System for HIV/AIDS surveillance system which can be used to systematically capture health-related data. In order to develop this system, an existing HIV/AIDS disease surveillance data model designed for Nigeria was used. The surveillance system could be used in surveillance, monitoring and management of HIV/AIDS in Nigeria and it will also serve as a national HIV/AIDS database for Nigeria. With the system, data from everyone living with HIV/AIDS will be captured in order to make useful decisions, and provide information on the spatial location, and accurate statistics of people living with HIV/AIDS in the country, the most vulnerable age group, gender statistics, and mode of transmission. The carriers' biodata will also be on a national database, which will be used for surveillance, monitoring and prediction of HIV/AIDS in Nigeria.

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BACKGROUND

This section of the chapter reviews the literature on some of the concepts. Section 2.1 discusses disease surveillance and commonly used methods in disease surveillance with the roles played by disease surveillance in the health sector. Section 2.2 provides information about state of health informatics in Nigeria. Section 2.3 discusses the origin of HIV/AIDS and gives some statistical information about HIV/AIDS globally. Section 2.4 focuses on HIV/AIDS in Nigeria and finally section 2.5 provides information about the existing health data models for Sub Saharan Africa and describes the strengths and limitations of the models.

Disease Surveillance

Disease surveillance describes the ongoing efforts directed to assess the health and disease status of a given population over a given period of time. It describes a system that provides useful information about disease status and sometimes it may imply that some form of directed action will be taken if the data show a disease prevalence or incidence above a certain threshold (Salman,2003).

Disease surveillance is a common terminology used by epidemiologists and it is often used interchangeably with disease monitoring. It is aimed at providing early detection and control of diseases. Disease surveillance systems will aid public health workers in providing useful information about diseases in a given location in order to discover the pattern of incidence in such a location which will eventually help in avoiding outbreaks of these diseases. Due to the movements of people and animals from one country of the world to another, diseases spread across geopolitical and international boundaries and this makes almost all the countries of the world vulnerable to these diseases. Though some developed countries have means of curbing and controlling diseases, most developing nations do not have records or information about the number of people living with these diseases in their country. While effective disease surveillance systems are important in all the countries of the world, they are currently lacking in most developing nations.

With a disease surveillance system, the health workers / physicians, in all the hospitals would be able to input patient information such as demographic data, diseases associated with each patient and information about the geographical location of each patient into the disease surveillance system. At the front end the epidemiologists, disease agents, policy makers and any other authorised users will be able to query, analyse, and view the distribution of the diseases, which will effectively help them to make useful decisions at any point in time.

Disease Surveillance Methods

In order to carry out disease surveillance effectively, specific methods must be employed. The following disease surveillance methods are the most commonly used (Harter *et al,* 1995; Disease Control Priorities Project, 2008):

1. **Sentinel Disease Surveillance:** This is a method whereby a small group of people are used as sample population for the entire population. In case of HIV/AIDS in Nigeria, the sentinel survey makes use of pregnant women that attend antenatal clinics. Sample reporting is a good way to use limited resources to monitor diseases in a particular location among selected population.

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2. **Laboratory Based Surveillance:** This is used to detect and monitor infectious diseases. In the United States, the centres for Disease Control and Prevention maintain PulseNet, an Internet-based network of laboratories that make use of standard methods for identifying and reporting the genetic makeup of disease-causing agents. "DNA fingerprinting by pulsed field gel electrophoresis on disease bacteria isolated from humans and from suspected food using standardized equipments and methods is being performed by PulseNet participants" (Centre for Disease Control [CDC], 2006). PulseNet is moving to Asia, Latin America and the Pacific.
3. **Household Survey:** This can be used to monitor diseases if the surveys are consistent and repeated periodically. The survey allows certain households to be selected at random and the selected households will represent the whole population. Example includes the behavioural risk factor surveillance system in the United States (Disease Control Priorities Project, 2008).
4. **Integrated Disease Surveillance and Response (IDSR):** This collects communicable diseases data from both health facilities and laboratories. IDSR has several activities such as detecting, registering and confirming individual cases of disease, reporting the analysis used and feedback of data and preparing for the response to epidemics (Disease Control Priorities Project, 2008).

Roles of Disease Surveillance

A good disease surveillance system will require an electronic tool for collection of data that will be able to accurately synthesise, analyse and present data and information over time to health workers and stakeholders.

Disease surveillance systems play important roles in the health sector of both developed and developing nations (National Institute of Communicable Diseases, 2001) and some of the roles are:

1. **Early Detection of Epidemics:** The disease surveillance system when developed would allow the stakeholders to be able to quickly detect if a particular disease is becoming epidemic in a particular location so they could intervene. This would help Nigeria to reduce spread of diseases and the untimely death of citizens. In addition, by targeting support, it would assist in helping to prevent already overstretched health facilities from being overwhelmed - with the risk of collapse.
2. **Analysis and Interpretation of Data:** Analysis of the data and its interpretation would aid health workers to be able to identify and understand the spatial distribution of diseases so as to detect any location that might be a source of a disease epidemic. A disease surveillance system would help the country to be able to analyse and interpret the spread of any disease in line with organisational policy or depending upon the degree of danger such a disease can cause.
3. **Investigation and Confirmation of Cases/Outbreaks of Diseases:** With a disease surveillance system which would be developed using the proposed model, the spread of the disease can be easily identified. Health workers could investigate and confirm the reliability of the disease data from the disease surveillance system and take necessary action.
4. **Monitoring, and Controlling of Diseases:** A disease surveillance system would allow the health workers and stakeholders to be able to monitor the distribution pattern of any disease in Nigeria and control the disease as need arises.
5. **Planning and Allocation of Resources:** In order to plan and allocate health facilities in any country, there is a need to know what resources and facilities are required in all the locations in such a country. In Nigeria, with the disease surveillance system, the health ministry would be able to know

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the type of health resources that are required in a location at a given period of time. Data from a disease surveillance system would aid in identifying areas that require additional health facilities such as hospitals. It would also be used to know where to deploy certain experts based on the type of diseases that are common in such a location.

6. **Estimated Magnitude of the Disease:** With the disease surveillance system, health workers would be able to know if a particular disease may likely become epidemic and take necessary intervention. For example, if in a local government area with population of 250,000, 5000 cases of cholera were recorded within one week, then there is a need to find out the root cause and take necessary action. But without a disease surveillance system it may be difficult to know the number of cases of this disease since a local government area comprises many towns and cities which are geographically separated from each other.
7. **Portray the Natural History of a Disease:** A disease surveillance system would also allow health workers to be able to have a history of disease in any location in the country. For example, if during the dry season, there are cases of cholera in a particular town, local government area or state, the stakeholder would have to be prepared to address what may cause a future occurrence.
8. **Determine Geographical Distribution of Diseases:** A disease surveillance system would allow the stakeholders to be able to view and query the distribution of diseases based on geographical location at a given period of time.

The main focus of this chapter is to present an effective disease surveillance and monitoring system for HIV/AIDS in Nigeria. Presently in Nigeria, there are almost no available epidemiological data to determine the geographical distribution of any diseases, most especially HIV/AIDS. The system was developed from an existing spatial disease surveillance data model for Nigeria.

Health Information System in Nigeria

Nigeria has one of the highest mortality rates in sub-Saharan Africa (WOCON, 2004), with a population of 140,003,542 (Nigerian Census, 2006) which is the highest in Africa but with an inadequate health care delivery system. According to Hyman & Silver in 2004 (Hyman & Silver, 2004), inadequate health care delivery gives birth to additional health risks, which means that the Nigerian population is highly vulnerable.

The history of health information systems in Nigeria started in the late 1980s when a collaborative research project between the Computing Centre of the University of Kuopio, Finland, the Obafemi Awolowo University, and the Obafemi Awolowo University teaching Hospital (OAUTHC), Nigeria (Idowu *et al*, 2003) was initiated and this initiative was part of INDEHELA (a long term research project on Informatics Development for Health in Africa details of which can be found at http://www.uku.fi/indehela/). The joint project produced a very rudimentary hospital information system based on the Veterans Administration's (VA) Admission Discharge Transfer, running on a stand-alone PC, which was in use at OAUTHC in 1991 (Daini *et al*, 1992). According to Daini et al in 1992, the group then organised the first International Working Conference on Health Informatics in Africa which was held on April 19-23, 1993 at Ile-Ife, Nigeria (Daini *et al*, 1992).

In the late 1990s, the Finnish / Nigerian research team decided to expand their rudimentary hospital information system with the aim of developing a comprehensive system suitable for use in all Nigerian teaching hospitals and medical centres. The plan then was that by 2001 all the teaching hospitals in

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Nigeria would have Health Informatics Units which could make use of standardised software. In reality, though some hospitals have computer or IT units, these serve primarily to support word processing for typing pools and offices. Development of the commercial software 'Made in Nigeria Primary Healthcare and Hospital Information System' (MINPHIS) ran alongside the doctoral programme of one of the staff of the Department of Computer Science & Engineering, Obafemi Awolowo University, and was completed in 2004. Unfortunately, the system was not tested at OAUTHC and only five teaching hospitals and medical centres used the system as of 2007. The primary reason for this limited use is the cost of purchasing the commercial software. As the Finnish/Nigerian research team were working on a primary healthcare and hospital information system, a Norwegian and South African team focused on a district-level information management system (Anja, 2002).

Although there are other software packages developed for hospital use in Nigeria, most of this software is developed by researchers in Nigeria who identified the need for an electronic information system in the Nigerian hospitals, but almost all this software was never put into use. In 2003, the State Hospital Network known as SHONET was developed for sharing of hospital resources over the computer network in Nigeria. The philosophy behind the development of SHONET was to minimize the cost of running state hospitals; hospital resources such as personnel, laboratory and equipment would be distributed to various zones in the state. The allocation of the resources depend on the diseases that are common in the zone and whenever there is need for any of those resources in another zone within the system, the hospital equipment can then be allocated over the network (Idowu *et al*, 2003).

In 2004, another system was developed at the Department of Computer Science & Engineering, Obafemi Awolowo University, Nigeria. The system was developed for referral of patients from one hospital to another such that a patient's case file, referral note and medical examination result that were usually transferred manually from one hospital to another could be transferred over a computer network (Idowu *et al*, 2004). Of all this software, only MINPHIS is being used in a very few teaching hospitals in Nigeria.

HIV/AIDS

Human Immunodeficiency Virus (HIV) is the infectious agent that causes Acquired Immune Deficiency Syndrome (AIDS). AIDS is a set of symptoms and infections that result from the damage to the human immune system caused by HIV (Weiss, 1993) . The origin of the virus has always been controversial; some claimed it originated from Africa whereas others claimed it originated from the United States of America (USA), however the first recognised cases of AIDS occurred in the USA in the early 1980s. "A number of gay men in New York and California suddenly developed rare opportunistic infections that seemed stubbornly resistant to treatment" (Chandra, 2008). By this time, AIDS did not yet have a name but it was discovered that all these men were suffering from the same syndrome. Shortly after this, the discovery of HIV was made (Chandra, 2008).

Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome (HIV/AIDS) has claimed well over 25 million lives. Almost 40 million people are living with the virus worldwide (UNAIDS, 2006) with an additional two million people yearly and more than one quarter are young people (WHO, 2006). HIV/AIDS is most commonly found in developing nations, to be specific sub-Saharan Africa. Sub-Saharan Africa hosts almost 65% of the world's HIV/AIDS population and almost 70% of people living with HIV/AIDS in this region are between the ages of 14- 49 years. Females are in the majority of people living with HIV/AIDS in sub-Saharan Africa. Worldwide, as at 2005, Swaziland has the highest prevalence rate and South Africa has about 5.5 million people living with HIV/AIDS (UNAIDS, 2006).

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HIV/AIDS has reduced the life expectancy of the people mostly affected by over 20 years, increased their poverty level, and reduced the economic growth of their countries, which are mostly developing nations (UNAIDS, 2008). In Asia, where the infection rate is slightly lower than Africa, HIV/AIDS has led to greater loss of productivity than any other disease and is increasing the poverty level of the continent. It is predicted that by 2015, an additional six million households will be pushed into poverty if there is no quick response (Commission on AIDS in Asia, 2008).

According to UNAIDS/WHO (WHO/UNAIDS, 2008), more than 25 million people have died globally as a result of AIDS since 1981 and Africa alone has 11.6 million AIDS orphans. At the end of 2007, women accounted for 50% of all adults living with HIV worldwide and 59% of these women are from sub-Saharan Africa. People under the age of 25 account for half of the new HIV infections worldwide. Table 2.1 below gives the summary of the latest statistics of global HIV/AIDS estimates and Table 2.2 gives the regional statistics for HIV/AIDS as at end of 2007. Also globally during 2007, 2.7 million adults and children became infected with HIV. By the end of 2007, an estimated 33 million people were living with the HIV/AIDS virus globally as shown in Figure 1 and the year 2007 also saw two million deaths from AIDS.

Sub-Saharan Africa remains the region most heavily affected by HIV, accounting for 67% of all people living with HIV and for 75% of AIDS deaths in 2007. Almost all the countries in this region have a reliable means of epidemiological data collection. This necessitates the need for disease surveillance and monitoring system in Nigeria, which is the focus of this chapter. Figure 2 depicts the HIV prevalence rate

Figure 1. Global view of HIV infection as at end of 2007
Source: World Health Organisation/Joint United Nations Programme on HIV/AIDS

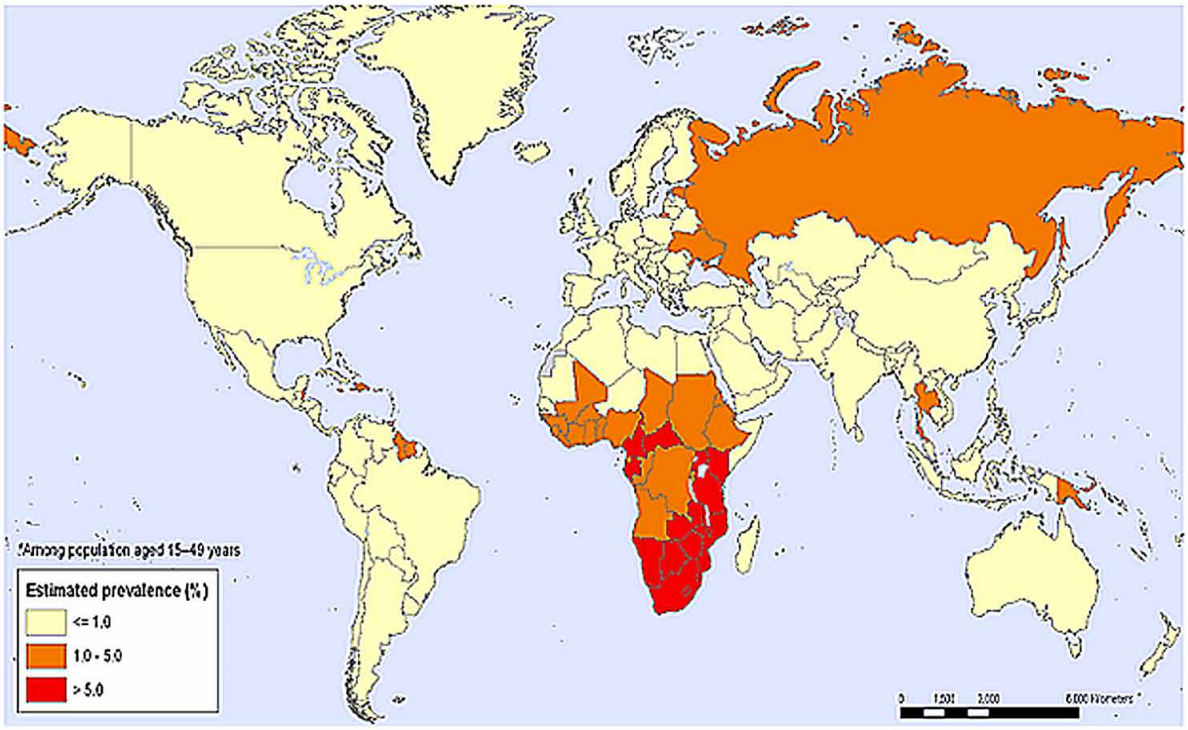

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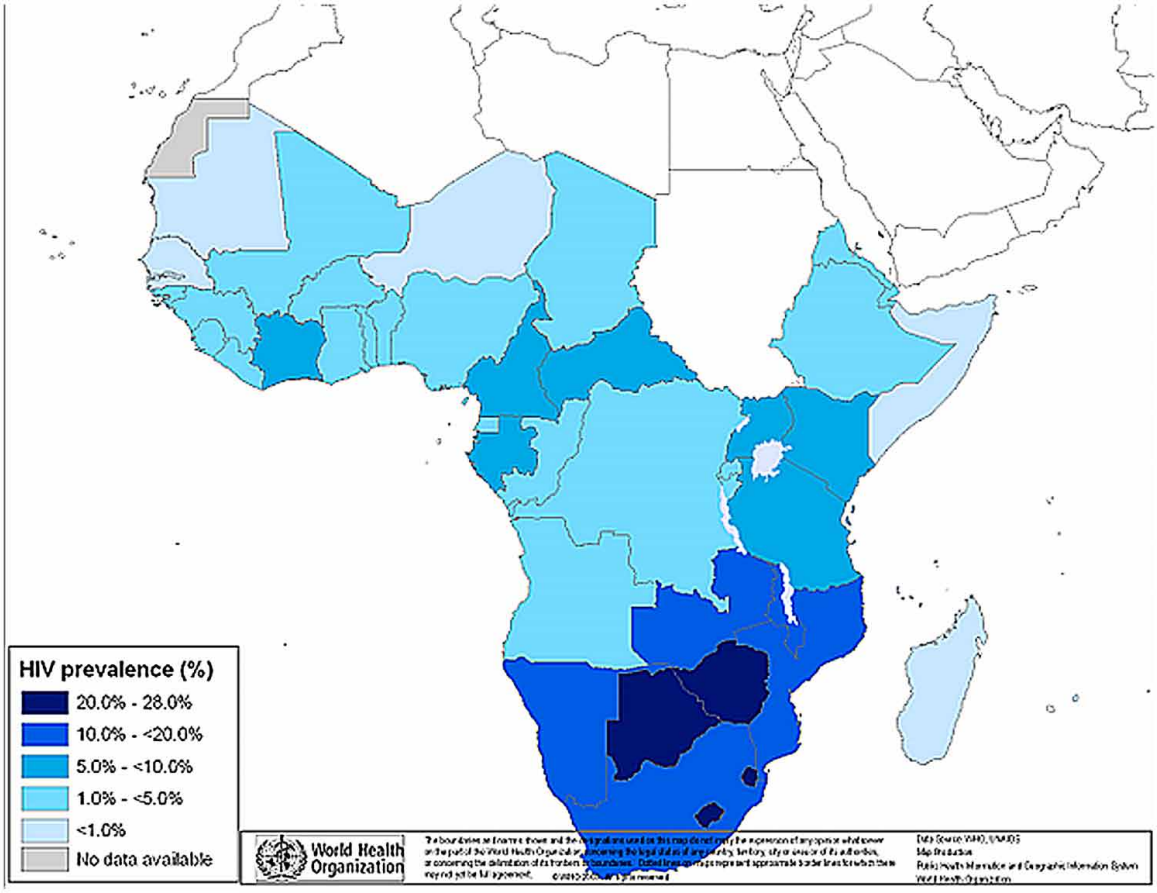
Figure 2. HIV prevalence (%) in adults in sub-Saharan Africa
Source: World Health Organisation/Joint United Nations Programme on HIV/AIDS



among adults in sub-Saharan Africa. The data used for mapping of HIV/AIDS in sub-Saharan Africa is based on sentinel surveillance. With the proposed data model, the development of a disease surveillance system would be possible.

However, some of the most worrisome increases in new infections are now occurring in populous countries in other regions such as Indonesia, the Russian Federation and various high-income countries. Globally, the percentage of women among people living with HIV has remained stable at 50% for many years, although women's share of infections is increasing in many countries (UNAIDS, 2007). Although it is quite difficult to know who the first person to be infected with HIV was, or how it spread from that person, the reality is that HIV/AIDS is now a deadly disease which has posed a lot of challenges to scientists all over the world.

HIV/AIDS in Nigeria

HIV/AIDS is one of the most rapidly increasing epidemics in Nigeria. It is quite difficult to give an accurate number of people living with HIV/AIDS in Nigeria because there is no mechanism to determine the number of people living with HIV/AIDS in the country. However, UNAIDS estimate that almost

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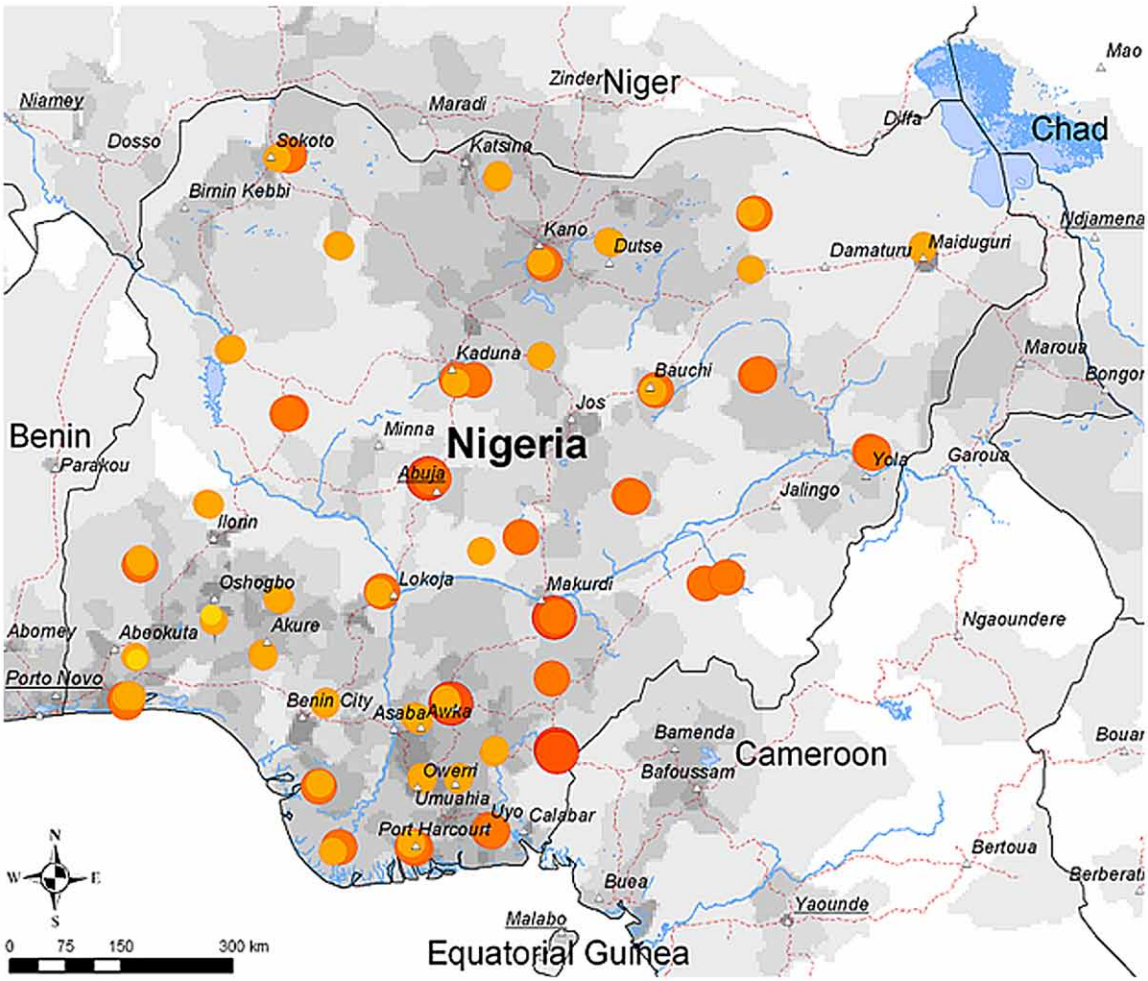
3.1 percent of adults between the ages of 15-49 are living with HIV/AIDS (WHO/UNAIDS, 2008). Although the Nigeria HIV/AIDS prevalence rate has reduced, the country still has the highest number of people living with HIV/AIDS in Africa (Utulu & Lawoyin, 2007). It was estimated that by the end of 2007 over 2, 600 people were infected with HIV/AIDS (WHO/UNAIDS, 2008).

More than 400,000 people died from AIDS in 2007 in Nigeria and women formed the majority of victims of this disease (Nigeria Tribune, 2008). The present means of HIV/AIDS data collection in Nigeria is based on sentinel surveillance among pregnant women and Figure 3 depicts the sentinel surveillance conducted among pregnant women between 2002 and 2006. This sentinal method of HIV/AIDS data collection is inefficient and cannot give an accurate estimate of people living with HIV/AIDS in Nigeria. So, in order to solve this problem, a disease surveillance system was developed to capture all required disease data, especially HIV/AIDS, and the location of people living with those diseases.

HIV/AIDS continues to be the most significant contributor to public health problems in Nigeria. HIV/AIDS has led to a decline in the life expectancy of Nigerians as it has done in other countries with high

Figure 3. HIV sentinel surveillance in pregnant Nigerian women
Source: World Health Organisation/Joint United Nations Programme on HIV/AIDS



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prevalence rates of HIV/AIDS. The average life expectancy of Nigerian women reduced from 53.8 years to 46 years and men from 52.6 years to 47 years from 1991 to 1999 (WHO/UNAIDS, 2008). Nigeria is the 12th largest world producer of oil and the largest country in Africa, yet the poverty level of the country continues to increase. Nigeria is ranked 158th out of 177 on the United Nations Development Programme (UNDP) human poverty index (UNDP, 2008). These deadly diseases, especially HIV/AIDS, are one of the major contributors to this problem of poverty.

The first case of HIV/AIDS in Nigeria was identified in 1985 and was reported at an international AIDS conference in 1986 (Adeyi & Kanki, 2006). In 1987, the Nigerian health sector established the National AIDS Advisory Committee which was later followed by the establishment of the National Expert Advisory Committee on AIDS (NEACA). In 2001, the Nigerian government, under the leadership of President Olusegun Obasanjo established the President's Committee on AIDS and the National Action Committee on AIDS (NACA), and set up a three year HIV/AIDS Emergency Action Plan (HEAP) as well as hosting the organisation of African Unity's first African Summit on HIV/AIDS, Tuberculosis and other related infectious diseases (Adeyi & Kanki, 2006) in order to track the epidemic. The National Action Committee on AIDS (NACA), whose name was later changed to the National Agency for the Control of AIDS, emphasizes a multi-sectorial approach to AIDS and membership includes representatives from the Ministries, the private sector, non governmental organisations (NGOs) and networks of people living with HIV/AIDS. The State Agency Control of AIDS (SACA) and Local Agency Control of AIDS (LACA) were also formed to spread the local multi-sectorial response to HIV/AIDS.

Almost 80% of the HIV infections in Nigeria are transmitted through heterosexual sex, and 10% are through blood transfusions (Avert, 2008). Other means of transmission include mother-child transmission. In 2005, it was estimated that 220,000 children were living with HIV, and almost all of them were infected through their mothers (WHO/UNAIDS, 2008). The spread of HIV/AIDS in Nigeria does not exclude the Nigerian military. In recent developments in the last five years, no less than 94,000 cases of HIV/AIDS were reported in 24 medical military centres (Nigeria Tribune, 2008). The spread of HIV/AIDS among the military may be due to the fact that they are often not transferred from a particular location to another. The factors that contribute to the spread of HIV/AIDS in Nigeria are:

1. **Lack of Sex Education:** In Nigeria, sex is a private issue and its discussion is seen as inappropriate among teenagers. This has been a major barrier to reducing HIV and other sexually transmitted diseases in the country. According to UNAIDS in 2006 (UNAIDS, 2006), only 18% of women and 21% of men between the ages of 15 and 24 can correctly identify ways to prevent HIV transmission.
2. **Lack of Voluntary and Routine HIV Test:** According to WHO in 2007 (WHO, UNAIDS & UNICEF, 2007), only 6% of women, 14% of men and 1% of pregnant women were tested for HIV/AIDS. Moreover, in developed nations most people living with HIV/AIDS are not aware they are HIV/AIDS-positive (Williams, 2008). So in a country like Nigeria, with a high prevalence rate of HIV/AIDS, there is a greater need for people to be tested so as to ascertain their HIV/AIDS status in order to minimise the spread of the disease.
3. **Poor Health Facilities:** Most cities and towns in the country lack basic healthcare facilities and this makes it difficult to establish testing and prevention services. The hospitals that are capable of providing testing, contraception and treatment for sexually transmitted disease are few and the existing health facilities in these hospitals are inadequate.

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4. **Poverty:** Poverty is another major cause of HIV/AIDS in Nigeria because, if the sex workers were gainfully employed in other professions, they might not resort to commercial sex, which is a significant cause of the spread of HIV in the country (Oyefara, 2005; Achebe, 2004).
5. **Lack of a Disease Surveillance System:** In Nigeria, there is almost no existing disease surveillance system in place and that is the focus of this thesis. If there were a disease surveillance system, the health workers would be able to monitor the spread and location of these diseases and intervene with the limited available resources. With this proposed disease surveillance data model, the development of a disease surveillance system will be possible and the health workers will be more able to monitor and manage the spread of HIV/AIDS and any other diseases in the country. Though the cost implications of disease surveillance may be high, in the long run it will minimise the cost of providing health services in the country.

Health Data Model

In order to develop a good public health system, there is a need for a reliable and efficient public health data model. A data model may be defined as a formal structured representation of real world entities. This representation is often focused on the definition of an object and its associated attributes (Business Intelligence Solution, 2004). It is neither a knowledge representation model nor a model representing processes. This type of model is most useful in identifying the data to be captured. It is an important area in the field of public health.

A health data model may be defined as the representation of subjects and their features within the health domain. There are two existing health data models for sub-Saharan African (SSA) nations namely the AMPATH Medical Record System Data Model (AMRS) and the Conceptual Data Model for Diseases Surveillance, Monitoring and Prediction in Nigeria (DSMPN). In this chapter DSMPN was used to develop the spatial HIV/AIDS surveillance and monitoring system for Nigeria.

Existing Health Data Models in SSA

i. Academic Model for Providing Access To Healthcare (AMPATH) Medical Record System Data Model

The AMPATH Medical Record System (AMRS) data model was developed in response to the need to address the growing number of people suffering and dying from HIV/AIDS in Kenya. In 2001, the partnership between Indiana University School and Moi University School of Medicine, Eldoret, Kenya led to the development of the Mosoriot Medical Record System (MMRS) which was adopted to serve as an HIV/AIDS database.

In 2003, WHO, USAIDS and other international organisations asked the developers to scale down the database to meet the needs of AMPATH and this led to the AMRS data model (Mamlin & Biondich, 2005). The aim of this data model is to meet the immediate need for an electronic medical record system to help scale up HIV/AIDS prevention and treatment. In addition, it aims to reduce critical human errors and support the research necessary to guide future efforts.

The strength of this model is that the model is already implemented using MySQL, Plone and Python; and the model makes use of coded data so as to allow both flexibility and scalability. One of the limitations of the model is that it only covers HIV/AIDS surveillance and focuses on Kenya alone, which

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is what the model was developed for (see Table 2.1). The model also lacks spatial and environmental features, which makes it difficult to adopt elsewhere.

ii. Conceptual Data Model for Disease Surveillance, Monitoring and Prediction in Nigeria (DSMPN)

This model (DSMPN) was developed as a means of having a HIV/AIDS surveillance system that could be used for surveillance and monitoring of HIV/AIDS in Nigeria. The aims of the research according to Idowu (2010) were to identify and document the detailed information needed in order to develop an effective disease surveillance and monitoring system. It was also meant to enhance the existing health data model by providing support for flexible spatial data.

The model comprises three core components or subject areas, which provide required data for the development of the disease surveillance database. The components are party, location and health activity. The strength of the model is its spatial feature, which is not clear in any of the existing health data models. A major limitation of the model is its inability to cover environmental features.

Existing Disease Surveillance System

There are several disease surveillance systems and HIV/AIDS surveillance systems. Two disease surveillance systems and three HIV/AIDS-related surveillance systems are discussed below.

i. National Electronic Disease Surveillance System (NEDSS)

The National Electronic Disease Surveillance System (NEDSS) is a Surveillance System developed by the Centers for Disease Control and Prevention (CDC) and implemented across the United States of America, NEDSS is a system to improve the public health monitoring of diseases. NEDSS is a secure online framework that allows healthcare professionals and government agencies to communicate about disease patterns and coordinate a national response to outbreaks. This Disease Surveillance System was developed based on a framework/architecture that includes software, hardware, databases, data format standards and the internet (Gianfranco, 2001).

NEDSS is not an actual surveillance system in the traditional sense of the word. Rather, it is an internet-based system that, according to the CDC, will "electronically integrate and link together a wide variety of surveillance activities and will facilitate more accurate and timely reporting of disease information to CDC and state and local health departments" (CDC, 2011).

NEDSS aims to improve timeliness by establishing electronic reporting systems, which will hopefully reduce the reporting burden for many health care providers. It also aims to make surveillance data more accessible to health officials by having a central system for storing and accessing data. This is a monumental task, and many years and dollars have been invested in accomplishing it. The enormity of the task is due in part to the variety of data types and sources that make up the existing surveillance systems. Also, due to the use of the internet for reporting, it is necessary to develop specific security measures to address the confidentiality issues inherent in transmitting sensitive health information electronically. Conveniently, NEDSS provides users with the ability to query the data for surveillance purposes.

The system was created to bring about the sequential replacement and integration of existing standalone public health surveillance systems with a distributed system that is architecturally based on defacto industry standards intended to simplify public health surveillance processes and to add additional

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functionality that is not provided by the current systems. The primary aim of the system is a streamlined disease data collection, analysis, and reporting process. This process will improve the reporting timeliness, improved accessibility and availability of data, improve the efficiency of the system and give a better understanding and documentation of the processes used in surveillance. NEDSS focuses mainly on Infectious diseases, HIV/AIDS and STD, Tuberculosis and Immunizations.

In legacy systems, systems have been isolated from one another due to their different data standards, patient's privacy concerns, lack of tools for proper information exchange etc. Health departments received most of the public health data by mail and then transferred the data on the documents into the computer databases. These data transfers often occurred a long time after the disease incidence was first reported. Many of the diseases were under-reported, inaccurately recorded and not even properly documented for analysis. This motivated the need for a system that would integrate public health surveillance systems data, and process them in a secure environment. The system was then made up of five components:

1. Web-based modules that allow easy online entry and management of data sets, including demographic and disease data
2. A Web application server called Silverstream that supports these Web-based modules
3. An integrated database management system
4. Messaging software that allows electronic data interchange between state agencies and the CDC or state laboratories
5. Intranet-based authentication and authorization for security that is fully compliant with HIPAA regulations.

ii. National Notifiable Diseases Surveillance System (NNDSS)

The National Notifiable Diseases Surveillance System (NNDSS) was established by the Communicable Diseases Network Australia in 1990. The system coordinates the national surveillance of more than 50 communicable diseases. In this system, health reports are made to the state or territory health authority. The health data reported includes the record reference number, the state, disease code, the date of onset, date of notification to the relevant health authority, sex, age, indigenous status and postcode of residence. Generally, the notifiable diseases are reported electronically, but in some cases reports may still be made on paper forms that are submitted at the local level, compiled, and then reported to the state. Each state reports the number of notifiable diseases that occur to the CDC each week (North Carolina, 2012).

The quality and completeness of data compiled in the National Notifiable Diseases Surveillance System are influenced by various factors. Notification may be required form physicians, diagnostic laboratories or hospitals. The mechanism of notification of a particular disease may differ between states and territories. The proportion of cases seen by health care workers which are the subject of notification to health authorities is not known with certainty for any disease, and it may vary among diseases, between states or territories and over time.

iii. Unified Web-Based National HIV/AIDS Information System in China

The unified web-based national HIV/AIDS information system in China is a system that provides real time data to monitor HIV/AIDS by prevention and treatment program across China. It improved the efficiency of data collection, reports, analysis and use, as well as data quality and security. It is a powerful tool for a national HIV/AIDS program and this may serve as model for other countries (Yurong Mao *et*

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al, 2010). Although the system is a web-based application, it does not have spatial features which make it different from the system developed from Nigeria. With spatial features, the system would allow spatial queries of the spread of the disease in any location.

iv. Integrating HIV/AIDS Surveillance into a Web-Based System That Includes Electronic Laboratory Reporting to Improve Case Reporting and Monitoring of HIV Care and Treatment Status

The integration of HIV/AIDS case surveillance into the TriSano system allowed Electronic Laboratory Reporting (ELR) to obtain laboratory information on cases. Data exports from TriSano were obtained for the evaluation of HIV and ELR. The initial evaluation included all reported laboratory results entered into TriSano during 2013, tabulated by disease, and included whether the lab results were entered manually or via ELR. Due to ELR being implemented in August 2013, another dataset containing only the laboratory results from the last third of 2013 was obtained. Analysis included cross-tabulation of the lab results entered and also the number of events created either manually or by ELR. These data support the benefits of integrating HIV/AIDs case surveillance into the TriSano system and the resulting improvements in completeness and timeliness of HIV/AIDS data because of ELR. These changes in the HIV/AIDS surveillance will improve our ability to monitor retention-in-care (Mietchen *et al,* 2014).The system is a web-based application but with some limitations, namely, it focuses on electronic laboratory reporting and it does not allow for queries based on people living with HIV/AIDS in a particular location.

v. Web-Based HIV/AIDS Behavioral Surveillance Among Men Who Have Sex with Men: Potential and Challenges

With more men who have sex with men (MSM) seeking sexual partners through the internet, the internet has been characterized as a newly emerging risk environment for HIV transmission. Meanwhile, the flourishing of gay websites provides a good opportunity for health professionals to conduct systematic HIV/AIDS behavioral surveillance among MSM. Effective methods to recruit online MSM users have been developed, and online surveys have suggested many practical advantages over surveys in the traditional gay community. Although surveys among MSM via the internet have a few limitations and risks, online surveillance can still be viewed as a feasible and convenient approach, especially in countries where the HIV/AIDS epidemic is concentrated in high-risk populations and where the conducting of such surveillance in traditional gay venues is difficult. This system is not actually an HIV/AIDS tracking system but HIV/AIDS behaviour surveillance system among gay men (Zhang *et al,* 2008) and the system lacks spatial features which is the major contribution of the system developed as described below.

METHODS

In order to develop the surveillance and monitoring system, Conceptual Data Model for Disease Surveillance, Monitoring and Prediction in Nigeria, (DSMPN) was used and the database developed using MySQL. In the process of developing the HIV/AIDS disease surveillance and monitoring database, different tables, files, records and fields were created. The MySQL in wampserver was used to create and populate the database.

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The system was implemented using Dreamweaver, and PHP. Apache was used as the server to provide basic functionality of the web GIS. PHP was used as a scripting language to program the server side that manipulates the knowledge in the database. The web-based spatial HIV/AIDS surveillance and monitoring system (HSMS) for Nigeria was implemented on the HSMS architecture.

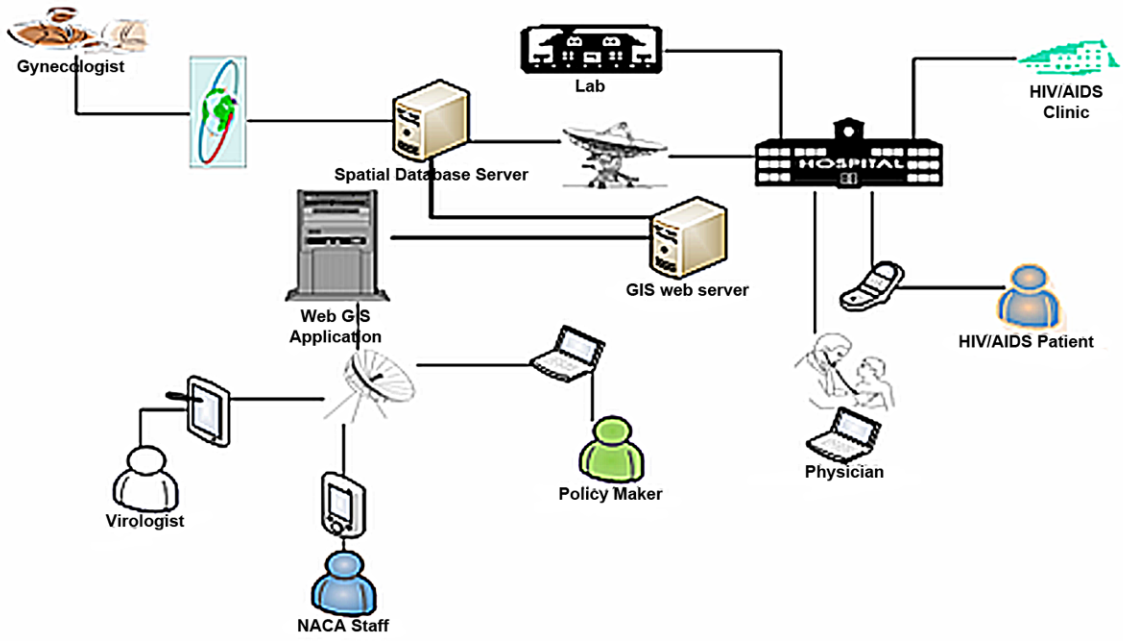
System Architecture

In the design of any system related to surveillance or tracking, there is a need for system architecture. In the HSMS, the design of the system needs to be easy, flexible and portable as much as possible. This allows users to be able to make use of portable computers, desktop computers, and mobile phones as web browsers to access the system. In this chapter, client-server system architecture is used and it is a thin client-server. The spatial HIV/AIDS surveillance and monitoring system has two components, namely, the server-side and client-side that run on the browser.

The system was modelled using client-server architecture. In the client approach, almost all the processing work was done on demand at the server end and the client task was to display data and information on the screen. In thin client-server architecture, the web browser is the client. This architecture was used because users would not be required to install any software on their systems except a standard web browser, which often comes with most computer operating systems and almost all the current standard mobile phones.

Clients would also not require any powerful computer systems; users could use any computer with a web browser such as laptop/notebook, mobile phone, and desktop computer systems. The servers would require a higher configuration (in terms of hardware) computer system because it would be regularly subjected to a heavy load. These would be the HTTP server, database server and webGIS server. Figure 4 below depicts the spatial HIV/AIDS surveillance and monitoring system architecture.

Figure 4. System Architecture of the HIV/AIDS Disease Surveillance and Monitoring System



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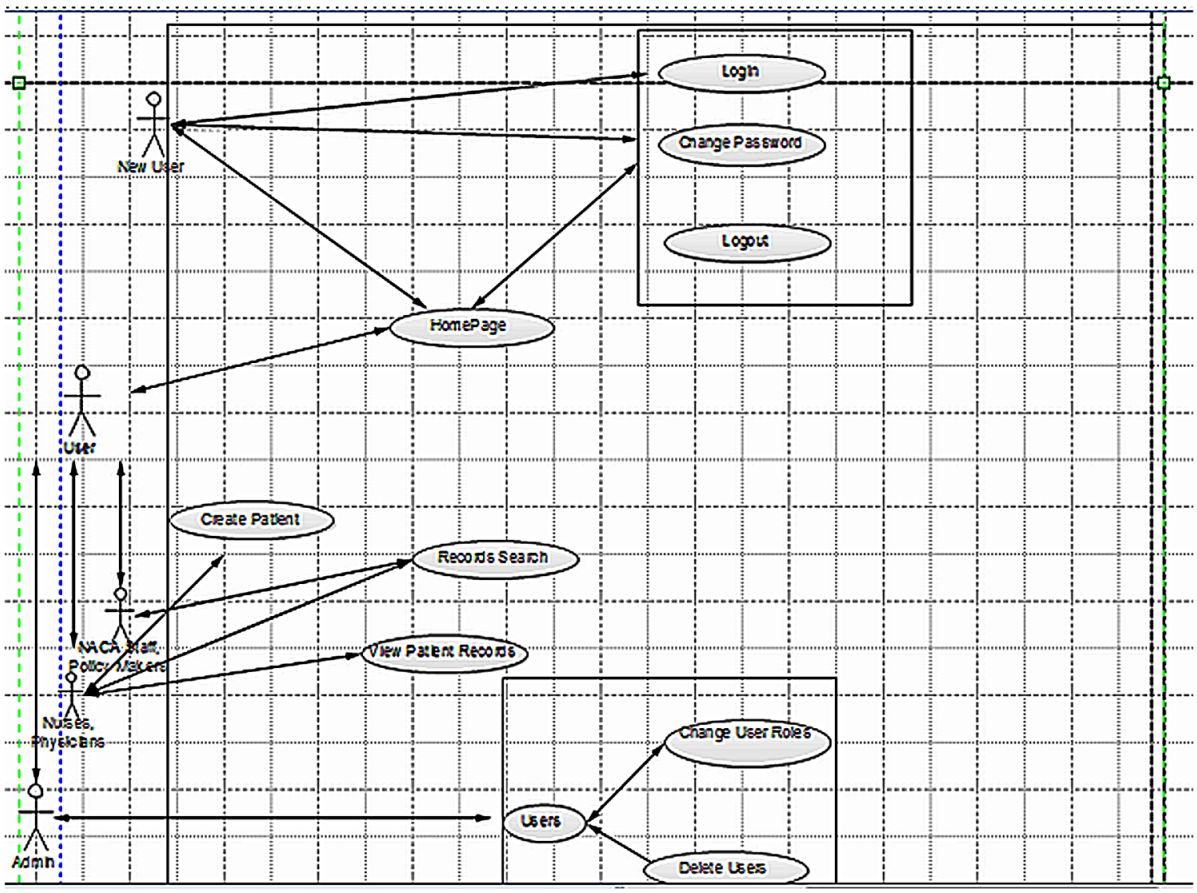
Use Case Diagram for HSMS

The use case diagram is used in presenting the system requirements of any proposed system. A use case is a realistic description of the workflow of the system and is used to explicitly describe the intentions and actions of users, i.e. to show how the proposed system works in practice. The interaction between actor and use cases is also described using the use case diagram. The use case diagrams of the spatial HIV/AIDS disease surveillance and monitoring system are shown in Figure 5.

The use case diagrams show how data will be entered and viewed from the spatial HIV/AIDS disease surveillance and monitoring system. Virologists and other stakeholders would be able to query any HIV/AIDS data based on any location in the country. Also, the virologists and other stakeholders would be able to capture and analyse all HIV/AIDS data of entire streets in the specified location into the health information system or national HIV/AIDS database. The online monitoring and tracking of HIV/AIDS status of all locations in Nigeria would also be possible. As a result, the system is capable of monitoring diseases that are paramount in a particular area.

Policy makers would also be able to view the HIV/AIDS status of any state, local government area, city/town, ward and street in the study area. Any authorised international organizations and non-gov-

Figure 5. Use case diagram for HIV/AIDS Surveillance and Monitoring System for Nigeria



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ernmental organizations would also be able to view the state of environmental health of any location in the study area and channel any health assistance to the appropriate location.

IMPLEMENTATION OF THE DSMS

User Interface Design

The user interface allows the user to navigate the surveillance and monitoring system and communicate with the database. The system design is simple enough for use by anyone with little knowledge of computing and since the targeted end users are virologists, physicians and other hospital staff in the study area, the system is user-friendly and made easy to use through the use of windows, interface menu and pointing devices (WIMP) which is very important in computer graphics design and architecture. Figures 6 and 7 depict the user interface which allows authorised users login into the system.

Figure 6. Homepage for HIV/AIDS Disease Surveillance and Monitoring System

Figure 7. Login Menu for HIV/AIDS Disease Surveillance and Monitoring System

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Data Collection Menu

The Registration/data collection screen which is depicted in Figure 8 is used to capture the entire data of HIV/AIDS patients. It is categorized into sections namely the Bio-data, Personal Information, Contact Information, Other information, Work information, Relationship details, Health Diagnosis and Treatment. Each Section of this data registration captures its own specific patient records. This section allows users to capture information about an HIV/AIDS patient. It stores information about the general health of the patient. In this menu, the health officers and any other authorized users can log on to the HIV/AIDS surveillance application and add, edit and manipulate the data, while the external users such as the policy makers, NACA staff can only view the information.

Bio-data Menu

The Bio-data section captures the personal data of the HIV/AIDS patients. The data captured in this section includes the Title e.g. Mr, Miss, Dr etc, FirstName which captures the first name of the patient, the MiddleName captures the other name of the patient and the Surname captures the family name of the patient. The Bio-data section also captures the Date of Birth of the patient which in turn gives the age of the patient; the Marital Status captures the status of the patient which is susceptible to change. Also Gender, in this section of the bio-data, captures the sex of the patient. This information is obtained from the HIV/AIDS patient in confidence. The information captured on this screen is mostly contained in the party component with sub-classes such as the PersonName which contains information about the patient's Title, FirstName, MiddleName, Surname etc and this is depicted in Figure 9 below.

Figure 8. Data Collection Menu

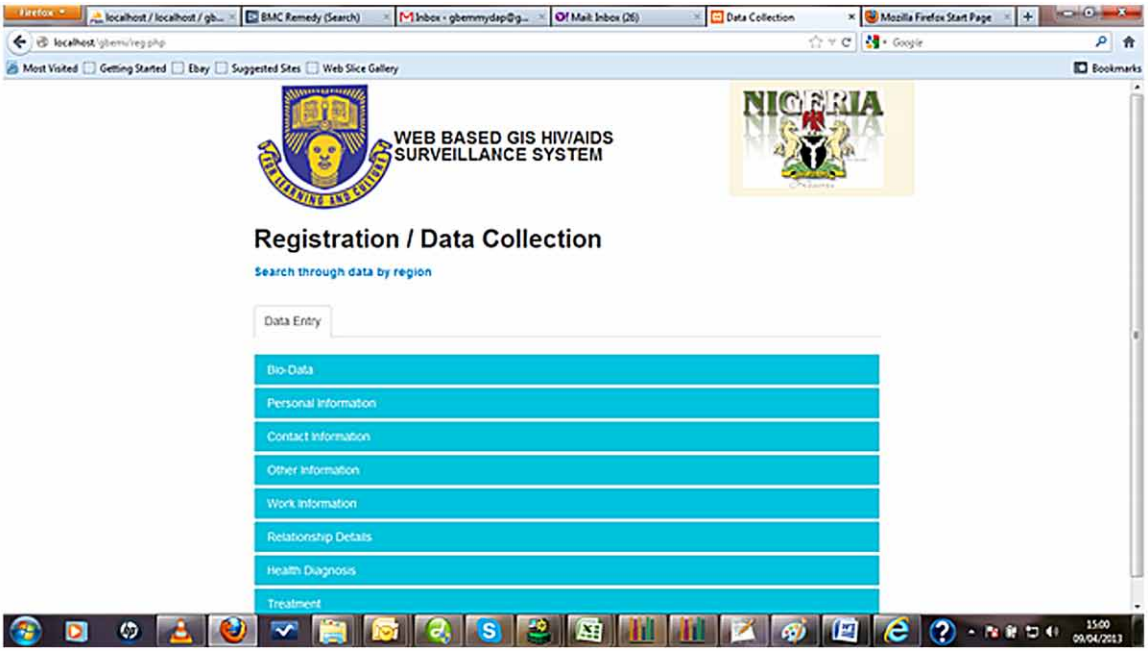

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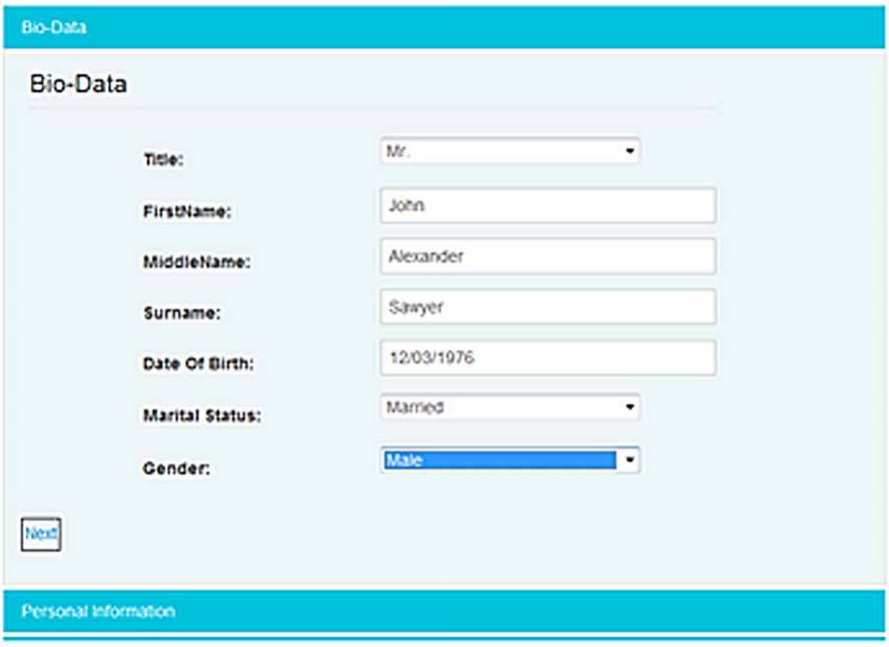
Figure 9. Bio-Data Menu



Personal Information Menu

The Personal Information Section is for capturing the personal details of an HIV/AIDS patient and this is depicted in Figure 10. The section captures the education level of the patient, patient's occupation or profession, and religion. The ethnic group describes the ethnicity of the patient; the phone number captures the telephone contact details of the patient, the email address and website of the patient. Identification captures the valid means of identification of the patient and the identification number on the card. Also, the location of the patient is used to capture information about the geographical location of the patient. The information captured in this section comprises party and location components and subclasses such as the party holds patients education, occupation etc, PersonIdentifier contains information about means of identification and the ID Number, current PersonContactDetails subclass holds the email, telephone number and website and address and LocationRelationship gives the location of the patient during a particular period of time.

Contact Details Menu

The contact details screen is used to capture the contact details of a patient such as the house number of the patient, the street number, the city or town, the local government area, and the state in which the patient resides. The nationality of the patient is also captured to provide information on the number of non-citizens residing in Nigeria that are infected with HIV/AIDS, as depicted in Figure 11 below. The postal address of the patient is also captured. This form allows the contact details of HIV/AIDS patients to be captured extensively for proper and efficient monitoring and surveillance of HIV/AIDS in the different locations. This Contact Information form also comprises party and location components. The

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Figure 10. Personal Information Menu

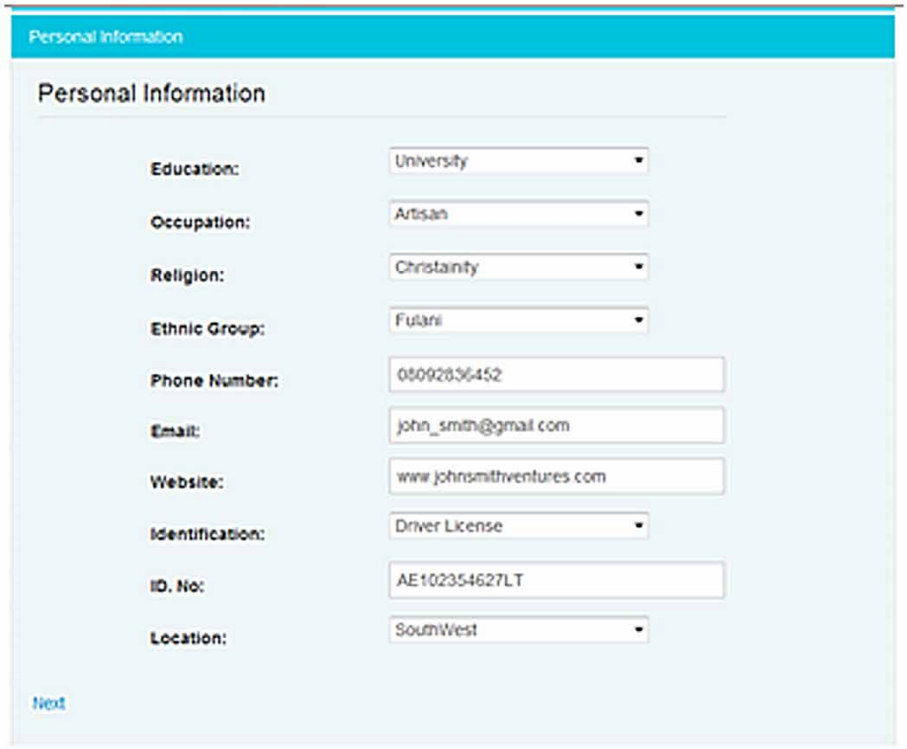
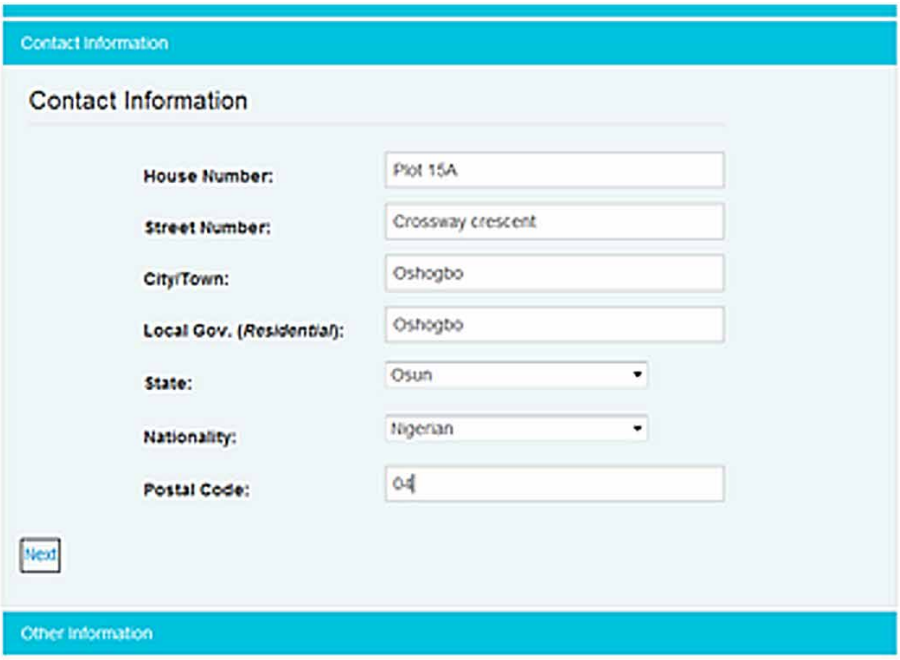


Figure 11. Contact Information Menu



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PartyLocation, Address and LocationRelationship subclasses capture the HouseNumber, StreetName, City/Town, LocalGovt, State, Nationality and the PostalCode of the patient. The location component is important in this HIV/AIDS Surveillance system because the occurrence of HIV/AIDs will be determined based on locations in Nigeria. Also, the surveillance and monitoring of the disease will be carried out based on locations.

Other Information Menu

The Other Information section captures additional information about the patient as depicted in Figure 12. This information includes the blood group and genotype of the patient. Also the section captures the history of any previous ailment/disease that the patient might have had. Any history of HIV/AIDS infection within the family will also be captured to realize imminent threats within the family. This form also accepts comments on the health related information about the patient. This form represents the party and Health Activity components of the data model. The Contact Information form also comprises the party and location components. The PartyLocation, Address and LocationRelationship subclasses capture the HouseNumber, StreetName, City/Town, LocalGovt, State, Nationality and the PostalCode of the patient.

Work Information Menu

This section captures work-related information to analyze the risk other colleagues at work are exposed to due to sexual relations or handling of instruments that can transmit HIV. This is depicted in Figure 13. The data captured in this section include the occupation of the patient, the office address, the city or town where the office is located, the local government area where the office is located, the state where the office is located and the duration of stay in the office. These records are obtained from the patient to

Figure 12. Other Information Menu

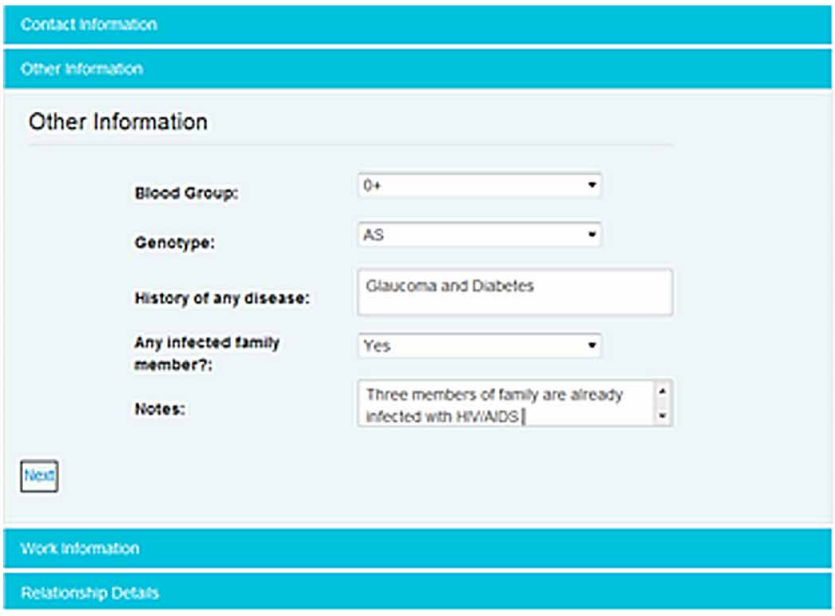

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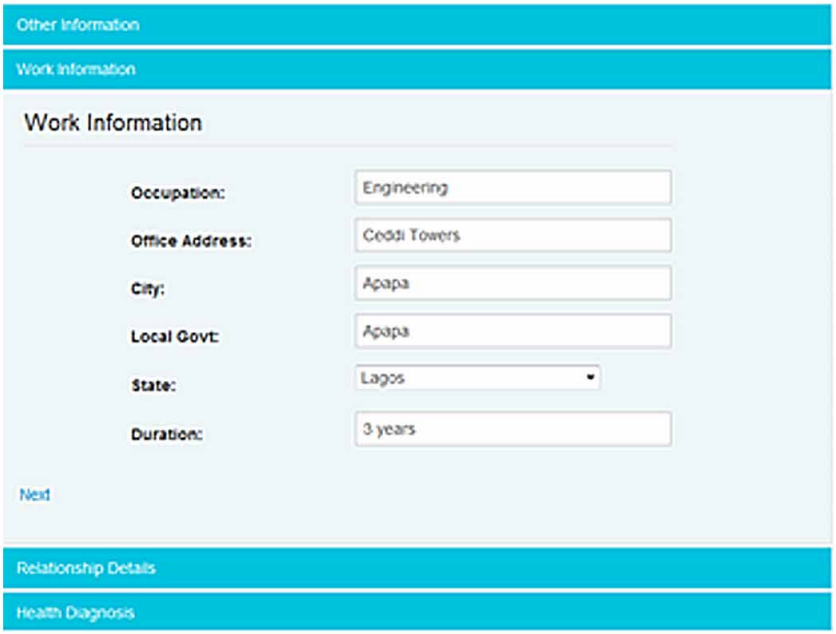
Figure 13. Work Information Menu



obtain work related information about the HIV/AIDS patient. The Work Information form also comprises the party and location components. The PartyLocation, Address and LocationRelationship subclasses capture the Occupation, OfficeAddress, City/Town, LocalGovt, State and the Duration the patient has been working in that particular location. This form gives the flexibility to users to query based on a particular occupation to know the total number of HIV/AIDS infected people within a profession and organization.

Relationship Details Menu

The relationship details section captures information about the patient's relationship status; this is depicted in Figure 14. The name of the patient's next of kin is captured, as well as the form of relationship with the next of kin. The total number of dependants the patient has will also be captured. If married, the total number of spouses will be determined, and in addition, the total number of active sexual partners will be captured to determine the level of risk posed by the patient through sexual transmission of the disease. The protection status of the patient will be ascertained so as to identify the risk of exposing others to infection. Also the spread control technique used by the patient should be known when relating or having sexual relations with uninfected partners.

Health Diagnosis Menu

The health diagnosis section captures the disease diagnosis and this is depicted in Figure 15. The date of diagnosis is the starting date of observation and the confirmation date is the date of the disease confirmation, usually after the observation date. The disease method description is the method by which the

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Figure 14. Relationship Details Menu

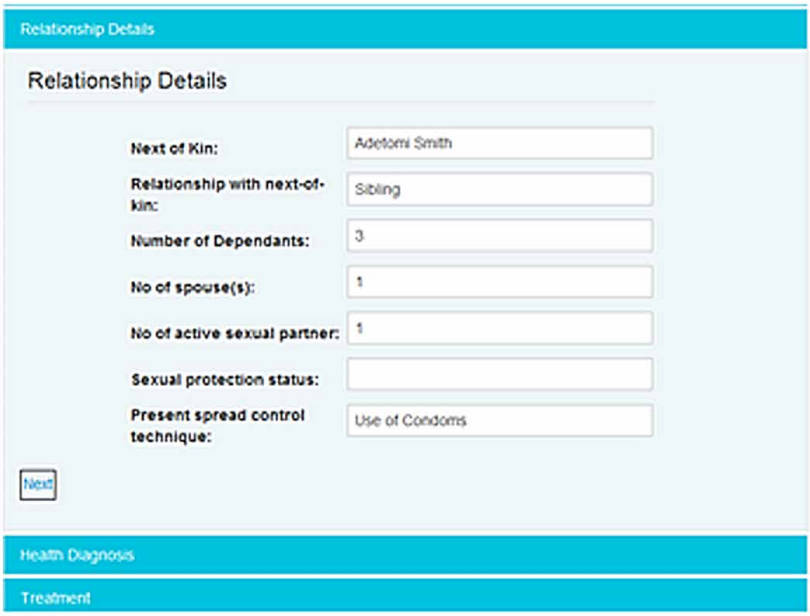
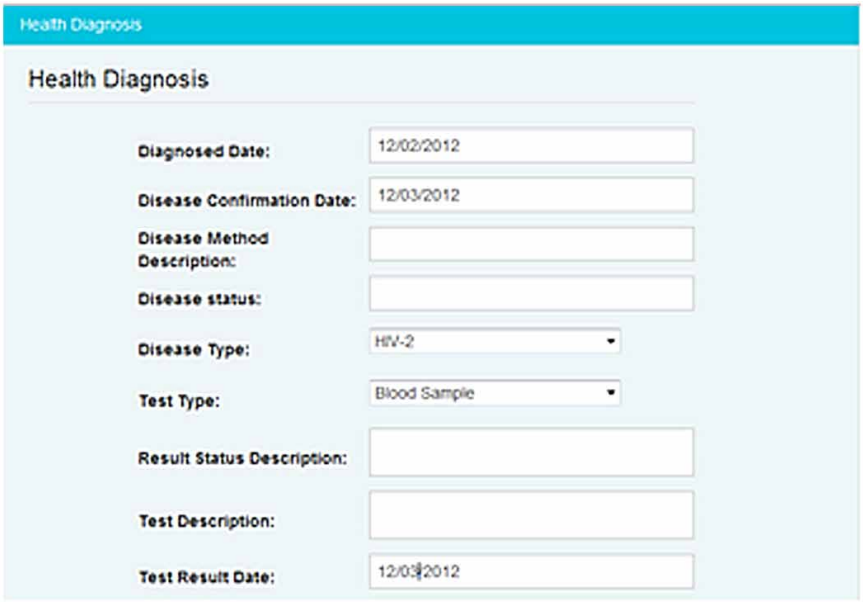


Figure 15. Health Diagnosis Menu



disease was confirmed in the patient. The disease status captures the status of the disease, and the stage which the disease has reached. The disease type represents the type of disease. The result type captures the description of the type of result and the test description specifies the description of the test taken by the patient. The test result date captures the date at which the test result is received. The Health Diagnosis

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Information form also represents the Health Activity component. The Diagnosis subclass captures the DiseaseType, DiseaseDescription, DiseaseStatus, DiseaseDetectionMethod, DiseaseConfirmationDate and the Test subclass captures the ResultStatus TestDescription, ResultTypeCode and TestResultStatusDate.

Treatment Record Menu

The Treatment Details section captures the form of treatment undertaken by the HIV/AIDS patient and this is depicted in Figure 16. The access to antiretroviral (ARV) treatment is captured. This section captures the last treatment date of the patient, the type of treatment administered to the patient; also, the form of improvement noticed by the patient is recorded to know if progress is made in the administration of the treatment. The cost of treatment incurred by the patient over a period of time is also captured as well as the time interval between treatments. The Treatment Information form also includes the Health Activity component. The Treatment subclass contains TreatmentType, TreatmentDate, TreatCost and TreatmentInterval. The treatment subclass gives the flexibility to know the access to treatments and availability of antiretrovals.

View Report Analysis by Region and Search Results Menu

The View Report Analysis by Region module of the HIV/AIDS disease surveillance system is used to query for the HIV/AIDS statistics in a particular region, and this is depicted in Figure 17. The map of Nigeria with all the 36 states is displayed for the user to select a particular state. The user clicks on a state and selects a particular local government to view the reports.

The Search Result module, which is depicted in Figure 18, is used to query the database for the records of HIV/AIDS patients captured for the purpose of analysis, monitoring, evaluation and surveillance of the disease. The data can be queried based on some criterion e.g. gender, which can be used to obtain the

Figure 16. Treatment Records Menu

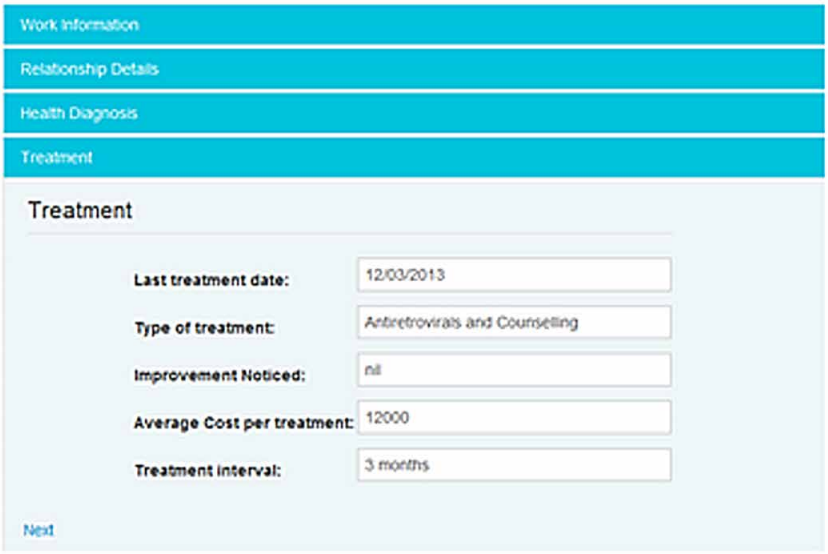

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Figure 17. Report Analysis By Region Menu

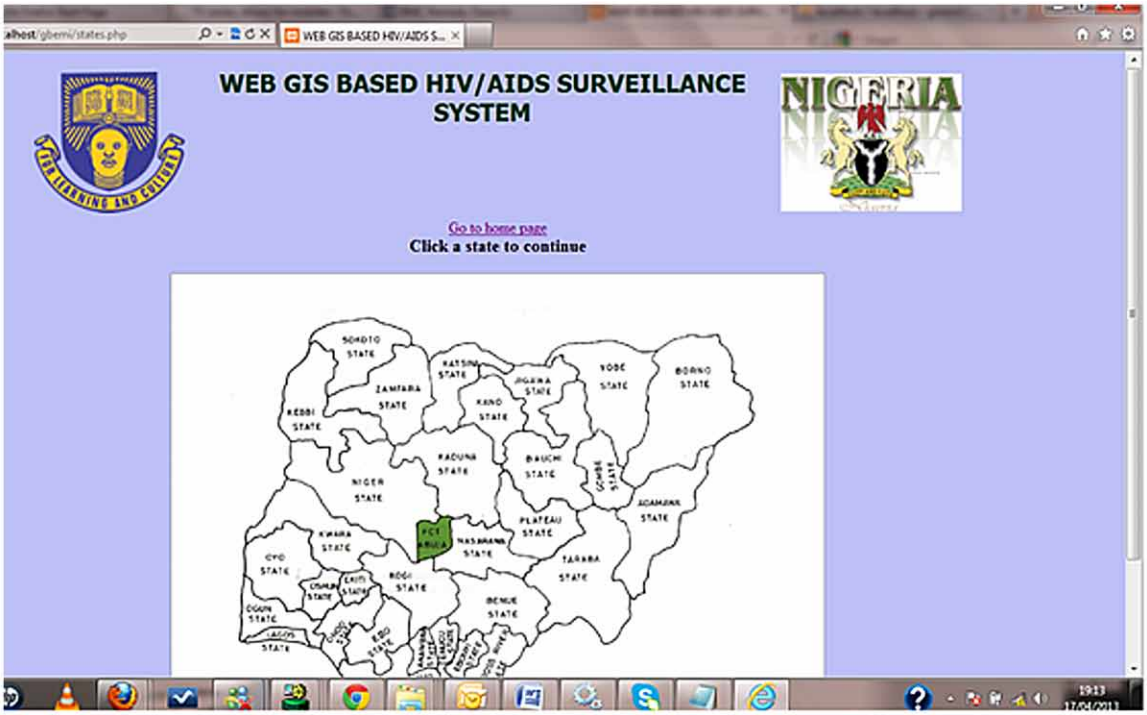
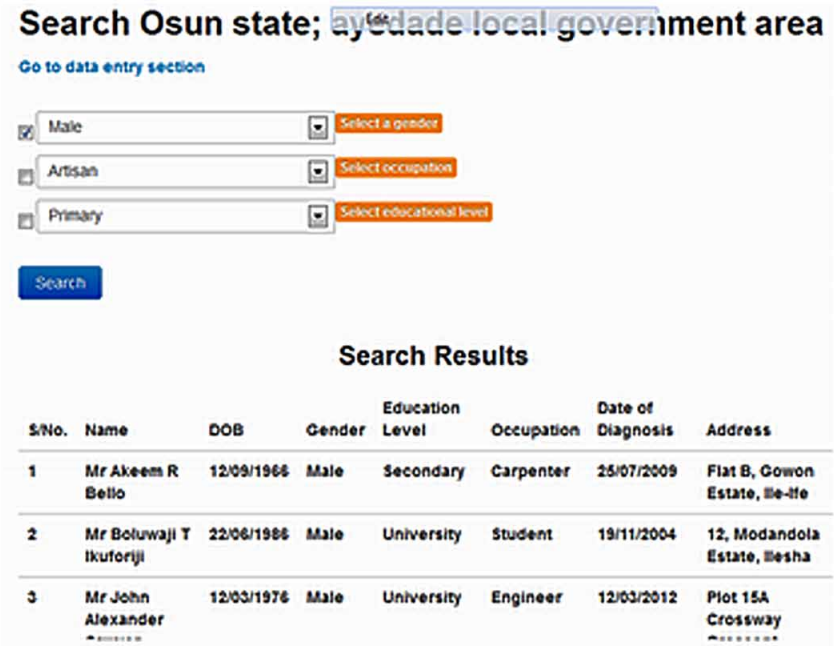


Figure 18. Search Results Menu



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records of HIV/AIDS patients that are either male or female within a particular location. Occupation can also be used as a search criterion; this selects records of people that are within a particular profession. The Education Level is also used as a criterion to spool the records of people that fall within a particular educational level in a particular geographical location.

DISCUSSION

The HIV/AIDS disease surveillance system was developed based on the adopted data model to capture comprehensive information about HIV/AIDS patients which will help monitor the spread of the disease and provide a national health database for Nigeria for monitoring and surveillance of diseases. This will also help in predicting and forecasting the distribution, pattern and prevalence rate of HIV/AIDS in Nigeria. The system will allow users to be able to spatially query any location in Nigeria. The system will be used to generate reports in any format based on query parameters for analysis and decision making. The HIV/AIDS disease surveillance system will go a long way in providing a healthcare advantage to Nigeria ahead of other sub-Saharan African countries.

With this HIV/AIDS surveillance system, health policy makers, disease agents or any authorized users would be able to login into the website and be able to view the pattern and distribution of any diseases. The users would click on the feature query menu and then click on a particular state in order to view all available information on any disease at a local government level or at a state level. Users can query a point of interest on a map in order to ascertain the pattern and distribution of HIV/AIDS in the vicinity of that location. A Web Feature Server could also be used to fetch the name of locations which have more than a certain prevalence rate for a particular disease, for example, to produce the name of a state or local government areas with more than 5% prevalence rates for HIV/AIDS.

The system would allow users to spatially query and view data on any disease in order to ascertain the patterns, distribution and prevalence rate of any disease such as HIV/AIDS, malaria, tuberculosis, etc in any location in Nigeria. Users will be able to select a polygon on the map and the features of the polygon such as the name of the state, population at risk and prevalence rates will be displayed. The system would also allow physicians/health officers in the hospitals to input patient information such as demographic data, diseases associated with each patient, information about geographical location of each patient and other related information into the system. This system would be able to keep information about any diseases in the country which eventually would make medical information about people living with certain diseases such as HIV/AIDS confidential (because only authorised users of the system would be able access the patients' records compared with paper files, in which clerks working with medical records unit could open the file and read the contents). Also epidemiologists, policy makers, and any other authorised users would be able to query, analyse, view and generate disease information based on street, town/city, local government area, year, population at risk, total number of cases, prevalence rate, sex, marital status, educational status and age distribution of disease carriers in the country.

In addition, the system will allow special queries based on some features, such as a query based on occupation, education level, mobility level among other things. The system will allow a physician or delegated health worker to input group data of people living with a particular disease at a particular location over a given period of time.

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CONCLUSION

This chapter describes the development of a web-based GIS HIV/AIDS surveillance system for Nigeria. Due to the lack of database information on HIV/AIDS in Nigeria, the Conceptual Data Model for Disease Surveillance, Monitoring & Prediction in Nigeria was analyzed and a fully-fledged HIV/AIDS surveillance system was developed for surveillance, monitoring and management of HIV/AIDS disease. This enables health officers, epidemiologists and stakeholders to easily query the distribution and the pattern of any diseases in Nigeria.

The web-based GIS disease surveillance system was designed based on the Conceptual Data Model for Disease Surveillance, Monitoring & Prediction in Nigeria. The model identified and documented the detailed information needed in order to develop and effective disease surveillance, monitoring and management information system. The model uses three core components which are party, location and health activity. The party component of the model contains information about a person, groups and any features that are of interest to the health system, including physicians, epidemiologists, public health workers, hospitals, laboratories, patients, association of laboratory scientists, people living with HIV/AIDS. A health activity is the provision of a specific health service to a health service recipient by a service provider at a given place during a particular period of time. The location component contains information about the addresses and spatial positions associated with the other two core components that is Party and Health Activity. HL 7 codes were adopted and modified intensively in the Conceptual Data Model for Disease Surveillance, Monitoring & Prediction in order to allow interoperability and flexibility of the disease surveillance system.

The system was designed and developed to capture HIV/AIDS patients' information such as gender, occupation, religion, education level, marital status, ethnicity, mobility, race, address etc. The developed system will provide a national health database that will enhance the monitoring and surveillance of any disease in the nation.

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KEY TERMS AND DEFINITIONS

Data Model: A formal structured representation of real world entities, focused on the definition of an object and its associated attributes.

Disease Surveillance: A system that provides useful information about disease status and sometimes it may imply that some form of directed action will be taken if the data show a disease prevalence or incidence above a certain threshold.

Geographical Information System: A computer based information system that combines people, hardware and software to capture, model, store, retrieve, share, process, and manipulate, analyze and present geospatial (geographically referenced) data for the purpose of decision making.

Health Information System: A system that integrates data collection, processing, reporting and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services.

Human Immunodeficiency Virus: An infectious agent that causes Acquired Immune Deficiency Syndrome.

Monitoring: A process of routinely gathering information on all aspects of the project.

Surveillance System: An electronic tool for collection of data that will be able to accurately synthesise data, analyse data and present data and information over time to stakeholders.

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Chapter 25
Early Warning System and Adaptation Advice to Reduce Human Health Consequences of Extreme Weather Conditions and Air Pollution

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ABSTRACT

The authors developed a multi-site Internet service to provide the public with real time information about local weather and air quality, how they may affect health, and how general population and different sensitive population groups can protect their health during periods of extreme weather conditions or increased air pollution levels. The information service is based on data obtained from the Republic Hydrometeorological Service of Serbia and Serbian Environment Protection Agency. Health warnings and recommendations are given separately for each AIQ and heat index or wind chill index value, for each sensitive population group, as well as for the general population. The project is currently implemented on the website of the Institute of Occupational Health Niš and will be offered to other healthcare institutions in Serbia. Evaluation of the system should enable redefinition of heat and wind chill indices and air pollution threshold values if necessary. This chapter explores the service.

INTRODUCTION

Exposure to adverse weather conditions or high concentrations of air pollutants is associated with a wide range of acute and chronic health effects, especially in children, the elderly, and in patients with chronic diseases. Pyramid of the health effects of adverse weather conditions and air pollution starts from subclinical effects, continued with deterioration of organ functions, the appearance of new or worsening of

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existing symptoms, increased use of drugs, activity reduction, an increased number of physician visits, increased use of emergency medical services, increased number of admissions to hospital treatment, and ends with the increased number of deaths.

The growing problems of climate change and air pollution have caused the development of a system for monitoring health risks and issuing warnings in many countries. In the U.S., the National Weather Service was developed, using the National Weather Hazards application to monitor, alert, and provide advice on risk due to the effects of many meteorological factors: snow, wind, floods, extreme heat and cold over the Internet (http://www.nws.noaa.gov). United States Environmental Protection Agency - EPA calculates and displays the Air Quality Index (http://www.airnow.gov) and issues warnings for increased concentration of pollutants in the air. In the UK, the website of the National Weather Service (http://www.metoffice.gov.uk) gives an overview of the current meteorological conditions and air quality index. Warnings are issued when the values of these factors are sufficient to pose a threat to human health and the presentation contains a number of recommendations regarding appropriate behavior and preparations for risk mitigation due to the effects of extreme weather conditions. Similar systems exist in other countries: Canada (http://www.ec.gc.ca), Australia (http://www.bom.gov.au), France (http://france.meteofrance.com), Germany (http://www.umweltbundesamt.de), as well as other countries.

Internet applications for weather and air pollution monitoring, as well as for providing health advice and issuing warnings have been developed, not only on national level, but also for regions of large countries (USA, Canada, China, Australia), as well as in many cities in the world.

Within the "New information technologies for analytical decision-making based on the organization of experiments and observations, and their application in biological, economic and social systems" project, funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia, the first system for early warning and providing recommendations for reducing the adverse health consequences of air pollution and meteorological conditions is under development in Serbia. The system is interfaced with using a web application and is intended for use by the general population and vulnerable population groups in the cities of Serbia. At this stage, the system has been implemented on the website of the Institute of Occupational Medicine in Nis, and will be offered in other towns in Serbia.

BACKGROUND

Air Pollution

The earliest recorded problems with outdoor air pollution occurred due to burning fossil fuels in large cities (Brimblecombe, 1987). Industrialization and transport have led to an increase in the concentration of pollutants in the air. By the mid- twentieth century, there have been a few short-lived episodes in which exceptionally high levels of air pollution have influenced the occurrence of excessive mortality and morbidity. The most dramatic three episodes took place in the Meuse Valley in Belgium in 1930. (Nemery et al., 2001), Donora, Pennsylvania in 1948. (Davis, 2002) and in London in 1952 (Bell & Davis, 2001; UK Ministry of Health, 1954) These episodes prompted the authorities in many countries to start the research on the impact of air pollution on human health and to enact legislation that would improve air quality. These measures and activities have greatly contributed to alleviating the problem in the developed countries, but air pollution remains a serious, now global, worldwide problem, with

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intense negative effects on public health (Ezzati et al., 2002) In many areas of the world, the levels of air pollution are still extremely high, as is the case in large cities of China and India (WHO, 2001)

While the impact of the extremely high concentration of pollutants was clearly visible during the above excess situations, contemporary studies of air pollution in developed countries give attention to the impact of much lower concentrations of pollutants.

Pollutants in the Outside Air

Particles

Many pollutants can, alone or in combination with others, affect the health of people, but over the last two decades particles (particulate matter - PM) are becoming the main subject of research (Brunekreef & Holgate, 2002). They represent a heterogeneous mixture of solid and liquid substances suspended in the air, which vary in size and chemical composition in space and time.

Natural and artificial sources of particles are: internal combustion engines, dust from roads, industry, metal processing operations, agricultural and construction activities, firing, clay dust, pollen, molds, forest fires and the burning of agricultural waste, volcanic emissions and sea spray.

There are thousands of elements and compounds that were detected in the particles at various locations, but the most common ones are: nitrates, sulfates, organic and elemental carbon, organic compounds (e.g., polycyclic aromatic hydrocarbons), biological substances (endotoxin, cell components), and metals (iron, copper, nickel, zinc and vanadium).

Due to the complex nature of the particles, their measurement, classification and regulation are based mainly on the defined size ranges. They are most commonly classified as the total suspended solids or TSP, particles that easily penetrate the tracheobronchial tree or PM_{10} (aerodynamic diameter of less than 10 μm) and the fine particles that can reach alveoli or $PM_{2.5}$ (aerodynamic diameter of less than 2.5 μm). More recently, the attention of researchers is focusing on ultrafine particles or UFP, with a diameter of less than 0.1 μm, which originate from combustion processes (Daigle et al., 2003).

Sulfur Dioxide

Sulfur dioxide (SO_2) is very irritating, colorless, soluble gas with an intense smell and taste. In contact with water, it produces sulfuric acid, which is responsible for its strong irritating effect on the eyes, mucous membranes and skin (Lipset, 2001). It can also cause narrowing of the airways and lead to an exacerbation of chronic lung disease symptoms and increased frequency of attacks in asthmatic patients.

The main source of this pollutant in the air is the burning of fuels containing sulfur, especially in power plants and diesel engines (the primary reason for the change in the composition of diesel fuel) and smelting of metal ores that contain sulfur. Sulfur dioxide oxidizes to sulfur trioxide, which, due to the strong affinity to water quickly turns into sulfuric acid (WHO, 1987).

Nitrogen Oxides

Nitrogen oxides are reactive compounds which include NO, NO_2, NO_3, N_2O_4, and N_2O_5. These compounds are commonly labeled with NO_X because a mixture of these compounds is usually present in the air.

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Nitric acid in the gaseous state (HNO_3) is a major source of particulate nitrates and is produced when nitrogen dioxide reacts with hydroxyl radicals during the day, or when the nitrogen pentoxide reacts with water vapor during the night (U.S. EPA, 1993).

A large number of toxicological and epidemiological researches have focused on nitrogen dioxide, due to the fact that the creation of tropospheric ozone and other photochemical oxidants starts with the photolysis of nitrogen dioxide.

The main artificial source of nitrogen oxides in the air is the combustion of fossil fuels in motor vehicles and industrial processes. The high combustion temperature leads to the oxidation of atmospheric nitrogen, first to nitrogen monoxide, then to nitrogen dioxide. A typical daily pattern of nitrogen oxide concentration movement indicates a low base concentration with morning and afternoon spikes, due to the traffic rush hour.

Nitrogen dioxide and nitric oxide are naturally produced as a product of metabolism of bacteria, and in far lesser extent as a result of volcanic activity.

Carbon Monoxide

Carbon monoxide (CO) is a gas without color, smell and taste that links to hemoglobin with the affinity 250 times more potent than oxygen and is therefore affecting the reduction of systemic delivery of oxygen to tissues. Carbon monoxide also binds to cytochrome oxidase, which further adds to cell hypoxia, and is associated with the other extravascular proteins such as myoglobin, cytochrome P-450, catalase and peroxidase (Seger & Welch, 2001). On exposure to high concentrations, which usually occurs indoors, it leads to loss of consciousness, and high concentrations can lead to death. At lower levels of concentration, reduced oxygen transport may increase the risk of cardiovascular disorders and mental dysfunction.

Carbon monoxide is the product of partial oxidation of carbon. External sources include motor vehicles, motor boats, lawn mowers, chain saws and other equipment running on fossil fuels, and using fuel for heating purposes. According to the study on the measured concentrations of this pollutant, it is more often used as an indicator of air pollution resulting from the burning than it actually causes adverse health effects. However, under certain conditions, for example in poorly ventilated public garages, carbon monoxide can reach concentrations that lead to a significant increase of carboxyhemoglobin in patients with atherosclerosis or other diseases of the cardiovascular system.

Ozone

Ozone (O_3) is a highly reactive, colorless gas with a characteristic odor. Exposure to low concentrations is inevitable because ozone is formed in natural processes and during human activities. The negative effects of short-term exposure to high concentrations of this pollutant are the inflammatory response of the airways and increased sensitivity to allergens, such as pollen, resulting in reduced pulmonary function.

In the troposphere ozone is caused by the action of solar UV radiation on nitric oxides and reactive hydrocarbons, emitted by motor vehicles and many industrial sources (U.S. EPA, 1996).

Ozone concentrations are increased during hot, sunny days. Typical concentration profile in cities is characterized by a broad peak which lasts from late morning to late afternoon and early evening.

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Biological Mechanisms of Action of Air Pollution

Estimated biological mechanisms of air pollution influence on cardiovascular and respiratory systems include direct effects on the cardiovascular system, blood, lung receptors and indirect effects expressed through pulmonary oxidative stress and inflammatory responses. Direct effects may arise from the action of agents that can easily pass through the pulmonary epithelium into the blood circulation, such as gases and possibly ultra fine particles - UFP (Nemmar et al., 2002a) together with the soluble components from $PM_{2.5}$. The activation of pulmonary neural reflexes due to the interaction of particles with lung receptors can also play an important role. Direct effects, under appropriate conditions, can contribute to instability of vascular plaques, or initiate a cardiac arrhythmia. These effects of air pollution are the likely explanation for the occurrence of rapid (within a few hours) cardiovascular responses such as increase in the number of acute myocardial infarction.

Less acute (up to several days) and chronic indirect effects may occur due to oxidative stress or pulmonary inflammation induced by inhaled pollutants. This, consequently, can contribute to a systemic inflammatory condition, which can, in reverse direction, activate hemostasis mechanisms and accelerate atherosclerosis.

Pulmonary and Systemic Oxidative Stress and Inflammation

Inhalation of air pollutants causes pulmonary oxidative stress and inflammation (Kelly, 2003). Lung exposure to high particle concentrations and ozone causes an inflammatory response as evidenced by the in vivo animal models (Godleski et al., 2002) as well as in vitro cell models (Li et al., 1996). The presence of $PM_{2.5}$-associated-metals is associated with acute changes in cardiovascular and respiratory physiology (Cakmak et al., 2014), and soluble metals in the particles contributes to the inflammatory process by increased oxidative stress (Ghio & Devlin, 2001). In addition, lung inflammation can occur by direct effects of ultrafine particles, which are independent of the transition metals or soluble components (Brown et al., 2000). Similarly, ozone provokes pulmonary inflammatory response through oxidative stress and deterioration of lung function (Samet et al., 2001).

In the studies it was established that the oxidative stress occurs after exposure to ultra-fine particles of coal and exhaust gases of diesel engines (Shukla et al., 2000) as well as $PM_{2.5}$ (Sorensen et al., 2003). In vivo experiments on rats with the use of in situ hemiluminescence methods showed a rapid occurrence of oxidative stress in the lung tissue, but also in the cardiac muscle (Gurgueira et al., 2002). This can occur as a response to the presence of transition metals or of free radicals, which are known to exist in $PM_{2.5}$ as a result of the atmospheric chemical reactions. Exposure to increased concentrations of $PM_{2.5}$ is also associated with increased levels of markers of lipid and protein oxidation in the human blood. Free radicals also contribute to the development of pulmonary inflammation.

Oxidative stress triggers specific transcription factors, including nucleus factor B and the protein-1 activator that regulate the expression of genes producing cytokines, chemokines and other proinflammatory mediators.

The exhaust gases of diesel engines or their organic extracts may, through oxidative effects on mitochondria, induce apoptosis or necrosis of macrophages and cells of the respiratory epithelium, which may impair the ability to defend against infection and to increase the reactivity of the air passages (Li et al., 2003).

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Larger particles, rather than fine, affect the release of endotoxin in a yet unsolved way, which also induces proinflammatory cytokines (Monn & Becker, 1999), increases the pulmonary inflammation and airway reactivity, increases the number of systemic immune cells, and reduces lung function.

Intrapulmonary responses stimulated by particles can also affect neurogenic inflammation. Sensitive neurons in contact with the irritating particles within the air passages can be stimulated to release neuropeptides (for example, substance P, a peptide that affects the calcitonin gene and neurokinin A), which initiate inflammation that involves the release of cytokines, secretion of mucus and vasodilation.

Neuropeptides act on various types of cells in the lungs, such as the epithelial and smooth muscle cells, which results in the modulation of inflammation, and increased air passage sensitivity. They also affect immune cells (polymorphonuclear leukocytes, lymphocytes, eosinophils, and others), which enhances the inflammatory response. In vitro experiments indicate that the receptors for specific irritants (vanilloid or capsaicin) in neurons are mediators of neurogenic inflammation associated with particles (Veronesi et al., 2000).

Several controlled exposition studies showed that the inhalation of particles (Nightingale et al., 2000), and ozone (Aris et al., 1993) causes both pulmonary and systemic inflammatory response in humans. One hour of exposure to very high concentrations of exhaust gases from diesel engines has caused an inflammatory reaction in the lungs of healthy adults. This response included an increased number of polymorphonuclears, T and B lymphocytes, mast cells and increased level of mediators of inflammation (Salvi et al., 1999).

Diesel engine exhaust gases enhance mRNA transcription of interleukin-8 (IL-8, the protein which draws polymorphonuclears onto the damaged location), and increased IL-8 and growth-regulatory oncogene amplify the airway inflammation (Salvi et al., 2000).

All of these controlled exposure studies indicate that particles can cause moderate pulmonary inflammatory response in healthy individuals, and increase the level of blood factors affecting coagulation, even without any damage to the lungs.

Some studies suggest the existence of a systemic inflammatory response after exposure to air pollution. In humans, exposure to the forest fire smoke (as measured PM_{10} and SO_2), at concentrations that did not cause changes in pulmonary function, have led to the stimulation of bone marrow to release immature polymorphonucleates into circulation (Tan et al., 2000). In an experiment on animals, in rabbits who intrapharyngeally received 5 mg of PM_{10} twice a week for 3 weeks, the production of polymorphonucleates in the bone marrow increased and they were released into the circulation (Mukae et al., 2001). PM_{10} exposure caused a diffuse inflammation in the lungs, with particles present in the alveolar macrophages, lung epithelial cells, and the walls of the air passages.

The Effects of Inflammation, Oxidative Stress, and the Increase of the Blood Factor

Exposure to air pollution can cause changes in the composition of blood, with possible serious consequences in patients with cardiovascular diseases. Seaton et al (1995) gave the general hypothesis that exposure to the particles causes alveolar inflammation, exacerbation of pre-existing lung disease, increases coagulation and with it the risk of adverse cardiovascular events. As already mentioned, a number of studies with the controlled exposure to particles showed an increase in cellular and biochemical markers of pulmonary and systemic inflammation.

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Particles affect the increase of fibrinogen level (Ghio et al., 2003), key component of the coagulation and platelet thrombosis and major determinant of blood viscosity. Blood viscosity affects the severity of cardiovascular disease (Junker et al., 1998) and its increase depends on the increased levels of dissolved SO_2 and particles (Peters et al., 1997). Fibrinogen is also important as an independent risk factor for myocardial infarction.

Epidemiological data indicate possible effects of air pollution with particles on blood coagulation (Seaton et al., 1999). In contrast, Stark et al. (2013) have, in the semi experimental study conducted in adult healthy volunteers, found that the ex vivo creation of thrombin is associated with exposure to NO_2, nitrates and sulphates, but not with suspended particles and oxidative potential of inhaled ambient air.

Of note is the fact that the prediction of death and heart stroke in middle-aged men according to the level of fibrinogen in the plasma may be influenced by the presence of other, inflammation-sensitive proteins (Peters et al., 2000a), which suggests that inflammation plays an important role in determining cardiovascular risk. In addition, platelet aggregation may further enhance the development of acute thrombotic formation after exposure to the exhaust fumes (Nemmar et al., 2003) from a diesel engine, and fine particles (Nemmar et al., 2002b). The mechanism responsible for the activation of platelets and fibrinogen increase is not fully understood. These findings still support the contention that air pollution can acutely increase the risk of thrombosis, which may further result in ischemic disorders.

Increased concentrations of IL -6 are associated with increased risk of cardiovascular events (Ridker et al., 2000) and mortality (Volpato et al., 2001). The levels of serum IL-6, IL-1 and stimulating factor of granulocyte macrophage colons grow in healthy male subjects after exposure to air pollution from forest fires, and also grow in in vitro with exposure of macrophages from human lung to PM_{10} originating from urban areas (Van Eeden et al. 2001). IL-6 is directly involved in the regulation of the C-reactive protein synthesis in the liver. This protein is a sensitive indicator of infection, injury and inflammation, and is associated with an increased risk of cardiovascular disease (Ridker, 2001). The concentration of C-reactive protein is directly related with the exposure to the total suspended particulate matter and PM_{10} (Peters et al., 2001a). The mechanisms by which C-reactive protein increases the risk of cardiovascular events have been the subject of intensive research. One possibility is that it weakens the endothelial vasoreactivity in patients with already diseased coronary artery (Fichtlscherer et al., 2000). In addition, the C-reactive protein can directly contribute to the development and progression of atherosclerosis by a number of mechanisms which include changes in the formation of foam cells, the entry of monocytes into the arterial walls, the stimulation of prothrombin tissue factors and expression of adhesion molecules (Bhatt & Topol, 2002).

Inflammation (proinflammatory cytokines, C-reactive protein, and components of innate immunity) plays a significant role in the development of atherosclerosis and plaque instability (Libby, Ridker, & Maseri, 2002). It is possible that air pollution affects the systemic inflammation, causing atherosclerosis progression during a prolonged period of time (Suwa, et al., 2002) as well as activating acute plaque instability and sudden cardiovascular events in short time intervals.

In rabbits with hyperlipidaemia which have been exposed to the particles, progression of coronary atherosclerosis and increased extracellular lipid depot creation occured after 4 weeks (Libby, Ridker, & Maseri, 2002). Degree of the plaque formation correlates with the number of alveolar macrophages which conduct particle phagocytosis. These effects seem to be influenced by age, hypertension, hyperlipidemia, diabetes and other conditions associated with inflammation.

Changes in the blood vessels due to exposure to air pollution have also been proven. Inhalation of particles and ozone for 2 hours has resulted in a moderate vasoconstriction in healthy adult subjects

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(Brook et al., 2002). Similarly, in rats, the small pulmonary arteries reacted by constricting to short-term exposure to high concentrations of particles (Batalha et al., 2002). It is assumed that acute systemic inflammation and oxidative stress act as the trigger for endothelial dysfunction which can lead to vasoconstriction (Bonetti et al., 2003).

For now, the mechanisms that lead to changes in the state of blood vessels are not clear. However, several studies point to the fact that air pollution affects the cardiovascular hemodynamics (Bouthillier et al., 1998).

Literature data indicate that the external air pollution increases the blood pressure in coronary rehabilitation patients (Zanobetti et al., 2002) and also in adults with pulmonary diseases (Linn et al., 1999). Arterial vasoconstriction is the probable explanation for the findings of the ULTRA study (The Exposure and Risk Assessment for Fine and Ultrafine Particles in Ambient Air) (Pekkanen et al., 2002). The levels of particles in the air for two days prior to physical stress testing were significantly related to the increase of ST-segment depression during testing. This finding suggests the hypothesis that air pollution has an effect on myocardial ischemia, which was confirmed in an experimental study on dogs exposed to high concentrations of pollutants in the air (Wellenius et al., 2003). The results also provide a possible explanation of the theory of the impact of airborne particles on the dynamics of acute myocardial infarction. The research has identified a significant association between onset of symptoms and acute (levels within 2 hours before symptoms) and subacute (mean concentration during the previous day) exposure to $PM_{2.5}$ particles. Sudden arterial vasoconstriction (and / or possible endothelial dysfunction) can probably accelerate the emergence of acute coronary syndromes by initiating plaque instability or impairing myocardial nutrition in patients with existing atherosclerosis.

Cardiac Autonomic Nervous System

The impact of air pollution on mortality may be partially explained by its action on the autonomic nervous system. The ability to change heart rate (heart rate variability - HRV), a period of heart rate rest and blood pressure are regulated by the balance between the two parts of the autonomic nervous system: sympathetic and parasympathetic. Reducing the ability to change rhythm increases the risk of cardiovascular morbidity and mortality in the elderly, and in people with severe heart disease (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). This conclusion was reached by analysis of heart rate by determining the standard deviation of the periods between normal R-R intervals, and the low frequency / high frequency relationship, measured with an electrocardiograph over a 24-hour period. Exposure to ambient particles reduces the ability to change rhythm (Magari et al., 2001). Reducing the parasympathetic influence on the heart may be an important mechanism of cardiovascular mortality increase due to tachyarrhythmias. Experimental studies of controlled exposure to air pollution confirmed the assumption that particles can impair the ability to change rhythm (Devlin et al., 2003; Pope et al., 1999). It has been found that the reduction of the ability to change rhythm occurs rapidly and in inverse proportion to the increase of the particle concentration.

It is not sufficiently clarified whether the observed short-term changes of the ability to alter the rhythm are in relation to the deterioration of cardiovascular outcomes and the initiation of serious arrhythmias in the long run. It is possible that for certain people, bradyarrhythmias caused by air pollution may affect sudden death.

Some evidence indicates that exposure to particulate matter causes clinically significant changes in the electrophysiology of the heart. The incidence of cardiac arrhythmias is associated with the $PM_{2.5}$

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exposure in high-risk individuals (e.g., individuals with a artificial cardiac pacemaker). In a study on 100 patients who were observed for 3 years, it has been determined that the concentrations of nitrogen dioxide and carbon monoxide present in the air have been strongly linked with the artificial cardiac pacemaker malfunctions, and the soot exhibited somewhat lower effect (Peters et al., 2000b). Although this study was limited by a small number of high-risk patients and the lack of data on the device malfunctions, it points to the existence of possible adverse effects of particulate and gaseous pollutants on the balance of cardiac autonomic nervous system.

The study that used time series analysis to monitor the impact of particles on mortality (Hoek et al., 2001) supports this finding. It was proven that the risk of death from arrhythmia increases with the increase of the seven-day average concentrations of soot and particles.

The results of this study coincide with the result of a number of experimental studies on animals which indicate the induction of cardiac arrhythmia in the previously diseased animals (e.g., with pulmonary and systemic hypertension) that have been exposed to particles. In dogs exposed to particles for 6 hours for three consecutive days, an increase in the frequency of low and high heart rate frequencies occurred, as well as increased values of low frequency / high frequency relation (Godleski et al., 2000). Exposure to ashes produced by burning oil (component particles) led to tachyarrhythmias in rats (Wellenius et al., 2002). Such findings support the contention that air pollution may alter the balance of the autonomic nervous system in the direction of causing serious tachyarrhythmias. The mechanism of action remains unclear, but it is assumed that involves activation of pulmonary neural reflex arc, the direct effects of pollutants on ion channels of cardiac cells, or the consequences of systemic inflammatory status.

RESULTS OF PREVIOUS EXAMINATIONS OF AIR POLLUTION INFLUENCE ON MORBIDITY AND MORTALITY

Increased concentrations of pollutants in the air usually exert their negative impact on the health by worsening the symptoms of pre-existing cardiovascular and respiratory diseases. (Samet et al., 2000). The increase in relative risk for morbidity and mortality due to air pollution is relatively low compared to the confirmed risk factors such as hypertension, increased cholesterol levels, infections or smoking. Nevertheless, this is a serious health problem if the number of exposed and length of exposure (the whole human life) is taken into account.

In recent years a number of studies that suggest an association between air pollution and cardiorespiratory disease increases significantly (Pope et al., 2000; Vanos, Hebbern, & Cakmak, 2014; Franchini & Mannucci, 2009). The studies are mainly based on the study of the impact of short-term and long-term exposure to air pollution on health. Observations relating to the adverse effects of short exposure are more numerous. In these studies, widespread short-term resultant occurrences in the population (mortality, incidence of symptoms, hospitalizations and doctor visits for health care) are associated with short-term variations in the concentration of pollutants in the outside air, usually through the use of population-based time series analysis.

Fewer studies have focused on the study of the adverse health effects of long-term exposure. These studies include analysis of data (eg, total mortality and in some cases cardiovascular events) from large cohorts from different geographic locations that differ in composition and concentrations of pollutants in the outside air.

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EFFECTS OF LONG-TERM EXPOSURE TO AIR POLLUTION

The first large, prospective cohort study that confirmed the negative health impact of prolonged exposure to increased concentrations of pollutants in the air was the Harvard Six Cities study conducted by Dockery et al. (1993). It has been shown that chronic exposure to air pollutants has an impact on cardiovascular mortality. In a cohort of 8111 adults over 14 to 16 years of observation, overall mortality ratio in the most polluted and least polluted city was 1,26:1,00. Additional analysis adjustments in relation to the selected individual risk factors: gender, educational level, occupational exposure, BMI, smoking, hypertension and diabetes did not significantly modify this relationship. Of all the pollutants, the increase of concentration of particulate matter (PM) and sulfates showed the strongest association with the disease.

Tracking the cohort by Pope and associates (1995), organized by the American Cancer Society (ACS) is the largest study of long-term effects of air pollution. In about 500 000 adult residents from all 50 states from the USA, chronic exposure to a mixture of pollutants in the air is associated with mortality statistics for a period of 16 years. ACS study has increased the level of control for associated factors by introducing new ones, such as diet and gaseous pollutants. The results showed that any increase in annual mean $PM_{2.5}$ concentration of 10 μg/m^3 was accompanied by an increase in overall mortality by 4%, mortality from cardiopulmonary disease by 6%, and lung cancer mortality by 8%. Mortality was mostly associated with particles ($PM_{2.5}$), sulfate particles and sulfur dioxide. There was also an established dependence of cardiopulmonary mortality on average ozone concentrations for the 1982-1998 period. Educational level was a significant modifier in assessing the impact of particles on human health. People with low to medium education had increased risk of death and morbidity compared to those with higher education.

Hoek et al (2002) confirmed the importance of housing location within the city as the factor that can affect mortality from air pollution. In a cohort of 5000 adult patients observed for 8 years, exposure to pollutants originating from traffic caused the increase in mortality in the population of the city center in relation to the residents who live in less polluted urban areas. Of all the risk factors, living near busy roads was most strongly associated with cardiopulmonary mortality in this cohort (relative risk - RR: 1.95 and 95% IP: 1.09 to 3.52). This study also suggests that individual exposure to toxic components of air pollution can vary significantly among residents of a city.

Until recently, the specific causes of increased cardiovascular mortality due to long-term exposure to air pollution were vague. In the analysis of the ACS study, investigators point out the impact of particles on the specific causes of death (Pope et al., 2004). A statistically significant association between particulate matter ($PM_{2.5}$) and total cardiovascular mortality was confirmed by an increase in the concentration of $PM_{2.5}$ in 10 μg/m^3 (RR: 1.12, 95% IP: 1.08 to 1.15) during long-term exposure. The highest risk was found for ischemic heart disease (RR: 1.18, 95% IP: 1.14 to 1.23), which also represents the most common cause of death. The risk of death from arrhythmia, heart failure and cardiac arrest has also increased (RR: 1.13, 95% IP: 1.05 to 1.21). No evidence for increased mortality from other causes was found (e.g., aortic aneurysm, diabetes, hypertensive heart diseases or any respiratory diseases). These results indicate that the pollutants in the air deteriorate both non-ischemic and ischemic cardiovascular diseases.

Data on the impact of long-term exposure to air pollution on mortality is largely derived from the United States. A research in England has followed 835,607 patients in the 2003-2007 period, and the concentration of particulate matter, nitrogen dioxide, ozone, and sulfur dioxide. The obtained results suggest that exposure to the above pollutants, except ozone, increases the risk of all-cause mortality. A stronger association was found with respiratory disease mortality, which is not in accordance with the

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results of studies in the U.S., where the relationship was stronger between pollutants and mortality from cardiovascular disease (Carey et al., 2013).

In addition to the impact of the deterioration of the existing cardiopulmonary diseases, air pollution can also lead to an increase in the number of congenital heart defects. The biological mechanism of action of pollutants in their formation has not been clarified. Data from Eastern Europe, from areas that for many years have had high concentrations of pollutants originating from the industry, point to the possibility that high air pollution can affect an increase of the number of congenital heart defects (Smrcka & Leznarova, 1998). A recent study of birth registrations in Los Angeles found that the risk for ventricular septal defect increases by the dose-response principle with increasing exposure to carbon monoxide. Thus, the approximate relative risk (odds ratio - OR) for the second quartile compared to the first was 1.62 (95%IP: 1.05 to 2.48) for the third quartile 2.09 (95% IP: 1.19 to 3.67), and in the fourth quartile a whole 2.95 (95% IP: 1.44 to 6.05) (Ritz et al., 2002). A connection between valve defects, aortia and truncus and the levels of ozone was also noted. Particles and other pollutants measured did not show this correlation.

EFFECTS OF SHORT-TERM EXPOSURE TO AIR POLLUTION

The two largest studies so far to have analyzed the acute effects of air pollution are the National Morbidity Mortality and Air Pollution Study (NMMAPS) in the United States (Dominici et al., 2003) and Air Pollution and Health: a European Approach-2- APHEA-2 project (Katsouyanni et al., 2001).

The NMMAPS study followed the health outcomes for 50 million people in the 20 largest U.S. cities. Any increase in PM_{10} concentration of 10 $\mu g/m^3$, was followed by increase of daily rate of general mortality of $0.21 \pm 0.06\%$, and mortality rate from cardiovascular disease of $0.31 \pm 0.09\%$.

APHEA-2 showed a slightly stronger association between adverse health outcomes and air pollution. With 43 million people in 29 European cities, the increase in daily mortality was 0.6% (95% IP: 0.4% to 0.8%) for any increase in PM_{10} concentration of 10 $\mu g/m^3$. Mortality from cardiovascular disease was higher by 0.69% (95% IP: 0.31% to 1.08%) (Zanobetti et al., 2003).

Both studies have confirmed the differences in their findings in relation to the geographical region. In Europe, cities with warmer climates have shown a greater degree of influence of air pollution on mortality. On the other hand, NMMAPS study confirmed the greater impact in the northern than in the southern areas. Perhaps such differences between these studies were caused by different habits of residents: time spent outdoors, use of leisure time, as well as various ambient conditions, and differences in the composition of mixtures of pollutants (Smith et al., 2001).

Hundreds of small, short-term studies on the effects of acute exposure to air pollution have been published in the last decades, as presented by Brunekreef and Holgate (2002) as well as Pope (2000) Most frequently, the daily mortality rate, the number of hospital admissions (Linn et al., 2000) health care visits (Delfino et al., 1997), and worsening of symptoms (Schwartz et al., 1994) show an increase in line with the increased levels of air pollution. Observations in North America (Burnett et al., 1999) and Europe indicate a higher rate of hospitalization for all cardiopulmonary diseases. Number of hospital admissions due to heart failure and ischemic heart disease rose by 0.8% and 0.7% for every increase of PM_{10} of 10 $\mu g/m^3$ (Morris, 2001).

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More focused studies have shown an increased risk for acute myocardial infarction (Peters et al., 2001b), installation of artificial cardiac pacemakers (Peters et al., 2000b) and the finding of myocardial ischemia during stress tests (Pekkanen et al., 2002).

The extreme increase in air pollution has affected the increase in blood pressure during episodes of extended stagnation of air due to temperature inversions in Europe (Ibald - Mulli et al., 2001).

Bronchoconstrictory effects of sulfur dioxide are manifested mostly in people already suffering from asthma and chronic bronchitis. APHEA authors found a significant effect of this compound on the increase in mortality from respiratory diseases in almost all the cities of Western Europe (Katsouyanni et al., 2001).

The study of time series that examined the impact of air pollution on daily mortality in Austrian cities Graz and Linz has determined a correlation between nitrogen oxides and suspended particulate matter and daily mortality, including during summer when the concentrations of pollutants had lower values (Nurberg et al., 2013).

Studies in Seoul (Hong et al., 2002) and Taiwan (Tsai et al., 2003) indicated an increase of ischemic stroke incidence, which is directly related to the concentration of particles in the air.

The studies in Serbia have also shown that air pollution significantly affects the increase of the number of hospital admissions (Stankovic et al., 2012; Milosevic et al., 2010; Nikic et al., 2008) and mortality (Bogdanovic et al., 2006; Nikic et al., 2009) from cardiovascular and respiratory diseases.

THE INFLUENCE OF METEOROLOGICAL FACTORS

Air Temperature

The role of the center for body temperature regulation, which is located in the hypothalamus, is to maintain the temperature within an optimal range. At idle state, it is around 37° C, while during physical activity body temperature can rise to 38-39° C without any harmful effects on health. For the temperature to be within the physiological range, a balance between the creation and loss of body heat is necessary. The main source of body heat is metabolic activity, and there are other sources, such as solar radiation or various heaters. The means of body heat loss are convection-heat transmission to the surrounding air, conduction in contact with hard objects (e.g. floor), respiration, radiation and evaporation of sweat. Several mechanisms are involved in the regulation of body temperature, and the most important for heat loss are sweating and expansion of peripheral blood vessels, while muscle tremors and constriction of peripheral blood vessels are used to increase the temperature. To make the body temperature stable, the heat loss must be equal to the heat produced (Havenith, 2002).

Increased temperature can cause rash and redness of the skin, weakness, syncope and collapse. The basic mechanism of this phenomenon is the expansion of peripheral blood vessels and blood pressure decrease. In the absence of physical activity, the drop in blood pressure is greater because of the absence of muscle pump and the reduced flow of venous blood into the heart. Conversely, with increased muscle activity, blood pressure is maintained longer within the range of normal values, which creates the possibility of a further increase in body temperature, and when it reaches 40.5°C it can result in a heat shock, which involves cellular structure damage and dysfunction of the center for thermoregulation with a high risk for the occurrence of death. Heat stroke usually occurs in young and healthy people who are exposed to great physical strain at high temperature, for example at sporting events. The occurrence

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is sudden, and there are very severe complications such as respiratory distress, kidney and liver failure and disseminated intravascular coagulation (Donoghue, 1997).

In addition to increased physical activity, the most important predisposing factors for the occurrence of adverse health effects of increased temperature were older age, lack of acclimatization, dehydration, use of drugs that affect the thermoregulatory center (phenothiazines, barbiturates), obesity, poor physical condition and wearing protective clothing to prevent evaporation.

Elderly people are more sensitive to high temperatures due to physiological changes in the thermoregulation center, associated cardiovascular diseases, poor physical fitness and decreased ability to create sweat (Basu & Samet, 2002; Havenith, 2001).

The process of short-term acclimation to increased temperature takes 3 to 12 days, and full acclimatization is achieved only in a few years. Short-term acclimation physiologically involves an efficient sweating mechanism (earlier onset, higher quantity and wider distribution) and increased peripheral circulation, and it takes a few weeks after stopping high temperature. Long-term acclimation involves reducing basal body temperature, heart rate and metabolic rate, and these adaptive changes are retained for years after cessation of exposure to high temperature (Havenith, 2002).

At increased air temperatures, a greater amounts of liquid intake is necessary. Dehydration or hypohidration rarely occur in young healthy people if they are able to drink sufficient amounts of water and other liquids. In the elderly the presence of chronic diseases (dementia, incontinence), restricted mobility and decreased functional capacity have caused chronic hypohidration to becomes almost a physiological condition. Therefore, older persons are susceptible to the action of very small meteorological and pathological stress influences (Mentes & Culp, 2003; Hodgkinson, Evans, & Wood, 2003).

Good physical condition is a protective factor against the occurrence of adverse events, both from increased and decreased air temperatures. It contributes to an increased cardiovascular reserve, ie the possibility of the cardiovascular system to enhance the blood supply of the target tissue as needed, which is a prerequisite for efficient thermoregulation. In the elderly, the decline in fitness leads to avoidance of physical activity, and that in turn causes an even worse physical condition. Additionally, elderly people avoid exposure to low and high temperatures, which diminishes the ability of acclimation to such conditions (Anderson, 1999).

Obesity is another factor that increases the risk of adverse effects of increased temperatures on health and often correlates with a poor physical condition. Adipose tissue conducts heat poorly so the subcutaneous tissue in obese patients acts as a thermal insulator between the body and the external environment. In obese people is less metabolic activity per unit body weight leads to a higher degree of heating of the body, and when the temperature of the body increases in obese patients, more blood must be diverted to the peripheral blood vessels, which leads to a greater heart frequency and its stress. However, when the outside air temperature exceeds the temperature of the skin in obese people less heat is absorbed from the environment, which has a protective effect (Chan et al., 2001).

Low air temperatures affect the health of the people through a number of physiological processes. Stimulation of the skin thermoreceptors by increased sympathetic activity results in increased levels of catecholamines in plasma, peripheral vasoconstriction, tachycardia and increase in blood pressure. In addition, exposure to cold causes an increase in blood viscosity due to the increase in the number of red blood cells and platelets, as well as increased levels of cholesterol and fibrinogen in the plasma (Keatinge & Donaldson, 1995), and haemoconcentration yields occurrence or deterioration or existing thrombotic changes (Donaldson, 1997). Sudden death occurs as a result of rupture of atheromatous plaques due to hypertension and cold-induced coronary spasm (Donaldson & Keatinge, 1997). Because of bronchocon-

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striction caused by inhalation of cold air the risk of respiratory disease increases, and decline of cellular and humoral immunity was also demonstrated (Schaanning et al., 1996).

The air temperature has a major impact on morbidity and mortality. Studies that examine the effect of this factor on health are many and varied (Kovats & Koppe, 1994). Some of them are estimating "excess deaths" occurred under the influence of heat waves. Excess mortality is calculated as the difference between the increased and "expected" mortality, or one that can be predicted for a particular period in a particular area, based on data from previous years. Heat-waves constitute a great health risk and they are associated with significant excess morbidity and mortality. Cardiovascular and respiratory diseases were reported as the most common causes mortality (Bogdanovic et al., 2013). Risk factors for heat- related death include older age, pre-existing diseases, living alone, living on the top floor, lack of air- conditioning, and being overweight (Semenza et al., 2008). Populations in regions where extremely hot weather is relatively infrequent are most vulnerable to heat waves owing to a lack of behavioral adaptations (Piranda et al., 2005). Heat waves could reveal or aggravate several adverse drug reactions in elderly (Sommet et al., 2012). During the heat wave the greatest increase in mortality rates is related to diabetes mellitus, chronic kidney disease and diseases of the respiratory, nervous and digestive systems. Malignant neoplasms and cardiovascular mortality accounted to the highest absolute numbers of excess deaths (Basagaña et al., 2011).

People with diabetes are particularly vulnerable to heat because their bodies are less capable of adjusting to increases in temperature due to impairment of their autonomic control and endothelial function (Schwartz, 2005). Persons with kidney disease have a reduced ability to retain fluids and electrolytes. This can make dehydration and overheating happen more quickly. Moreover, when the body gets warm, it moves more blood to the skin in an attempt to reduce body temperature. This reduces both the blood flow and pressure in the kidneys making them more prone to overheating and less able to function (Hansen et al., 2008a). The mechanisms underlying the higher heat- mortality risk among those with nervous system diseases include impaired self -care, inadequate medical care and physiologic vulnerability (Hansen et al., 2008b). Heat stress can lead to down- regulation of epithelial growth -factor signaling, intestinal epithelial injury, impairment of the intestinal epithelial barrier function and increased mortality due to gastrointestinal hemorrhage (Liu et al., 2009). Cardiovascular and respiratory deaths can be triggered by heat when the thermoregulatory mechanisms of the body, such as increased respiratory and heart rate, increased blood circulation and surface sweat, put an additional stress on already ill heart and lungs (Schifano et al., 2009).

Study of time series is an effective way to evaluate the effect of temperature and other climatic factors on mortality in long periods of time. The regression lines obtained in this study show higher mortality rates when the measured temperature values are above and below optimum, that is, they possess an approximately U-shape. The values of the optimum temperature suggest the best adaptation of populations to local weather conditions and vary from city to city (Keating et al., 2000). Thus, the average daily air temperature during whitch there is the lowest number of fatalities, that is, when the inhabitants are acclimated the most, is 24°C in Valencia (Ballester, 1997), and 10°C in Oslo (Skrondal, & Bjertness, 2001).

Literature shows that temperature has an effect on increasing mortality rates from cardiovascular and respiratory diseases as a stress factor associated with the body, which is already burdened with a chronic illness. In France, a heat wave from 1 to 20 June 2003 caused the greatest increase in mortality in persons older than 75 years (National Institute of Public Health Surveillance, 2003). In children and infants the risk of dying due to the effects of high temperature also increased. In the U.S., approximately 4% of deaths associated with the effects of high temperature related to children aged up to 4 years (Centers for

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Disease Control and Prevention, 2002) People of lower socioeconomic status may be a more vulnerable group because of poor living conditions and lack of air conditioning (Smoyer, 1998).

The study of mortality data from 14 EU countries shows that the mortality rates in winter are significantly higher compared to the annual average (Healy, 2003). In Portugal, the increase in mortality in winter was 28%, followed by Ireland and Spain with an increase of 21%. The lowest variability was observed in Finland (10%), while the average increase in mortality in winter in all 14 countries was 16%. The occurence of a large increase in winter mortality in countries with warmer climates is called the "paradox of winter mortality." The most likely factor to explain this phenomenon is the method of construction of the residential buildings. In countries with higher average annual temperatures there is insufficient attention paid to heat insulation of households and they are therefore more difficult to heat in the winter when the temperature drops. In contrast, in countries with harshly cold climates, as is the case with Scandinavia, high-quality insulation is a construction standard, so that the temperature in the living space is easily maintained at the desired level (Clinch & Healy, 2000).

A study in England showed that mortality in persons older than 75 years during the winter months increases by 17% compared to the annual average, and that 8% of deaths in the elderly during winter is associated with low temperatures (Wilkinson et al., 2004). The mortality rate due to the effect of cold was 11% higher in women and by 20% in people whose medical history included chronic respiratory diseases, while the socioeconomic status did not show a significant influence.

The relationship between the mean daily temperature from June to August and mortality, particularly mortality from respiratory disease and mortality in the elderly was determined by examining the impact of the maximum daily temperature on mortality in 15 European cities (Baccini et al., 2008).

A study conducted in China in four different climatic zones has identified the connection between the high and low temperatures and an increased risk of cerebrovascular mortality in all climatic zones, but this relationship was significant only for low temperatures. It was also found that people who live in colder climate areas are more susceptible to the effects of high temperatures, and the ones from warmer climate areas are more susceptible to the effects of low temperature (Zhang et al., 2014).

Research in Serbia showed that Roma population had significantly higher excess winter mortality - EWM rate per 10,000 (129.2 vs. 76.6) for all causes, all respiratory diseases (26.5 vs. 8.0), and chronic lower respiratory diseases (23.0 vs. 5.2) in comparison to non - Roma population. Influenza and pneumonia related deaths Represented a small proportion of EWM in both populations. Cardiovascular EWM rate was slightly higher among non - Roma population. Regression analysis demonstrates that Roma ethnicity was associated with significant increase of respiratory rate EWM (regression coefficient (B) = 1:49, 95% CI: 0:45 to 2:54). There was no relationship between ethnicity and cardiovascular and all causes EWM rates (Blagojevic et al., 2012).

In addition to the impact on mortality, temperature changes also influence the increase of the number of hospital admissions and other indicators of morbidity. The project "Assessment and prevention of acute health effects of weather conditions in Europe" (PHEWE) was conducted in 16 major European cities with a variety of climate conditions, in which over 30 million people live (Michelozzi et al., 2007). The study included data on mortality and inpatient receptions in the 1990-2000 period. Each year is divided into winter (October to March) and summer (April to September) season. On average, the rate of overall mortality in the winter season was higher than in the summer season by 16%. The difference between the rates was lowest in Helsinki (10%), and highest in Valencia (22%) and Milan (21%). The rate of death from cardiovascular disease in the winter season was, on average, increased by 21% in Helsinki, by 7%, and in Milan for 34%. Death from respiratory disease in the winter season was on average 36%

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more frequent, 21% in Athens and in Zurich as much as 68%. The number of hospital admissions for cardiovascular disease in the winter season was higher by 11%, in London and Dublin by 5%, and in Paris by 16%. Hospital admissions for respiratory disease in winter season were 42% more frequent, 22% in Ljubljana and 57% in Valencia.

Atmospheric Pressure

Atmospheric pressure is a direct result of the weight of air (Martin, 1999). At sea level and 0°C temperature the atmospheric pressure is 760 mmHg (101.3 kilopascals, or 1 atmosphere). Atmospheric pressure decreases with increasing altitude, but it also decreases with increase in the temperature and humidity so its value varies according to the changes in these parameters. On the other hand, atmospheric pressure value is directly correlated with the value of the partial atmospheric pressure of oxygen (PO_2), which amounts to 160 mm Hg absolute pressure of 1 atmosphere. Decrease of the atmospheric pressure value causes less oxygen in the inhaled air and lower blood oxygen saturation, or tissue and organ hypoxia. The optimal values of PO_2 range from 120 mmHg to 460 mmHg. PO_2 values below 120 mmHg represent the dangerous hypoxic zone and a further decline seriously endangers human life functions, leading to a sudden loss of consciousness when the PO_2 value drops below 76 mmHg, and death if PO_2 value drops below 50 mmHg. Hypoxia causes cells of the central nervous system and the myocardium to suffer the fastest. PO_2 values above 460 mmHg to 1500 mmHg is the zone of hyperoxia which the body tolerates well over a longer period of time (from a few tens of minutes to a few hours). PO_2 values greater than 1500 mmHg relatively quickly lead to the manifestation of the toxic effects of oxygen.

Mountaineers, people in aircrafts and caisson workers may be exposed to extreme changes in atmospheric pressure, and health effects of exposure to these changes are the focus of analysis of a number of studies. The studies of health effects of pressure changes as meteorological factors- the changes that commonly occur in the environment- are rare.

Epidemiological studies suggest that possible mechanisms for the influence of air pollution on health are reduced blood oxygenation and heart rate changes. In a study conducted in Utah (USA) (Dockery et al., 1993) it was found that exposure to particulate pollutants leads to a significant increase of heart rate, while decreased hemoglobin oxygen saturation was statistically significantly correlated with the concentrations of pollutants in males over 80 years of age. The same study demonstrated that value oscillations of the atmospheric pressure lead to small, but statistically significant changes in hemoglobin oxygen saturation, as well as heart rate changes. Any drop in pressure of 25 mmHg caused a drop in the measured level of saturation of 0.6 to 0.7%, while the frequency of the heart rate increased by 1.5 beats per minute.

A controlled experiment was conducted in Ukraine on 12 healthy volunteers who were exposed to mild fluctuations in atmospheric pressure, which otherwise often occur in nature (Delyukov & Didyk, 1999). Oscillation amplitudes of 30 to 50 Pascals were applied, and pressure frequency changes ranged from 0,011 to 0,170 Hz. Exposing subjects to such pressure oscillations lasting 15 to 30 minutes caused a significant change in concentration and short-term memory, breathing became deeper and slower, and the heart rate frequency was also reduced.

An investigation of the possible effects of variations in atmospheric pressure on mortality, in which the control of the influence of other atmospheric parameters was performed, was carried out in Madrid

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(Gonzalez et al., 2001). Time-series analysis confirmed a significant correlation between anticyclone trend (high-pressure field from which spiraling winds originate) and mortality from circulatory and respiratory diseases.

The World Health Organization conducted the MONICA Project (MONitoring trends and determinants In CArdiovascular disease) in Lille (Danet et al., 1999), a city with moist ocean climate, and confirmed the existence of significant influence of atmospheric pressure- both decrease and increase- on the incidence and mortality of myocardial infarction.

Research in Serbia showed that the increased average daily values of atmospheric pressure for 1 mBar on the day when the event took place before and 7 days, were associated ($p < 0.05$) with the increase of the total risk of the occurrence of lower idiopathic extremity deep vein thrombosis (DVT) for 5.1% (0.7 to 9.8%) (Damnjanovic et al., 2012).

Air Humidity

Absolute air humidity is the amount of water vapor in a given volume of air and is expressed in g/m^3. Relative air humidity is the ratio of the amount of water vapor in the air sample at a certain temperature and the maximum amount of water vapor that can be contained in the same sample at the same temperature, and is expressed as a percentage. Warm air has a greater water vapor binding potential than cold air.

People are very sensitive to changes in humidity because it affects the process of evaporation of sweat. When the relative humidity reaches 100%, that is, when the air is fully saturated with water vapor, the process of evaporation is completely interrupted. As a result of this interaction, high humidity makes it difficult for the body to cool in the summer. The human body is best adapted for relative humidity of 40-60%.

The effects of low humidity are also significant in the winter. The cold dry air that passes through the respiratory system also heats within it. This heating increases the potential of air to absorb water vapor, which leads to the extraction of moisture from the upper airways and the dehydration of the epithelium of the nose, pharynx, larynx and trachea. Increasing the of the epithelial mucus viscosity reduces its defensive capability and influences the increased risk of viral and bacterial respiratory diseases.

In a study conducted in 12 U.S. cities, a significant correlation between relative humidity and the number of deaths from cardiovascular disease in general, acute myocardial infarction, obstructive lung disease and pneumonia (Braga, Zanobetti, & Schwartz, 2002) as well as the number of hospital admissions for cardiovascular disease (Schwartz, Samet, & Patz, 2004) has not been confirmed. Similar results were found in a study in Birmingham, where the temperature, pressure and humidity did not significantly influence the assessment of the impact of soot and sulfur dioxide on the number of hospital admissions for respiratory diseases (Walters et al., 1994). In contrast, examination of the influence of climatic factors on mortality from myocardial infarction on the territory of Athens showed that the average monthly value of relative humidity significantly affects the number of deaths from this disease (Dilaveris et al., 2006). On the territory of Athens, a significant correlation was established between the humidity and the number of emergency hospital admissions for acute coronary syndrome (Panagiotakos et al., 2004). A statistically significant correlation was confirmed only between the average monthly values of relative humidity and morbidity. A conclusion can be made that this weather factor takes longer to exert its effect on the cardiovascular system, in relation to changes in temperature and air pressure.

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Other Meteorological Factors

In addition to the atmospheric pressure, temperature, and humidity, while assessing the acute impacts of air pollution on the health, some studies performed control of the effects of winds, clouds and precipitation.

The human body heats air molecules that surround it, transferring heat away from the skin. Under the conditions without air flow, a layer of warm molecules is held against the body and provides protection from colder air molecules. Wind removes this layer of warm air and in proportion to its speed body is cooling faster (Office of Climate, Water and Weather Services, 2001).

Stronger winds occur when large air masses are moving, and can affect health because they bring changes in weather conditions within very short intervals. Rapid changes in temperature affect the pH of the blood, blood pressure, diuresis and tissue permeability (Persinger, 1980). A study by the Climatological center of Canada has confirmed the increase of the rate of migraine attacks in the days when strong winds are blowing, barometric pressure drops, humidity rises and there are rapid variations of temperature (Cull, 1981). Rosen (1989) found that rapid changes in barometric pressure during the days with high winds are causing increased mortality from cardiovascular disease. On the other hand, the wind velocity influences the ventilation of housing, wherein due to smoking, firing, and cooking, the concentration of particles can be higher than the outside air.

The reduction of solar radiation caused by cloudiness may also cause adverse effects on human health. Increase of light levels leads to increased mental activity through stimulation of the autonomic nervous system and causes a general feeling of satisfaction. The sun's rays cause changes in neurotransmittory hormone synthesis, and increased production of epinephrine leads to physical and mental stimulation. In contrast, low light intensity leads to fatigue and sleepiness (Wolfe, 1981).

The largest number of previous studies on the health impacts of precipitation relates to the effects of snow. It was found that extensive snowfalls significantly impact the increase of death rates, as well as an increase in the number of hospitalizations due to cerebrovascular stroke and myocardial infarction (Faiche & Rose, 1979). The majority of negative health effects occurs three to eight days after the cessation of precipitation. The supposed mechanism of effect is the increased physical activity that snow requires (removal of snow, difficulty with walking, etc.). In men, the risk is higher than in women, probably because they are exposed to greater physical activities related to snow.

Rainfall has a limited impact on human health. Kalkstein proved that the overall mortality rate declines one day after a summer rain, and the supposed mechanism of effect is the indirect effect of lowering of high summer temperatures (Kalkstein & Valimont, 1986).

Precipitation and temperature also affect the shortening of the time spent outdoors, and the length of exposure to the outside air pollution.

OBSERVATIONS AND RESPONSES TO CLIMATE CHANGES

Growing concerns about air pollution and climate changing issues have introduced partnerships between weather services, civil protection agencies, and public health authorities in many communities to inform their residents about and protect them from the dangers of air pollution and weather to health. Major components of these systems are announcing advisories and implementing emergency measures when air pollution levels and forecast weather is expected to adversely affect the health of residents of a city or region.

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We developed the first such system in Serbia, which issues information on meteorological conditions and air pollution, on the health risks due to the effect of these factors, and provides advice on reducing risk to both the general population, and particularly vulnerable population groups. At the same time, a database is being formed on the health consequences of unfavorable meteorological factors and air pollution, and the use of the system itself, which will allow the monitoring of the effectiveness of solutions and possible correction of limits of meteorological factors and air pollution for certain classes of health risks.

The system is a Web service that is used in the prevention of the consequences of the effects of adverse meteorological conditions and air pollution on health.

Our solution uses meteorological data that is retrieved via a direct link from the website of the Republic Hydrometeorological Service of Serbia (http://www.hidmet.gov.rs) and data on air pollution that are downloaded via a link from the website of the Agency for Environmental Protection of the Republic of Serbia - SEPA (http://www.sepa.gov.rs).

Meteorological data include temperature, air pressure, wind speed, and humidity. Based on the temperature values (T) expressed in degrees Celsius, and humidity (H) expressed in percents, the heat index (Hi) is calculated according to the formula:

$$Hi=T+5/9\times((6,112\times10^{(7,5\times T/(237,7+T))})\times H/100-10)$$

Heat index values are, in relation to the level of health risk, divided into five classes: no risk (up to 26°C), caution (27 to 32°C), increased caution (33 to 41°C), danger (42 to 54°C) and extreme danger (over 54°C).

When the temperature is below 5°C, instead of the heat index, the wind chill index (WCi) is calculated, based on the temperature value (T) expressed in degrees Celsius, and wind speed (W) expressed in kilometers per hour:

$$WCi=13,12+0,6215\times T-11,37\times W^{0,16}+0,3965\times T\times W^{0,16}$$

This formula is used when the wind speed is greater than 2.5 kilometers per hour, and when it is lower, the wind chill index value is equal to the air temperature.

Wind chill index values in relation to the degree of health risk are divided into five classes: no risk (above 4°C), low risk (4 to 6°C), moderate risk (-7 to -17°C), high risk (-18 to -28°C), and very high risk (below -28°C).

The average 24-hour values of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter up to 10 micrometers in diameter (PM_{10}), carbon monoxide (CO) and ozone (O_3), expressed in micrograms per cubic meter ($\mu g/m^3$) are classified in five classes of air quality index (AQI) in accordance to the limits defined by SEPA.

For the final classification of air quality index, the concentration of the least favorable pollutant is used. When the concentrations of pollutants are measured at a number of measuring points, highest measured values are used for classifying the air quality index.

The technical solution is a web application that is integrated into the existing website of the Institute of Occupational Health Niš. Application is managed by an administrator. Users access the application by clicking on the "Environment and Health" field. On first accessing the application, users are required to register and create a username and password which they use for all subsequent access. On first access, the users are presented with a survey that includes information on general socio-demographic charac-

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Table 1. Air quality classification

Air Quality Index					
Pollutant	**Excellent**	**Good**	**Acceptable**	**Contaminated**	**Extremely Contaminated**
SO_2	do 50,0	50,1-75,0	75,1-125,0	125,1-187,5	above 187,5
NO_2	do 42,5	42,6-60,0	60,1-85,0	85,1-125,0	above 125,0
PM_{10}	do 25,0	25,1-35,0	35,1-50,0	50,1-75,0	above 75,0
CO	do 2500	2501-3500	3501-5000	5001-10000	above 10000
O_3	do 60,0	60,1-85,0	85,1-120,0	120,1-180,0	above 180,0

teristics (age, sex, weight, height, smoking habits), and health status (chronic diseases, medication use, health services use, hospitalization).

Users are presented with the same survey every subsequent month of application use.

At the bottom of the survey is the "Forward" command for data recording. By entering this command the user is granted access to the application.

The application includes five web pages.

"Home" includes the application name, a brief description of the purpose of the application, and a warning that users must not modify their continuing therapy based only on the information and recommendations from this website without previously consulting their doctor. The "About" page gives information about the project name and participants.

At the top of the "Data" page are the values of meteorological factors and the concentration of pollutants in the air sorted by date, time and measuring points. Below these values are tables with the air quality index classes and the indices of heat or wind chill.

Below the tables is the information about how these three factors can affect the health, what their class values in relation to the level of health risk are, as well as information on specifically vulnerable population groups. Next are recommendations on ways to reduce or eliminate health risks.

THE IMPACT OF AIR POLLUTION AND ADVERSE WEATHER CONDITIONS ON HEALTH

Air pollution and adverse weather conditions usually exert their negative impact on the health by worsening symptoms of pre-existing disease.

The biological mechanisms of air pollution effects include direct effects on the cardiovascular system, blood, lung receptors and indirect effects expressed through pulmonary oxidative stress and inflammatory responses. Direct effects may arise from the action of agents that can easily pass through the pulmonary epithelium into the circulation, such as gases, and the ultra-fine particles. Direct effects may contribute to the instability of vascular plaques, or initiate a cardiac arrhythmia. These effects of air pollution are the likely explanation for the occurrence of rapid (within hours) cardiovascular responses such as the increase in the number of acute myocardial infarction. Less acute (up to several days) and chronic indirect effects may occur due to oxidative stress or lung inflammation, which are caused by inhaled pollutants.

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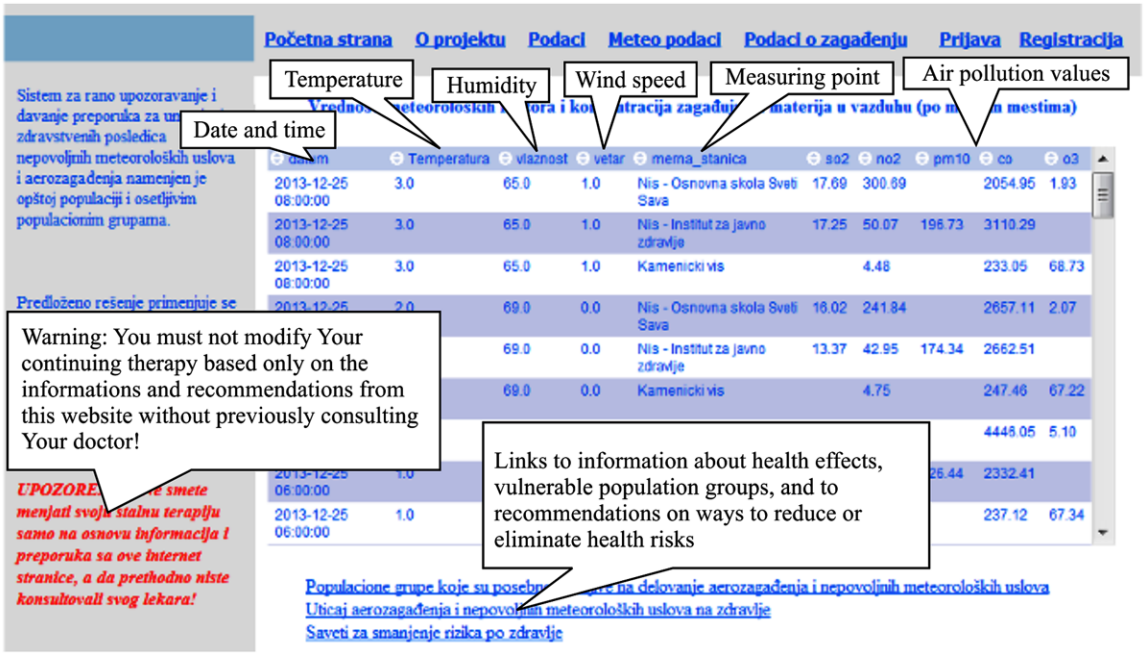
Figure 1. "Data" page



While at rest, the body temperature is around 37°C, and during physical exertion it can rise to 38-39°C without any harmful effects on health. In order to maintain the temperature within the physiological range it is necessary to create a balance between the heat generation and loss. Several mechanisms are involved in the regulation of body temperature, and the most important for heat loss are sweating and expansion of peripheral blood vessels, while the most important mechanisms for temperature increase are muscle tremors and the constriction of peripheral blood vessels. Both excessively increased and decreased temperatures act as stress factors for the organism, especially in individuals who already suffer from chronic diseases.

Population Groups that are Particularly Vulnerable to the Effect of Air Pollution and Adverse Weather Conditions

Population groups that are particularly vulnerable to the effect of air pollution are children, people over 65 years of age, people with chronic diseases of the cardiovascular or respiratory systems- especially asthma, emphysema, chronic bronchitis, heart insufficiency and coronary artery disease, as well as people of all ages who train or perform heavy physical labor in the environment (Faustini et al., 2012; Calderón-Garcidueñas et al., 2007; Curtis et al., 2006).

Population groups that are particularly sensitive to the action of excessive heat are: people over 65 years of age, people living alone, obese people, people with diabetes, people with chronic kidney disease, lung, cardiovascular, nervous and digestive system disease, as well as persons in therapy with diuretics, antipsychotics, antiparkinsonian drugs, antiepileptic drugs, and beta blockers (Kravchenko et al., 2013; Baccini et al., 2008).

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Population groups that are particularly sensitive to the action of excessive cold are: children, people over 65 years of age, people with mental health problems, people with health disorders that affect thermoregulation (decreased thyroid function, malnutrition, stroke, severe arthritis, Parkinson's disease, trauma, spinal cord injuries, burns), diabetics, and people in therapy using antidepressants, antipsychotics and/or sedatives.

Tips for Reducing Health Risks

If the concentrations of air pollutants are elevated:

- Reduce or limit your outdoor activities, especially those that require physical effort.
- Avoid staying in locations that you know to contain sources of air pollution, such as heavy traffic roads.
- Take your therapy on a regular basis.
- Stop smoking tobacco.
- Heat:
  - Avoid exposure to sunlight or heat sources.
  - If possible, stay in an air-conditioned space.
  - If you do not have air conditioning during the hottest part of the day, dim your apartment, close the blinds and draw the curtains, and ensure good ventilation during the night.
  - Avoid strenuous physical activity outdoors.
  - Edit your schedule of sports training.
  - If possible, conduct business activities in air-conditioned space, and if it is not possible, take frequent breaks at work.
  - Drink plenty of water and natural fruit juices (avoid alcohol, coffee and soft drinks).
  - Wear loose clothing that permits the evaporation of sweat.
  - Wear a hat and use sunscreen (spf of at least 15).
  - Never leave children or pets unattended in a car.
  - Rest as much as possible.
  - Call or visit friends and neighbors who belong to the group of people who are particularly sensitive to the action of excessive heat.
- In cold weather:
  - Put on warm, multi-layered clothing.
  - If you go outside, put on a hat, gloves and scarf, clothing should be resistant to wind.
  - Keep your apartment/house warm, 21°c in the living room and the kids' rooms, 18°c in other rooms.
  - Be physically active.
  - Take plenty of hot food and drinks.
  - When the value of the wind chill index is lower than -18°c, shorten your outdoor activities or stop them completely.
  - Have yourself vaccinated against the flu on time.
  - Provide a small stash of drugs that you constantly use.

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The "Weather Data" page contains the values of meteorological data per hour for the current day, obtained from the Hydrometeorological Institute, the heat or wind chill index values, depending on the air temperature, and the level of health risk.

The "Information on pollution" page contains concentrations of pollutants in the air, sorted by the place and time of measurement, as well as the value of air quality index. If any of the pollutants in a particular time and a particular place is not measured, the field remains blank.

Early warning systems for adverse health effects due to air pollution are the most developed in the United States, Canada, and Europe. There are few successful cases in Asia (Taiwan, China, Hong Kong, Korea, Japan and Thailand), and several in Latin America (Argentina, Brazil, and Mexico City), and only one in Africa (Cape Town, South Africa). Most existing systems focus on monitoring the concentration of pollutants in real time at the surface. Information on air quality is usually communicated via web services. The EPA provides e-mail alerts (EPA), but this service is available only in the United States. E-mail alerts are also provided by the Ministry of Environment, Ontario, Canada. The EPA information service provides information on air quality to its subscribers via e-mail, cell phone or pager, in real time, allowing them to take steps to protect their health in emergency situations. Forecasting is an essential component of the early warning system, and agencies such as the Agency for Environmental Protection of the USA, Belgium, Germany, and Canada provide forecasts, which are fundamental for early warning. (Grasso & Singh, 2011). The aim of these notifications is to help people adapt their behavior in situations of increased concentrations of some pollutants (eg, "do not go out", "increase the use of medication in consultation with your doctor", etc.) (Kelly et al., 2012)

Even if climatic factors are studied separately, they are mutually dependently connected, taking into account that many pollutants such as carbon dioxide are greenhouse gases and their increase leads to

Figure 2. "Weather data" page

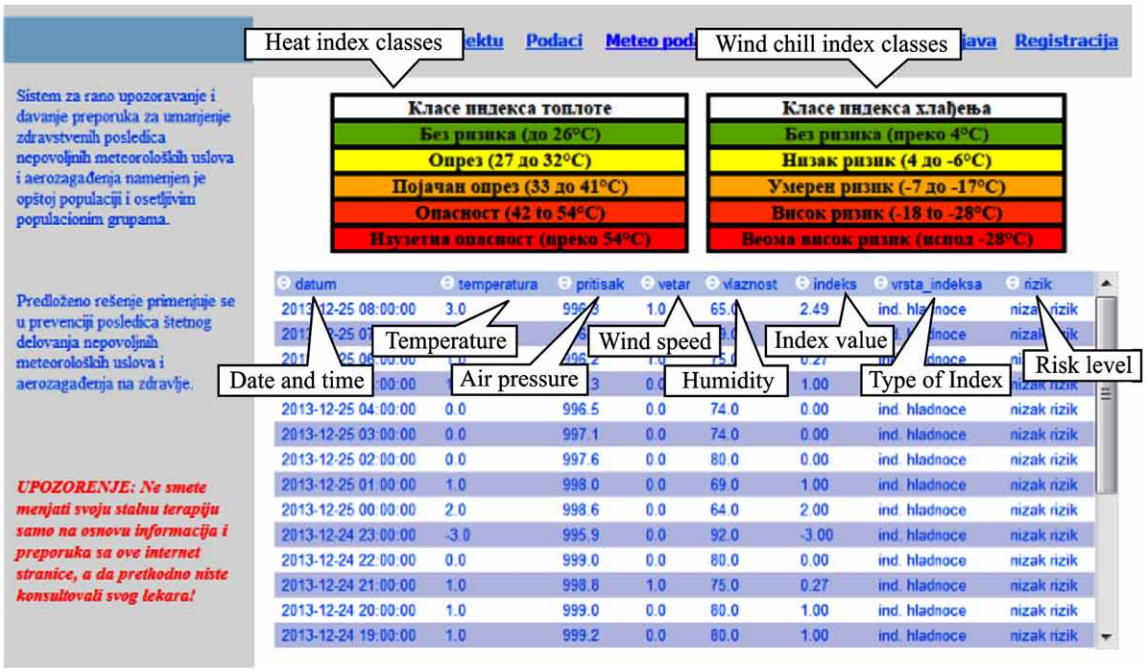

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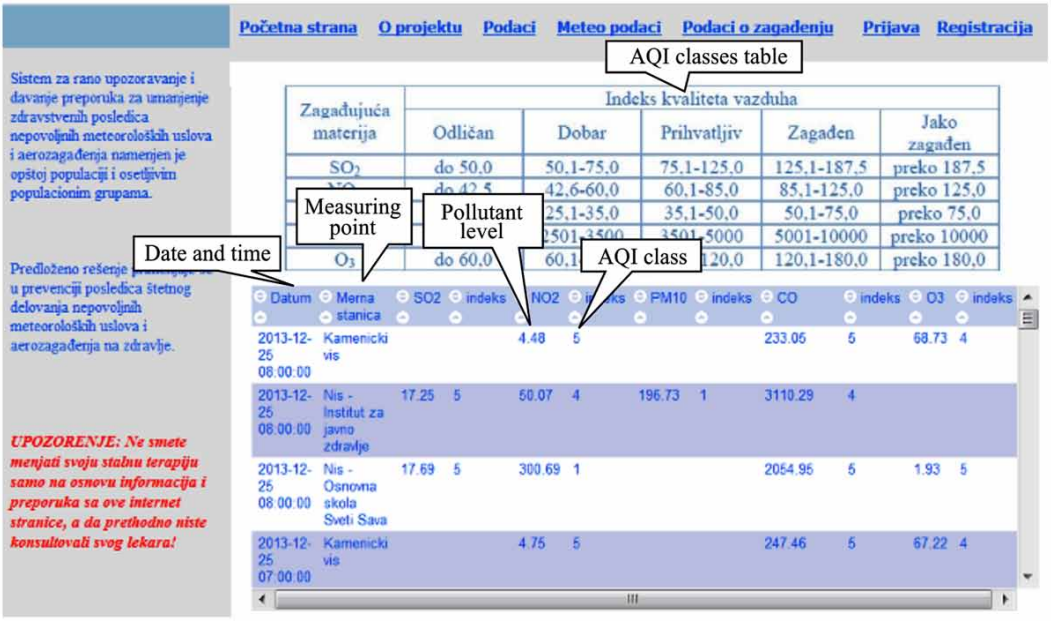
Figure 3. "Information on pollution" page



global warming and climate change (von Schneidemesser & Monks, 2013). Since the 2003 heat wave in France (National Institute of Public Health Surveillance, 2003) caused a significant increase in mortality of persons older than 75 years, a number of European countries has, as part of its public health policy, introduced plans, systems and guidelines for the purposes of prevention of adverse health effects caused by the heat waves. The European Commision has funded the EUROHEAT project, which aims to give guidance in public health actions in the event of adverse weather conditions, especially heat waves (Matthies & Menne, 2009)

The Government of Quebec has introduced a real-time integrated system for monitoring and tracking of extreme heat events as part of its Action Plan on Climate Change (2006-2012). That system is a component of a broader approach that will also monitor the public health impact of all types of extreme weather events. After conducting a detailed needs analysis, the National Institute of Public Health of Quebec has developed and implemented an integrated web application, at first applied only for heat waves. The system is available to health professionals through a secure web portal and provides access to the weather forecast and indicators (including mortality and hospitalization). The system was implemented and used during the summer of 2010, where it served as an important tool in decision-making during the heat wave in the province of Quebec. The next steps will be to provide access to the application to other groups of professionals who are involved in the prevention, monitoring and analysis of extreme weather events and their effects on the health of the community and the individual (Cheban et al., 2013).

A question is raised on the effectiveness of these systems in reducing heat wave related mortality. Toloo et al. (2013) have cited 15 studies that examined the efficiency of heat wave early warning systems. Six studies found that fewer people died during the heat waves after the implementation of the warning system, and there was less use of health care. One study also estimates that the costs of running the heat wave early warning system will cost the U.S. $210,000, and that 117 lives were saved thanks to the

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system. The remaining eight studies examined the behavior of the population in relation to the warning systems. Evidence suggests that the warning systems were efficient in reducing mortality and morbidity, but other factors that affect morbidity and mortality during heat waves must also be considered.

FUTURE RESEARCH DIRECTIONS

A database is formed from all the data from the questionnaires filled in by users, as well as data on meteorological factors and air pollution which, in addition to the user characteristics and the number of adverse health events also includes the value of the concentration of pollutants in the air, and the values of meteorological factors, which will be used to evaluate the effectiveness of the application and its further development. The number of physician visits, use of emergency medical services, as well as the number of hospitalizations before using the application and during its use will be compared. It is expected that the number of adverse health events during use of the application will significantly decrease. In addition, regression analysis will be used to examine how great is the impact of meteorological factors and air pollution on the number of adverse health events. Regression analysis will also be used to check if the class of heat and wind chill indices and air quality index are adequately defined in accordance with the findings which will be acquired during the implementation of the application, and appropriate limit value corrections will be performed.

CONCLUSION

Use of this system provides citizens with information about weather conditions and air pollution, how they can affect the health and how the general population and various vulnerable population groups can protect their health during periods of adverse weather conditions or increased levels of air pollution. Also, this system provides formation of a database on concentrations of pollutants in the air, the values of meteorological factors, as well as changes in the number of adverse health consequences of air pollution and meteorological factors in application users. This will allow the tracking of the solution efficiency, as well as a possible correction of limit values of meteorological factors and air pollution for certain classes of health risks.

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KEY TERMS AND DEFINITIONS

Air Pollution: Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

Early Warning System: Early warning system is any series of steps established to spot potential problems, and reduce their adverse effects.

Health: Health is a state of complete physical, mental and social well-being.

Heat Index: Heat index is a measurement of the air temperature in relation to the relative humidity, used as an indicator of the perceived temperature.

Wind Chill Index: Wind chill index is the perceived decrease in air temperature on exposed skin due to the flow of air. When the air temperature is below 5°C, the wind chill index is used as an indicator of the perceived temperature instead of the heat index.

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Chapter 26
Identification of Associations between Clinical Signs and Hosts to Monitor the Web for Detection of Animal Disease Outbreaks

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ABSTRACT

In a context of intensification of international trade and travels, the transboundary spread of emerging human or animal pathogens represents a growing concern. One of the missions of the national veterinary services is to implement international epidemiological intelligence for a timely and accurate detection of emerging animal infectious diseases (EAID) worldwide, and take early actions to prevent their introduction on the national territory. For this purpose, an efficient use of the information published on the web is essential. The authors present a comprehensive method for identification of relevant associations between terms describing clinical signs and hosts to build queries to monitor the web for early detection of EAID. Using text and web mining approaches, they present statistical measures for automatic selection of relevant associations between terms. In addition, expert elicitation is used to highlight the most relevant terms and associations among those automatically selected. The authors assessed the performance of the combination of the automatic approach and expert elicitation to monitor the web for a list of selected animal pathogens.

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1. INTRODUCTION

In recent years, the increased globalisation, movement of passengers and international trade has influenced the (re)emergence of new and exotic infectious diseases (Morens, Taubenberger, & Fauci, 2013). The traditional disease surveillance systems, organized via a multilevel health infrastructure, show delays in reporting disease outbreaks, starting from the first observation of clinical signs, laboratory confirmation until public communication (Chan et al., 2010). In consequence, the delays in reporting of disease outbreaks have themselves delayed the implementation of disease control measures, and thus influenced the spread of pathogens to uninfected territories (Khomenko et al., 2013).

As a complement to the traditional disease surveillance systems, several event-based surveillance systems (web monitoring systems) gather information about infectious disease outbreaks from automatically retrieved articles from the web (Collier et al., 2010; Freifeld, Mandl, Reis, & Brownstein, 2008; Steinberger, Fuart, Best, Von Etter & Yangarber, 2008). For this purpose, the current web monitoring systems use a specific vocabulary, such as names of diseases and clinical signs. However, it is not clear how these systems identify the vocabulary to mine the web, and especially for animal infectious diseases.

Innovative, data mining approaches have been successfully applied to clinical records in human medicine (Chapman, Dowling, & Wagner, 2004; Friedlin, Grannis, & Overhage, 2008) and to articles retrieved from the web, such as with the web monitoring systems HealthMap and BioCaster (Brownstein, Freifeld, Reis, & Mandl, 2008; Collier et al., 2008). However, the data mining approaches in animal health face challenges such as multiple vertebrate and possibly invertebrate (insects, ticks…) hosts and less formal vocabulary (Santamaria & Zimmerman, 2011; Smith-Akin, Bearden, Pittenger, & Bernstam, 2007). Indeed, a single pathogen agent can affect multiple animal hosts at the same time (cattle, sheep, goats, pigs) and can manifest with similar or different clinical signs. Furthermore, the clinical signs can vary from very typical, specific clinical signs (congenital malformations and deformations, blister-like sores on the skin and mucous membranes, haemorrhagic syndrome etc.) to less typical, non-specific clinical signs (fever, weakness, diarrhoea, etc.).

In this paper, we propose and evaluate a new method that combines text and web mining approaches to select relevant associations between terms describing hosts and clinical signs to build queries to mine the web and detect an emergence of an infectious animal disease outbreak. We focus on the new and exotic infectious animal diseases.

After the presentation of the related work in the next section, sections 3 and 4 present the framework of our method and the text and web mining approaches for identification of associations between terms describing hosts and clinical signs. Sections 5 and 6 consider the experiments and the results of the evaluations. Finally, in the last section we discuss this paper and present our future work.

2. RELATED WORK

The Argus system, hosted at Georgetown University Medical Centre (USA), uses a simple method the to detect articles on the web, using search terms of multilingual disease names (Nelson et al., 2010; Nelson et al., 2012).

More complete, web search criteria are proposed by the HealthMap team, which include disease names (scientific and common), clinical signs, keywords, and phrases. The terms originate from a dictionary of pathogens (human, plant, and animal diseases) and geographic names (country, province, state, and city).

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HealthMap integrates outbreak data from multiple electronic sources, including news feed aggregators (e.g., Google News), expert curated accounts (e.g., ProMED-mail), multinational surveillance reports (e.g., Eurosurveillance), and validated official alerts e.g., from WHO and OIE (Brownstein, Freifeld, Reis, & Mandl, 2008).

To detect articles on the web (e.g., Google News), the International Biosurveillance System (IBIS) uses the knowledge of registered users of the system that propose the search terms themselves. Registered users can edit the search terms and add or edit the tags in the articles that are relevant to the search terms (Lyon et al., 2013).

The GPHIN system developed by the Public Health Agency of Canada, retrieves automatically articles from news feed aggregators (e.g., Al Bawaba and Factiva), based on search terms and Boolean expressions, updated regularly by experts (Keller et al., 2009). The automated system filters out duplicate articles and establishes relevance scores for articles based on a value assigned to each search term. The automated tool discards articles with a score below an established threshold value to a search term. The scanned, filtered and categorized articles are evaluated by GPHIN's human analysts before being shared with the users of the system (Mykhalovskiy & Weir, 2006).

Similarly, MedISys, the web monitoring system created by the Joint Research Centre of the European Commission, retrieves articles from a list of web pages and news-feed aggregators. The retrieval is based on a predefined multilingual terms for each disease included in the system using a list of weighted terms; and/or combination of terms, as proposed by experts. For example, the system retrieves an article and displays it in the disease category for dengue if the term "dengue" appears at least three times in the text. However, if the text of the web article includes a term (based on a list of irrelevant terms), such as the term "concert," the article will not be retrieved. An article is also retrieved by the system if two combinations of search terms appear in the text, such as "dengue" and "outbreak" (Mantero, Belyaeva, & Linge, 2011).

The conceptual framework for the system BioCaster that has run from 2006 until 2012 was a multilingual ontology (Collier et al., 2007). The ontology was a structured public health vocabulary and relations of diseases, agents, clinical signs, syndromes and hosts. The BioCaster ontology adopted a thesaurus-like structure with synonym sets linking together terms across languages with similar meaning. Synonym sets used root terms. Root terms themselves were fully defined instances that provided bridges to external classification schemes and nomenclatures such as ICD10, MeSH, SNOMED CT and Wikipedia (Collier et al., 2010).

Zhang and Liu (2007) explored the detection of sentences containing disease outbreak information in ProMed-mail. They addressed the issue that the vocabulary used to report disease outbreaks overlaps with that used in other public health news, such as the treatment of diseases, and therefore search terms and text classifiers based on standard word features would not be effective in identifying disease outbreak articles. They used a dependency parser to identify sentence structures, and extracted verbs and adjectives directly modifying disease names as features. As additional features, they detected tense and negation status of verbs and extracted word n-grams (consecutive *n* words in text) and time terms (e.g., "today," "three months ago," etc.) from sentences (Torii et al., 2011).

Recently, Gesualdo et al., (2013) developed a minimally trained algorithm that exploits the abundance of health-related web pages to identify all jargon terms related to a specific technical term for avian influenza surveillance of Twitter. Then they translated an influenza case definition into a Boolean expression, with each clinical sign described by a technical term and all related jargon terms, as identified by the algorithm. Subsequently, they monitored tweets that reported a combination of clinical signs meeting the

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case definition query and found a high correlation between the trend of their influenza-positive tweets and the trends identified by the US traditional avian influenza surveillance system.

Milinovich et al. (2014) found that the frequency of official notifications of exotic infectious diseases were correlated with a number of terms used as queries from the users on Google search engine. These terms varied from names of diseases or aetiological agent ("brucellosis, "Brucella"), colloquialisms ("flu," "help"), clinical signs ("cough," "cervical mucus") or medications or general health or treatment related queries ("clinical signs of dengue," "whooping cough treatment") to environmental ("flash flood," for leptospirosis) and behavioural vocabulary ("African tours," for malaria). Similarly, in our previous work we showed that queries consisting in the name of the animal disease such as "African swine fever outbreak" or "ASF outbreak" retrieve new articles about African swine fever (ASF) outbreaks, rather than general queries such as "fever outbreak" (Anonymous, 2014).

3. OUR PROPOSED METHOD

The work presented in this paper is a part of the methodology that we currently develop for the purposes of the French epidemic intelligence team in animal health (VSI). Since its creation in 2013, the VSI team focuses in detection of outbreaks of new and exotic animal infectious diseases of potential threat to France. Our contribution is in the methodology for monitoring the web, as one of the sources of information for the VSI team, and especially:

1. Automatic retrieval of documents based on search queries (queries);
2. Automatic classification of documents based on their content (relevant – disease outbreak documents and irrelevant – any other document);
3. Automatic extraction of information from relevant documents (name of a disease – if mentioned, date and location of an outbreak, affected hosts and clinical signs etc.); and
4. Evaluation of the process, using domain expert knowledge.

In this paper, we present our work related to the first step of the methodology for monitoring the web. To retrieve documents from the web, we use queries based on terms, such as disease names, for a known disease, but also associations between terms describing clinical signs and hosts, for a new or unknown disease. We explore the use of web and text mining techniques and domain expert knowledge to identify relevant associations between terms describing clinical signs and hosts that can permit detection of new relevant documents about disease outbreaks. More precisely, our method consists of four steps (Figure 1):

1. Extraction of terms from relevant documents, using a text mining approach;
2. Identification of terms describing hosts and clinical signs, using expert knowledge;
3. Association of terms describing hosts and clinical signs and calculation of statistical measures of association between terms, using text and web mining approaches; and
4. Evaluation of the relevance of the terms and the associations thereof, using expert elicitation.

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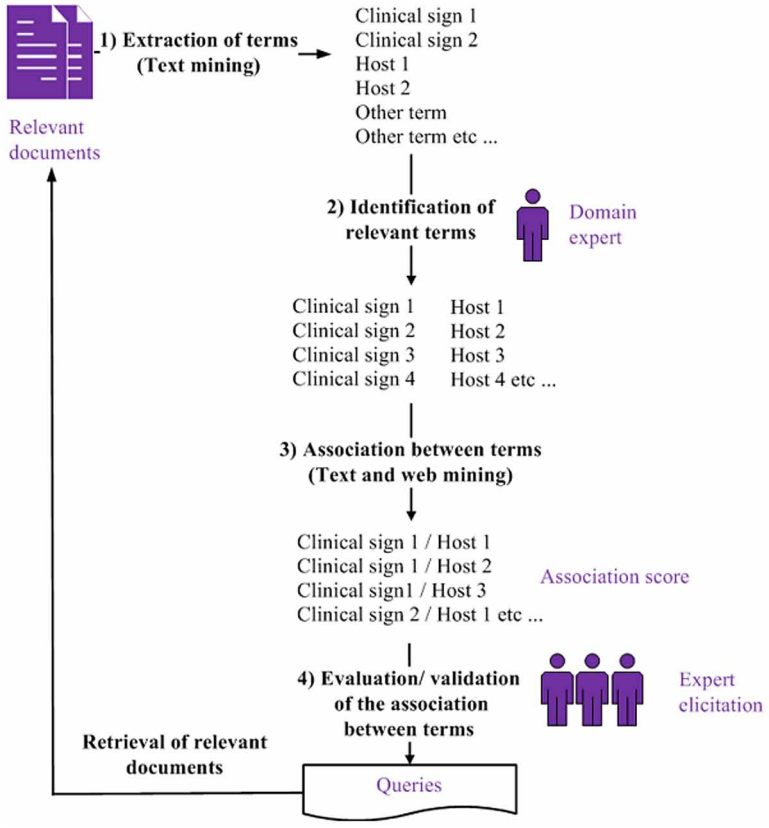
Figure 1. Workflow of the method for identification of relevant associations between terms describing hosts and clinical signs for monitoring disease emergence on the web



3.1. Extraction of Terms

A set of relevant (e.g., disease outbreak) documents for a certain disease serve as a basis for extraction of terms. Later, from each set of relevant documents, we automatically extract terms using *BioTex*[1], a tool that combines linguistic and statistic information adapted to biomedical area (Lossio Ventura et al., 2014). To select appropriate terms *BioTex* bases on two principles:

1. Implementation of a relevant combination of information retrieval techniques and statistical methods, e.g., term frequency - inverse document frequency (TF-IDF), OKAPI (a cross-platform and open-source set of components and applications that offer for localizing and translating documentation and software), or C-value measures;
2. Use of a list of syntactic structures of the terms that have been learnt with relevant sources, e.g., medical subject headings (MeSH). The terms extracted with *BioTex* can be either simple, one term (e.g., “pig”) or composed, multi-term (e.g., “domestic pig”) expressions.

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3.2. Identification and Association of Terms

In this second step, a domain expert identifies the terms describing hosts and clinical signs that characterize an emergence of a certain disease. For this purpose, the domain expert selects the terms from the list resulting from the former step.

Next, using text mining and web mining approaches, we propose statistical measures for automatic selection of relevant associations between terms describing clinical signs and hosts. We detail this contribution in the section below.

3.3. Evaluation

Economopoulou et al. (2014) elicited experts to prioritize exotic infectious diseases of importance to the European Union. Mantero et al. (2011) used experts to identify keywords for the purposes of the MedISys web monitoring system of the European Commission. Expert elicitation was also adopted to evaluate the quality of different data mining approaches for identification of terminology for monitoring the web and for syndromic surveillance (Furrer et al., 2015; Steinberger et al., 2008). Therefore, we considered the expert elicitation as a necessary step for our method and we elicited a panel of domain experts to evaluate the level of relevance of the terms extracted with text mining as well as the associations thereof.

4. MEASURE OF THE ASSOCIATION BETWEEN TERMS

This section describes the data mining techniques that propose relevant associations between the terms describing hosts and clinical signs. This corresponds to the third step of our proposed method (see Figure 1).

4.1. Web Mining Approach

Pointwise Mutual Information and Information Retrieval (PMI-IR) is an algorithm using the AltaVista search engine to query the web to determine appropriate synonyms to a given query (Turney, 2001). For a given word, PMI-IR chooses a synonym among a given list. These selected terms correspond to the TOEFL questions. The aim is to identify the synonym that gives a better score. To obtain scores, PMI-IR uses several measures based on the proportion of documents where both terms are present on the web. Turney's formula is inspired from Mutual Information (Church & Hanks, 1990). Our work applies this principle. First, we propose D_{web} measures based on the Dice's coefficient. Other statistical measures like Mutual Information (MI_{web}) (Church & Hanks, 1990) and Cubic Mutual Information (CMI_{web}) (Nazar, Vivaldi, & Cabré, 2008; Vivaldi, Màrquez, & Rodríguez, 2001) can be associated with web mining techniques.

The D_{web} measure computes the relationship between terms describing hosts (h) and clinical signs (cs). In this context, we measure the number of pages containing the terms h and cs together (i.e. *hit* (*h AND cs)*). We get this number of search pages with the search engine Exalead (http://www.exalead.fr). To calculate this association and the dependence of the terms, we also compute the number of pages where each term appears (i.e. *hit* (*h)* and *hit (cs)*). The following formula defines D_{web} with AND operator:

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$$D_{Web}^{AND} = \frac{2 \times hit(h \text{ AND } cs)}{hit(h) + hit(cs)}$$

We chose Exalead because it offers the NEAR function like in Turney's approach (2001). NEAR is an operator that returns web pages where both terms *h* and *cs* are present in a 16-word window. We can adapt the previous formula with this new formula given below:

$$D_{Web}^{NEAR}(h, cs) = \frac{2 \times hit(h \text{ NEAR } cs)}{hit(h) + hit(cs)}$$

Moreover, we can use Mutual Information (MI) and Cubic Mutual Information (CMI) to estimate the dependency between *h* and *cs*:

$$MI_{Web}^{AND}(h, cs) = \frac{hit(h \text{ AND } cs)}{hit(h) \times hit(cs)}$$

$$CMI_{Web}^{AND}(h, cs) = \frac{hit^3(h \text{ AND } cs)}{hit(h) \times hit(cs)}$$

We can adapt these measures with the NEAR operator. The original MI measure (Church and Hanks, 1990) uses a logarithm (i.e. $\log_2$ (P(*x*, *y*)/ (P(*x*) P(*y*))). The logarithm function is strictly increasing. So, the application or not of logarithm function does not change the ranking of the terms. Also, it is worth noting that *MI* tends to extract rare and specific dependencies (Vivaldi, Màrquez, & Rodríguez, 2001).

In our approach, we do not use other web mining measures such as "Google Similarity Distance" (Cilibrasi & Vitanyi, 2007) that needs specific parameters, e.g., the total number of web pages indexed by search engines.

4.2. Text Mining Approach

The *D, MI,* and *CMI* statistical measures can be used with the text mining approach. In this context, the Dice measure (*D*) is defined as the number of times (i.e. *nb* function) where *h* and *cs* appear in the same context over the sum of the total number of times each one appears in the corpus for each disease. We can adapt the text mining context with other statistical measures (*MI* and *CMI*). In this case, the choice of the context is crucial. In our data, both terms *h* and *cs* are very rare in a given sentence so we use a larger context (i.e. an abstract or an article). To summarize, the following formulas give the text mining statistical measures:

$$D_{text}(h, cs) = \frac{2 \times nb(h \text{ AND } cs)}{nb(h) + nb(cs)}$$

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$$MI_{text}(h, cs) = \frac{nb(h \text{ AND } cs)}{nb(h) \times nb(cs)}$$

$$CMI_{text}(h, cs) = \frac{nb^3(h \text{ AND } cs)}{nb(h) \times nb(cs)}$$

4.3. Combination of Text and Web Mining Approaches

Text mining and web mining approaches have a complementary behaviour. We apply text mining on specific texts in relation with each studied disease. Therefore, our global ranking function favours this type of approach. To overcome the case of rare associations, it is better to use a more global statistical measure calculated on the web, i.e. considering the web as a corpus. To take into account these principles, we propose a global measure called CMI_{global}. Based on our experiments (see following section) and the state-of-the-art review (Saneifar, Bonniol, Poncelet, & Roche, 2015; Vivaldi, Màrquez, & Rodríguez, 2001), the statistical measure CMI_{global} bases on the *CMI* criterion and the use of AND operator.

$$CMI_{global}(h, cs) = 1 + CMI_{text}(h, cs) \text{ if } CMI_{text}(h, cs) \neq 0 \text{ else } CMI_{Web}^{AND}(h, cs)$$

In this formula, the value 1 enables to favour the text mining value for the global ranking function (statistical measure) CMI_{global}. Table 1 shows examples of pairs of associations (hosts and clinical signs) for Bluetongue and Schmallenberg virus infection.

Table 1. Examples of ranked associations with CMI_{global}

Rank	Bluetongue *clinical signs / hosts*	Schmallenberg virus infection *clinical signs / hosts*
1	general clinical signs / pregnant ewes	stillborn bovine foetuses / bison
2	livestock deaths / sheep	aborted foetuses / sheep
3	embryonic death / cattle	deformed offspring / sheep
4	general clinical signs / sheep	stillborn bovine foetuses / deer
5	livestock deaths / cattle	aborted foetuses / cattle
6	livestock deaths / deer	deformed offspring / cattle
7	fever outbreak / sheep	stillborn bovine foetuses / calves
8	embryonic death / sheep	deformed offspring / lambs
9	fever outbreak / cattle	acute bronchopneumonia / bison
10	embryonic death / pregnant ewes	stillborn lambs / goat

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5. EXPERIMENTS

5.1. Selection of Emerging Animal Infectious Diseases

For our experiments, we have chosen four animal infectious diseases of importance to animal health. These diseases have emerged in the last years in several countries in Europe and North Africa and they pose a risk of spread to other non-infected countries, including France.

African swine fever (ASF) is a highly contagious haemorrhagic viral disease of domestic and wild pigs. Typical clinical signs are high fever, loss of appetite, haemorrhages in the skin and internal organs, and death (Sánchez-Vizcaíno et al., 2013).

Foot-and-mouth disease (FMD) is a highly contagious viral disease of cattle, swine as well as sheep, goats, and other cloven-hoofed animals. Typical clinical signs are fever and blister-like sores on the tongue and lips, in the mouth, on the teats and between the hooves. The virus causes severe production losses and while the majority of affected animals recover, the virus often leaves them weakened and debilitated (Rodeia, 2008).

Bluetongue (BT) is a non-contagious, viral disease of domestic and wild ruminants transmitted by biting midges of the genus *Culicoides*. The clinical signs are most severe in sheep, resulting in weight loss, disruption in wool growth, and death (Wilson & Mellor, 2009).

In summer 2011, a new virus - Schmallenberg virus (SBV), appeared in The Netherlands and Germany. It quickly spread in many European countries. Affecting ruminants, it caused temporary, flu-like signs, with a short fever and drop in milk production, and sometimes abortion, stillbirth and severe foetal malformations (Wernike, Hoffmann, & Beer, 2013).

5.2. Textual Data

As sources of terms, we used a set of relevant documents (news articles and abstracts) for each of the studied diseases, which we manually retrieved in August and September 2014 from the Google search page and the PubMed database. We retrieved the news articles using the query in English-language "name of the disease" AND "outbreak" and we retrieved the abstracts using the query in English-language "name of the disease," when present in the title or the body of the text. A relevant article described a disease outbreak event for each studied disease. A relevant abstract was indexed with the MeSH term "epidemiology," and when not indexed, contained epidemiologic information for each studied disease. We used 181 news articles for ASF, 79 for BT, 84 for FMD, and 148 for SBV from Google and 45 abstracts for ASF, 116 for BT, 143 for FMD, and 53 for SBV from PubMed. The relevant documents principally covered topics about ASF outbreaks in Europe, FMD outbreaks in Northern Africa, BT outbreaks in the Balkans, and SBV outbreaks in Western Europe, for the period from 2011 to 2014.

5.3. Evaluation Protocol

5.3.1. Relevance of the Terms and the Associations Thereof

For each studied disease, we elicited a panel of domain experts (21 for ASF, 7 for FMD, 7 for BT, and 5 for SBV). Using an online questionnaire, the experts evaluated a representative number of terms ex-

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tracted with text mining that described clinical signs and hosts for each studied disease. Tables 2, 3, and 4 show details of the terms describing clinical signs and hosts.

For the studied disease, the experts evaluated the relevance (specificity) of the terms describing the clinical signs. The relevance of the clinical signs was:

Table 2. List of terms extracted with text mining, which described clinical signs and hosts that characterize a foot-and-mouth disease emergence. In bold are the terms proposed to the experts for evaluation

Clinical signs	Terms
General	**production losses, low mortality**
Mucous/ cutaneous	**mucosal disease, papular stomatitis, swine vesicular disease, vesicular disease, vesicular stomatitis**
Hosts	**Terms**
	cattle herds, **wild boar**, cattle and **buffaloes**, Bactrian **camels**, dairy cattle, beef cattle, cattle and **pigs**, pig farms, **small ruminants**, cattle farms, **deer** farm

Table 3. List of terms extracted with text mining, which described clinical signs and hosts that characterize a bluetongue emergence. In bold are the terms proposed to the experts for evaluation.

Clinical signs	Terms
General	**livestock deaths, general clinical signs, onset of weakness, excess mortality, fever outbreak**
Reproductive	**embryonic death,** reproductive disorders, **occurrence of abortion**
Hosts	**Terms**
	red deer, adult **sheep**, **cattle** herds, **roe deer**, cattle population, **newborn calves**, newborn dairy calves, dairy calves, dairy ewes, **pregnant ewes**, cattle and **goats**, small ruminants, cattle production, goat farms

Table 4. List of terms extracted with text mining, which described clinical signs and hosts that characterize a Schmallenberg virus emergence. In bold are the terms proposed to the experts for evaluation.

Clinical signs	Terms
Congenital malformations, deformations	congenital malformations, deformed lambs, malformed offspring, ovine congenital malformations, **arthrogryposis hydranencephaly syndrome**, severe foetal malformations, **foetal malformations**, **vertebral malformations**, severe congenital malformation, **hydranencephaly syndrome**, **limb malformations**, congenital malformation, malformed calves, **severe congenital malformations**, malformed lambs, malformed progeny, **deformed offspring**
Digestive	**watery diarrhoea**
General	**nonspecific febrile syndrome**, **mild transient disease**, febrile syndrome
Reproductive	**perinatal death**, **premature birth**, lamb losses, **aborted foetuses**, **reproductive losses**, **enzootic outbreak of abortion**, outbreak of abortion, **stillborn bovine foetuses**, substantial reproductive losses, **stillborn lambs**
Respiratory	**acute bronchopneumonia**
Hosts	**Terms**
	newborn calves, sheep holdings, cow herds, **red deer**, goat holdings, lambs and **calves**, kids and calves, adult dairy cows, cows and ewes, **lambs** and **goats**, adult cows, cattle herds, dairy cows, bovine foetuses, goat population, dairy **cattle**, sheep herds, small ruminants, bison population, European **bison**, **fallow deer**, bovine foetus, **goat kids**, goat farms, goat foetus, deer populations, **sheep** farm, cows and calves, sheep herd, sheep population, cattle farms, newborn lambs, small ruminant, cattle population

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1. Very low, when their occurrence was very unlikely to characterise the disease emergence;
2. Low, when they probably did not characterise the disease emergence;
3. Medium, when they possibly characterised the disease emergence;
4. High, when they very probably characterised the disease emergence; and
5. Very high, when they characterised in almost all cases the disease emergence.

Next, the experts noted the groups of clinical signs that are most likely to appear in the hosts during an emergence of the disease.

5.3.2. Precision of the Associations obtained with the Statistical Measures

After consideration of the evaluation made by the experts, for each studied disease and for the terms evaluated by the experts, we noted the relevant associations. For these purposes, we analysed the relevance of 36 associations for FMD, 42 associations for BT and 144 associations for SBV. Further, we analysed the precision for the first 20 highest ranked associations obtained with the statistical measures D_{Web}^{AND}, D_{Web}^{NEAR}, MI_{Web}^{AND}, MI_{Web}^{NEAR}, CMI_{Web}^{AND}, CMI_{Web}^{NEAR}, and CMI_{global}. The precision of ranking was the number of relevant associations from the 20 highest ranked associations obtained with the statistical measures.

The precision of retrieval was the number of returned relevant pages (first 10 pages) for the 20 highest ranked associations obtained with the statistical measures and when tested as queries (in Google news, period from 2011 to 2014). A relevant page (RP) was a page that covered disease related information, including disease outbreak information. For these purposes, we analysed the relevance of 587 web pages for FMD, 733 web pages for BT and 564 web pages for SBV.

6. RESULTS

In the present section, we analyse the results for FMD, BT and SBV. We discuss ASF elsewhere (Anonymous, 2014).

6.1. Relevance of the Terms and the Associations Thereof

Eighteen terms extracted with text mining described clinical signs and hosts that characterize a FMD emergence (Table 2). The experts evaluated 14 representative terms describing clinical signs and hosts. Two terms described general clinical signs (mortality, production losses) and five terms described mucous/ cutaneous clinical signs (vesicular and papular stomatitis, vesicular and mucosal disease, and swine vesicular disease). Seven terms described the hosts (cattle, small ruminants, buffaloes, pigs, wild boar, camels, and deer).

The majority of the experts (> 50%) evaluated the formation of vesicles as highly to very highly relevant; mucosal disease as medium to highly relevant, and production losses and formation of papules as medium relevant to characterise a FMD emergence (Figure 2). During a FMD emergence, the majority of the experts noted as relevant the apparition of mucous/ cutaneous clinical signs in cattle, small ruminants and pigs and the apparition of general clinical signs in cattle and pigs (Figure 3).

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Figure 2. Expert evaluation of the relevance of the terms describing clinical signs to characterize a foot-and-mouth disease emergence

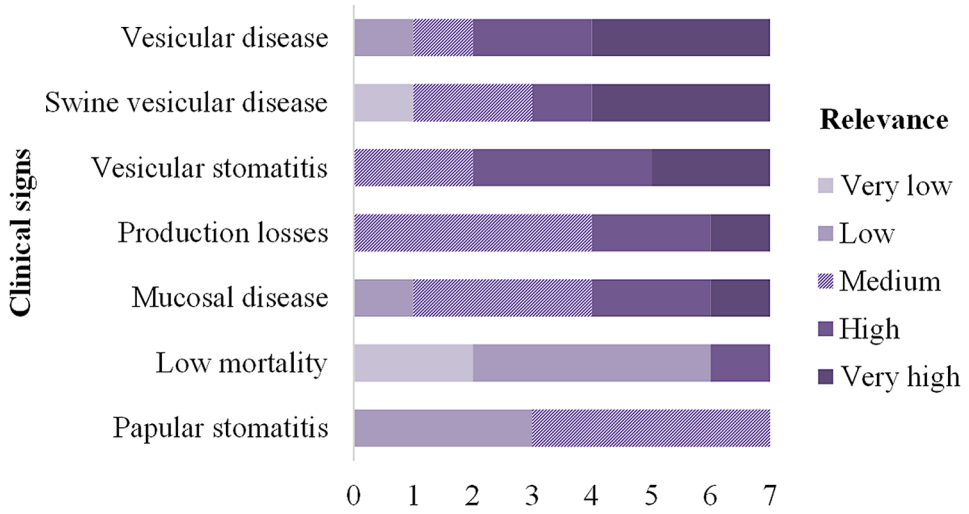
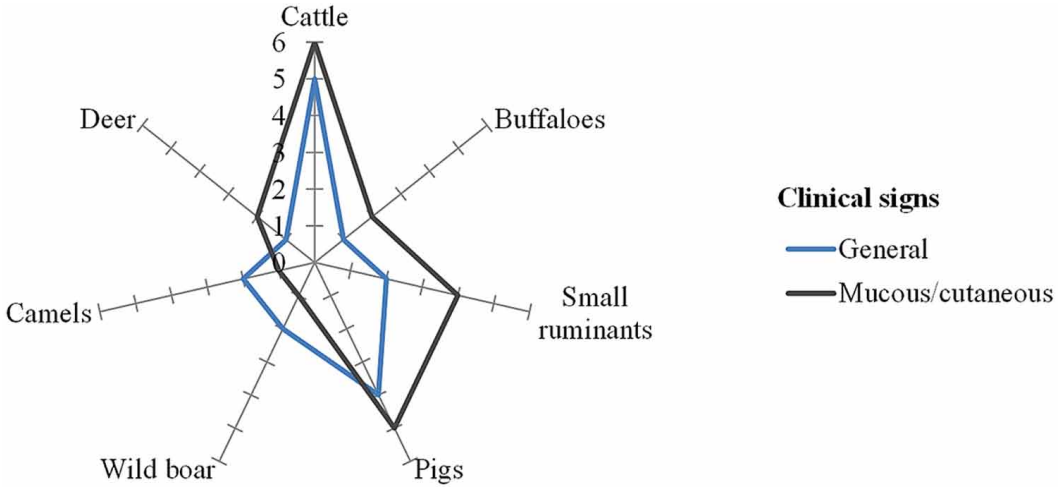


Figure 3. Expert evaluation of the relevance between the terms describing hosts and clinical signs to characterize a foot-and-mouth disease emergence



Twenty - two terms extracted with text mining described clinical signs and hosts that characterize a BT emergence (Table 3). The experts evaluated 13 representative terms describing clinical signs and hosts. Four terms described general clinical signs (deaths, general clinical signs, weakness and fever) and two terms described reproductive clinical signs (embryonic death and abortion). Seven terms described the hosts (cattle, sheep, goats, ewes, calves, red deer and roe deer).

The majority of the experts (> 50%) evaluated the general clinical signs, including weakness, fever and mortality, the embryonic deaths and the abortions, as very low to low relevant to characterise a BT emergence (Figure 4). During a BT emergence, the majority of the experts noted as relevant the apparition of general and reproductive clinical signs in cattle and sheep (Figure 5).

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Figure 4. Expert evaluation of the relevance of the terms describing clinical signs to characterize a bluetongue emergence

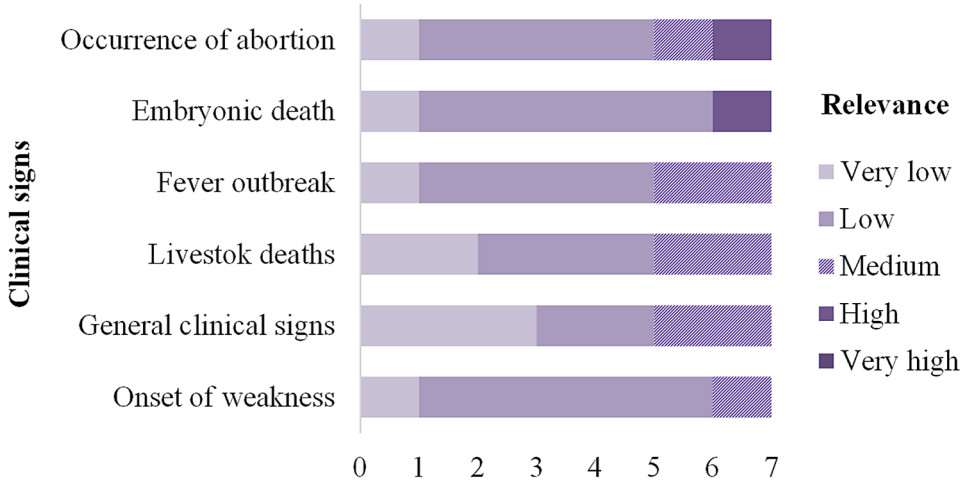
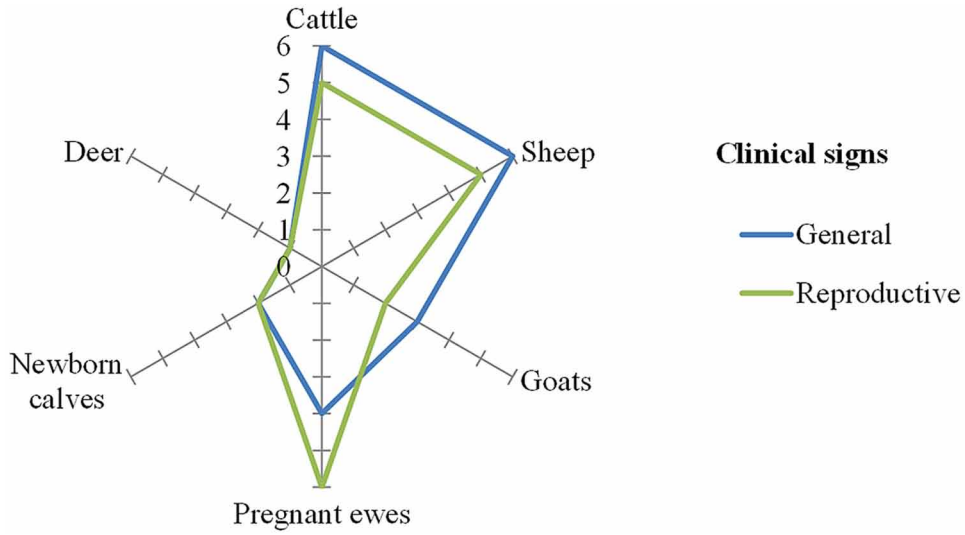


Figure 5. Expert evaluation of the relevance between the terms describing hosts and clinical signs to characterize a bluetongue emergence



Sixty - six terms extracted with text mining described clinical signs and hosts that characterize a SBV emergence (Table 4). The experts evaluated 29 representative terms describing clinical signs and hosts. Seven terms described congenital malformations or deformations (arthrogryposis hydranencephaly syndrome, foetal malformations, vertebral malformations, severe congenital malformations, hydranencephaly syndrome, limb malformations, and deformed offspring). One term described digestive clinical signs (watery diarrhoea). Two terms described general clinical signs (nonspecific febrile syndrome, mild transient disease). Seven terms described reproductive, including postnatal clinical signs in new-born (perinatal death, premature birth, aborted foetuses, reproductive losses, enzootic outbreak of abortion,

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stillborn bovine foetuses, stillborn lambs) and one term described respiratory clinical signs (acute bronchopneumonia). Nine terms described the SBV hosts (cows, goats, sheep, calves, and goat kids, lambs, bison, red deer and fallow deer).

The majority of the experts (> 50%) evaluated the congenital malformations and deformations as very highly relevant; the postnatal mortality and stillbirth as highly relevant; and the reproductive losses as medium relevant to characterize a SBV emergence (Figure 6). During an SBV emergence, the majority of the experts noted as relevant the apparition of congenital malformations and deformations and postnatal mortality and stillbirth in calves, kids and lambs, reproductive clinical signs in cattle, sheep and goats and digestive and general clinical signs in cattle (Figure 7).

6.2. Precision of the Associations Obtained with the Statistical Measures

Fourteen from 36 associations for FMD were relevant. The statistical measure CMI_{global} had the highest precision in ranking the relevant associations (12/ 20 associations), followed by CMI_{Web}^{AND} (11/ 20 associations) (Table 5). The precision of the relevant associations for FMD to retrieve relevant pages from the web for all statistical measures was > 0.92 (Table 6). From the relevant associations, the highest precision results to retrieve relevant pages from the web had the associations: vesicular stomatitis / cattle (10/ 10 pages), vesicular disease / cattle (9/ 10 pages), production losses / cattle (10/ 10 pages), and the associations: production losses / pigs (8/ 10 pages), vesicular disease / pigs (7/ 8 pages), and

Figure 6. Expert evaluation of the relevance of the terms describing clinical signs to characterize a Schmallenberg virus emergence

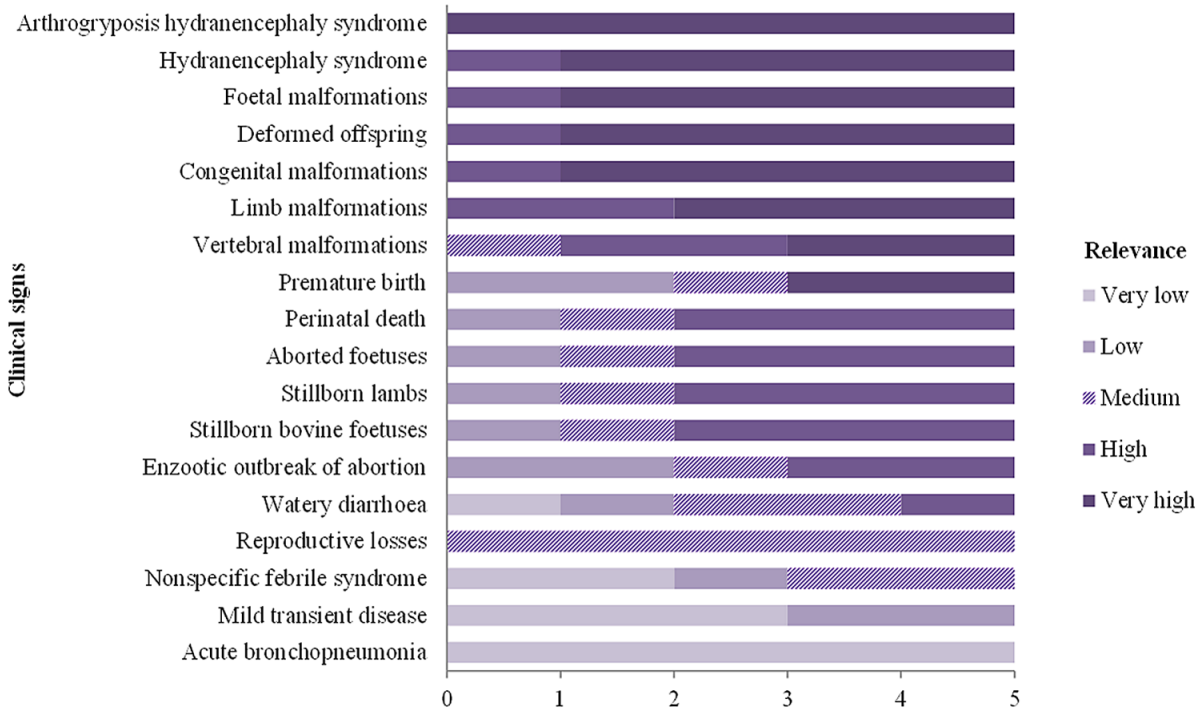

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Figure 7. Expert evaluation of the relevance of the terms describing hosts and clinical signs to characterize a Schmallenberg virus emergence

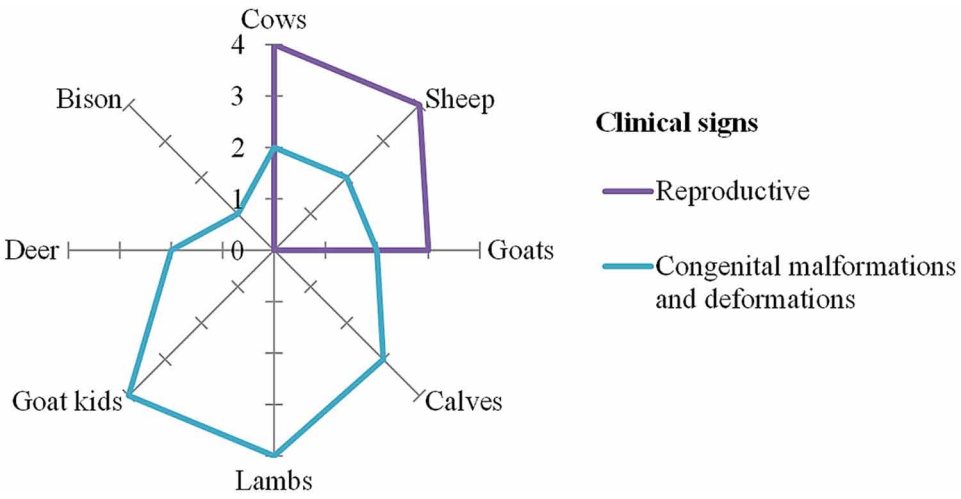

Table 5. Precision of ranking of the associations obtained with the statistical measures

Statistical measure	Foot-and-mouth disease	Bluetongue	Schmallenberg virus infection
D_{Web}^{AND}	0.40	0.25	0.45
D_{Web}^{NEAR}	0.40	0.40	0.50
MI_{Web}^{AND}	0.45	0.35	0.50
MI_{Web}^{NEAR}	0.45	0.35	0.40
CMI_{Web}^{AND}	0.55	0.25	0.60
CMI_{Web}^{NEAR}	0.50	0.35	0.40
CMI_{global}	0.60	0.30	0.50

vesicular stomatitis / pigs (3/ 4 pages). From the associations evaluated as less relevant, the highest precision had the associations: vesicular stomatitis / deer (10/ 10 pages), and vesicular disease / deer (4/ 4 pages).

Eleven from 42 associations for BT were relevant. The statistical measures had a precision for ranking the relevant associations < 0.4 with the highest precision for D_{Web}^{NEAR} (8/ 20 associations) (Table 5). The precision of the relevant associations to retrieve relevant pages from the web for all statistical measures was ≤ 0.1 (Table 6). From the relevant associations, the highest precision to retrieve relevant pages from the web had the associations: livestock deaths / cattle (2/ 10 pages). From the associations evaluated as less relevant, the highest precision to retrieve relevant pages from the web had the associations: embryonic death / cattle (10/ 10 pages), embryonic death / sheep (4/ 4 pages), fever outbreak / cattle (3/ 10 pages), and fever outbreak / sheep (2/ 10 pages).

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Forty-five from 144 associations for SBV were relevant. The statistical measure CMI_{Web}^{AND} had the highest precision for ranking the relevant associations (12/ 20 associations) (Table 5). The precision of the relevant associations for SBV to retrieve relevant pages from the web was the highest for the associations obtained with the statistical measure CMI_{global} (precision of 0.4) (Table 6). From the relevant associations, the highest precision to retrieve relevant pages from the web had the associations: deformed offspring / lambs (6/ 6 pages), deformed offspring / calves (7/ 8 pages), and limb malformations / goat kids (3/ 3 pages). The associations: watery diarrhoea / cattle, and reproductive losses / cattle retrieved three relevant pages from seven pages. The associations: aborted foetuses / cattle, aborted foetuses / sheep, aborted foetuses / calves retrieved relevant pages with precision < 0.25. From the associations evaluated as less relevant, the highest precision results to retrieve relevant pages from the web had the associations: deformed offspring / sheep (8/ 10 pages) and deformed offspring / cattle (5/ 6 pages).

7. DISCUSSION AND FUTURE WORK

The work presented in this paper is part of the global methodology that we develop for the French epidemic intelligence team in animal health where we focus on monitoring the web to detect disease emergence (Arsevska et al., 2014). We currently have a list of more than twenty exotic diseases (including ASF, FMD, BT and SBV) and ten groups of clinical signs in five animal species.

In one of our previous works (Arsevska et al., 2014), we did experiments with data for African swine fever (ASF). We compared the predictive performance of (i) a Discriminative Multinomial Naïve Bayes (DMNB) algorithm and (ii) a Sequential Minimal Optimization (SMO) algorithm, using a 10-fold cross-validation method. Both classification algorithms reported good predictive performance for text documents about ASF, with precision, recall and F-score of 0.75 for DMNB, and precision, recall and F-score of 0.73 for SMO (Table 7). Similar results were obtained elsewhere (Conway et al., 2009; Freifeld et al., 2008; Zhang & Liu, 2007). In the future, we intend to use machine-learning techniques to extract other specific information from non-structured texts retrieved from the web, such as outbreak location, date, hosts, their numbers and clinical signs.

Table 6. Precision of document retrieval based on relevant associations obtained with the statistical measures

Statistical measure	Foot-and-mouth disease	Bluetongue	Schmallenberg virus infection
D_{Web}^{AND}	1.00	0.05	0.25
D_{Web}^{NEAR}	1.00	0.07	0.25
MI_{Web}^{AND}	1.00	0.10	0.21
MI_{Web}^{NEAR}	0.98	0.10	0.21
CMI_{Web}^{AND}	0.92	0.05	0.19
CMI_{Web}^{NEAR}	0.92	0.10	0.22
CMI_{global}	0.93	0.10	0.40

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Table 7. Classification results for African swine fever documents

Classification algorithm		**Naïve Bayes**			**Support Vector Machine**		
Performance		Recall	Precision	F-score	Recall	Precision	F-score
Class	disease	0.72	0.77	0.74	0.66	0.68	0.67
	economy	0.48	0.53	0.50	0.49	0.73	0.58
	general	0.86	0.87	0.83	0.86	0.76	0.81
Average		0.75	0.75	0.75	0.73	0.73	0.73

In this paper, we explored the use of the data mining approaches to automatically extract relevant terms (clinical signs and hosts) from a corpus of relevant documents and to automatically select relevant associations (between clinical signs and hosts) for monitoring the web for disease emergence. We were mostly interested in the terms describing clinical signs and hosts for known exotic animal infectious diseases. Considering their specificity, we got a highest number of specific terms (clinical signs and hosts) for SBV. Indeed, the relevant documents used for extraction of SBV terms described in detail the emergence of the newly discovered pathogen. In contrast, we got a limited number of specific terms (clinical signs) for BT because the relevant documents described the consequences of this disease for animal productivity, reproduction and lifespan rather than the specific clinical signs.

The statistical measures varied in precision of the ranking of the relevant associations, as well as in precision of retrieval of relevant documents from the web. The highest precision of the ranking was obtained with the statistical measures for CMI_{Web}^{AND} (SBV: 0.6) and for CMI_{global} (FMD: 0.6). The highest precision results for the retrieval of relevant pages from the web were obtained from the relevant associations for CMI_{global} (FMD: 0.93), and the lowest for CMI_{global} (SBV: 0.4; BT: 0.1).

The precision was highly influenced by the criteria selected to note the relevance of each association. Indeed, each association was evaluated based on the experts' answers (taking into consideration the highest notes) but also the semantic context of the terms in the association. For example, for SBV, most experts evaluated the congenital malformations and deformations in offspring (lambs, calves, goat kids) as relevant to characterize a SBV emergence. Accordingly, the associations such as deformed offspring / lambs and deformed offspring / calves – noted as relevant, retrieved a high number of relevant pages from the web. However, the associations such as deformed offspring / cattle and deformed offspring / sheep – noted as less relevant, also retrieved a high number of relevant pages. As these associations were highly ranked with the statistical measures, we do not exclude their value to build queries. These observations provide evidence that the statistical measures used in this work are a valuable decision-supporting tool to facilitate the evaluation of the associations.

The two evaluations we conducted for the ranking and the retrieval of relevant web documents for BT did not exceed a precision higher than 0.4 and 0.1, respectively. One reason for these results was the evaluation by the experts of the terms describing clinical signs – as low specific to characterize a BT emergence (these evaluations correspond to what is known in the literature). This assertion was confirmed by the low performance of the relevant associations as queries. However, the associations that had the highest precision to retrieve relevant documents from the web, such as: fever outbreak / sheep and fever / outbreak / cattle, livestock deaths / cattle, embryonic death / cattle, embryonic death / sheep, corresponded to what was described in the relevant documents – source of terms. For example, the majority of the articles discussed the mortality and reproductive disorders in sheep, goats and cattle

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for the 2014 BT epizootics in the Balkans, and the abstracts, discussed the BT clinical signs such as fever and weakness, reproductive disorders and abortions in ruminants.

The precision of our evaluations was also influenced by the number and type of associations used in the experiments. Indeed, in this first work, we only evaluated the representative associations proposed to the experts. In the future, we intend to evaluate all associations from all combinations of extracted terms (describing clinical signs and hosts). For example, we already evaluated 506 associations obtained with text mining for ASF, where the precision of ranking was 0.5 for CMI_{Web}^{AND} and 0.65 for CMI_{global}, and the average precision of retrieval of relevant documents from the web was > 0.83.

The expert elicitation method allowed us to benefit from the common knowledge of many experts. Most experts agreed on the specificity of the terms for each studied disease, and these evaluations corresponded to what is found in the literature. The experts also proposed new terms important for our future work. For example, for BT they proposed associations such as buccal lesions and ulcers, facial oedemas, cyanosis of the tongue and hypersalivation, principally in sheep and cattle. For FMD they proposed associations, such as lameness and hypersalivation, mortality in young animals, along with vesicle and ulcer lesions of the hoofs, mouth, tongue, and udder, principally in cattle. The proposals by the experts for SBV and ASF corresponded to the extracted terms with the text mining. In future, we intend to evaluate the expert proposals as queries.

Finally, we intend to build queries using the following associations - obtained with text mining:

1. For FMD, production losses, vesicular stomatitis and vesicular disease in cattle and pigs;
2. For BT, deaths and fever in cattle and sheep; and
3. For SBV, malformations and deformations in goat kids, lambs and calves, including deformed offspring in cattle, sheep and goats, as well as reproductive losses and abortions in cattle, sheep and goats.

We consider that the combination of text and web mining approaches and expert knowledge enable to identify relevant associations between terms describing clinical signs and hosts that can improve the detection of infectious disease emergence on the web. Our method is generic and can have applications to both animal and public health.

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ENDNOTES

[1] http://tubo.lirmm.fr/biotex/_

[2] http://textmining.biz/Projects/Songes_

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Section 3
Utilization and Applications

This section discusses a variety of applications and opportunities available that can be considered by practitioners in developing viable and effective Public Health and Welfare programs and processes. This section includes 12 chapters that review topics from case studies to best practices and ongoing research. Further chapters discuss Public Health and Welfare in a variety of settings. Contributions included in this section provide excellent coverage of today's IT community and how research into Public Health and Welfare is impacting the social fabric of our present-day global village.

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Chapter 27
An Investigation of the Application of New Media and Its Impact on Taiwan Health Communication

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ABSTRACT

Along with the rise of social networks and mobile media, health communication models also change with each passing day. Compared to traditional media, are the new media more effective to achieve the dissemination of health knowledge, or help people and patients to implement lifestyle adjustments? With the shift in modern lifestyles, social media have revolutionized health communication. The means and channels for health communication are now very diversified. In order to assess the influence of social media in health communication, this study analyzed the "1922 Prevention Expert", a campaign launched by Taiwan's Centers for Disease Control. In this study, the researchers collected data through interviews and a survey to investigate the use and outcomes of social media in health communication and explores how to use social media well in health communication.

1. INTRODUCTION

1.1. Research Background and Motive

Owing to the rapid advances in and popularity of mass media, the applications of new media have become more and more important. Based on historical contexts, people can clearly understand how

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radio broadcast affected print media and television. As mass communication steps into the 21st century, accelerated technological advancements have brought about massive changes. The Internet has extensive applications, and displays ample evidence of the new media revolution. Therefore, computers and Internet will once again change the face of communication, from its form to its content. The sprouting of the Internet, multimedia, satellite broadcasting and broadband in our society can be traced back to the mid-1990sInternet. Voice communication devices have also changed, from the old telegraph to landlines, followed by mobile phones and free Internet calls. The rise of personal entertainment (mp3 players and mobile phones) and personal Internet space (blogs and tweeting) show the shift in the way messages are moving and communicated across the world.

According to a survey on the use of broadband in Taiwan by Taiwan's Network Information Center, 16.95 million people had access to broadband in 2011, an increase of 730,000 people as compared to 2010's 16.22 million (Taiwan Network Information Center, 2011). The ever increasing number of Internet users shows the dependency of the modern generation on the Internet. This in turn spurs companies and corporate groups to invest resources into developing the Internet as a marketing platform and using mass communication media (e.g. official websites, official blogs etc.), for branding and customer communication. On the whole, communication has already developed from one-way to interactive, from mass to niche; the means and concepts of communication are evolving. As new media has gained users, it is now more than just a communication tool but also an important player influencing society. By many, it is viewed as the source for sharing knowledge, information, viewpoints, public opinion, emotions, and even rumors.

With the help of technological advancements, Social Networking Sites (SNS) are the new wave sweeping through the virtual world. SNS are basically web-based services, providing the means for users to build open or partially open personal information and a recommendation system linked to trust so as to share this information within a personal network (Boyd & Ellison, 2007). SNS provide users with a platform through which to interact over the Internet via instant messaging, forums etc. The interaction results in socialization and acts as a media; thus it is named social media. One of the most popular social media is Facebook. According to one online survey, Facebook had the most hits in the United States in 2010, surpassing even Google; it is also the most searched for keyword. Since June 2008, after Facebook launched its Chinese version, users increased immediately through the second half of 2009, a sharp incline in its membership. As of December 2011, Facebook users in Taiwan stood at 11.6 million, a staggering 71.92% of its total Internet population and 50.38% of Taiwan's overall population (Socialbakers, 2011). Statistics from InsightXplorer (2009) show a growth of 23.6% in Internet usage time from 2010 to 2011. Facebook accounted for most of the Internet usage time (27.01%) followed by Yahoo! (20.68%), Youtube (4.29%), Wretch (3.59%) and Google (2.58%). Facebook has shown a steady increase in Internet usage time, going from 17.77% in 2010 to 27.01% in 2011 (InsightXplorer, 2009). These statistics illustrate the changeover in mass media, especially the rise of social media websites.

As medicine and hygiene are fundamental to one's personal safety and health, the media being one of the most important sources of medical information has raised concern amongst public health and communication scholars. Many domestic and international research studies have shown that public health education through mass media has effectively changed health behaviors, lowering health risks and even death rates. Governments all over the world have worked the use of mass media into their annual budgets as a form of communication for health and disease information, thus raising awareness among people in order to achieve disease prevention and health promotion.

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Along with the changing mass communication environment, health communications have become more dynamic. Information channels are more diverse and complicated than before, thereby increasing the difficulty in managing these channels. The benefits of media are that it is fast, effective and has wide coverage in terms of communication. In addition, the ability to use both the traditional media and new media well will be critical in achieving a high level of effective health communication. In this new digital era, managing public relations through social media has become essential and effective. This will help organizations to engage in two-way dialogue that includes the younger generation, media and social groups. Hence, as the use of social media, such as Facebook spreads, non-profit organizations, which are usually low on resources, are able to fully utilize the outreach provided by social media. With the above background in mind, this study aims to find out whether the new social media is more effective than traditional media in health communication. Besides, it also explores how social media to achieve effective health knowledge communication, thus helping the public and the patients to make behavior changes and bring about the well-being of society.

1.2. Research Objectives

Mass media is one of the most important communication channels for health-related information. According to some research, other than word-of-mouth to spread health information, mass media, especially news reports, are regarded as an important mechanism for health promotion (Hsu & Hu, 1998). With the shift in modern lifestyles, social media have revolutionized health communication. The means and channels for health communication are now very diversified. In order to assess the influence of social media in health communication, this study will analyze the "1922 Prevention Expert" campaign that was launched by Taiwan's Centers for Disease Control. This study collected information through interviews and surveys to investigate the use and effectiveness of social media in health communication and explored how to use social media well in health communication.

Although the communication environment, as well as the healthcare system, in Taiwan differs from other countries in terms of policies; still, much importance is placed on health communication, just as in other countries. Despite seeing some results in health education and communication through the use of mass media in the country, there is a lack of systematic study on the effectiveness of social media for health communication. It is not only important, but also necessary, to understand how to best reach the target audience through the use of social media such as Facebook and to find out if such sites are achieving optimum results. This study aims to explore the:

1. Outreach and advantages among social media's fan groups
2. Best evaluation of social media as a channel for health communication
3. Satisfaction factors among Internet users for social media
4. Willingness of Internet users to engage in re-diffusion

1.3. Research Subjects

Aside from medical personnel engaging in diffusion of health communication, mass media is also an important propaganda pipeline. The past research has shown that mass media, especially news reports, is viewed as an important mechanism for health promotion (Hsu & Hu, 1998). In the United States, health

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and medical communication is divided into two large systems. The first one is for communication within the community itself and is formed by the medical community. This includes publishing in journals and writings by researchers, doctors and medical scholars. The other system is focused on communicating with the society beyond the medical community. This involves the use of mass media such as television, newspaper, magazines, radio, Internet, conferences, and brochures, etc to achieve health promotion and information dissemination.

In recent years, Taiwan's health institutions have placed greater emphasis on using media as a channel to communicate medical knowledge, providing healthcare information or explanation on medical procedures, or for marketing of certain medical procedures. These health institutions have learned from the service industry and have paid more attention to health communications and marketing. In 2009, the "1922 Prevention Expert" campaign was launched by Taiwan's Centers for Disease Control for H1N1 prevention education. Furthermore, it was a creative step in the use of social media for health communication in our country. This study chose to analyze "1922 Prevention Expert" in order to understand Internet users' reactions to social media being a health communication vehicle. The analysis will also assist to evaluate the effectiveness of the campaign, thus assessing the influence of social media on health communication.

2. LITERATURE REVIEW

2.1. Health Communication

The combination of health and communication can be traced back to 1970, starting in the United States, when communication scholars and heart surgeons began to use communication theories for public hygiene education and in long-term health promotion within a community. In attempts to apply concepts from social education to health communication, Jack Farquar made efforts to involve communication scholars to drive "Stanford Heart Disease Prevention Project" (SHDPP), which can be regard as a milestone. Thereafter, researchers tapped the scientific research ability of Stanford to evaluate the influence of mass media and human diffusion of information on losing weight, cutting down on smoking, lowering of blood pressure and lowering of lipid indexes within a community. Due to this being the first project involving both communication scholars and medical experts; SHDPP was seen as the beginning of modern health communication in the U.S.. However, during the implementation of the SHDPP process, there was no such term as "health communication". Not until the mid-1970s did the International Communication Association (ICA) officially start to use the term "health communication" (Atkin and Marshall, 1996).

With regards to the definition of Health Communication, Rogers (1996) has mentioned an easy and widely accepted definition, that Health Communication is communication of humans in relation to health issues. Moreover, in order to communicate health-related issues, Rogers added four levels that form the core of health communication. These four levels comprise: intrapersonal, interpersonal, group and mass. The level of intrapersonal is about one's physical and mental health; interpersonal level is about doctor-patient and family relationships; group level is about hospital-patient relationship and medical staff training; and the mass level is about the relationship between an audience and media agenda-setting.

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2.2. Internet and Health Communication

Before the emergence of the Internet, health inquiries mainly relied on hospitals, doctors or specialists organized for examination, treatment, nursing and applying of medicine. Predictably, this caused imbalanced doctor-patient relationships; the public must accept the doctor's diagnosis without discussing or questioning it. Since the Internet gained popularity, medical service structures are changing. Patients can obtain medical-related information through the Internet, thus increasing overall health knowledge, which in turn helps establish two-way communication and interaction with doctors. This is an enormous change: Patients can fully utilize medical information archives to obtain medical information, and are no longer ignorant and weak. According to survey results published in 2005 by the Pew Research Center, almost 80% of Americans used the Internet at least once a month to search health-related information. This was an increase of 25% from 55% in 2000. Among these 80%, the ratio of women was higher than men at 54%, and 34% of them college educated. The results indicated that 48% of the users were willing to act upon health suggestions given via the Internet and change their health habits. In addition, 92% were willing to refer to online health information while 81% felt that they learned new medical knowledge online. Besides, 47% of the people surveyed were willing to change existing health treatments based on suggestions found online; more importantly, 50% of the users used websites as their reference for consultation with doctors or as a second opinion (Pew Research Center, 2005).

Above research also shows that users regard medical websites as search tools. Almost 91% of the users used the Internet to check on disease-related information, with 26% of them checking on mental health information, 13% on weight loss and nutritional information and 9% checking about doctors, hospitals and drug information (Pew Research Center, 2005). Growing numbers of people accept health information gleaned from the net, and make it a part of medical consultation, thus producing a positive influence.

2.3. The Rise of Social Media

Recently, social networking sites are springing up plentifully; for this reason, it is important to understand what SNS exactly are? This study will use Facebook as an example. Facebook was established by Harvard student Mark Zukerberg in 2004. Facebook's initial objective was to link up the different societies at Harvard. It became deeply loved by people; thence got the attention of schools and corporations. Since then, it has become one of the fastest growing SNS. Facebook not only combines lots of communication tools such as instant messaging, emails, blogs, file transfer and forum discussion, but has also developed gaming applications with other companies, such as Restaurant City, Happy Pets, etc. Users can interact with friends through these games, building relationships and expanding their network. Facebook can result a number of advantages, even the U.S. president, Barack Obama, used the site's networking well to win the 2012 election. In addition, lots of companies have set up fan pages to utilize the massive reach of a site such as Facebook to promote their marketing strategies, thus bringing in the fame and fortune. In past research, it was postulated that users mainly use SNS for information sharing and developing new relationships. Ridings et al. (2002) indicated that information sharing or exchange can be divided into giving of information and accepting of information. Other researchers feel that information sharing is divided two sectors, namely self-presentation and relationship maintenance, achieved through sharing of personal information such as photographs, real names, address, email, cell phone number, marital status, sexual orientation, nicknames etc. (Acquisti & Gross, 2006; Dwyer, 2007; Dwyer et al., 2007; Levin et al., 2008; Hoadley et al., 2009).

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2.4. Social Media and Health Communication

Since the dramatic changes in the communication landscape brought about by Internet use and social media, it is critical to develop a better understanding of these technologies, applications, and their impact on health communication (Chou, Hunt, Beckjord, Moser, & Hesse, 2009). In the health communication community, there is a widespread assumption that recent advances in Internet technologies, such as social media, have changed the way and pattern of communication, including health-related communications (Gunther, 2008). Social networking sites have evolved from a preoccupation of high-school and university students to a mainstream form of social interaction that spans divisions of age, profession, and socioeconomic status. At many hospitals, medical students, residents, nurses, attending physicians, and service chiefs can be found linked to one another as active members of social networking sites (Jain, 2009).

The use of many forms of new media has become widespread among the U.S. and other countries (Abroms, Schiavo & Levebvre, 2008). Health professionals are making increasing use of social media (Thackeray, Neiger, Smith & Van Wagenen, 2012), while Facebook, Twitter, and MySpace are the most popular social media sites used for health promotion (Vyas, Landry, Schnider, Rojas, & Wood, 2012). Facebook not only holds a great potential for promoting health, but also breaks into the health domain (Zhang, He & Sang, 2013). It is mentioned that Facebook holds the potential to influence individuals' health behaviors by shaping their perceptions of social norms and the expectations that they set for themselves, or by improving their access to personally relevant information (Morris, Consolvo, Munson, Patrick, Tsai, & Kramer, 2011). Moreover, it is also indicated that social media sites serve as a growing source of health care information, while Facebook is the preferred source of health information for those who use social media sites for health purposes (Dolan, 2011; Park, Rodgers & Stemmle, 2011). In this regard, this study investigated the use and outcomes of social media in health communication and explored how to use social media in health communication.

2.5. 1922 Prevention Expert

The government sector in Taiwan officially first used social media as a promotional tool during the "1922 Prevention Expert" campaign. In the United States, top-ranked electronic government services use social media such as YouTube, Blog, MySpace, Facebook, Twitter, widgets etc. for their disease control centers to manage health information dissemination. Back in August 2009, this fresh and controversial method caught the attention of the American press, which influenced Taiwan to take a bold step in using social media as the channel for dissemination of H1N1 information. With the use of social media, "1922 Prevention Expert" established a semi-official platform to disseminate accurate and timely information for public reference; this represents a new kind of communication creativity. The Internet is filled with different sources, but the semi-official status of "1922 Prevention Expert" ensures information accuracy thus creating a chain of accurate information dissemination through its social media fans. H1N1 specially posed a threat to teenagers under 20 years of age. In order to prevent the infection from spreading, the organizers chose to use social media to publicize health information via a platform which is commonly used by the target group. The statistics of gender, age, fan growth, interaction, and use of other social networking websites in "1922 Prevention Expert" is shown in the following sub-sections.

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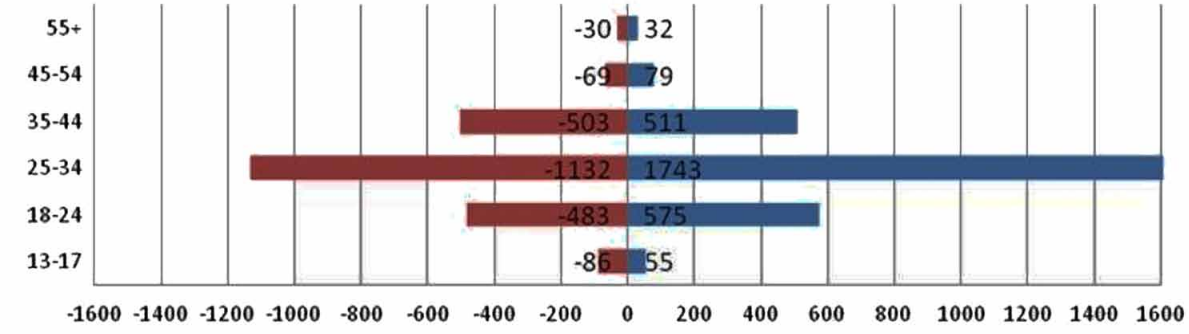
Figure 1. "1922 prevention expert" Facebook gender and age statistics. Source: Taiwan's Centers for Disease Control (April 2010).

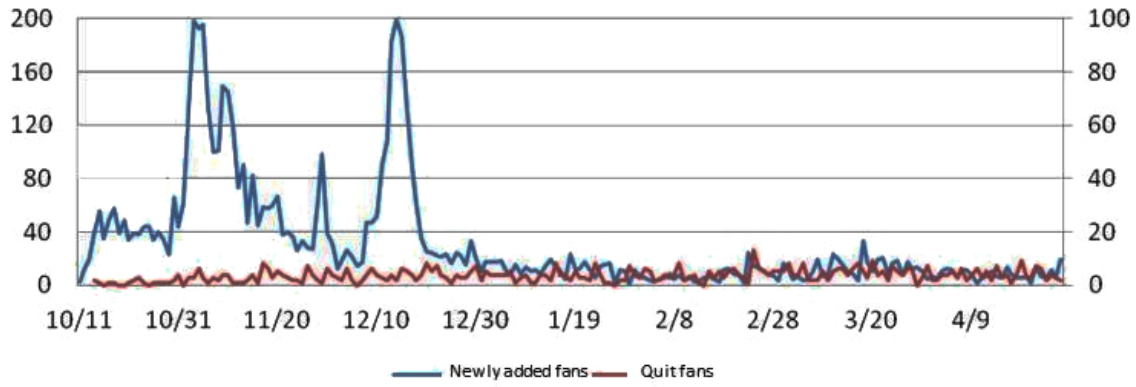


	13-17	18-24	25-34	35-44	45-54	55+
Female	55	575	1743	511	79	32
Male	-86	-483	-1132	-503	-69	-30

2.5.1. Gender and Age

The ratio of male to female fans for this group is 4:6, with more than 700 females. Amongst the total fans, 54% are aged 25-34, with 620 more females than males in this sub-group; the age 18-24 group accounts for 20%, while 19% are 35-44 years old with male to female ratio at 1:1 in this age bracket. The main reason for the bigger group of 25-34 years old is their status as first time parents, who are thus paying more attention to prevention and vaccination; and in this group, as females are the main caretakers of children, thus the ratio tilted toward females. The other groups show more even ratios.

Figure 2. 1922 Prevention expert" Facebook fans' growth chart. Source: Taiwan's Centers for Disease Control (April 2010).



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2.5.2. Facebook Fan Growth

After the "Influenza Prevention Expert" event in 2009, Facebook fan growth slowed due to Influenza Pandemic being under control, which influenced the felt need for related information. From January 1 2010, the number of fans increased by 7 daily, while the dropout rate held at 4, resulting in slight growth.

2.5.3. Facebook Interaction

From January 26 2010, Taiwan's Centers for Disease Control reported a decrease in interaction as the second wave of the pandemic died down, thus a decrease in public attention to pandemic issues.

Figure 3. 1922 Prevention expert" Facebook interaction chart. Source: Taiwan's Centers for Disease Control (April 2010).

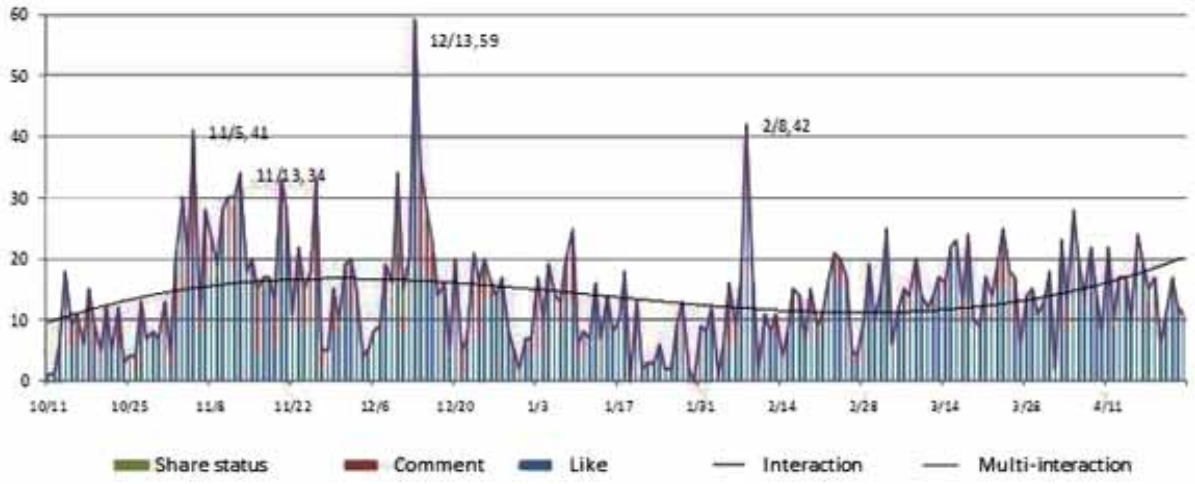
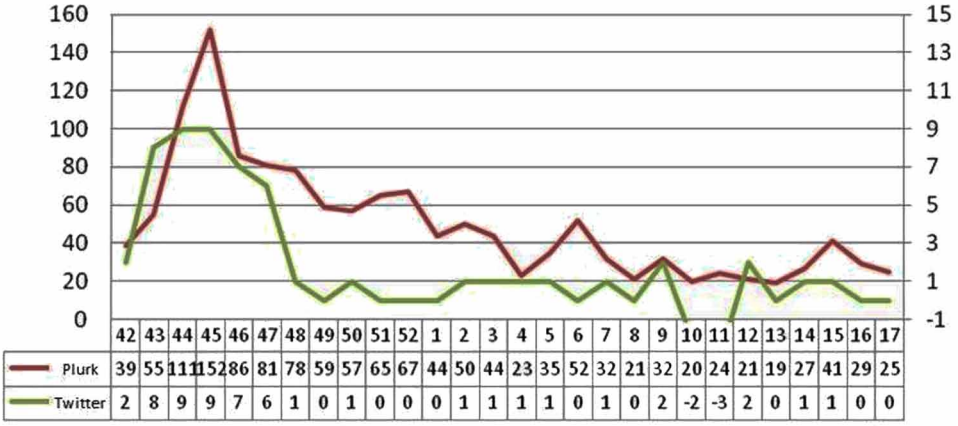


Figure 4. "1922 Prevention expert" Plurk and Twitter new friends chart. Source: Taiwan's Centers for Disease Control (April 2010).



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2.5.4. Plurk and Twitter Fans

The levels of growth for Plurk and Twitter remained stable at 20-40 new friends per week during the period late 2009 through the first quarter of 2010.

Other than public relation strategies for promotion, health communication needs to develop new communication channels and tools to keep up with the trends. The power of social media cannot be ignored and need to understand how to utilize this power. As "1922 Prevention expert" is Taiwan's first time to use social media to manage a public health threat: H1N1 pandemic, therefore, it can view this campaign as a benchmark for evaluation. As the H1N1 pandemic has died down, now the question is how effective can "1922 Prevention expert" be in spreading of information about all kinds of contactable disease. The above topics will be explored in this research.

3. RESEARCH METHOD

In this research, questionnaire and semi-structured interview were used for data collection. Descriptive statistics were calculated to analyze the data. The combination of qualitative and quantitative data presents effective evaluation results for the 1922 Prevention expert's Facebook fan page.

3.1. Survey of Fans

This research conducted a survey of '1922 Prevention expert' Facebook fans during January 2011 for one week. Below are the survey questions:

1. Have you ever interacted with 1922 Prevention expert before?
2. Are you satisfied with 1922 Prevention expert?
   2-1. What are your reasons for any dissatisfaction?
3. Are you willing to recommend 1922 Prevention expert's page to friends?
4. Have you ever visited 1922 Prevention expert's blog?
   4-1. If you have, are you satisfied with the content of the blog?
   4-2. What are your reasons for ant dissatisfaction?
5. Suggestions for content.

3.2. Interviews with Experts

In addition to the quantified survey mentioned above, this research also integrated quality viewpoints in order to avoid data under-representation. This involved examining the effectiveness of 1922 Prevention expert's Facebook fan page through in-depth interview with experts on health prevention and health information.

Moreover, this study used semi-structured interviews with experts based on the experts' prior knowledge in three sections. In descending order, these sections were: gathering experts' opinions and determining any problems, finding the cause of the problems and possible solutions and proposing new ideas. To reach the most effective interview, the researchers interviewed 5 experts who are familiar with disease prevention knowledge, news and media to evaluate 1922 Prevention expert's Facebook fan page.

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The interview outline as follows:

1. What are the advantages and disadvantages of using social media for health communication?
2. Where do you obtain your knowledge on the current use of social media for health communication?
3. What are the main difficulties faced when using Facebook fan pages and why?
4. What are the advantages and impacts of using Facebook fan pages?
5. How can the effectiveness of using social media for health communication be evaluated?
6. Do you have any suggestions for using social media for health communication?

4. RESULTS

4.1. Survey Results

In this study, 378 survey forms were collected and the results are summarized as follows: 15.3% suggested a more lively and creative promotion channel, 9% suggested more lively methods; still another 7.6% wanted more concrete content. Three orientations were covered in the results, including promotion, execution, and content. In terms of promotion: (a). The quality of the promotion should be improved; (b). There should be more relevant activities; (c). Due to lack of relevant information, it must dissemination in daily life; (d). There should be advertisements in television, magazines or newspapers. In terms of execution: (a). The expression through animation is good; (b). There should be more use of animation; (c). Too many words are tiring on the eyes. However, cute animations will make people not only interested but also willing to visit and obtain related information. In terms of content: (a). There should be more examples for illustration e.g. How to improve home environment?

4.2. Interview Results

The researchers interviewed Taiwan's Centers for Disease Control public relations senior executives, staff, and the organizers of 1922 Prevention expert campaign.

Question 1: What are the advantages and disadvantages of using social media for health communication?

This question aims to understand the experts' opinions on health communication practices, besides exploring evaluation of the advantages and disadvantages of the application of social media and traditional media.

According to the interview, experts grasp the advantages and disadvantages of traditional media and social media quite clearly. Social networking media can spread the message of health information immediately, reach the target object, and save transmission costs, which are considered as important advantages. The advantages of traditional media have not been neglected: Traditional media has a certain reputation; therefore it is still regarded as a formal and reliable dissemination of information in the pipeline. Achieving a good combination of these media may maximize the dissemination effectiveness.

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Question 2: Where do you obtain knowledge on the current use of social media for health communication?

This question is set to understand expert health communication practices in order to promote the application of social media in the current situation. One of the advantages of social networking is that it can be updated immediately; the content of popular sites is renewed almost every day. Experts reflected that this is an enormous challenge: To manage virtual community media well, the network should provide the user freshness, which requires frequent updates.

Question 3: What are the main difficulties faced when using Facebook fans pages and why?

On this topic, experts agree that the operation and management required for good page content requires a lot of creativity, manpower and time. One of the biggest challenges is that communication via Internet requires quick updates and immediacy. It is attractive, but also causes stress and difficulty if resources or manpower are limited.

Question 4: What are the advantages and impacts of the use of Facebook fan pages?

Experts pointed out that the differentiation of social networking sites is able to transcend the barriers of mainstream media. However, the mainstream media do not provide layout, but the immediacy of Facebook fans group offering some important health or medical information to the target audience has become an operational advantage. This information spread generated by the proliferation of sharing leads to effectiveness that is often beyond what was originally expected. In fact, according to the international marketing organization, Miniwatts, survey at the end of June 2011, Taiwan's Internet penetration rate of 70.0% is second only to North America's 78.3%. If the region regional statistic for the average online rate is valid for Taiwan, it has more Internet usage than Asia overall (23.8%), Europe (58.3%), Africa (11.4%), and Oceania (60.1%). Among the 12 major Asian countries, the penetration rate of China stands at number four, behind South Korea 80.9%, Japan 78.4% and Singapore 77.2%. As for growth rate, Taiwan's Council for Economic Planning and Development pointed out, that since 2000, Taiwan's Internet population has increased steadily, and from 6.26 million in 2000, to 16.15 million in 2011, increased about 1.6 times (Wang, 2011). That is to say, spread of healthcare information through the Internet cannot be neglected.

Question 5: How can the effectiveness of using social media for health communication be evaluated?

This question aims to understand the perspective of experts in health communication practices regarding promotion of the benefits of social media, and how to assess problems of effectiveness. They note that Facebook and YouTube systems provide a number of management tools for quantitative assessment. Social media has an important value in sharing experiences with people, enhancing users' awareness, goodwill, and trust. Reputation benefits may be intangible, but can be powerful in the long-term.

Question 6: Do you have any suggestions for the use of social media for health communication?

The experts generally agree with the positive benefits of social media for health communication, that it will continue to exert its influence.

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5. CONCLUSION AND SUGGESTIONS

In this study, the researchers raised four questions: (1) In what situations is social media being used for health communication in Taiwan; (2) What is the status of its use; (3) How is the effectiveness of social media use in this context evaluated; and finally, (4) What is social media's impact on health communication. The first section summarizes the research results; the second section covers the findings arising from this research; the third section discusses the limitations of this research, and the last section presents suggestions made for future research.

5.1. Research Conclusions

This research regards that using social media as a creative channel for health communication has obtained the positive feedback from the participants. Besides, instead of using only traditional media, the government's willingness to develop interactive channels by using social media meets with positive reactions. According to the example of "1922 Prevention Expert," without any help from traditional media, this campaign still attracts users to join its fans page. Users can link with the campaign through all kinds of Internet-information sharing channels, such as search engines, recommendations from friends and family, BBS and forums etc, rather than from traditional media such as television and newspaper. Obviously, the difference between managing social networking sites and traditional media is that the users expect interaction and not just one-way dissemination of data. Most users are willing to spread information when they feel it is useful and they have interacted with it. Solis and Breakenridge (2009) mentioned that in the social media domain, dialogue is key; only active and passive listening can bring meaningful relationships. Based on the findings in this research, if Taiwan can combine different kinds of communication tools to satisfy different target audiences, then the country can build a new pattern for health communication, thus achieving a high level of health promotion and well-being for people.

Furthermore, the researchers discovered there is an information overload in this era; thus all industries exist symbiotically with communications. To get the best results out of this relationship depends on both parties respecting and understanding each other. Although the main focus of this research is on the use and impacts of social media, it is also indicated that effective health communication requires the knowledge of all communication tools, and each tool has its own pros and cons. For example, a televised message containing sounds and lighting effects, prompts immediate reactions from the audience, thus engaging them. For this reason, television is superior to newspaper or radio. However, if an influential radio message could be combined with television, it might be much more effective by increasing television media's impact. Nevertheless, print media (magazines, newspapers) are much better than voice media (radio) or visual media (television), especially when the information is complicated. That is to say, if we make good use of both traditional media's strength and social media's coverage and sharing abilities, health communication can spread broadly with great results and result in better well-being among people.

5.2. Research Limitations

Although this research is based on the examination of Internet users and experts, the '1922 Prevention Expert' campaign is unique in nature; it cannot represent the whole impact of social media on health communication. In addition, this research cannot indicate all levels of evaluation, therefore it is also limited to descriptive results of effectiveness. This study is biased towards the Centers of Disease Control,

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as the expert participants may be affected by their status; so it does not represent a more complete and objective evaluation. If this line of research is carried on in the future, participants should be extended to the public or media.

5.3. Research Suggestions

According to this research, although "1922 Prevention Expert" can be regarded as milestone in using social media for health communication in Taiwan, there is much room for improvement. First of all, even although public policies are different from private sector marketing, policies can be executed with the essence of "Branding" and "Service". Health communication should not just focus on building distinguishing features and service but also concentrate on branding and marketing strategies. The researchers in this study propose that health communication can identify the needs of users, and concentrate resources on building unique networks. Only in this way, can health communication stand out in this era of information overload.

In this study, the authors explored the effects on traditional media and social media, as both have advantages and disadvantages. However, social media is not a passing fad. Rather, it is actually symbolic of human's need for information sharing and receiving. The government sector is more credible than other website hosts in disseminating health information. Thus, the government can establish a system to manage information and handle crises in a manner that eases the pressure in society. At the same time, policymakers and bureau directors must understand that the burden that comes with the social media is different from that related to traditional media.

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Chapter 28
Extending Care Outside of the Hospital Walls:
A Case of Value Creation through Synchronous Video Communication for Knowledge Exchange in Community Health Network

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ABSTRACT

In healthcare settings knowledge exchange among important stakeholders such as doctors, family and patients, and other care providers is a critical imperative. However, such a community modelled approach is missing, limited in scope or its business value not well understood. In this study, the authors illustrate the value potential and subsequent development of a business model for knowledge exchange within the healthcare delivery model outside a hospital setting. Specifically, they illustrate how Synchronous Video Consultation with social media features, in a staged approach, can support knowledge exchange among a network of community health care professionals who address global health disparities and sustain this exchange through resource generation. The authors discuss the contributions and implications of the proposed framework towards value creation in a collaborative setting in general and suggest opportunities for future research.

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INTRODUCTION

Community health information networks (CHIN) are fundamentally community and payer-centric means to healthcare prevention assessment; albeit with higher patient engagement through a collaborative support model. Two elements constitute a CHIN's foundation. First, a centralized knowledge platform and repository that contains individual level demographic, clinical, and eligibility information for a geographically defined community of stakeholder organizations (e.g. local agencies, payers, employers, and researchers). The stakeholder organizations are also consumers of the data for evaluation, diagnostic, or treatment activities and similar purposes (Rubin, 2003). Second, CHIN involves the use of a platform to enable both the community and patient to be actively engaged in the care delivery and management through collaboration, education and knowledge dissemination.

A number of CHIN models have shown success such as an Iowa based community health network (Japsen, 1996) and Wisconsin based community network (Payton & Brennan, 1999). Existing studies note that CHINs are emerging as successful in providing a platform for information collection, storage, archival and access (Vest & Gamm, 2010). Indeed, some CHINs have, over time, became regional health information organizations or health information exchanges (HIEs) and started supporting a wider community by efficiently providing information exchange services to participating stakeholders. The success of CHINs and later HIEs in the exchange of aggregate care related information has not translated into collaboration in support of care at an individual patient level. Hardly any successful CHINs today support collaboration among patients and care providers synchronously as and when needed in the continuity of care, especially when a patient is not within the confines of a hospital. While lack of trust in safeguarding patient information and limited or no financial incentives are partly to blame for not addressing patient care outside of the hospital, community can play an important role in addressing such care and leverage the best form CHIN efforts.

The role of community in support of pre and post-hospital care is critical for two reasons: First, although the current US healthcare delivery system (we call it as "inside hospital walls") is efficient and effective enough to provide "sick care", understanding its impact outside the hospital walls remains a challenge. For example, the current health system is not able to motivate a pre-diabetic patient to run a mile an hour or adhere to a diet control plan. Similarly, the current system does not provide emotional support to a cancer patient who has undergone chemotherapy with side effects that have a bearing on the physical and emotional state of the patient. A patient post-surgery may be able to reduce pain with pain-killers, but need avenues to discuss and get support for the emotional pain associated with the side-effect of the pain-killers or even the surgery itself. Similar examples reflect the type of emotional and cognitive states of patients, and disease management and treatment needs outside of a hospital will become critical if continuity of care is to become a key goal of CHINs. Hence, creating a platform to support a current patient (post-discharge) or a future patient (through prevention efforts) through community engagement is essential, if CHINs are to become relevant at an individual patient level.

As much as CHINs have a social objective to extend the care outside of the walls of the hospitals, there is no incentive in the current US healthcare to such extended care. As a result, many CHIN initiatives fail to sustain their work, specifically, after a period when the social objective faces the challenge of sponsorships or additional grants than the initial funding source. In this context, the avenue to generate revenue from operations or activities is crucial for the CHINs. Thus, as much as CHINs can shape their avenues of making money and plan their activities to meet the revenue generation goals, they will be able to go long way in providing service to the community. Studies have suggested that inappropri-

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ate design of business models is a key explanation for the failure of the exchange platforms and similar entities (Gosain & Palmer, 2004). Following the same arguments, development of CHINs for patient level support outside the hospital need a business model that can be helpful to sustain the CHINs within their realm of social objectives. Else, like many other badly formulated entities, they will struggle to accrue revenue and sustain operations after the founding years. In general, 30 to 50 percent of new ventures reach a sustainable stage (Parker & Belghitar, 2006; Reynolds, 2007), with the failure rate being high for most of the social business ventures. A business model is fundamentally a roadmap that aligns a firm's technical potential with market-based revenue generation opportunities in order to realize an economic value (H. Chesbrough, 2007; Teece, 2010). For a venture with a social goal, achieving the economic value is difficult. Given the focus of CHINs is information exchange, prior studies note that aligning a set of services involved in an exchange-based business with revenue generating opportunities is extremely difficult and often leads to failures (Ganesh, Madanmohan, Seshadri, & Seshadri, 2004; Koch, 2002; Ray, Barney, & Muhanna, 2004). In other words, there is a significant gap in research on how to develop a successful business model to sustain the work of a CHIN (for a review, see Zott, Amit, & Massa, 2011), especially when such a network is set up to support the needs of a patient outside the hospital walls using participation from a number of community care providers.

In this paper, we will propose an IT-enabled business model for CHINs and discuss the use of a specific IT (synchronous video communication (SVC) with social media features embedded) in support of collaboration among a community of care providers outside a hospital in a global public health care domain. Next section will discuss prior research on the use of IT in support of knowledge exchanges within a CHIN and the characteristics of a business model that can support such exchanges. Section three discusses the research framework and section four discusses the methodology used to develop the IT artifact (SVC with Social Media) in stages to support the needs of a CHIN involved in global public health and the business model set up to sustain its operations. The last section provides an analysis on how such models can be extended to knowledge exchanges used in other settings and provides concluding comments and directions for future research.

LITERATURE REVIEW

CHIN models, designed to engage patients and community in support of patient care outside a hospital, have to support various types of IT-enabled knowledge sharing using a sustained business model. This section looks at prior research on the characteristics of knowledge sharing networks in health care and the nature of alignment needed if these networks are to support the goals of CHIN.

Knowledge Sharing and Networks in Healthcare

When it comes to knowledge exchange in community networks, the notion is conceptually new in healthcare system. Two challenges are involved in developing such a network. First, although knowledge exchanges existed in healthcare, such as doctors' offices, hospitals, and laboratories share patient information; but extending these exchanges to the community wide efforts is not seen previously. Second, non-digital forms of knowledge exchanges such as paper based, fax based or snail mails exist, but digital forms of knowledge exchange is a unique proposition in recent times. Nevertheless, digitized knowledge exchanges are common in other industries such as finance, banking, telecommunications and

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airlines (Goldfarb, Pfarrer, & Kirsch, 2005). Learning from other industries and with the experience of accelerated adoption of health information technologies (HIT) in the United States healthcare (Agarwal, Gao, DesRoches, & Jha, 2010), digital knowledge exchanges with community wide involvement can potentially increase the value of HITs in increasing efficient and effective care delivery by health care organizations (Abraham & Junglas, 2011; Kohli & Kettinger, 2004; Menon, Lee, & Eldenburg, 2000). Indeed, in support of the argument that CHINs can enable such care delivery, more than 300 health exchanges in the US have surfaced in the last decade. At the same time, much like many business-to-business exchanges that emerged at the turn of the century, the health exchanges have been unable to construct the right business model, and led to several failures or non-sustainable businesses (Ganesh et al., 2004; Gosain & Palmer, 2004). CHINs are modelled to extend the concept of both physical and social media for community sharing of health information. In one perspective, CHINs are social media platform to generate, share, receive, and gather information and knowledge (Kamel Boulos & Wheeler, 2007; Kaplan & Haenlein, 2010). Social media are "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and allow the creation and exchange of user generated content" (Kaplan & Haenlein, 2010). For social media to be effective, the media selection and knowledge interaction framework has to support the CHIN stakeholders by enabling sharing of health care related information (Goffrnan, 1959; Short, Williams, & Christie, 1976).

Existing literature points to several limitations of social media for health care related communications. Moorhead et al (2013) points out that quality concerns, lack of reliability of information, and blurred lines between content producer and user are three major limitations. Beyond these limitations, the most important one is the "information overload" and "lack of validity of the information" as this poses a bigger challenge to the use of the social media for meaningful purposes (Adams, 2010a, 2010b). Lack of guidelines may lead to public not correctly applying information found online to their personal health situation, possibly leading to adverse health impact or consequences (Freeman & Chapman, 2007). There is limited evidence on the efficacy of online communities in their ability to support effective delivery of health related information to patients and positively impact people's health (Colineau & Paris, 2010). All these contribute to providers not actively participating in online social health networking portals (Kim, 2009). In summary, if CHINs in health care are to be successful, they need to support a knowledge exchange architecture that can support multiple actors, playing multiple roles exchange knowledge in public and private mode, all in support of patient care outside a hospital.

Business Model and Community Health Networks

Several studies conclude that business models can be efficacious in defining new organizational structures, customer-centric value propositions, and competitive strategies. Table 1 provides a list of important studies around the concept of business models.

Value creation for customers has been variously alluded to as a 'value proposition', 'creating value network' or 'value configuration' frameworks (Johnson et al., 2008; Osterwalder et al., 2005). Some suggest that business models play a more significant role for entrepreneurial firms or initiatives in identifying and establishing organizational design, resource structures, value structures, and transitive structures; and creating opportunities for their value creation mechanisms (George & Bock, 2011; Teece, 2010).

Prior research suggests that some focal elements that need to be emphasized while designing a business model. First, studies emphasize that the revenue model is a central element in most prior work, albeit referred to with different labels such as revenue logic, capture value, profit formula or return for

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Table 1. Review of recent studies on business models

Citation	Scope of Study	Business Model Concepts Used in the Study	Key Elements of Business Model Discussed in the Study
(George & Bock, 2011)	Review article based on literature and interview of managers to frame business model to entrepreneurial context.	Definitions for business models vary widely, incorporating organizational narrative, processes that convert innovation into value, recipes for firm activities that incorporate organizational design and strategy, "flows" of information and resources, and designed structures such as the firm's set of boundary-spanning transactions	• Resource structure • Transactive structure • Value structure
(Teece, 2010)	Summary article describing preliminary criteria for business model design.	• Business model articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers • It also outlines the architecture of revenues, costs, and profits associated with the business enterprise delivering the value	• Customer value proposition • Mechanisms for value creation through revenue and profits • Competitive strategy
(Zott & Amit, 2008)	Empirical study examining the fir between a firm's product market strategy and its business model.	• Business model is the structure, content, and governance of transactions between the focal firm and its exchange partners. • Business model represents a conceptualization of the pattern of transactional links between the firm and its exchange partners	• Transactions: content and structure and governance • Linkages with exchange partners for transactions
(Johnson, Christensen, & Kagermann, 2008)	Article based on case studies and examples suggesting business model as a strategy to bring change in organizations	A business model consists of four interlocking elements (customer value proposition, profit formula, key resources, key processes) that taken together create and deliver value	• Customer value proposition • Profit formula (revenue model, cost structure, margin model) • Key processes (metrics, rules & norms)
(Zott & Amit, 2007)	Empirical study exploring the impact of efficiency-centered and novelty-centered business model design on performance of entrepreneurial firms.	• A business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities. • A business model elucidates how an organization is linked to external stakeholders, and how it engages in economic exchanges with them to create value for all exchange partners	• Transactions: content and structure and governance • Design of business model to generate value
(Voelpel, Leibold, Tekie, & von Krogh, 2005)	Article based on case studies and examples suggesting business model as a tool to enable innovation.	The particular business concept (or way of doing business) as reflected by the business's core value proposition(s) for customers; its configurated value network to provide that value, consisting of own strategic capabilities as well as other (e.g. outsourced/allianced) value networks; and its continued sustainability to reinvent itself and satisfy the multiple objectives of its various stakeholders	• Customer value propositions • Value network configuration • Sustainable returns for stakeholders
(Tikkanen, Lamberg, Parvinen, & Kallunki, 2005)	Review article focused on providing a generic framework for business model and link it to managerial cognition.	Business model is a system manifested in the components and related material and cognitive aspects	• Material aspects: strategy & structure, network, operations, finance & accounting • Belief system: reputational rankings, industry, boundary beliefs, products
(Morris, Schindehutte, & Allen, 2005)	Review focused on providing definition, nature, structure, and evolution of business models.	A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets	• Factors related to offering • Market factors • Internal capability factors • Competitive strategy factors • Economic factors • Growth/exist factors

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Table 1. Continued

Citation	Scope of Study	Business Model Concepts Used in the Study	Key Elements of Business Model Discussed in the Study
(Shafer, Smith, & Linder, 2006)	Reviews of literature to identify and classify the components of business models.	Business model as a representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network	• Strategic choices • Value creating resources
(Osterwalder & Pigneur, 2003; Osterwalder, Pigneur, & Tucci, 2005)	Review articles on the understanding, usage and potential of business models in a firm.	• Business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm • Business model is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams	• Value proposition • Value configuration • Core competency • Partner network • Cost structure • Revenue model
(Magretta, 2002)	Review essay on relating business model to practical strategy regarding why business models matter.	Business model answers the questions such as who is the customer, what does the customer value, how do we make money in this business, what is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost	• Value to customer • Revenue logic • Economic logic
(Chesbrough, 2007; Chesbrough & Rosenbloom, 2002)	Case studies and examples from corporations to demonstrate how business models can be helpful in capturing value from innovation.	• Business model as an construct that mediates the value creation process • Business model performs two important functions: value creation and value capture	• Cost structure and profit potential • Competitive strategy • Target market • Revenue mechanism
(Amit & Zott, 2001)	Inductive data analysis from 59 American and European public traded corporations involved in e-business.	Business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities	• Transaction: content, structure and governance of transactions • Design of value chain

stakeholders (Chesbrough, 2007; Johnson et al., 2008; Magretta, 2002). Second, studies also converge on the notion that the structure of the firm that influences strategic decisions, choices and principles is a core element of the business model design, implementation, and execution process (George & Bock, 2011; Shafer et al., 2006; Tikkanen et al., 2005). Third, studies argue that to the degree that the business model is a reflection of the firm's core value propositions for customers, if configured appropriately, it can help the firm to achieve continued sustainability and satisfy the objectives of multiple stakeholders (Amit & Zott, 2001; Voelpel et al., 2005).

If a CHIN were to use an IT enabled platform to support patient care outside a hospital, such a platform has to be a strategic tool and help CHIN negotiate, coordinate and transact with the suppliers, partners, collaborators, and customers (i.e. support various types of knowledge exchanges). Further, the business models associated with CHINs have to make special efforts to seek alignment between IT and business, manage IT and health care environment dynamics, and look for niche positions to create value (Osterwalder & Pigneur, 2003; Osterwalder et al., 2005). The research question hence calls for the development of a business model around goals established by CHIN in support of patient care outside the hospital wall and select the right IT platform to support this goal.

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RESEARCH FRAMEWORK

Synchronous Video Communication as the IT Platform for the CHIN Business Model

In existing information systems research, media synchronicity is defined as "the extent to which a communication environment encourages individuals to work together on the same activity, with the same information and at the same time; all to support shared focus." (Dennis, Valacich, Speier, & Morris, 1998). Such a shared focus on patient care is highly relevant in the health care, especially when multiple community stakeholders outside the hospital are involved in support of patient care. As media synchronicity theory (Dennis, Fuller, & Valacich, 2008) proposes, to reach such a shared focus in a group setting two primary processes become important:

- **Conveyance:** The exchange of information. Here, not all participants need to agree on the meaning of the information or even focus on the same information at the same time. Low media synchronicity is generally preferred for the conveyance process;
- **Convergence:** The development of a shared meaning to information. Here, all participants must work together to establish the same meaning for shared information. High media synchronicity is generally preferred for the convergence process.

The synchronous video communication (SVC) that supports social media interactions for both conveyance and convergence is proposed here (see Figure 1) in support of knowledge exchanges needed to enhance shared focus as well as allow varied types of communication at different points of time among community care providers. There are a number of other technologies that can provide synchronous video communication services, albeit not within a social media platform oriented towards healthcare. Tools such as Skype, Voodoo, Google Chat with Video do facilitate multi-party video conferencing features. While it can be argued that social media users can always use these "external third party" solutions for synchronous communication; their use in a dynamic health care knowledge conversation context with privacy of conversations being paramount, is unclear. Either in a single patient-physician context, patient-patient context, or other combinations there-of, a well-integrated system that supports secure communication and knowledge sharing is important in today's evolving health care settings. For these reasons, an SVC artifact, designed with social media communication support, will be used in support of this research. The technical design features of this artifact were discussed in Park et al. (2014). In this study, our scope is to focus on the use and implementation of the SVC artifact in the CHIN model, and highlight the role of business model to sustain the CHINs. Thus, this study differs from the earlier study in that the earlier study emphasizes on the SVC design as a technical artifact, and this paper uses the design framework for use in the case of global public health in stages, with the exploration of business models to sustain the efforts.

Next section will discuss the methodology used in this research to align the SVC enabled IT platform to support knowledge exchange goals of a CHIN being developed for patient care in a global public health domain.

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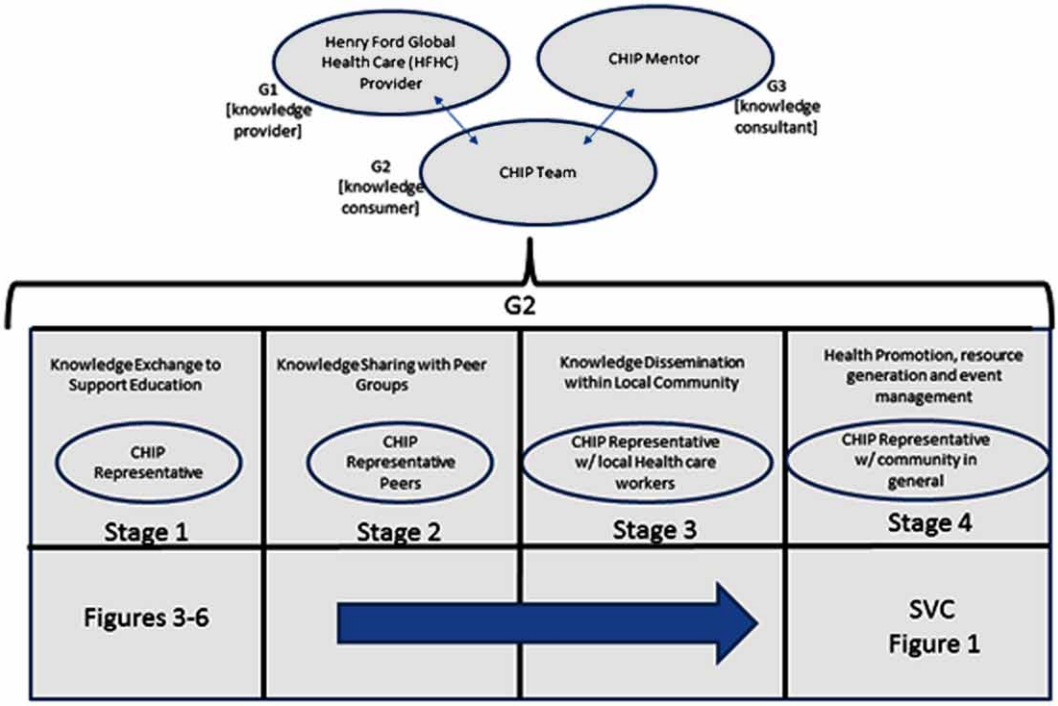
Figure 1. Staged model for developing support for CHIP team members



RESEARCH METHODOLOGY

In this conceptual study, our research methodology is focused on the crafting parameters of an appropriate business model for CHIN-SVC framework and plausible validation methods. First we discuss an application enablement of the CHIN model in a global public health scenario, and use that specific case to establish the business model and value creation criteria for CHINs.

The Case of CHIN-M: Application of CHIN and SVC in Global Public Health

The CHIN Model (CHIN_M) supports a unique program called Community Health Innovator Program (CHIP), being developed by Henry Ford Global Health Initiative. CHIP empowers community leaders to identify health challenges and address these challenges through innovative local ("on-the-ground") and global ("adaptable") solutions. CHIP is grounded in the theory that homegrown health promotion has the most positive outcomes. Often, community residents are less supportive of reforms when they view them as being externally imposed (Parke & Fails, 2014). On the other hand, when health challenges are identified locally and CHIP leaders obtain the support of local communities to create innovative solutions, community residents are more likely to embrace health behavior interventions (Chambers, 1994). Therefore, by promoting local health innovations that provide low-cost health and social benefits to marginalized and vulnerable communities, CHIP proposes novel avenues for wider and more inclusive participation in global health strategy design.

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Through CHIN-M, CHIP leaders are equipped with the skills and tools necessary to work with and identify barriers to maximizing the effectiveness of community health workers, and develop locally-relevant interventions. In addition CHIN-M is designed to foster mentoring and professional networks, which enable both intra- and inter-national exchanges of information and strategies to address local health challenges. In low- and middle-income regions CHIP leaders frequently lack access to low-cost training, adequate technologies, funding initiatives, and multi-sectoral networks who are interested in facilitating and adopting social innovations. Current social innovation frameworks and incubators have varied outcomes, but often lack required inputs for success. The CHIP program was designed to address these current limitations and its structure evolved through a collaborative effort between the global health Program Team and an International Advisory Board (IAB), composed of practitioners, academics, and community members from Detroit, Haiti, Ghana, and Nepal. The IAB identified CHIP as an approach, which is needed, feasible, and can be integrated within local infrastructures.

CHIN-M brings together a variety of participants including: CHIP leaders, the Program Team, the International Advisory Board, Mentorship Teams, and Community Health Workers. The leaders are community-identified individuals who work with CHWs and utilize a range of skills (for example, skills in business, technology, health, education and community organization) to impact health outcomes for communities. The Program Team is an interdisciplinary global health team aided by its International Advisory Board. The multi-stakeholder Mentorship Teams are composed of in-country Mentors from academia, business, government, healthcare, and other disciplines as needed.

The CHIN-M is laid out in several stages (see Figure 2). Initially, the Program Team and International Advisory Board identify both Mentors and leaders in each country, as well as build curriculum for the leader trainings and launch a web portal and supported interactions using mobile technologies. Next, after receiving training and being linked with a Mentor, the CHIP leaders meet with CHWs to conduct a community health needs assessment and learn about barriers that the community health workers within that community experience. In the third stage, the leaders connect with the Program Team, the Mentor Team, and Innovators across sites, to engage with the community to innovate possible solutions to locally-identified barriers and health challenges. As we move to stage four, the Teams help connect CHIP leaders with tools to develop the health solutions and generate resources to successfully implement and sustain these solutions. In other words, the CHIN-M grows in sophistication from a simple knowledge exchange platform to knowledge interaction, knowledge sharing and lastly information broadcasting and knowledge dissemination, by leveraging the use of various IT-enabled discussion and other social medial platforms.

Details of the CHIN-M portal development are discussed in another study (Tanniru et al., 2015). The current state of this pilot effort is as follows: Two teams in Detroit and Haiti; after completion of the pilot, will evaluate the web portal through an iterative process. The central purpose of the pilot will be to test the functionality of the CHIP web portal and assess the feasibility of using this technology in both a developing country (Haiti) and a low-income region of the United States (Detroit). The web portal will be evaluated for: (1) Logistical issues for program implementation and participation; (2) Maximized accessibility for LMIC users; (3) Ease of website navigation; (4) Ease of accessing and downloading course content; (5) Usefulness of course content; (6) Usage of the web platform components; (7) Communication issues (e.g. between Innovators, Mentors and the Program Team); and (8) Similarities and differences in issues across sites. Based on feedback, the Stage 1 phase of the CHIP web portal will be completed and Stage 2 will begin. At the same time, the teams in other countries (Nepal, Ghana) will be provided access to the web portal for further evaluation of the technology as well as some of the

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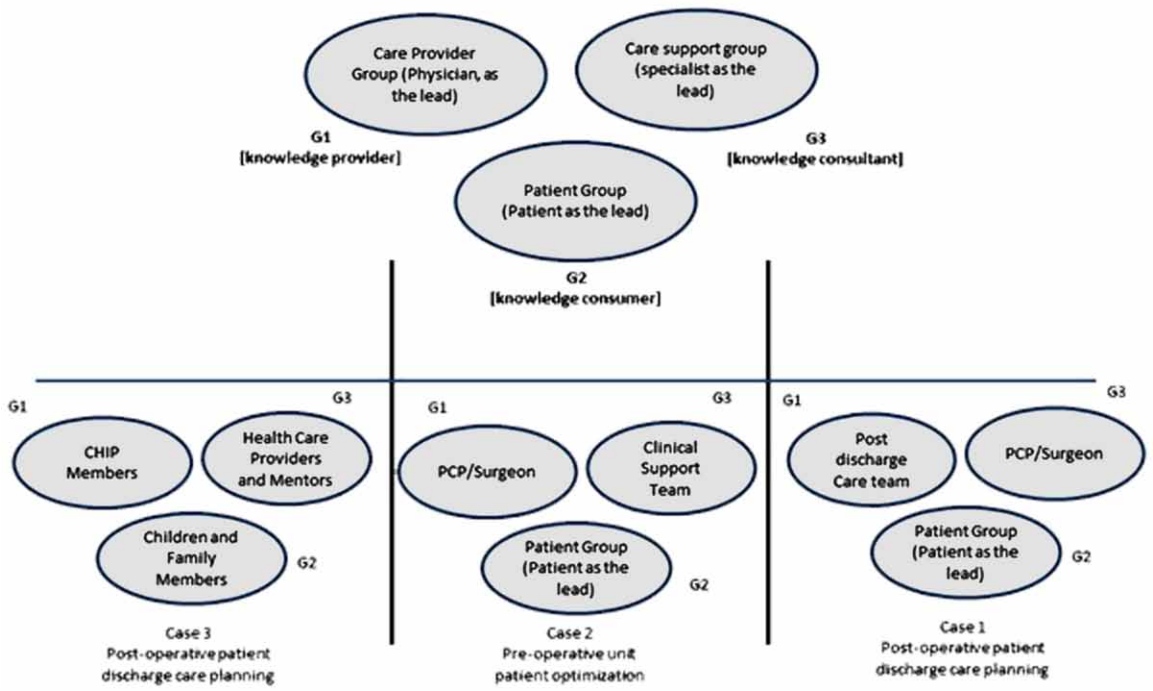
Figure 2. Knowledge exchange in three different case scenarios



process/work-flow challenges faced by the global community healthcare workers. It is anticipated that the successive stages of implementation and CHIP leader learning will continue in 2015.

In summary, by allowing increased communication among CHIP leaders across the globe, the CHIN-M will facilitate an exchange of ideas and comparison of solutions. Such a model has to be adaptable to meet local needs and develop a sustainable business model to address numerous global community health challenges, which is the discussed next.

Business Model and Value Creation for CHIN

The dominant value creation opportunity for the CHIN framework would be to leverage on the networked IT platform (e.g., SVC) and strategically design this platform to generate value. According to Chew and Gottschalk (2009), there are generally three value configurations: value shop, value chain and value net. Value shops are organizations designed to solve customer or client problems rather than creating value by producing output from an input of raw materials. A value chain is a chain of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service. A value network describes social and technical resources within and between businesses that are connected by interactions that represent tangible and intangible deliverables. These deliverables take the form of knowledge or other intangibles and/or financial value. Value networks exhibit interdependence across entities, and may be external facing to include customers or recipients, intermediaries, stakeholders, complementary, open innovation networks and suppliers; or internal facing to focus on key activities, processes and relationships that cut across internal boundaries, such as order fulfillment, innovation, lead processing, or customer support. Value is created through exchange and the relationships between roles.

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A cell phone company represent the value network concept where the users enter a contract with the company and immediately has access to all the value network of other customers of the phone company.

A CHIN is a value network as it is solely based on a network of relationships across a set of customers (patients) involving a set of stakeholders (e.g., hospitals, clinics, pharma), and channelizing the relational-efforts of the stakeholders to provide services that the customers use, through both stakeholder-customer and customer-customer interactions through the IT-enabled platform. As Johnson, Christensen, & Kagermann (2008) suggest, for an IT-enabled value network platform, value creation depends on the product or services offered, the revenue model, and the network of relationship through which value is created. Indeed, as reflected in Table 1, studies on business models have mainly focused on the issue of revenue models and value creation through customer engagement. Thus, although broadly, the concept of a business model includes all aspects of a company's approach to developing a profitable offering and delivering it to target customers; and might include a number of components depending on the context and circumstance where it is applied (Shafer et al., 2006). While there may be a number of factors that are important in the context of business models, what is pressing is how the CHINs can earn revenue within the limitations of a community-centric (e.g., social) service orientation is important puzzle. In this regard, the current study's focus on the sustainability of the CHIN-M model that inherently depends on CHIP leaders generating resources needed in support of various global public health challenges.

Product or service offered: In the case of the CHIN-M for global health, the customer focused value creation is the knowledge-centric exchanges between the community and its partners. A clear articulation of specific details on value proposition to various stakeholders, and a discussion of activities CHIP leaders are engaged to deliver this value is essential. In the early pilot, the community will be able to access the Global Health Initiative's section of Henry Ford Health System web site, search a program by either country or by sector (topic), and select the activities CHIP leaders are engaged in support of the program. For example, on Haiti and the country's need to provide vaccinations for Malaria, many activities have to be completed such as:

- Bring awareness to the locals (through radio advertisement, TV advertisement, fliers at schools, churches, hospitals, clinics, retirements homes, organizations, supermarkets, shopping centers, etc.);
- Attain buy-in support from the government and schools, in order to have them advertise on their webpage and to their contacts;
- Organize a social media platform to promote the vaccination (Facebook page, Twitter account, etc.);
- Attain a location to perform vaccinations (i.e. clinics, hospitals, community center, church, etc.);
- Obtain licensed nurses to administer the vaccination;
- Procure the vaccination and other materials required from citizens, local pharmacies, hospitals, clinics, and vaccine maker to provide/sponsor/donate vaccinations and other materials (i.e., bandages, band aids, sterile needles, gauze);
- Maintain records of those vaccinated in order to prevent double vaccination (i.e. computer, database, internet, computer literate workers, etc.);
- Ensure security protocols to keep patient data private.

Such a list will give the community information on how various activities will support a program of interest to them within a particular country.

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Revenue model to sustain the community program: Revenues of CHIN can be generated in three possible ways. First, a subscription based model can help a community or house hold to support select set of activities discussed within a program. Second a transaction based model can discuss ways in which a patient or a donor can contribute resources in support of this activity. Some of this support can be in terms of time, talent or monetary resources. Third, a sponsorship model can help CHIP leaders solicit targeted resources from donor community, including those representing private foundations, government and community organizations or wealthy philanthropic community. While some of these programs may initially depend on grants and sponsorships, the sustainability of these programs need a business model that can generate appropriate revenues and resources to complete myriad set of activities associated with these programs.

It is anticipated that CHIP leaders are responsible for the development of a list of active programs available, resourced needed to fulfill the goal, and establish a countdown to reach the goal. CHIP leaders will be asked to establish a minimum donation and allow donors to contribute to a program financially as well as through other means (time, materials, and expertise) to successfully execute a program.

Building a network of relationships: CHIP leaders, with the web portal, develop a network of relationships with other CHIP leaders across the globe, mentors and health care providers. With the help of this network, the CHIP leaders will be able to tailor resources to specific programs. Since the community will be involved in all aspects of funding their programs, it will lead to stronger social connection between the community and public health programs. As community members see the value of working closely together, beneficiaries of select programs will in-turn become future donors and/or other resource contributors. As more citizens get engaged in their community programs, the stronger the motivation for the community as a whole to address the health care needs of their local citizens.

In summary, sustainable business model here call for a clear articulation of value, listing of activities that contribute to this value, and the engagement of multiple members of the community in support of these activities. The goal of CHIN-M is to make CHIP leaders motivate and engage the community in building these sustainable business models. Next section will discuss the potential role of such a community based approach to address continuity of patient care post-discharge from a hospital, and conclude with some future research directions.

ANALYSIS

In the previous section, we have seen how CHIP-like model can help develop regional solutions to continuity of care using both a community relationship network and a shared resource model. While this is just one instantiation of CHIN network using SVC platform, the concept of knowledge exchanges among different groups can be broadened. We can view three types of knowledge exchange among different stakeholder types: knowledge providers (G1), knowledge consumers (G2) and knowledge consultants or those with specific knowledge in support of complex decision making (G3) (see Figure 2). A patient/family is arguably the knowledge consumer and a physician is the knowledge provider. It is assumed that basic information/data is exchanged between the patient (e.g. medical history) and the physician (medical diagnosis). The special knowledge or expertise that a physician provides is pursued by the patient before or during the care delivery process. When the treatment decisions become complex, either a physician or a patient may consult the views of another expert (here we call them as knowledge consultants/community care providers post discharge).

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Often the entities (patient, physician and consultant) extend to multiple members (e.g. patient may have family and support members as members of the knowledge consuming group) and physician and consultant may have their own groups to support their participation in the knowledge exchange. Such membership in groups is becoming more critical today given the evolving role of medical homes and specialist clinics where a patient may consult any available physician or specialist in the respective groups to answer an inquiry. The structure shown on top of Figure 2 can manifest itself in different forms for care related support.

Case 1 is a typical consultation post-treatment for a specific pain or medication related question (where often social media interactions are used), or as a part of a diagnosis of an illness based on a set of symptoms observed (where a physical visit to a clinic is often the frequently used approach). With many IT-enabled telemedicine/telehealth technologies becoming widely available, such consultation may develop a revenue stream if hospitals and insurance providers see this as a way to reduce expensive costs of hospital admission/readmission. In fact, states with many rural areas or areas that are urban but with limited transportation support, can start to see this type of exchanges as useful to reduce health care costs, especially those on Medicaid and Medicare.

Case 2 represents decision process related to surgical intervention. The primary care provider and surgeon are the knowledge providers (G1) and the patient and the family (G2) are the knowledge consumers, as they discuss the surgical procedure and eventual outcome/ consequences. The surgical team and/or patient may consult others (G2) regarding the surgical decision if needed. Again, which this discussion is done in relation to a hospital admission and patient preparation, this knowledge exchange might prove to be valuable in reducing costs of unnecessary surgeries. Often patient optimization for surgery is made on surgical success as opposed to continuity of care quality post-surgery. Having multiple stakeholders, including those that provide care post-discharge in this knowledge exchange can lead to more optimal decisions. Such a review may be encouraged by government, insurance companies and even hospitals, if they view themselves as accountable care organizations with a focus on reducing total cost of care.

In case 3, the community health workers are the knowledge providers (G1), who disseminate preventive health information to children/family members (G2), and health care providers/ mentors/specialists all act as knowledge consultants (G3). This of course is the primary mission of public health agencies as well as employers who are interested in the wellness programs that will prevent admissions to the hospitals in the first place. In fact, as shown in Figure 2, many employers are partnering with hospitals and communities to encourage wellness programs. States with public health care mission are looking to support such knowledge exchanges if they can prevent spread of diseases before they become too burdensome to handle.

In summary, the roles of knowledge providers, consumers and consultants may change the way community networks can leverage knowledge exchange effectively. With each instantiation of such knowledge exchange, different stakeholders have to see value in alignment with their goals (cost reduction, population health management, labor productivity lost due to health related absences) and provide resources to sustain these networks.

Developing a business model to sustain care outside a hospital using social networks is a major challenge. Hanafizadeh et al. (2012) reviewed prior work and discussed business use of social networks for marketing and advertising, knowledge management, e-commerce, relationship management, etc. Several of these applications are business value chain extensions or enhancements in support of internal and external stakeholder services, and are often funded by the firms as a part of their business strategy. In health care, multiple stakeholders are impacted by patient treatment post discharge, each with conflicting

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goals. Hospitals are penalized for unplanned early readmissions, and post-discharge care givers such as nursing homes and dialysis centers lose revenue when patient stay or visitation to these facilities gets interrupted. Primary care physicians still get paid on a fee per service model, thus limiting their focus on reducing patient readmissions. The payers (employees, government and insurance firms) should see a broader value of care post-discharge, but the near term impact of such care on their business is ill-defined. So, once the key missions of a social network is to support care provided to a patient outside a hospital using various types of knowledge exchanges among stakeholders whose goals are aligned with this mission and are willing to put resources behind it.

CONCLUSION

The paper describes the use of an SVC artifact in support of knowledge exchanges among community leaders as they develop a sustained business model in support of global public health. The use of local communities to address preventive care has been receiving wider support among employers who finance the health care costs of their employees. Similarly, innovative approaches to address patient care post-discharge have received significant attention recently since unplanned patient readmissions have cut into hospital reimbursements. However, preventive and continuity of care post-discharge are both major challenge given the diverse social, cultural, demographic and economic factors that can influence patient populations. Also, patients follow different paths prior to and/or post-discharge including receiving care at nursing homes, dialysis centers, home care, cancer and other rehabilitation centers, etc. Hence, no single approach can be effective. Kripalani, Yao and Haynes (2007) suggest a myriad set of approaches that can be used by leveraging both technology and community engagement, such as:

- External stakeholder engagement in providing home based services (e.g. home visits);
- Use of special care providers (e.g. mental health conditions managed by ambulatory care centers with those experienced in these areas);
- Community-based organizations and other health care partners (e.g. the CMS supported Community-based Care Transition Program network, which organizes partnerships between acute care hospitals and community based organizations); and
- Care giver engagement and support through education, medication counseling and outpatient follow-up.

Selecting the right IT artifact to make a social network support the knowledge exchanges needed among a community of care providers in support of continuity of patient care, and developing the right business model that can bring a mix of resources to sustain this care is key to the future of health care. Each context within which care is provided will determine the knowledge exchanges needed, the stakeholders who provide care and fund the effort, and technologies appropriate for reaching patients via the social network.

Several limitations of this study provides scope for future research. First, the case study uses SVC technology to support knowledge exchanges. Future studies may empirically validate the alignment of stakeholder goals with the type of knowledge exchanged. To our knowledge, use of SVC in a healthcare setting is very limited. Second, this study is focused on the application of one IT artifact (e.g., SVC), for

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the creation and implementation of a social network for collaboration. Future studies may explore the use of other IT artifacts that have the potential to be a key element or a central conduit to build a platform for social networks. For example, mobile based applications (e.g., APPs) are now emerging as a key element of building and integrating knowledge exchanges. Third, research is needed on the effectiveness of community based platforms, based on sustainable or profit-based models.

In conclusion, this study contributes to literature by demonstrating how social network embedded information technology offers innovative solutions to healthcare challenges outside a hospital. Specifically, by examining the Community Health Innovator Program (CHIP) model, the authors are exploring the viability of engaging a community of health care providers, family members and community in support of preventive care. This study proposes and illustrates the value potential of SVC for knowledge exchange within the healthcare delivery model outside the hospital setting.

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Chapter 29
The Analysis of Health Care Expenses of Turkey between 1990–2012

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ABSTRACT

Health is described not only as the absence of disease and disability but also as physically, psychologically, and socially general well-being of people. Best practices of individuals and the society from the health services depend on taking the correct decisions on health policies. In addition, the thought that a country spending much on health services must have a perfect status of health should not be perceived as right. Effectiveness of the spending result in the efficient practices of these services. Although there have been many institutions carrying out the health services, it has been observed that the share separated for the health from the gross domestic product in Turkey increased until 2009 but decreased as of the mentioned year and it has been stated as low compared with the other countries. In this chapter the effectiveness of Turkey's health spending between 1999 and 2012 has been analysed from this view.

INTRODUCTION

Undoubtedly, health care services is the one of the most important requirement for individuals. Providing the health care to community is considering the of the essential government's function. To fulfill society's requirement, government make a high rate of expenditure to provide health care services. But the high level on health spending does not mean always better health condition for society.

Improving the health status and health care services is related the effectiveness of spending rather than quantity. Effectivity of health spending means more people can reach the more qualified health care service to the minimum cost. To achieve this goal the decision makers should define cost effective

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health policies, and both public and private sector health institutions should managed by this policies. On the other hand the individuals behavior patterns is the one of the other important factor.

In this study first determined the research resources of health spending in Turkey. The data of the study was taken the OECD, the World Bank and World Health Organization's statics. And Turkey's health expenses analysed by the spending indications, the ratio of GDP, public and private sectors spending, out of pocket spendings, per capita for different income groups and position among the other countries.

BACKGROUND

When examined the studies about the impact of increasing in health expenses on health status; it has been noticed that the direct increase or deduction of health expenses does not affect health status or average life expectancy in generally. It is observed that in the European Commission report's (2013) a deduction of health expenses due to disruption of public health reducing the preventive health service and it is increasing the health expenses in the long run. According to IMF Fiscal Monitor Report (April 2014) and Joumard, Andre, vand Nicq (2010) and Grigoli an Kapsoli's (2013) estimates shows that 50% increases in the health expenses could lead the one year increase in the average life expectancy. And in this context inefficiencies on health system reduce approximately 2 years of life expectancy based on health. It is suggested that the positive life expectancy outcomes of policies for decrease the inefficiencies on health system by 10% could be equivalent to increase health expenses potentially by 0.7% to GDP . On the other hand as the noted Gaynor (et all, 2012) it has been found an improvement of health outcomes without increasing cost in the England practice which incentive the competition in the hospital sector. But this effectivity only can be for private health expenses. In Turkey most of health expenses provided by public. It can be possible that creating a competitive environment lead to negative results because the low access to preventive and curative health services in developing countries such as Turkey. Therefore it can be mentioned that the interventions for health such as increasing and deduction of health expenses or creation a competitive health sector has negative effect on health status. It has been estimated that public health expenses increase by 3.5% to 4% in OECD countries according to OECD health systems report (2010). Beside the limit for increasing in the health expenses, the effectivity of health expenses become more important because of rapidly aging population and increases in medical technology device prices.

AN ANALYSIS OF TURKEY'S HEALTH SPENDING

In Turkey, the statistics of health spending and other statistics on health are published by the Turkish Statistical Institute, State Planning Organization, annuals of the Directorate of Refik Saydam Hıfzıssıhha Centre and Social Security Institution[1]. At an international level, the OECD, the World Bank, EUROSTAT and World Health Organization have extensive statistics on health.

As a result of publication of different statistics of health from different institutions in Turkey, a decision was taken to set a coordination for the purpose of standardization and also it was decided that the Turkish Statistics Institution would report the statistics of health spending and these reports would be sent to the international institutions. With the decision taken, other institutions would also support the Turkish Statistics Institution on this issue. In this study, because other units also have current data and

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for the purpose of reliability of the study, the data of the OECD, the World Bank and the World Health Organization were used in addition to the data of the Turkish Statistics Institution.

As is seen in Table 1, the total health spending was 4 billion 985 million TL in 1999 and increased up to 74 billion 189 million TL in 2012. Similarly, the health spending per capita was 79 TL in 1999 while it was 987 TL in 2012. The data above will be examined in detail below.

As is seen in the Figure 1, when the data previously given as numerical is evaluated as proportionally, it has been observed that the total health spending to the gross domestic product ratio steadily increased until 2009 and then increased numerically but showed falling tendency proportionally to the gross domestic product. However in Turkey especially since 2008 health expenses is increasing but health expenses increasing ratio to GDP is tend to stop and after that tend to down. This situation does not seem significant when associated to the life expectancy of health.

Life expectancy at birth is an important indicator that used to measure to socio-economic development levels, quality of life and mortality levels of countries. This indication can be obtained by life tables. Life expectancy data is collected and published by Turkey Statistical Institute in Turkey. In Figure 2 data was taken from OECD's statistics for integrity. Besides that, Turkey's 2013 life expectancy did not estimated in OECD data set but according to Turkey Statistical Institute data, life expectancy in Turkey for 2013 has been estimated 76,3. Additionally, Turkey Statistical Institute has the ratio of total health expenditure to GDP for 2013. Accordingly, the ratio of total health expenditure to GDP is 5,4 in 2013. Also data for the year 2012 is revised and these ratio (health expenditure / GDP ratio) that indicated earlier 5.4 was drawn to 5.2 by Turkey Statistical Institute.

As is seen in the Figure 2, in 2008 the health expenses ratio to GDP was 6.1% and in 2012 this ratio was decreased to 5.2% but according to OECD data life expectancy in Turkey was 76.2% in 2008 and 77.2 (estimated) in 2012. Between 2000 and 2012 life expectancy in Turkey is increased 3.5 years. The increasing in life expectancy can be explained by more effective health expenses of Turkey and ensuring the large scope of community's utilize the health services instead of increasing or decreasing of health expenses. In fact, recently entered into force "The Transformation Programme on Health" include the purpose of increasing to large scope of community's access on health services. Because in the long term, does not expect any rapid increasing in the health expenses.

Figure 1. The total health spending to gross domestic product ratio
Source: (T.R. Prime Ministry, Turkey Statistics İnstitution, News Bulletin, Volume: 29-34-15871-16161, 2010 – 2011-2013-2014.

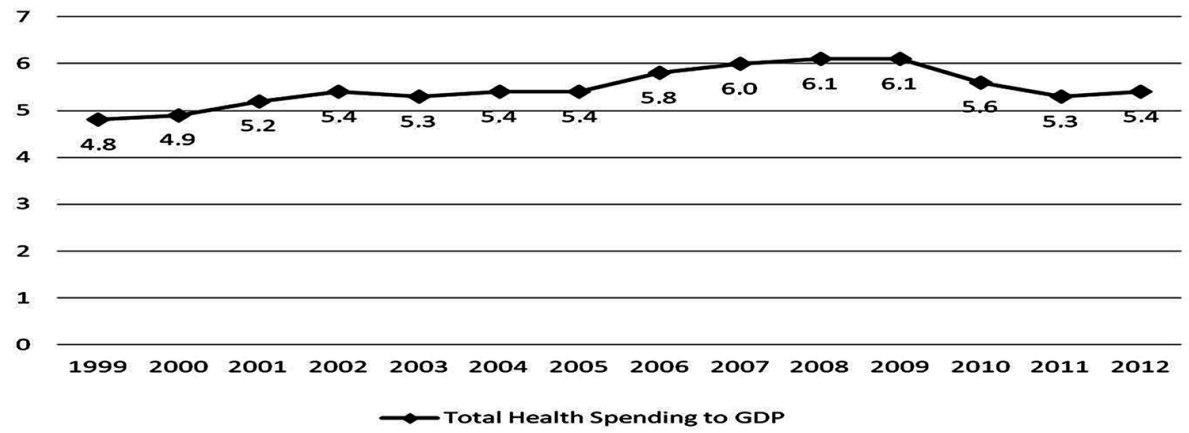

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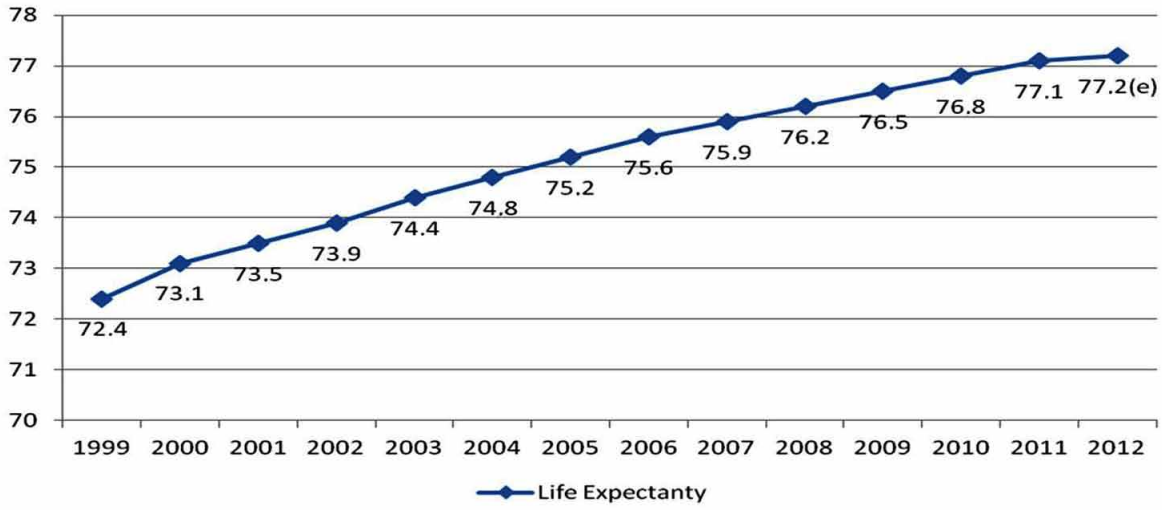
Table 1. Indications of the health spending in Turkey 1999 – 2012

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Health Spending														
Million TL	4 985	8 248	12396	18774	24279	30021	35359	44069	50904	57740	57911	61678	68607	76358
Million USD Dollar	11790	13140	10052	12389	16159	20975	26205	30599	38864	4436	37493	41067	40919	42376
Health Spending Per Capita														
Turkish Lira(TL)	79	128	190	284	363	443	516	635	725	812	804	845	928	1020
USD Dollar	186	204	154	188	242	310	382	441	553	624	521	563	553	566
The Total Health Spending to Gross Domestic Product Ratio %	4.8	4.9	5.2	5.4	5.3	5.4	5.4	5.8	6.0	6.1	6.1	5.6	5.3	5.4
The Public Health Spending to Total Health Spending Ratio %	61.1	62.9	68.1	70.7	71.9	71.2	67.8	68.3	67.8	73.0	81	78.6	79.6	76.8
The Household Health Spending to Total Health Spending Ratio %	29.1	27.6	22.8	19.8	18.5	19.2	22.8	22.0	21.8	17.4	14.1	16.3	15.4	15.4

Source: T.R. Prime Ministry, News Bulletin of Turkish Statistics Institution, Volume: 34, 18 February 2011, Volume: 15871, 10 October, 2013, Volume: 16161, 5 November, 2014

Figure 2. Average life expectancy in Turkey (1999-2012)
Source: Oecd Health Data: (http://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT)



The decreasing in the health expenses increase speed have been seen almost all around the world. It is seem that this situation make pressure all countries budgets for future (IMF, 2014: 29). But health reforms mostly are tended to increase the saving instead of effectivity of health expenses. Despite the deduction of health expenses leads to saving in the short run, the deduction of preventive health service and health development causes disruption of basic health services and community health, in the long run and it may cause increase in the public health expenses in the long run (European Commission, 2013). As is seen in Table 2, Korea had the lowest the total health spending to GDP (gross domestic product) ratio and Turkey also follows Korea in 1999. However, according to the data of 2011, Turkey had the lowest the total health spending to GDP ratio. It has been estimated that the rapid development of Turkey and the structural changes conducted in the field of health services will increase this ratio relatively. Although a numerical increase occurred, this rapid development and the structural changes reduced GDP ratio. In many of the OECD countries where regulations were carried out in the field of health services, especially after 2009 the total health spending to GDP ratio reduced. However, in 2009 the total health spending to GDP ratio was 9.6% on average in the OECD countries and also reduced to 9.3% in 2011. Similarly, this ratio was 6.1% in 2009 in Turkey and reduced to 5.3% in 2011 (5.2% in 2012). In Table 2, the mentioned comparison was conducted for the year of 2011 because the data of 2012 of all the countries could not be obtained.

It is of much importance to know the shares of public and private sectors within the total health spending. In Figure 3, the shares of public and private sectors within the total health spending are given separately.

As is seen in Figure 3, of the total health spending 61.1% was met by the public and 38.9% was met by the private sectors in 1999. However these rates were 81% and 19%, respectively. It has been estimated that the highest public share occurred in 2009 as a result of the arrangements carried out in the field of health services. The public share increased in the short period of time; however, it has been stated that the private sector health spending had a tendency in steadily increasing and it has been also

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Table 2. The total health spending to gross domestic product ratio in the countries of OECD (1999-2012)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Australia	7.8	8.0	8.1	8.4	8.3	8.5	8.5	8.5	8.6	8.8	9.0	8.9		
Austria	10.1	9.9	10.1	10.1	10.3	10.4	10.4	10.2	10.3	10.5	11.2	11.0	10.8	
Belgium	8.1	8.1	8.3	8.5	10.0	10.2	10.0	9.5	9.5	10.1	10.6	10.5 (d)	10.5 (d)	
Canada	8.9	8.8	9.3	9.6	9.8	9.8	9.8	10.0	10.0	10.3	11.4	11.4	11.2	11.2
Chili	6.6	6.6	6.8	6.7	7.5	7.1	6.6	6.3	6.5	7.1	7.9	7.4	7.5	7.6 (e)
Czech Republic	6.6	6.5	6.7	7.1	7.4	7.2	6.9	6.7	6.5	6.8	8.0	7.4	7.5	
Denmark	9.0	8.7	9.1	9.3	9.5	9.7	9.8	9.9	10.0	10.2	11.5	11.1	10.9	
Estonia	5.9	5.3	4.9	4.8	5.0	5.1	5.0	5.0	5.2	6.1	7.0	6.3	5.9	
Finland	7.4	7.2	7.4	7.8	8.2	8.2	8.4	8.3	8.0	8.3	9.2	9.0(e)	9.0(e)	9.1 (e)
France	10.1	10.1	10.2	10.5	10.9	11.0	11.0	11.0	10.9	11.0	11.7	11.7	11.6	
Germany	10.3	10.3	10.4	10.6	10.8	10.6	10.8	10.6	10.5	10.7	11.8	11.5	11.3	
Greece	8.6	7.9	8.8	9.1	8.9	8.7	9.7	9.7	9.8	10.1	10.2	9.5	9.1	
Hungary	7.2	7.0	7.1	7.5	8.3	8.0	8.4	8.3	7.7	7.5	7.7	8.0	7.9	7.8 (e)
Iceland	9.6	9.5	9.3	10.2	10.4	9.9	9.4	9.1	9.1	9.1	9.6	9.3	9.0	8.9 (e)
Ireland	6.1	6.1	6.7	7.1	7.4	7.6	7.6	7.5	7.9	9.1	10.0	9.3	8.9	
Israel	7.5	7.5	8.0	7.9	7.9	7.8	7.9	7.6	7.6	7.7	7.7	7.7	7.7	
Italy	7.8	8.1	8.2	8.3	8.3	8.7	8.7	8.8	8.5	8.9	9.4	9.4	9.2	9.2
Japan	7.5	7.7	7.9	8.0	8.1	8.1	8.2	8.2	8.2	8.6	9.5	9.6		
Korea	4.3	4.5	5.1	4.9	5.2	5.3	5.6	6.1	6.4	6.6	7.1	7.3	7.4	7.5 (e)
Luxemburg	5.8	7.5	7.4	8.3	7.7	8.2	7.9	7.7	7.1	7.2	8.0	7.2	6.6	
Mexico	5.1	5.1	5.5	5.6	5.8	6.0	5.9	5.7	5.8	5.8	6.4	6.2		
Netherland	8.1	8.0	8.3	8.9	9.8	10.0	10.9	10.7	10.8	11.0	11.9	12.1	11.9	
New Zealand	7.5	7.6	7.7	8.0	7.9	8.3	8.4	8.8	8.5	9.3	10.0	10.2	10.3	
Norway	9.3	8.4	8.8	9.8	10.0	9.7	9.0	8.6	8.7	8.6	9.7	9.4	9.3	9.4
Poland	5.7	5.5	5.9	6.3	6.2	6.2	6.2	6.2	6.3	6.9	7.2	7.0	6.9	
Portugal	8.0	9.3	9.3	9.3	9.8	10.1	10.4	10.0	10.0	10.2	10.8	10.8	10.2	
Slovak Republic	5.8	5.5	5.5	5.6	5.8	7.2	7.0	7.3	7.8	8.0	9.2	9.0	7.9	
Slovenia	7.9	8.3	8.6	8.6	8.6	8.4	8.4	8.3	7.9	8.3	9.2	8.9	8.9	8.8 (e)
Spain	7.3	7.2	7.2	7.3	8.2	8.2	8.3	8.4	8.5	8.9	9.6	9.3		
Sweden	8.2	8.2	8.9	9.2	9.3	9.1	9.1	8.9	8.9	9.2	9.9	9.5	9.5	
Switzerland	10.2	10.2	10.6	10.9	11.3	11.3	10.9	10.4	10.2	10.3	11.0	10.9	11.0	11.3 (e)

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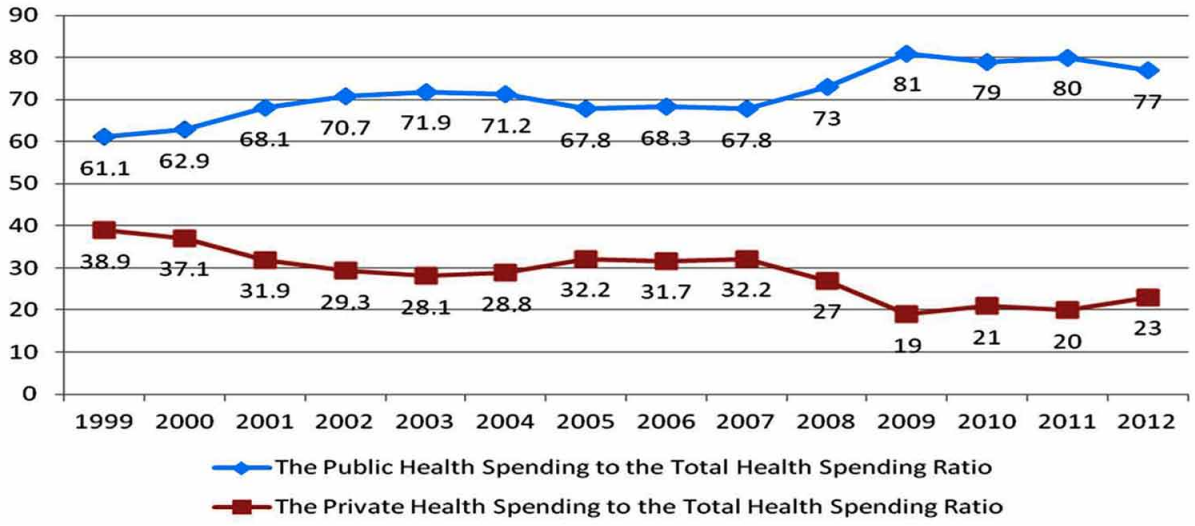
Table 2. Continued

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Turkey	4.8	4.9	5.2	5.4	5.3	5.4	5.4	5.8	6.0	6.1	6.1	5.6	5.3	5.4
United Kingdom	6.9	7.0	7.2	7.6	7.8	8.0	8.3	8.4	8.5	9.0	9.9	9.6	9.4	
United States of America	13.6	13.7	14.3	15.2	15.7	15.7	15.8	15.9	16.2	16.6	17.7	17.7	17.7	

Source: OECD Health Data, November 2011, www.oecd.org, www.worldbank.org.
The Data of 2005 and afterwards have been updated by www.oecd.org

Figure 3. The public health spending and private sector health spending to the total health spending ratio
Source: Turkey statistics institution, news bulletin, Volume: 29, 34, 15871 and 16161, 2010 – 2011- 2013-2014



estimated that the share of the private sector will increase in the long term when it is considered that many of the arrangements conducted in the field of health services have been oriented to privatization. The share of the private sector within the total health spending in 2012 was 15 billion 404 million TL and at the rate of 21%.

It is of much importance to know the rates of the out-of-pocket expenses as much as the importance of knowing the share of the public and private sector within the total health spending in a country. Being aware of these rates is significant in the social state understanding for indicating that the government fulfills its responsibilities to which degree and also it is important for estimating the burden of the health sector on the public sector (Çelik, 2011: 301). According to IMF report (2010:16) between 2011 and 2030 public health expenses will increase by 1% to GDP in the developing countries and this ratio estimated 1.3% for Turkey. In the same way OECD is determined this ratio between 3.5% and 4% for 2050. Turkey's macro-economic indicators raises the possibility of this forecast. In fact earlier studies showed that growth have a significant effect on health expenses.

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In Turkey, the data of the out-of-pocket expenses was obtained via the household budget questionnaire completed by the Turkish Statistics Institution. As is seen in Figure 4, the out-of-pocket health expenses to the total health spending ratio reduced at 13.7 point from 1999 until 2012 and was calculated as 15.8 in 2012. The OECD average for the out-of-pocket health expenses were determined as 19.6 (OECD Health Statistics, 2013). Steadily reducing of the household out-of-pocket health expenses in Turkey and this rate's being below OECD average and also less leaning of the government to the household compared with most of the OECD countries indicate that the government act within the framework of social state understanding. However, along with the entering into force and implementation of the provisions of the General Health Insurance in 2012, it has been estimated that especially premium payments of health insurance and patient shares will increase out-of-pocket health expenses.

Comparing the health spending levels of a country in terms of the similar income groups and other income groups is quite important. As is seen in Figure 5 that we prepared by using the data of the World Bank of 2011, there is a correlation between the income level and health expenses of a country. In addition, the total health spending to GDP ratio was 5.3 in Turkey in 2011. The health spending per capita in Turkey is in a better situation compared with middle income countries. However, when compared with the OECD countries, both the health expense per capita and its ratio to GDP is much lower in Turkey.

To determine which institution is effective in health spending, it is required to examine the distribution of total health expenses in terms of the finance subsidiaries. The distribution of total health expenses in Turkey in terms of the finance subsidiaries is given in Figure 6 below.

As is stated previously, the total health expense in 2012 was 76 billion 358 million TL. Of this expense, 72 billion 820 million TL was for the current health expenses and 3 billion 538 million TL was for the investment expense on health. Within the current health expenses, hospitals, nursing care at home, retail sale and other presenters of medical equipment, the presentation and management of public health programs, general health management, insurance and 7 separate items with one category that could not be classified. In 2012, health expense of central government was 16 billion 348 million TL, of local administrations was 662 million TL, of social security institution was 41 billion 630 million TL and of private sector was 17 billion 718 million TL. Here, the key point is the increase of the burden on the Social Security Institution compared with the previous years.

Figure 4. Out-of-pocket health spending to the total health spending ratio
Source: Turkey Statistics Institution, News Bulletin, Volume: 29 – 34- 15871-16161, 2010 –2011-2013-2014

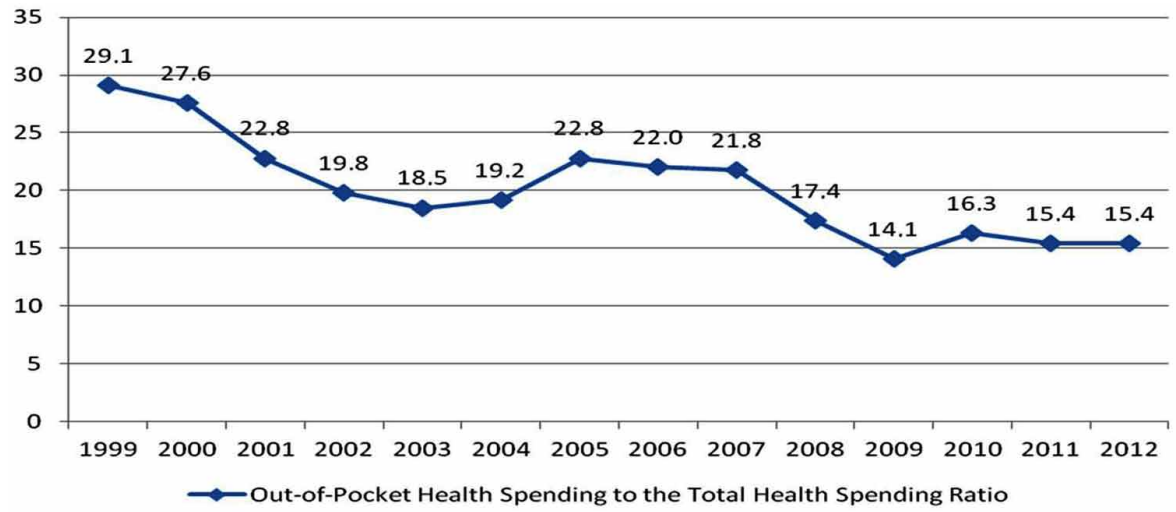

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Figure 5. 2011 Health spending levels of the countries per capita according to the income groups
Source: World Bank (http://www.worldbank.org)

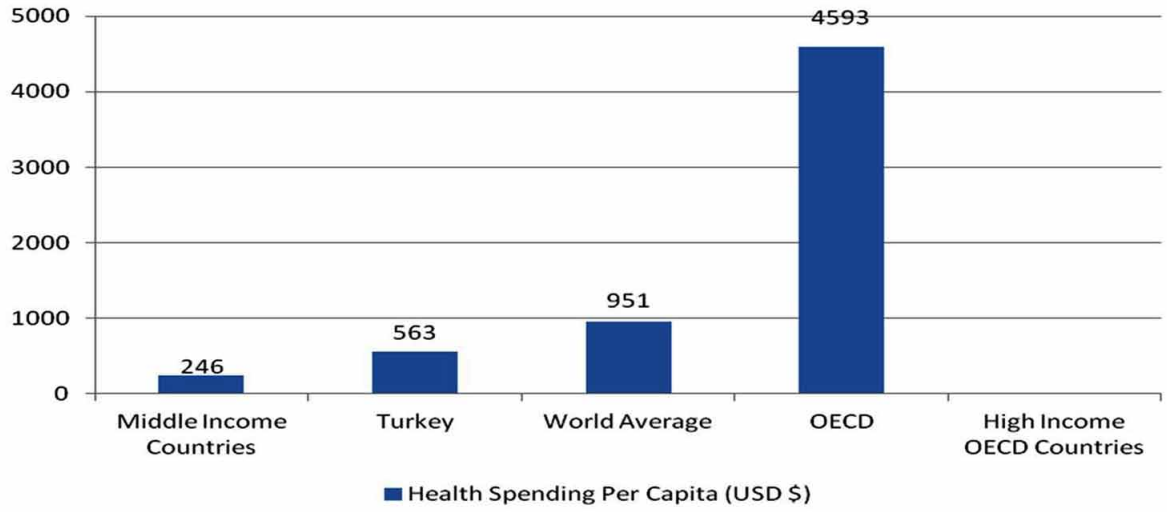
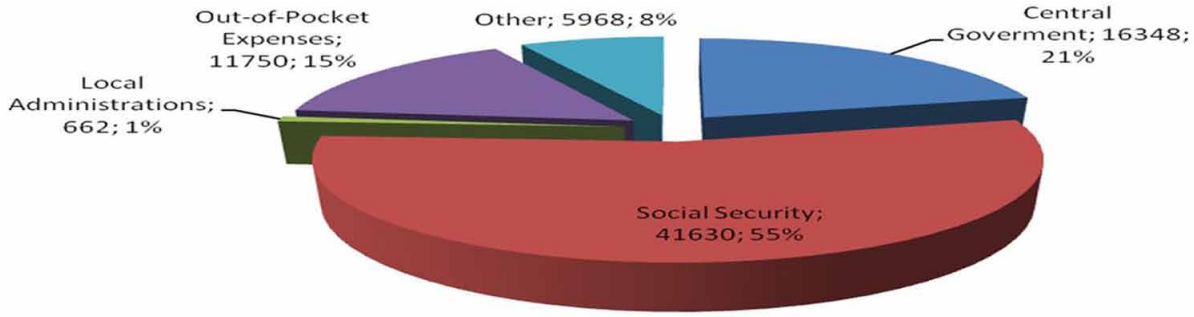


Figure 6. 2012 The distribution of current health expenses to the finance subsidiaries
Source: Turkey Statistics Institution, News Bulletin, Volume: 15871, 2013



"Other" includes health expenses, private social insurance (bank funds), non-profit organizations serving for household, State Economic Enterprise, foundation universities, the institutions included in the privatization and the health expenses of other in

CONCLUSION

In Turkey, health expenses to GDP ratio steadily increase until 2008; however, it was cut down after 2009. According to the analysis conducted with the data of the World Bank, World Health Organization, OECD and Turkey Statistics Institution, the total health sending of Turkey to GDP ratio was 6.1 in 2009 and 5.6 in 2010 and 5.3 in 2011 and 5.2 in 2012. As a result of the current regulations conducted in the field of health services, the health expenses increased numerically; however, the total health expenses to GDP ratio reduced. According to the existent data, the health expense to GDP ratio in Turkey is quite below the average of the OECD. It was thought that the amendments made within the framework

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of Transformation of Health would increase the health expenses. However, the increase in the health expenses may not be an indication of a better health status. The increase in the health expenses does not always reflected as an improvement in real terms. Particularly, the increase in the expenses in the health systems that are convenient for corruptions does not mean that the accesses to these services also have advanced. There exist countries that have less health expense and have much better health status compared with the countries that have much health expense. This shows us that only health expenses are not a measure for health status. Efficient use of the expenses is significant. Also, the regulations conducted in the field of health services in Turkey reduced the health expenses (GDP%) rather than increasing. The decreases in these numbers indicate an improvement in the mentioned services. Indeed in the most of earlier studies it was estimated that the inefficiency of health expenses have negative effect on average life expectancy and reducing this inefficiency has equal to increasing health expenses to a level. Saving in the health expenses also reducing the expenses but this may cause disruption of preventive health service and effect common health in negative way.

Reducing expenses could pressure in curative health services so without a good analysis process, decrease in the expenses can be conduct increase in the expenses in the long run. So it is inconvenient to saving by health spending on an important issue such as health. In recent years it was observed that even though decreasing in the health expenses level to GDP, life expectancy is increasing in Turkey. This observation could be show the importance of effectivity which described above. According to the estimates (OECD, 2010) for future years (to 2050), and in the light of available data, there is no other way except provide the effectivity in the health expenses because of the limited increase ability of the public health expenses, rapidly aging population and the technology used in the health services become expensive. However it should be considered that dangerous consequences of competition and excessive marketing for health services while provide the effectivity for health expenses. In fact the "Transformation Programme on Health" in Turkey have been criticized for encouraging to commercialization and marketing of health care services. At this point, it is important to establishment of public balance in terms of service priority for access to health service while providing the effectivity in health care services.

Health expenditure topics such as relations between economic growth rate and health spending, the discrimination of public and private health expenditures, the effect of health expenses on life expectancy are promising research topic for developing counties. Macroeconomic balance of the economy, social-economic development, social security approach is extremely significant for public health and associated with health policy. Actually, not only Turkey but also for all developing country the health expenditures has importance. It is recommended for researchers who will work on this issue to use multiple sources and compares the world and local data.

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KEY TERMS AND DEFINITIONS

Effectiveness: Effectiveness is defined to achieve the intended results.

Efficiency: Efficiency can be defined as optimization of resources. In this chapter efficiency refers the least waste of health sources.

GDP: The monetary value of all the finished goods and services produced within a country's borders in a specific time period.

Health Economics: Health economics is a branch of economics which aims to produce using the highest level of health care with most economical (efficient, effective, rational) resources allocated to health sector and crates best way to divide them for community and the members of social groups.

Health Spending Per Capita: Portion of total health expenditure for each individual person.

Health Spending: All of spending which aim to protect the health promotion or prevention, improvement, maintenance, nutrition and emergency programs are regarded as health spending.

Life Expectancy: Life expectancy is a statistical indicator that showed life time for an infant. The Turkey Statistical Institute defines as the average life years for an infant which exposed to age specific mortality rate in a specific periods during the life time.

Out-Of-Pocket Health Spending: OOP is defined as payments made by the patient directly or households.

Private Sector Health Spending: The spending which held by economy that is not state controlled, and is run by individuals and companies for profit.

Public Health Spending: The part of health spending hat is run completely by the government.

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ENDNOTES

[1] Directorate of Refik Saydam Hıfzıssıhha Centre, was repealed in the recent organization structure of the Ministry of Health.

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Chapter 30
The Greenhouse Gas Emissions of Various Dietary Practices and Intervention Possibilities to Reduce This Impact

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ABSTRACT

This chapter examines the link between dietary choices and greenhouse gas (GHG) emissions and possible interventions to reduce this impact. The connections between climate change, food systems and public health are explored. It is shown that there is variance in the impact of different food types on GHG emissions, with animal products having the greatest impact. The role of food system activities in the production of GHG emissions is also explored. Dietary choices and GHG emissions are examined using case studies from a variety of countries. Results show that reduced animal food production has increased potential to reduce GHG emissions compared to technological mitigation or increased productivity measures. Finally, a systems science approach is used to explore possible interventions aimed at reducing consumption of animal products.

INTRODUCTION

Climate change is now acknowledged as a significant public health issue and its impact on food security has become a major concern (AIWH, 2008; McMichael, Powles, Butler & Uauy, 2007). The links between climate change, food supply systems and dietary choices are complex (Sulda, Coveney & Bentley, 2010), and with a growing population, the global food system (comprising agriculture, food processing,

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distribution, retail and consumption) is predicted to experience an unparalleled number of converging pressures in coming decades (Pearson, Friel & Lawrence, 2014). In response to the global increase in population growth, food production in the second half of the 20th century more than doubled (Kahn & Hanjra, 2009). This has resulted in changes to climate systems, loss of biodiversity, degradation of land, and increased resource inputs placing unprecedented demands on the food system (Ericksen, Ingram & Liverman, 2009). A large amount of natural resources (land, minerals, water, energy) are used for food production and consumption, which generates significant emissions of greenhouse gases (GHGs) (Elferink, Nonhebel & Moll, 2008). Projected variability in climate systems without sufficient mitigation strategies to address climate change, anticipated loss of agricultural productivity, pasture growth and livestock production, as well as increased costs for agricultural production will influence trade patterns and have substantial consequences for global agricultural production (Gunasekera, Tulloh, Ford & Heyhoe, 2008). Such effects on the food system foresee long-term impacts on both the environment and public health, with increasing difficulty in achieving food security (McMichael et al., 2007).

As climate change affects diet and nutritional status, so too do dietary choices and food systems effect levels of GHG emissions, and consequently climate change. The level of GHG emissions from food production has been shown to be on par with levels produced by the transport sector, with the latter frequently viewed as a major GHG contributor (Garnett, 2009). A regional analysis for Europe found that food accounts for 31% of the EU-25's total GHG impact (Tukker et al., 2006), and studies from developed countries show that food consumption contributes between 15% and 28% to overall national GHG emissions (Garnett, 2011). This chapter explores how dietary choices impact on climate change by reviewing case studies from countries with diverse food cultures and habits. It then examines possible intervention approaches to shift dietary practice, particularly reduced meat consumption, from a systems thinking perspective.

BACKGROUND

Food Type and GHG Emissions

The type of food produced, animal-based or plant-based, has a large influence on GHG emission levels. Raising livestock in particular, is GHG intensive and responsible for approximately half of all food-generated GHGs. Ripple et al. (2014) reported that the livestock sector accounts for approximately 14.5% of all anthropogenic GHG emissions worldwide, with ruminant production (mainly cattle and sheep) the largest source of anthropogenic methane, contributing more than monogastric livestock (pigs) (Friel, Barosh & Lawrence, 2013). In addition to the methane released by enteric fermentation and dung, other gases that contribute to the overall level of GHG emissions are carbon dioxide and nitrous oxide from agricultural soil, and fertiliser production and use (Risku-Norja, Kurppa & Helenius, 2009).

The dairy industry also contributes to GHG emissions with approximately 85% occurring at the primary production stage (mostly methane). The emission levels increase as the degree of processing increases, with yoghurt and cheese production yielding 1.4 and 5.7 times, respectively, the amount of GHGs produced by milk production (Bradbear & Friel, 2011). On a weight basis, less emissions are generated from the production of vegetables and grains than from animal-based foods, and these generally stem from the power used for irrigation, processing and packaging (Friel et al., 2013).

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The global demand for food, including meat, is increasing due to rising incomes and urbanisation (Steinfeld et al., 2006). Steinfeld et al. (2006) have predicted demand for meat to double by 2050 from 1999/01 levels, resulting in considerable challenges for society given that livestock production affects almost all components of the environment (air, land, soil, water, biodiversity) (de Vries & de Boer, 2010). In particular, land use for livestock production and feed grains consumes significant natural resources and alters and reduces natural habitats (Garnett, 2009). Intensive livestock production not only contributes a high level of GHG emissions, but may lead to overuse of fertilisers and other inputs which create environmental problems such as contaminated soil and increased nutrient levels in waterways. Intensive livestock production may also lead to degradation and nutrient stripping of soil (Steinfeld et al., 2006). As well as the type of food produced, the systems used for producing food can also have significant impacts on GHG emissions. The next section will examine how these different food system activities can contribute to GHG emissions.

Food System Activities

Food system activities can be categorised as preproduction, production, and postproduction. Within each category, many activities produce GHGs, with emissions varying significantly between activities within the global food system (Vermeulen, Campbell & Ingram, 2012). There are key differences among countries, with postproduction usually having a larger role in high-income countries, while in other countries specific subsectors may be more important (e.g. high contribution from fertiliser manufacturing in China) (Vermeulen et al., 2012). Overall, the food system contributes 19% - 29% of total global anthropogenic GHG emissions, with agricultural production making up 80% - 86% (Vermeulen et al., 2012). Most GHG emissions associated with livestock production occur at the farm stage. The remainder result from preproduction activities such as fertiliser production and postproduction activities such as processing, packaging, refrigeration, retail, transport, catering, and waste disposal.

Preproduction Activities

Vermeulen et al. (2012) identify the main preproduction activities contributing to GHG emissions as the manufacturing of fertilisers and energy use in animal feed production, which can include such activities as production of pesticides and herbicides. While there may be other indirect inputs, for example antibiotic production and infrastructure (i.e. buildings and machinery), they are not discussed here as they have not been categorised as significant drivers of GHG emissions in relation to food systems.

Fertilisers

Production of plant food for human consumption or animal feed relies on inputs such as seeds, irrigation, pest control and fertilisers. Among these inputs, fertiliser production accounts for the majority of GHG emissions due to the energy intensity and emissions of nitrous oxide released when nitrate fertiliser is manufactured (Snyder, Bruulsema, Jensen & Fixen, 2009). Steinfeld et al. (2006) estimate that of the 80 million tonnes of nitrogen fertiliser produced yearly, approximately 20% is used in the production of livestock feed. In the United States where consumption of meat is high, around 50% of nitrogen fertiliser is used to fertilise crops for livestock feed (Eshel, Shepon, Makov & Milo, 2014).

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Animal Feed

There are both direct and indirect factors contributing to GHG emissions through the production of animal feed. Producing feed for livestock and the aquaculture industry directly contributes to GHG emissions as a result of fossil fuel use in transport, plant cultivation and feed processing, with indirect inputs from land cover change (grazing and feed cultivation) (Vermeulen et al., 2012). While there is scant literature in this area it has been estimated that production of animal feed accounts for more than half of the total energy used within livestock production itself (Steinfeld et al., 2006). As Vermeulen et al. (2012) discuss, energy is used for production of animal feed via fertilizer production, manufacturing and distribution of herbicides and pesticides, fossil fuels (i.e. diesel) used in machinery, electricity used for irrigation and any heating, drying or processing which occurs.

Production Activities

Agricultural production is a significant driver of GHG emissions through current agricultural practices and increasing land area being used for agriculture (Vermeulen et al., 2012). Although there has been much research into the contribution of agriculture to climate change, including reviews conducted by the Intergovernmental Panel on Climate Change (IPCC), there remains ambiguity in many estimates (Smith et al., 2007). The IPCC estimates that direct GHG emissions from agriculture were 14% of total global anthropogenic emissions in 2004 (Metz, Davidson, Bosch, Dave & Meyer, 2007). Of all direct agricultural GHG emissions, 39% can be attributed to livestock production (enteric fermentation 32% and manure management 7%), with the remaining 61% to nitrous oxide from soil (38%), biomass burning (12%) and rice production (11%) (Vermeulen et al., 2012).

Indirect GHG emissions from agriculture are also a significant contributor to global GHG emissions with an estimated 12% (range 6% - 18%) of total anthropogenic emissions being a result of land cover change (van der Werf et al., 2009). In 2005 37% of the earth's terrestrial surface was used for agriculture (Smith et al., 2007) with around 80% of new agricultural land used for crops and pasture coming from replacement of forests (Gibbs et al., 2010). The livestock sector alone now accounts for 30% of global agricultural land use (Havlík et al., 2013). Such changes to livestock production practices and land use can thus be anticipated to have a significant effect on future GHG emissions.

Postproduction Activities

Postproduction activities relate to what happens to food once it has been produced. These activities include processing and packaging food, transport and refrigeration, food preparation and food waste. While some activities such as packaging may have minor impact on GHG emission, others such as refrigeration may have a more significant impact.

Processing and Packaging

Advances in food processing and packaging have played a key role in extending shelf life of food products and maintaining food safety for consumption (Marsh & Bugusu, 2007). This extended shelf life allows

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food to be stored for longer periods and to be transported safely over long distances before consumption, thereby improving food security (Marsh & Bugusu, 2007). Although packaging is an essential component of many food products, it is also a source of environmental burden and waste (Roy et al., 2009). For some food products, packaging is excessive and often unnecessary, resulting in release of additional emissions (Berners-Lee, Hoolohan, Cammack & Hewitt, 2012).

There is little information available on GHG emissions associated with food packaging and as Vermeulen et al. (2012) note the research is difficult to interpret as packaging can include manufacturing of packaging materials, the process of packaging and possibly refrigeration costs. Garnett (2011) attributes 7% of the GHG emissions associated with the food chain in the United Kingdom to packaging and a further 2% to waste disposal. One study by Jungbluth, Tietje and Scholz (2000) found that packaging for both animal and plant products is of only minor consequence in relation to total food system GHG emissions.

Transport

Food transport contributes to carbon dioxide emissions from agricultural products and is responsible for up to 12% of total food-chain emissions in the United Kingdom (Garnett, 2011; Meisterling, Samaras & Schweizer, 2009). The distance that food is transported is increasing as arable land is abandoned because of erosion and degradation and food crops are grown farther from urban areas. This change translates to increased GHG emissions from transport and greater cost to deliver produce to markets, thus raising the cost of food supplied to the consumer (Meisterling et al., 2009). Garnett (2009) and Berners-Lee et al. (2012) both noted that in addition to usual transport costs, 'out of season' produce that is freighted from another state or country significantly adds to the GHG emissions associated with a food product.

Refrigeration

Refrigeration is energy intensive and is reportedly a larger contributor to energy use in the food chain than transport or food miles (Pelletier et al., 2011). While there is limited data, it is estimated that approximately 1% of total global GHG emissions can be attributed to the food cold chain (James & James, 2010). This percentage varies by country with a higher percentage in high-income countries.

Retail Activities and Food Preparation

Vermeulen et al. (2012) discuss that modern food retail enterprises are a significant contributor to GHG emissions. In the UK an estimated 4MtCO_2e total annual emissions are related to major retail food outlets (Tassou, Ge, Hadawey & Marriott, 2011). Supermarkets can also contribute to GHG emissions via energy consumption, the main source being refrigeration. Food preparation contributes to GHG emissions through energy use from cooking and refrigeration. An estimated 9% of direct food chain GHG emissions in the UK can be attributed to home based cooking, storage and preparation of food (Garnett, 2011). Vermeulen et al. (2012) also notes that as household incomes increase there is likely to be an increase in emissions related to changing types of fuels used for domestic cooking. As an example, in China the shift towards using commercial fuels such as coal based electricity from more traditional biomass fuels has nearly doubled rural residential energy consumption.

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Food Waste

In addition to the composition of the diet, actual consumption patterns should be considered when looking at the environmental impacts of food production. Berners-Lee et al. (2012) reported that less than two-thirds of available food globally is consumed and that reducing or eliminating both pre- and post-purchase food waste could prevent large quantities of GHGs emissions. Unused food is effectively 'wasted' emissions being generated throughout the entire length of the food chain: growing, processing, storing, retailing, transporting and cooking. This large proportion of food entering the waste stream is a considerable loss of energy and emissions to landfill (PHAA, 2009). Garnett (2011) suggested that approaches to reducing food waste, such as better coordination between primary producers and industry, public awareness campaigns, and innovative packaging developments, may help to reduce these unnecessary emissions. In addition, overconsumption also contributes to GHG emissions. With reference to the 2013 Australian Dietary Guidelines, Friel et al. (2013) commented that any food that is consumed above a person's energy requirements represents 'avoidable' GHG emissions in producing that foodstuff.

DIETARY CHOICES AND GHG EMISSIONS

Dietary Studies

There have been a number of recent studies examining the connections between dietary choices, food production systems and resultant impact on GHG emissions. Joyce, Hallett, Hannelly and Carey (2014) conducted a systematic review of research modelling different dietary patterns and GHG emissions with exploration of the effects on public health and policy making. They identified 21 primary studies that modelled GHG emissions and dietary patterns published since 1995. Due to considerable differences in study designs and assumptions a qualitative review was conducted which described the study methods and findings. Most studies examined were European, with one study from each of Australia, New Zealand, North America and India.

In all studies, an average diet based on food surveys or population data was used as a reference point for other additional diet scenarios. All diets used were based on reducing meat consumption with 11 studies including a diet without meat and 8 studies including a diet without any animal products (vegan). The majority of studies used a life cycle assessment (LCA). This is a method which allows for identification of inputs (i.e. water, electricity, other resources) and outputs (i.e. GHG emissions, waste) connected to production of products. It is a comprehensive method for calculating the global warming potential or GHG emissions emitted over the life cycle of a product. The following case studies represent the most recent research from the UK, Nordic region, continental Europe, Australia, New Zealand, North America and India. In examining these case studies what is apparent is that despite significant differences in dietary types across these examples there are great similarities in the direction required to reduce GHG emissions.

Australia: Hendrie, Ridoutt, Wiedmann and Noakes (2014)

Hendrie, Ridoutt, Wiedmann and Noakes (2014) compared four different diets in the Australian context according to GHG emissions. The first diet was the average Australian diet taken from the 1995 National

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Nutrition Survey. This included data from males and females aged over 19 years and was weighted to provide an average intake per person per day of different food types. The second diet modelled was the average diet with minimal non-core foods, which were defined as those high in energy but low in nutrients and included processed meat, snack foods, confectionary, soft drinks, saturated fats and oils, and alcohol. Tea, coffee and offal meat were also classified as non-core foods but were included in this diet scenario. The third diet modelled was called the "Total Diet" and based on the Australian Dietary Guidelines. Average serves of food groups were modelled for Australian males of height 160cm and females 150cm aged 31 to 50 years assuming a very sedentary lifestyle. The fourth diet modelled was labelled a "Foundation Diet" which met all the minimum nutrient and energy requirements and only included core foods.

The GHG emissions of the different diet scenarios were modelled using input-output analysis based on food category. These estimates are larger than those produced with food product life cycle analysis as the approach takes a broader focus on whole of economy impacts and thus cannot be compared to other studies using the product-focussed LCA. As well as food category there was some differentiation of meat products given their larger GHG impact so that more accurate figures could be produced. The average Australian diet per person per day had a GHG emission of 14.5kg of carbon dioxide. The best performing diet was the Foundation Diet at 25% less than the average diet. The Total Diet and average diet without non-core foods were similar with an approximate 23% relative reduction each compared to the average diet.

The difference in GHG emissions between the diets in these models related to the presence or absence of non-core foods, which contributed 27% of GHG emissions in the average diet. While the Foundation Diet was optimal it was considered unlikely to be accepted by the Australian population. Despite the fact that red meat had the largest GHG emissions it was not recommended that this food group be reduced due to what the authors considered important nutrients provided and potential environmental impact of the "production of alternative protein sources – especially environmental impacts related to land and water use, and indirect land use change" (Hendrie et al., 2014, p. 298). Suggestions instead related to improved agricultural practices in this sector which could lower emissions. The study was 'funded and approved for publication by Meat & Livestock Australia' (Hendrie et al., 2014, p. 300). Alternatives posed for reducing GHG were adoption of the Total Diet which balanced nutrition and environmental impact or more modest reductions in food intake across the population such as a 10% reduction across all food groups (noting that this was not a nutritionally complete diet). It was also noted in the introduction, that while there are various policy mechanisms available to government to influence food choices, currently there is no evidence of population wide change to reducing food intake.

North America: Soret et al. (2014)

The objectives of the study by Soret et al. (2014) were to compare the GHG emissions of vegetarian, semi-vegetarian and non-vegetarian dietary patterns consumed by a large population in North America, and to independently assess mortality in consumers of each dietary pattern within the same population. This study is the first to assess the impact of reduced meat consumption diets on GHG emissions and health outcomes using non-simulated data from a large and diverse population. Data from the Adventist Health Study 2 (AHS-2) were used to characterise and measure the dietary patterns. The AHS-2 is a sizeable prospective cohort study of Seventh-Day Adventists in North America and Canada, who form a large ethnically, culturally and geographically diverse population. A self-administered food-frequency

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questionnaire of 210 food items including both plant and animal foods, was used to assess dietary intake. Dietary patterns were classed according to the stated combined intake of all meats (including fish), and were categorised as vegetarian (meat rarely or never consumed), semi vegetarian (meat consumed >1 time/month, but <1 time/week) and non-vegetarian (meat consumed at least 1 time/week).

A LCA approach was used to calculate GHG emissions associated with the foods consumed in the AHS-2 population. The carbon dioxide equivalents (CO_2e) within the 210 foods in the diet questionnaire were estimated by using LCAs and from published GHG emission data. Mean annual GHG emissions for each diet were calculated, with 1113 kg CO_2e for non-vegetarians, 872 kg CO_2e for semi vegetarians, and 788 kg CO_2e for vegetarians. Using the non-vegetarian diet as a reference point there was found to be a 29.2% (325 kg CO_2e) reduction in GHG emissions for the vegetarian diet and a 21.6% (241 kg CO_2e) reduction for the semi vegetarian diet. The difference in emissions reflected the amount of meat and plant foods consumed in the different diets. Mortality rates and mortality hazard ratios (HRs) were also examined for each diet, with the mortality rate for non-vegetarians found to be 20% higher than for vegetarians and semi vegetarians. The mortality HRs, were adjusted for a large range of lifestyle factors and also mirrored these results, showing a lowered risk for vegetarians and semi vegetarians compared with the non-vegetarians.

The results showed both public health and environmental sustainability benefits to diets with reduced meat consumption. By using observational data, a realistic assessment of dietary patterns over an extensive time frame as consumed by a large population was enabled.

Other studies examining the GHG impacts of different diets have used designed diets to model nutritional requirements and GHG emission reductions. However Soret et al. (2014) noted that the drawbacks of designed diets are that they may differ markedly from what populations actually consume on a daily basis, and the choice of foods to construct an 'ideal' diet can be influenced by researcher bias. Additionally, other research, which has assessed the impact of meat free diets has concentrated on single food exchanges (i.e. replacing meat with soy). In the real world people are unlikely to replace meat with soy only. Thus these approaches lead to results, which are theoretical in nature and do not necessarily reflect real life, potentially causing misrepresentative results and thus limits on their value in policy making.

Soret et al. (2014) concluded that relatively small changes in consuming plant foods rather than meat in populations whose dietary profiles are on a spectrum of no meat to low/moderate meat intakes can have a non-trivial impact on reducing GHG emissions. The meat consumption of the non-vegetarians in the AHS-2 study was 2 times less than that of average Americans and thus the difference in levels of GHG emissions could be greater if compared with typical non-vegetarian American diets. The public health benefits of reduced meat diets were also made clear with mortality rates being 16-17% lower in vegetarians and semi vegetarians. Soret et al. (2014) however, cautioned against making outright extrapolations to the general public as the association between GHG emissions and mortality with dietary patterns are not directly assessable from their study. Any implications made are only relevant to Western societies where populations have sufficient access to reduced meat in favour of plant based dietary choices. Within this context modification of dietary choices can be both a practicable and effective instrument for climate change mitigation and public health improvement.

New Zealand: Wilson et al. (2013)

Wilson et al. (2013) used linear programming to model 16 diets within the New Zealand context. Linear programming is a mathematical technique, which generates optimal solutions, for example identifying a

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mix of foods of the lowest cost, which fulfil minimum and maximum nutrient levels. The authors used a "bottom up" approach by acquiring data on a range of specific food items and optimizing diets meeting nutritional requirements from that point on. They used four groups of diet scenarios which all meet nutrient requirements. The groups identified were

1. Low-cost (scenarios C1 – C4),
2. Low in GHG emissions and low-cost (scenarios G1 – G4),
3. "Relatively healthy diets" utilising high vegetable intake – a Mediterranean style diet (scenario MED) and an Asian style diet (scenario ASIAN and ASIAN-G), and
4. "More familiar meals" designed to be more acceptable to most New Zealanders.

To select foods to be included in the models the study used a range of foods such as those covered by the New Zealand Food Price Index (includes 44 commonly purchased food items), previous research identifying low-cost protein sources in New Zealand, unprocessed food (i.e. lentils) and low-cost canned food, and lists of foods from a previous French optimization study. For the low-cost group, scenario C1, all energy and nutrient requirements modelled for NZ men were met via only 9 selected foods all of which were vegetarian (wholemeal flour, pasta, dried peas, eggs, sugar, milk powder, carrots, vegetable oil and kiwi fruit). Scenario C2 included slight changes to increase cooking suitability, C3 for ease of preparation and C4 had a relatively high vegetable intake with all other food amounts optimized. For the low-cost low GHG group all diets were lacto-ovo vegetarian with the exception of G4, which was fully vegan. The fully vegan diet resulted in slightly higher GHG emissions and cost than the other low GHG emission diets. While there was no direct explanation for this in the study it may have been due to the G4 scenario being a high-vegetable diet and the use of alternative foods containing micro-nutrients such as calcium in order to meet nutritional requirements. In contrast the other low GHG emission diets may have been based around a small number of foods with less vegetables but higher inclusion of lower GHG food items.

All modelled diets were markedly cheaper and produced less GHG emissions than the NZ average diet, which was modelled using national data from the New Zealand Adult Nutrition Survey. In addition the low-cost and low-GHG diets provided health benefits in comparison to the typical NZ diet such as less saturated fat from meat and lower sodium consumption. The high vegetable diets (C4, MED, ASIAN) were also identified as being healthier. All diet scenarios including meat and fish had larger GHG emissions than the vegetarian and vegan diets. The study identified a number of vegetarian dietary patterns, which were low-cost, low GHG and had health benefits while meeting all nutritional requirements for NZ adults. Including more dietary variability and acceptability of diets (more familiar meals which included meat) increased cost and GHG emissions, but were still lower cost and lower GHG emissions than the NZ average diet.

The authors noted as a study limitation that GHG emissions data are likely to be underestimates given the lack of consideration of factors such as land use required for food production which can significantly increase GHG values for meat and dairy foods, and the emissions associated with food transport, refrigeration and preparation. Policy implications from this study were identified, such as local government policies to ensure that optimized foods (low-cost, low GHG, and healthy) are exempt from food taxes imposed on less healthy foods and identification of foods to be promoted by the public health sector and environmental stakeholders, i.e. food labelling. These foods could then be incorporated into food being served in public institutions such as schools, retirement homes, prisons and hospitals.

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India: Pathak, Jain, Bhatia, Patel and Aggarwal (2010)

Pathak et al. (2010) examined the carbon footprint of food commonly consumed in India and analysed differences in GHG emissions from vegetarian and non-vegetarian foods. As India is a diverse country in terms of both climate and culture, there are wide variances in the types of food consumed in different regions. For the purpose of the study the GHG emissions at various stages of the life cycle of the 24 most common Indian food products were analysed. A LCA was used which factored in four stages: production, processing, transportation and preparation. The GHG emissions from food item production varied substantially – GHG emissions from rice were 10.2 times greater than for wheat and 43.3 times greater than for vegetables. Higher emissions from rice were due to methane emissions from anaerobic soil conditions whereas wheat and vegetables are grown aerobically. Production of meat and milk also emitted large amounts of GHG emissions due to methane production from ruminant livestock. In terms of global warming potential (GWP) mutton contributed 36.5 times that of chapatti (wheat based product) over the food life cycle. Indians generally consume local, fresh food, so 87% of emissions were generated from production. This is in contrast to Europe, America, Australia and New Zealand where more processed food is consumed and thus the GWP contribution of processing and transport are greater.

The GHG emissions for a balanced diet per day for an adult man and woman at a moderate level of work were calculated based on dietary requirements (different foods in quantities and proportions that meet nutritional needs to withstand short duration of leanness). Five common diets, vegetarian, lacto-vegetarian (vegetarian with milk), ovo-vegetarian (vegetarian with egg), non-vegetarian with poultry and non-vegetarian with mutton were also used as a comparison of GHG emissions from each diet. Overall, GHG emissions for the non-vegetarian diet were 40% greater than for the vegetarian diet. In the lacto vegetarian diet rice and milk were the greatest contributors to GHG emissions. In the non-vegetarian meal mutton was the largest contributor.

The authors concluded that differences in food consumption could be used for mitigation of GHG emissions, for example, a shift from animal food products to crop foods. Within crop foods, wheat based products produced less GHGs than rice and thus either rice consumption needs to be reduced or grown in a way which does not emit methane. The authors also noted that in substituting food products it is important to pay attention to nutrient levels and achieving a balanced diet. They suggested that meat could be replaced by foods such as pulses and vegetables, but that replacing meat with milk products would be less effective in reducing GHG emissions.

United Kingdom: Scarborough et al. (2014)

Scarborough et al. (2014) estimated the variance in diet related GHG emissions of self-selected meat eaters, fish eaters, vegetarians and vegans in the UK. Data from participants in the EPIC-Oxford cohort were used for analysis. This cohort comprised 65,000 participants over the age of 20 recruited between 1993-1999 in the UK via collaboration with general practitioners, vegetarian and vegan societies and advertisements in health food and vegetarian magazines. Participants also recruited friends and relatives. A validated semi-quantitative food-frequency questionnaire was used whereby participants estimated their intake of 130 different food items consumed in the previous twelve months.

Six dietary groups were characterised: high meat eaters, medium meat eaters, low meat eaters, fish eaters, vegetarians and vegans. Participants were then classified as meat-eaters, fish-eaters, vegetarians and vegans in response to yes/no questions on dietary behaviours, with the final dataset comprising 29,589

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meat eaters, 8,123 fish eaters, 15,751 vegetarians and 2,041 vegans. Nutritional analyses of the 130 food items were based on nutritional data from UK food composition tables for 289 food codes. The authors estimated GHG emissions for these 289 food codes using a method, which utilised a life cycle approach to estimate GHG emissions for food commodities from the earliest production stages to retail distribution. The GHG emissions for each participant were standardised to a 2,000 kcal daily diet to ensure that any difference in estimated energy consumption between different dietary groups did not affect results.

The study results showed that dietary GHG emissions were highest for high meat eating men and lowest for vegan women. Mean observed values for dietary GHG emissions for meat eaters were 52% higher than for vegetarians and 100% higher than for vegans. Statistical analysis (ANOVA) revealed highly statistically significant differences in dietary GHG emissions between the six dietary groups with increasing emissions in groups, which consumed more animal products. After adjusting for sex and age it was shown that on an average 2,000 kcal daily intake a high meat diet produced 2.5 times as many GHG emissions than an average vegan diet. The authors concluded that consuming less animal based products is a feasible method for reducing individual GHG emissions as well as providing health benefits. Further, the authors commented that any updates to national government dietary recommendations, which aim to define sustainable and healthy diets must include the recommendation to reduce consumption of animal based products.

Continental Europe: Vieux, Darmon, Touazi and Soler (2012)

Vieux et al. (2012) analysed the GHG emissions of the average French diet from a survey conducted in 2006-2007 where a nationally representative random sample of adults completed a 7-day diet recall. The final sample size used for these analyses was 1918 adults (776 men and 1142 women). All food items that were reported as consumed by the participants in the survey (1314 food items) were categorized into 16 food groups and 36 food categories. For each food the percentage of participants who consumed it was calculated and within the 36 food categories foods were ranked based on these percentages. At least one food item from among the most widely consumed foods was used to represent each category. This resulted in 73 representative foods, of which most were consumed by 10 or greater percent of participants.

Life cycle analysis up until the point of sale was used to calculate the GHG emissions of the 73 food types. The mean GHG emissions of the male diets were 4170g carbon dioxide/day and for women this figure was 3667g carbon dioxide/day. Simulated models were conducted whereby the energy levels of the diets were reduced to meet the energy expenditure of someone with low physical activity and another model to meet the energy needs of someone with moderate physical activity levels. Under the low physical activity scenario relative to the average diet the required reduction in calories resulted in a 10.7% reduction in GHG emissions. For the moderate physical activity simulation this reduction was 2.4%.

The contributions of the food groups to diet associated GHG emissions was analysed, showing that the meat and deli meat food group had the greatest impact with a mean contribution to GHG emissions of 27% - more than two times higher than emissions from other food groups. From these findings the authors devised two scenarios to analyse the impact of meat reduction on diet associated GHG emissions. In the first simulation meat/deli meat reduction was reduced by 20% without caloric compensation, which resulted in reducing mean GHG emissions by 4.1%. When the caloric loss was compensated for, there was a smaller decrease in the observed emissions. In the second simulation the meat content was held at 50g per day and deli meat was removed. This resulted in a 12% decrease in GHG emissions when there was no caloric compensation.

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When fruits and vegetables were used for iso-caloric compensation there was a gain of 2.7% in GHG emissions owing to the large amounts of fruit and vegetables needing to be consumed (426g/day). However, the meat reduction analysis was conducted on the caloric content of the current diet situation (2118 kcal/day), which the authors had shown to be greater in energy than required to meet energy needs. Thus in both meat reduction scenarios without caloric compensation, the caloric content of the diet still exceeded that which is needed in the low activity level diet scenario. As Friel et al. (2013) showed, any food consumed above a person's energy requirements is an avoidable source of GHG emissions given the GHG emissions required to produce the extra food. Additionally while substituting fruit and vegetables for meat as an iso-caloric compensation resulted in higher GHG emissions (due to the amounts needed) this may not be a realistic real life scenario as other higher energy density foods with lower GHG emissions than meat, i.e. legumes and soy protein are typically consumed by vegetarians and those on low meat diets as substitutes for meat. For example in the study by Scarborough et al. (2014) a daily 2,000 kcal vegan diet produced less than half the GHG emissions than a daily 2,000 kcal high meat diet.

The authors concluded that simulating reduced meat diets to reduced GHG emissions using health measures such as caloric intake and energy density showed no systematic benefits from a health viewpoint or union between health and environmental impacts. This was because of assumptions related to caloric compensation for animal products; in that environmental effects are cancelled when meat is iso-calorically compensated for by only large amounts of fruit and vegetables. Thus, while this may beneficial for health, environmental and health effects do not converge. Additionally the findings in this paper are in contrast to other studies who found beneficial interactions between meat reduction, GHG emissions and public health (Hallström, Röös & Börjesson, 2014; Soret et al., 2014).

Nordic: Hallström et al. (2014)

Hallström et al. (2014) looked at the impact of reducing meat consumption on the dietary contribution of nutrients, GHG emissions and land requirements in Sweden. Three diet scenarios were modelled: a reference scenario (REF) based on current average Swedish meat consumption, and two nutritional scenarios (NUTR-1 and NUTR-2) of reduced meat intake. The REF scenario used data from 2009 national statistics on meat supply and consumption. For the NUTR-1 scenario the amount of meat was based on dietary guidelines with meat limited to 126g of uncooked meat per day and red meat restricted to 60g uncooked. In NUTR-2 the same amount of meat is used but beef is sourced entirely from production systems producing both meat and milk, which are more resource efficient.

The nutritional findings of the study were that Swedish per capita consumption of meat is double that recommended by public health guidelines. Reducing the average meat consumption to recommended levels according to dietary guidelines has only small effects on overall energy and protein contributions but a considerable reduction in fats, iron and zinc. From a nutrition point of view the decreased fat would have positive health benefits but more research is needed to examine the effect of replacing meat with different plant based foods to provide adequate levels of iron and zinc. Owing to overconsumption, it may however be possible to reduce meat intakes without any requirements for nutritional compensation. In environmental terms the average Swedish meat consumption accounts for an estimated 40% of the long-term per capita budget for sustainable GHG emissions and occupies half the available cropland. Reducing meat consumption to recommended levels (approximately 25% reduction in current intake) would reduce GHG emissions from meat production by around 15-25%. The authors conclude that more

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research is required in order to develop recommendations for dietary patterns with a lower environmental impact, which also meet nutritional requirements.

Summary

These case studies are representative of the 21 studies to date that have modelled the GHG impact of different dietary scenarios (Joyce et al., 2014). Nineteen of these 21 studies found that the greater the reduction in animal-based foods, the lower the GHG emission impact. The two studies that did differ in results produced divergent results due to differences in methodologies. As discussed, Vieux et al. (2012) used fruits and vegetables as an iso-caloric compensation for a 20% reduction in meat consumption rather than a broader and more realistic plant based substitute and caloric intake in the reduced meat diets was above what was required to meet energy needs. Wilson et al. (2013) found that while vegetarian diets had lower GHG compared to meat based diets, the vegan option had higher GHG compared to other vegetarian options due to the replacements for eggs and dairy which were more costly economically and had greater GHG emissions for the equivalent nutrient levels.

Hence, it can be concluded that reduced animal food production has increased potential to reduce GHG emissions compared to technological mitigation or increased productivity measures (Hedenus, Wirsenius & Johansson, 2014; Popp, Lotze-Campen & Bodirsky, 2010), with the greatest GHG reduction potential achieved by a combination (Popp et al., 2010). In respect of particular food types, beef has a much greater GHG impact relative to other types of animal products and vegetable products (Eshel et al., 2014). Modelling of future scenarios shows that current consumption patterns are unsustainable and that reduction in livestock will be an important element in achieving future food security (Bajželj et al., 2014).

The diet modelling studies have provided guidance on the areas requiring policy and program attention, particularly, reduced consumption of animal-based foods, but this research base does not provide much direction about the form of those interventions (Joyce et al., 2014). There have been conclusions made about the need to educate consumers on the health and/or environmental benefits of certain dietary types but these recommendations were based on the results of the simulated diet studies, not from the literature on social and behavioural models of change (Joyce, Dixon, Comfort & Hallett, 2012; Joyce et al., 2014). At present these recommenations on educating consumers seems naïve given the challenges involved in achieving behaviour change at a population level (Joyce et al., 2014). The remainder of this chapter will explore what research is required to better inform the development of policy and program interventions.

INTERVENTION POSSIBILITIES TO REDUCE THE GHG IMPACT OF DIETARY CHOICES

A Systems Science Approach to Reducing Meat Consumption

The term ‘systems’ is used in many different ways within public health and food industry. It is important to clarify our meaning of the word in the context of the ‘systems thinking approach’ discussed within this chapter. Here, ‘systems’ is used to refer to the interrelationship between parts of a system and draws upon many theoretical approaches including general systems theory, complexity science, chaos theory, and network theory (NCI, 2007). Pivotal to this approach is identifying system behaviours such as feedback

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loops, information flows, and organisational structure (Foster-Fishman, Nowell & Yang, 2007; NCI, 2007). This is in contrast to the food system as described in the first section of the paper (in relation to the mechanics of the different stages of pre-production, production, and post-production). Similarly, it differs from how the processes of each stage could be improved through system redesign and engineering with technological developments in the agricultural sector. However, it is worth noting that we are not proposing in this chapter that a social and behavioural perspective should be considered in isolation from other elements of the food system.

The remainder of this chapter explores how social and behavioural approaches to reducing meat consumption could be enhanced by applying a systems thinking perspective. To date a programmatic approach for shifting environmental behaviours is the predominant model used (McKenzie-Mohr & Schultz, 2014) and while there is good evidence for their effectiveness, there are significant challenges in scaling up such interventions and/or sustaining change. These include resource constraints of implementing evidence based approaches across multiple topics in real life conditions compared to the single issue focus of research (Bond & Butler, 2009) and the challenge of transferring the results of a project from one context to another context (McTaggart, 1991). Part of the impetus for a systems based approach is the challenge of using a programmatic approach when aiming for population level change (Hawe, Shiell & Riley, 2009).

System thinking approaches and tools have gained traction in a range of fields to help shed light on how to address complex problems such as obesity prevention (Johnston, Matteson & Finegood, 2014). In public health, new systems methodologies have emerged which have utility for shedding new light on how to think about intervening in complex settings for effective and sustained change. In particular, Johnston et al. (2014) recently developed a new systems framework, which has shown to have heuristic value for planning interventions and evaluating recommendations for change. Based on Meadows (1999) seminal paper, they outline a number of critical leverage points to intervene in a system. Their Intervention Level Framework includes five levels, ranging from weak to strong leverage points: structural elements, feedback and delays, system structure, goals, and paradigm. The remainder of this chapter explores potential approaches for reducing meat based consumption within each of these five 'Intervention Levels'.

Structural Elements

The most common approach for intervention is the structural elements which include interventions designed to influence policies, subsidies, and community attitudes and behaviours. While there is evidence that in combination these types of strategies are effective (Johnston et al., 2014), Meadows (1999) considers this to be the least effective type of intervention in its ability to leverage significant change – many actions at this level are required to create substantive change. Unfortunately, structural elements is the area that has attracted greatest research attention. While this research can help intervention design, a quick overview of this type of research will outline its limitations in providing a base for systems level interventions.

The research on attitudes and knowledge of diet-related behaviour can provide some useful background for intervention projects. The general public is more aware of the health consequences rather than environmental costs of different dietary choices (Joyce, Dixon, Comfort & Hallett, 2008). The adoption of plant-based diets is driven more by health and ethical concerns rather than for environmental reasons (Fox & Ward, 2008a, 2008b). After an individual adopts a vegetarian diet, their self-identity develops and motivations broaden to include environmental benefits and a combination of health and ethical concerns. Research has explored some of the barriers to adoption of plant-based diets with convenience, ease of

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preparation, and lack of information identified as key (Lea, Worsley & Crawford, 2005; Lea, Crawford & Worsley, 2006). Specific research on barriers to adopting vegetarian diets highlighted enjoying eating meat (78% agreed), not wanting to change eating habits and thinking that humans were meant to eat meat as barriers. It was concluded that targeted information needs to be provided on nutrition and preparation of plant-based meals. There has also been research applying behavioural models including the Theory of Planned Behaviour (Ajzen, 1991) and the Trans-theoretical Model (Prochaska & DiClemente, 1983) to predict intention to follow a plant-based diet (Wyker & Davison, 2010). This research discovered that the decision process to eat more fruit and vegetables differed from the decision process to adopt a plant-based diet. It was also found that attitudes towards a plant-based diet varied according to gender and particular stage of change. This research has some potential in guiding appropriate education campaigns, and information style strategies have an important place within an overall multi component approach (Howat, Sleet, Elder & Maycock, 2004).

The limitation of this research in guiding intervention design is that it views decision making as a rational process (Beverland, 2014) and the stages of change model in particular has been criticised for its lack of scientific rigour and evidence from intervention trials (van Sluijs, van Poppel & van Mechelen, 2004; West, 2005). Resnicow and Page (2008) offered a critique of the linear, reductionist approach to understanding health behaviour change using a systems perspective. They suggested that health behaviour change may be better construed as an unconscious and chaotic process that resembles a complex adaptive system. They listed factors that could influence change such as knowledge, attitudes, mood, social support, social norms, environmental factors and genetics and contended that given the possible permutations of these factors is infinite, predicting health behaviour change becomes extremely difficult. However, while information type approaches may have little utility in shifting attitudes or behaviours of the public, they may assist in creating a climate whereby other more effective approaches are supported – known as a tension for change in a system. Diffusion of innovations research (which theorises how new ideas spread through complex systems) has shown that creating a 'tension for change' within a social system is essential for the adoption of future innovations (Rogers, 1983).

Educational interventions on their own are unlikely to yield behavioural change but can support and augment other interventions (Howat et al., 2004). Thus while increasing education may not directly alter behaviour it may increase attitudes and knowledge and lead to increased support for economic, organisational and policy interventions that might be more effective in driving change (Stafford, Allsop & Daube, 2014). This is commonly accepted within health promotion and this multidisciplinary approach incorporating economic, organisational, policy and education interventions has produced a number of successes, most noticeably in the areas of reducing smoking rates, decreasing road fatalities, decreasing rates of cardiovascular disease and reducing rates of skin cancer (Moodie, 2004). The strength lies in a multidisciplinary approach incorporating economic, organisational, policy and education interventions (Howat et al., 2003).

Critical to this multidisciplinary approach and pursuing both policy and individual change is engaging a broad coalition of support. Policymaking and policy implementation take place within, and are influenced by, networks. These networks consist of individuals, coalitions and organisations (Kickert, Klijn & Koppenjan, 1997). From this perspective, policymaking is viewed as cooperation or non-cooperation between interdependent groups with different interests, ideologies and strategies (Kickert et al., 1997). Thus recommendations made for consumer information on the environmental impact of foods (Hoolohan, Berners-Lee, McKinstry-West & Hewitt, 2013) may have little impact on consumer behaviour. Yet, it may increase knowledge and subsequent acceptance for more significant policy reform such as

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the recommendations to reduce subsidies for animal based agriculture towards plant based agriculture. Thus even if consumer behaviour is rigid around meat consumption, a contention which itself has been challenged when examining consumer behaviour (Dagevos & Voordouw, 2013), promoting messages around the environmental impact of food choices may increase support for policy change which could be more effective in changing consumption patterns. Further discussion of partnerships required for policy reform is presented in the section on system structure.

Feedback and Delays

Information itself can be a very important leverage point as it can highlight the need to change and motivate action (Meadows, 1999). Research has found that information flows receive less attention relative to other intervention areas, and yet, inadequate or missing information flows are often the reasons for poorly performing systems (NCI, 2007). Information itself can be a very strong motivator to take action and begin a change process (de Savigny & Adam, 2009; Meadows, 1999; Mrazek, Biglan, Hawkins & Cody, 2007; NCI, 2007). It assists in making decisions about allocation of resources based on need to address issues of most concern (Mrazek et al., 2007). Information can also be used to monitor the effectiveness of interventions (Mrazek et al., 2007).

Viewed as an important leverage point, monitoring data can motivate improvements in performance and attainment of goals (Rowe, 2009). Improved surveillance of plant-based diets and levels of meat consumption along with related attitudinal trends could highlight areas of need for educational campaigns, those with significant public support to leverage legislative change and for policy advocacy and track population impacts of changing policies and social mores. Improved corporate social disclosure and increasing transparency in animal agricultural practices could also assist in providing information to consumers that may impact behaviour. Consumer pressure and increased regulation to improve animal welfare outcomes during farming and slaughter may increase costs of animal products thereby reducing demand. The potential of feedback loops to create this pressure for change needs to be tested and from such a research base, effective surveillance and monitoring systems would need to be established.

System Structure

Johnston et al. (2014) described this level as referring to the connections between system elements. Many disparate groups have an interest in shifting dietary practice, and the policies required to support this change, including health, environmental, and animal welfare and rights groups. Exploring means of connecting these groups will be critical in advancing policy and practice given the importance of cooperation between interdependent groups with different interests, ideologies and strategies in advancing a policy position (Kickert et al., 1997). It has been suggested that encouraging the adoption of healthy diets could improve both population health and reduce carbon emissions (Hendrie et al., 2014; Macdiarmid et al., 2012). However, there is little evidence that health related messages are effective for obesity prevention (Robinson, 2010). Robinson (2010) suggests that messages around environmental sustainability or animal rights might be more effective in producing health gains.

Writing from an environmental sustainability perspective, Beverland (2014) put forward that certain types of health messages might influence dietary shift to realise environmental gains. There have also been suggestions that promoting the cultural value of more traditional diets that include less meat consumption may have resonance with the public (Beverland, 2014; Pairottia et al., 2014). Thus there is

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acknowledgement of the need for cross-disciplinary work to address this issue (Johnston et al., 2014). Clearly there needs to be further research examining which messages will resonate with different sections of the public and linking together related organisations and groups that can advocate for policy reform (Beverland, 2014; Joyce et al., 2014). Understanding how to connect disparate groups interested in shifting dietary practice, and the policies required to support this change, is a critical research need. The challenge for future research is therefore to explore how to promote cooperation between health and environmental organizations to enable policy change.

Goals

Goals have a very important role in influencing the previous leverage points of feedback and delays, system structure and system elements as the goals of the system influence its direction and scope (Meadows, 1999). Meadows (1999) comments on how values can determine the selection of goals, which has dramatic system effects. Johnston et al. (2014) describe how unrealistic goals can raise expectations so that programs are destined to be viewed as failures and that setting process system goals may better direct effort, the example they gave was: "Make physical activity an integral and routine part of everyday life" rather than a goal on reducing obesity rates (Johnston et al., 2014, p. 1276).

Establishing goals for sustainable diets will be an interesting process given the competing interests and viewpoints, even among those directly concerned with the research, let alone professional organisations. Vieux et al. (2012) recommended, due to the rigidity of diets, that the focus should be on improving efficiency in the supply side rather than trying to shift consumer behaviour. This neglects the previously cited research on the importance of a multi-component strategy to enable policy change. This finding also is contrary to recent research suggesting some malleability in dietary practice. Dagevos and Voordouw (2013) found a reduction in frequency of eating meat from 2009 to 2011 from a population survey and reported that certain sectors of the population could be receptive to messages about reducing meat consumption for reasons of ethics, health, social norms or price. A study of Finnish university students found that the feasibility of adopting a vegetarian diet was high although they did not rank this behaviour as important thus highlighting the low level of knowledge about environmental impact of dietary choices (Salonen & Helne, 2012).

While there is general consensus on the need to reduce meat consumption to reduce GHG (Joyce et al., 2014), in the Australian study sponsored by the Meat & Livestock Australia, it was concluded that improved agricultural practices rather than reduction in meat consumption were appropriate goals (Hendrie et al., 2014). The position of this industry within Australia both at a broad economic and social level and also as a funder of nutrition related research, underscores policy formation. This issue will vary considerably across countries and regions depending on the formation of coalitions and message framing (Joyce et al., 2014). The process by which goals and then consequent policies and programs get developed is an area requiring further research.

Paradigm

Although the most difficult leverage point to shift, intervening in a system's paradigm can be very effective (Johnston et al., 2014). A paradigm describes a system's deepest held beliefs (Johnston et al., 2014; Meadows, 1999) and underpins the identification of goals as well as many of the other leverage points. By changing systems at the level of their paradigm or their underlying assumptions, transforma-

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tion of the system can occur (Meadows, 1999). Indeed without changing the institutional structures of a culture, sustained behavioural change of individuals or organisations is unlikely (Kilbourne, Beckmann & Thelen, 2002).

Kilbourne et al. (2002) described the dominant social paradigm in relation to environmental attitudes as one which was engendered during the Enlightenment and collates values, beliefs and institutions into a social lens of how the social world is interpreted. Although a paradigm may be held by the majority it is not this that enables it to be dominant but it being "held by dominant groups who use it to legitimize and justify prevailing institutions" (Kilbourne et al., 2002, p. 194) and may function as an ideology. Relevant aspects of the dominant social paradigm include self-interested individualism, anthropocentrism, technological optimism and support for economic growth and limited government (Kilbourne et al., 2002; Kilbourne & Polonsky, 2005). Studies suggest that when individuals value self-enhancing and materialistic aims they are more likely to have negative environmental attitudes, less likely to engage in simple environmentally beneficial behaviours and choose behaviours that degrade the environment (Kasser, 2011).

Related to anthropocentric values is the relationship socially conceptualised between humans and other animals. The dominant paradigm vacillates around a utilitarian view of animals that as long as they are treated humanely (varying in definition) their use for human purposes including human consumption is acceptable. An alternative viewpoint comes from animal rights activists who want to not just improve the conditions under which animals live and are treated but attempt to change the way we conceptualise animals and abolish their use by humans completely (Payne, 2002). An ethically driven agenda based on revising the human relationship to animals and the resulting moral imperative may be more persuasive to shift dietary behaviours for some than messages related to health or sustainability. This would align with Kasser (2011, p. 94) suggestion that interventions to increase the importance that people place on "values such as benevolence and universalism and goals such as self-acceptance, affiliation, and community feeling" would assist in de-emphasising the prevailing materialist values associated with ecological degradation.

CONCLUSION

The diet modelling research has provided consistent findings that reduced consumption of animal based products and increase in consumption of plant-based foods would result in considerable reductions in GHG emissions. These findings are similar across countries and regions with diverse agricultural and dietary practices. At present the intervention recommendations stemming from this research are not grounded in the research on social, behavioural and policy change (Joyce et al., 2012; Joyce et al., 2014). This chapter has made apparent that what is available on these topics is focused somewhat narrowly on research leading to programmatic interventions rather than broader systems thinking approaches. Research and debates on the merits of promoting a paradigm shift in people's attitudes to animals compared to promoting a small reduction in meat consumption need to be explored. How to best implement surveillance and monitoring systems on food consumption and attitudes to plant-based diets need to be investigated and the formation of system structures and goals in this domain requires further research as well. While this research is still in its infancy, as it develops, possible strategy solutions should emerge that can be tested and refined and progress made towards reducing dietary related GHG emissions.

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KEY TERMS AND DEFINITIONS

Climate Change: A change in the earth's climate, especially a change due to increased global average atmospheric temperature apparent from the mid to late 20th century onwards which is primarily recognised as being due to increased emissions of greenhouse gases into the atmosphere.

Dietary Choices: The types of foods chosen to be consumed by individuals.

Food System: The activities which relate to the production, processing, transport, storage and consumption of food.

Greenhouse Gases: Gases which absorb infrared (heat) radiation in the atmosphere, causing a greenhouse effect.

Greenhouse Gas Emissions: The emission of any of a variety of gases such as carbon dioxide and methane, into the earth's atmosphere which contribute to the greenhouse effect.

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Life Cycle Assessment: A method which allows for identification of inputs (i.e. water, electricity, other resources) and outputs (i.e. GHG emissions, waste) connected to production of products.

Livestock Production: The raising of domesticated animals in an agricultural setting for the purpose of producing food.

Meat Consumption: The consumption of meat as part of an individual's diet.

Systems Thinking Science: An approach which looks at the interrelationship between parts of a system and identifies system behaviours such as feedback loops, information flows, and organisational structure.

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Chapter 31
An Evaluation of Partnership for Productive Development in Brazil's Healthcare:
Measuring the Knowledge Translation from Implementation to the Impact

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ABSTRACT

21st Century brings great challenges in the information and knowledge areas. The public health is intensified in Developing and Less Developed Countries on account of parasitic diseases as well as developed countries because emerging and reemerging diseases. This diseases associated with chronic or acute diseases can intensify causing a serious health problem as drugs resistance, neglected disease and to afford perpetuate poverty. Thus, it is urgent new ways for information management. The management of the Partnership for Productive Development (PDP) have been shown a promising tool to help internalize new technologies and foster R,D&I. This chapter gives an evaluation for Healthcare using the example of the Brazilian PDP whose last way may be considered as a Knowledge Translation. In five years were conducted 103 PDP involving public and private pharmaceutical companies and international producer, promoting the development of local economy and reducing government spending from medicines derived from PDP.

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1. INTRODUCTION

The information can be seen as a condition for survival, given that it extends the communication context and rescuing and preserving social memory. Its value is intangible and resists all the mechanisms of destruction and oblivion since the collection of information. This is due, on the grounds that allows reconstructing the cognitive and knowledge assessment of a given situation in question (Lawrence & Giles, 2000).

However, in the 21 century the capacity to generate speed information is modern and unprecedented in the world because of the Internet. Data created are practically instantaneous. Technological per-capita capacity of the world to store information nearly doubled every 40 months since the 1980s. From 2012, every day 2.5 quintillion (2.5×10^{18}) bytes of data are created (Lynch, 2008). This phenomenon growing is called Big Data (Lawrence & Giles, 2000; McKinsey Global Institute, 2011)

Quantity of daily data posted on the Web has led to a constant training of new professionals in all science areas. New activities have appeared such as the Data Scientist - one who constantly seeks the best way to deal with the phenomenon of Big Data. The Big Data term has been consolidated within the scientific community due to the set of technological solutions capable of dealing with the ongoing accumulation of data that are unstructured and are captured from several sources. They are presented in order of petabytes, i.e.; quadrillion bytes of stored data. It's challenging the way to deal with these issues both for conducting scientific projects and any type of business organizations (Lynch, 2008).

At the institutional level decisions made without the right information lead to inaccurate decisions and sometimes disastrous. Decisions based on facts and reliable information are more likely to generate good results thereby enabling decision maker's subsidies to meet the everyday challenges. Proper and timely information can develop effective strategies and acts proactively. This action can be called a competitive strategy when it involves business approach, which maximizes the value of the capacity of the organization to distinguish the company from its competitors (Porter, 2008).

Any scientific research area or an organization to lead to the advancement in technology, i.e., to improve to the management of large volumes of data, must apply the concept to extract data in order to have a more consistent view for decision making of managers. An example about online (and in time) information on a particular topic can be seen in Figure 1, in this case it was used the term "technology transfer".

It should be emphasized that the data shown by Newsmap are interactive and they gather all the information commented on a certain day and time period on the topic researched. Thus, it is possible to have an overview of the particular subject and immediately report to the most relevant topic for the decision maker. Thereby, from this point to extracting the core information into other scientific bases. Figure 1 shows also that the greater the size of the rectangle, greatest the consistency of the research topic, i.e. it reflects that topic got a bigger number of reviews and publications in relation to the others shown in the search. In this sense, clicking the selected rectangle, you can redeem the respective articles.

It is globally recognized that the Science is data intensive and information but the scale with which it presents itself in recent times is exponential in any science area. Even considering their correlations in a globalized context. Therefore, requires new tools for extracting, analyzing and informational treatment. One approach that has enabled this activity is that the information science which have focused on information enables multidisciplinary interface with several areas (Magalhães, Quoniam, & Boechat, 2013; Quoniam, L, 2011; Trigo, Gouveia, Quoniam, & Riccio, 2007).

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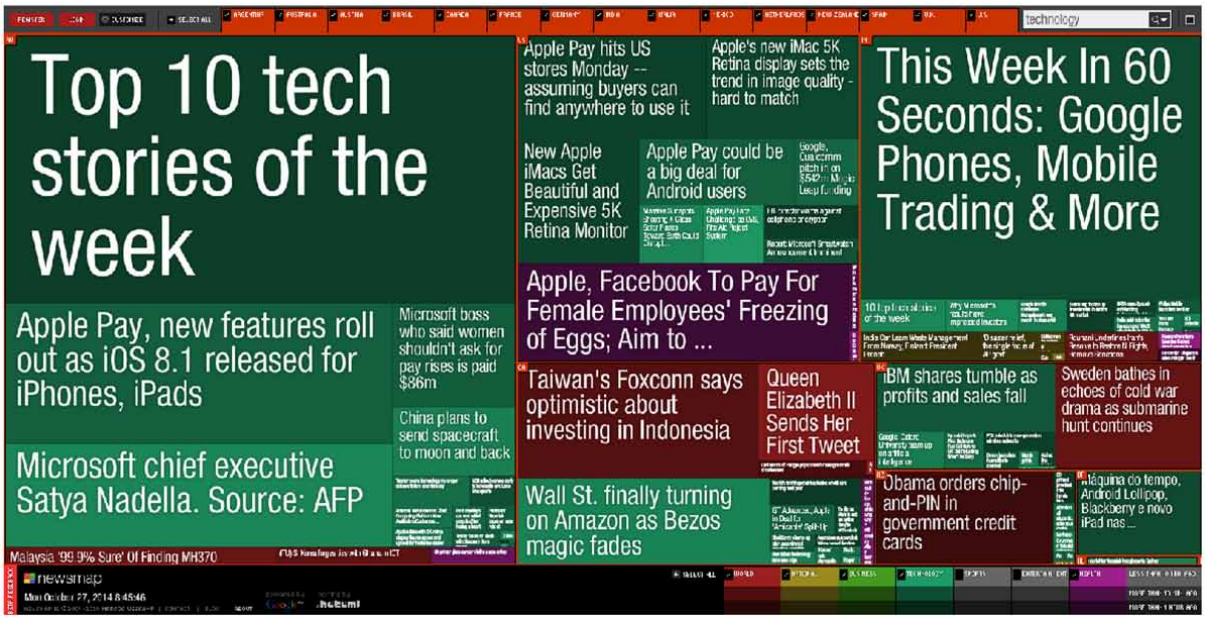
Figure 1. Overview about technology in the world in general news.
Source: Newsmap (http://newsmap.jp/. (Access: October 6, 2014).



In this sense, this work considered a case study of management information in "Public Health" area. The choice of this area occurred due whereas the term "health" is present in about 50% of Big data. This data total, 47% are relate to the "Public Health". Therefore, it is urgent to seek studies aimed at helping better management of this science area (Magalhães & Quoniam, 2013).

Regarding choosing a tool to assist in a study program in the field of Public Health, it used the "Health Evaluation" assigned to the Policies for Science, Technology and Innovation in Health in Brazil. On the other hand, the work aims not only to verify the existence of the policy, but to measure the "Knowledge Translation" as a practical case study, in this case, the Partnership for Productive Development (PDP) held by Brazil. It is noteworthy that this expertise "Evaluation" is not trivial in Brazil compared with Canada, for example, where it has consolidated and usually practiced in large Canadian research centers allied government agencies in that country (HARTZ, 1997).

It is understood the paradigm existing of "Evaluation" not only with a disciplinary matrix, but also on its "exemplary" sense, which proposed solutions to concrete problems and accepted by the scientific community as the features of the theory of Piaget & Garcia (1983). According Morin (1982), it is necessary to elevate the concept of "system" of his theoretical level the paradigmatic level. A paradigm for the author is the set of fundamental relationships of association and/or opposition between a small number of "master concepts" that command/control all existing knowledge in all the speeches and theories. Thus, it is necessary to try to identify/define what are these notions, featuring the new paradigm and to resume as the (re)definition of the system where the logic of complexity in modeling the actual performance interact with a posture of the researcher and the actors involved in evaluative process (HARTZ, 1997; MORIN, 1982; PIAGET; GARCIA, 1983).

When an organization holding a given technology of a product and will transfer it there is managing a knowledge. In this point, the PDP knowledge one can think that is an architecture of information

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management that will lead innovations in a sector. Hence, they are absolutely essential to be evaluated from implementation to the impact on society.

Thus, this chapter shows an example about information architecture could be applied in any science are. In this case, through the management of information technology transfer for health. Therefore, the focus chosen were the PDP implemented in Brazil which will provide an average savings to government spending in the order of US$ 1.7 billion upon the expiration of 103 PDP (BRASIL. MS., 2014).

2. OVERVIEW ON PUBLIC POLICIES IN BRAZIL'S HEALTHCARE

Development in science, technology and innovation are key components for socio-economic growth of the Brazil. In this context the health sector plays a key role as a space for technological innovation, new jobs and income and the promotion and protection of health for the welfare of people. It is the duty of the State to ensure the health of the entire population, through the formulation and implementation of economic and social policies aimed at reducing the risks of diseases and other health problems and to establish conditions that ensure universal and equal access for all. Similarly to promote actions and services for protection and recovery of the society (A. L. B. de Carvalho, Souza, Shimizu, Senra, & Oliveira, 2012; De Negri & Kubota, 2008; Gonçalves, 2006).

Brazil, as well as the global trend, has undergone processes of demographic, epidemiological and nutrition transition with significant reduction in fertility rates and birth rates besides a steady increase in life expectancy. This process resulting in changes in the patterns of occurrence of pathologies and increased significantly the prevalence of chronic diseases. This changing in epidemiological profile of the country cause an increased demand for new medical technologies to ensure continuous improvement in the health population (P. Gadelha, Carvalho, & Pereira, 2012).

In this context, health products are expanding and occupying an important space in the Brazilian economy. It consists of an overload of items with different levels of complexity, ranging from a simple infrared lamp until the MRI equipment to a culture medium to a reagent kit for detection of HIV and medicines. Therefore this products are used in conducting medical, dental and physiotherapy procedures, as well as the diagnosis, treatment, rehabilitation or patient monitoring.

Regarded as one of the most vital and dynamic sectors of the economy, it is responsible for 8% of formal qualified employment and corresponds to 5% of total health spending. According to the Ministry of Health (MoH) in Brazil there was a 72% growth in the number of devices in health services in the National Health System (SUS - Brazilian term) over the past five years. Sector revenues reached more than 100% from 2005 to 2013 reaching the order of US$ 5.5bn.

According on the Monthly Survey of Physical Production of IBGE, the sector growth of 8.5% in production of medical and dental instrumentation equipment from January to September 2013 compared to the same period in 2012. Meanwhile, sales in retail trade of pharmaceutical, medical and orthopedic goods grew at around 9.5% in the same period (Gadelha; Costa; Maldonado, 2012; Gadelha; Quental; Fialho, 2003; IMS Institute for Healthcare Informatics, 2012; Ministério Da Saúde, 2014).

The growing of market in Brazil is maintained for years to come. However, according to industry experts to maintain that growth is necessary for progress to continue at the same pace. In others words, prioritizing policies and actions that can increase access by incorporating new technologies and eliminate any regulatory barriers aiming to meet and discuss the scenario of health care products in Brazil.

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Another factor contributing to market expansion and access to medication is the advancement of research in the development of innovative products. In this sense of stimulate the development and domestic production of medicines and drugs. So, Ministry of Health (MoH) in Brazil increased purchases of medicines and supplies within the SUS. Thus, it is responsible for creation of the Program for the Development of the Health Industrial Complex - PROCIS and the PDP measured the scope of this work. These actions promote joint technology development and exchange of knowledge for innovation within public and domestic private producers, making them competitive and skilled (CARTAXO, 2011; Centro de Gestão e Estudos Estratégicos & Ministério da Ciência, Tecnologia e Inovação, 2013).

The PDP are considered one of the most important actions of the government in health care that are part of a larger Brazilian plan that have been replicated in the Production Development Policy. This is part of the government's industrial policy entitled "Greater Brazil" ("Brasil Maior" Plan – Brazilian term) - http://www.brasilmaior.mdic.gov.br/). The focus is on innovation and growth of Brazilian industry using the transfer of technology for the production of medicines, vaccines and equipment from private companies to public laboratories. Offset by the guarantee of the purchases made by the government around of US $ 12 billion/year. In addition, to generate significant savings for the Ministry of Health (MoH) and decrease the trade deficit of health, which reached US $ 11 billion in 2012. This initiative also brings great benefits to the population because it ensure the supply of essential drugs to the Public Health System (SUS - Brazilian term).

The SUS was constituted in the 1988 Federal Constitution to serve the whole population, from the poorest to the wealthiest, in equal measure. Socially speaking, it was a great step forward for a developing country like Brazil. However, it still falls short in its goal of providing comprehensive healthcare, with months-long waiting lists for doctor's appointments and shortages or lacks of essential medicines for free distribution.

Aligned to the purpose of the macro plan "Greater Brazil" the National Health Plan (NSP) 2012-2015 and the National Policy on Science, Technology and Innovation Management (PNCTIS) is an integration of policies is aimed at local production of medicines considered high value-added and essential in the successful treatment of chronic and complex diseases, i.e., strategic medicines for the country. Thereby, it is possible to see in Figure 2 the National Strategy for Science, Technology and Innovation.

The government has been directing the development of PDP with strategic product as well as the high cost or biologic drugs made from living cells. The federal government is responsible for the purchase of 60% of these products, which represent only 5% of all drugs procured and distributed and can represent 43% of the total spent annually by the MoH with medicines.

Since 90s, the federal government has given expression to its interest in developing the pharmaceutical sector by introducing the Forum for Competitiveness in the Pharmaceutical Production Chain, mainly the creation of the Law for Generic Medicines (Law No. 9,787, February 10, 1999). It was set up as a space for discussing government policies for the pharmaceutical production chain and was jointly coordinated by the Ministry of Development, Industry and Foreign Trade and the MoH.

In 2004, Industry, Technology and Foreign Trade Policy (PITCE) targeted the pharmaceutical industry as one of its strategic objectives. Recognizing the importance of this sector globally, its dynamic, knowledge-and innovation-intensive nature, and the high demand for global investments in Research, Development and Innovation (R,D&I). The PITCE was conceived with the aim of strengthening and expanding Brazilian industry by improving businesses' innovative capacity. With its long-term strategic vision, the central pillar of PITCE was to innovate and add value to the processes, products and services of

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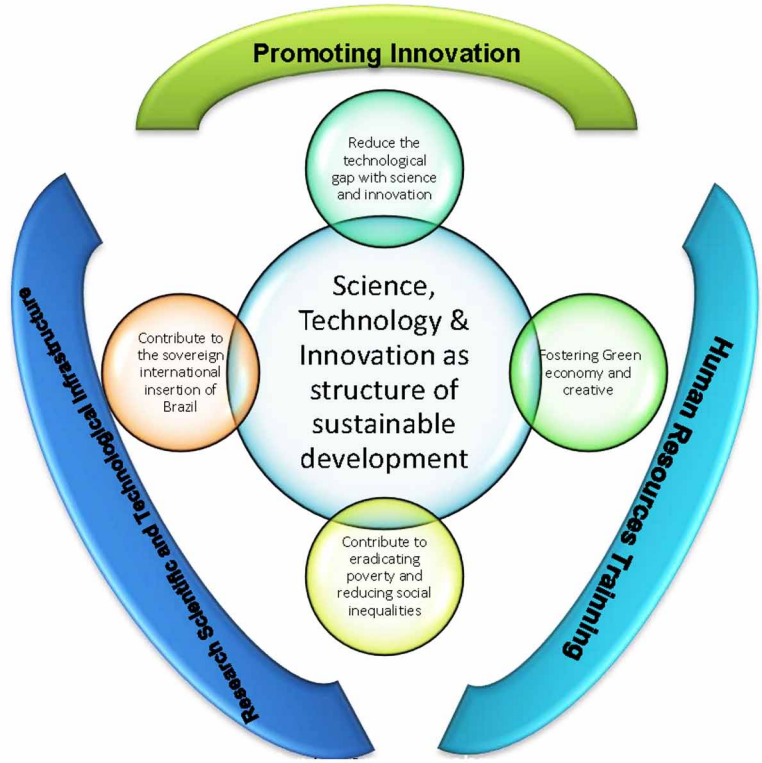
Figure 2. National Strategy for Science, Technology and Innovation 2010-2015.
Source: http://www.mct.gov.br/ (Access: September 26, 2014).



national industry. This Policy operated on three aspects: horizontal action lines (technological innovation and development, exports / entry to foreign markets, industrial modernization, institutional environment), strategic sectors (software, semiconductors, capital goods, drugs and medicines) and future-oriented activities (biotechnology, nanotechnology and renewable energy) (C. A. G. Gadelha & Costa, 2012a).

BNDES's Profarma program was developed to contribute to the implementation of the PITCE and is now used to finance PDPs. It is divided into three sub-programs which provide funding for investments in production, RD&I, and the strengthening of Brazilian companies.

The government also created the Innovation Economy Funding Program, aimed at boosting innovation and improving the competitiveness of Brazilian companies and the economy as a whole. The program is funded by FINEP funding agency, linked to the Ministry of Science, Technology and Innovation (MCTI – Brazilian term) and operates by awarding public funds in the form of grants to companies with which they share the costs and risks inherent to these activities (Furtado & Urias, 2009).

Brazil's industrial policy was reformulated in 2008 into the Production Development Policy. It involves different ministries and has integrated goals and actions, clear financing and concrete mid-term responsibilities. The Production Development Policy's actions are divided into three levels: systems, structuring programs, and strategic highlights. There are programs for a variety of industries, including the health industry (Costa, Gadelha, & Maldonado, 2012; C. A. G. Gadelha & Costa, 2012b).

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In 2008, Brazil created the Health Industry Executive Group under the MoH. Its purpose is to take concrete actions and measures to further the creation and implementation of regulations for the government's development strategy for health sector, based on the national guidelines for strengthening the health industry, as well as other related measures.

The Innovation Law (#1097 from December 2, 2004) provides incentives for science and technology research and innovation in industry. This law aim to capacity building, technological autonomy and industrial development. The law recognizes the different social actors involved and encourages the participation of science and technology institutions into innovation process, regulating partnerships and alliances and the sharing of infrastructure and intellectual property.

It is worth noting that patenting is a strong stimulant for RD&I in the health industry[1]. Brazil's research are done at public research institutions. So the way is interacting with the business world and the evaluation criteria of the nation's academic system must be taken into account. Within the scope of the Industry, Technology and Foreign Trade Policy (PITCE), the Innovation Law aims, among other things, to make it easier for public institutions and universities to grant licenses for their patents to private companies, while encouraging greater efficiency in this system by means which include making it an evaluation criterion (Antunes & Mercado, 2000; Magalhaes, JL et al., 2012c; "Parceria para o Desenvolvimento Produtivo - PDP", 2014).

Nonetheless, the sector for medical and in-vitro diagnostic materials and equipment (also known as health products) is one of the most dynamic. Brazil is the second largest market of the emerging countries, with sales of US$ 12 billion of these products, or 5% of world demand. Global sales are estimated at around US$ 250 billion and are growing at around 6% a year. The Brazilian market exceeds this growth rate, rising at 10% a year. However, the full potential of this market in Brazil is not being harnessed because, depending on the product, purchases for the SUS account for 35-65% of the existing market (Brasil/MS/Fiocruz/IPEA, 2012; Brasil/TCU, 2014).

One of the Brazilian government's key incentive policies is the Greater Brazil Plan for 2011-2014 (replacing the PITCE), which organizes inter and intra-sectorial initiatives. The former is designed to improve the efficiency of domestic production. Meanwhile, the intra-sectorial measures are devised according to the key features, challenges and opportunities of the industries in question, and are organized into five blocks for the formulation and implementation of programs and projects. These cover areas such as strengthening production chains, building new technological and business competencies, energy supply chains, export diversification and internationalization and competencies in the natural knowledge economy (Brasil/MS/Fiocruz/IPEA, 2012).

The policies introduced in recent decades have sparked the need to integrate the knowledge produced in alignment with the previously defined strategies. To assure success and the effective absorption of knowledge in Brazil for the production of strategic medicines from the SUS list, the Brazilian government through the MoH, has prepared partnership agreements under the Production Development Policy. The partnerships must include at least one foreign pharmaceutical laboratory, one official pharmaceutical laboratory, and one Brazilian pharmaceutical laboratory or pharmaceutical company.

It is worth mentioning the creation of the Patent Act. In the world, in 1994, was signed by members of the World Trade Organization (WTO) Agreement on Aspects of Intellectual Property Rights (TRIPS) is known as an international agreement administered. This agreement establishes that the production entire member countries must granted patents for chemical and pharmaceuticals. The patents in the field

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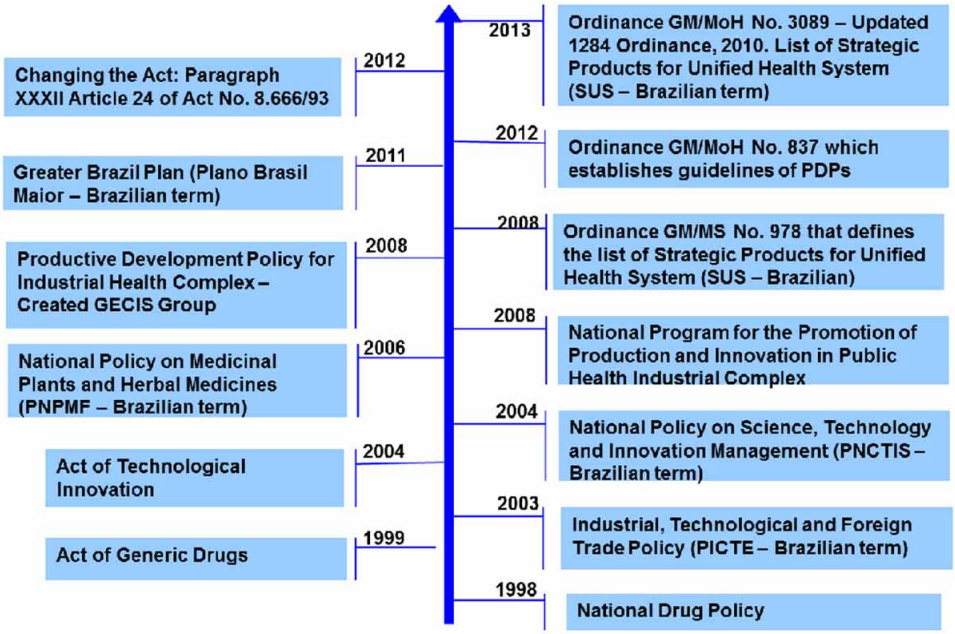
has become more intense and controlled in member countries of the WTO. This agreement establish that the production and sale of drugs only can be made by the holder of the patent for a period at least 20 years. In this way, it prevents the production and marketing of pharmaceutical products for other pharmaceutical companies encouraging investment in innovation. In Brazil, it was regulated by Law No. 9.279 of May 14, 1996.

Therefore, pharmaceutical patents have become so important once that contain novelty and reveal the details of the invention, if process or product. By the other hand, the researchers and / or managers consider patents as an important indicator of innovation. Studies related that patent of the company, in particular countries and owners of the invention, can reveal the technological dynamism of a particular industry, and provide information about the direction of technological change. As regards the field of health, the pharmaceutical industry is essential for the R,D&I. This industry is growing every year with nearly US $ 1 trillion and sales are expected to reach 1.2 trillion dollars in 2016.

The Production Development Policy became the government's new industrial policy under the legal provisions of the Innovation Law (10.973/2004). Laws: 11.196/2005 (providing tax benefits for technology RD&I); Law 11.105/2005 (Biosecurity) and 6.041/2007 (Biotechnology Development Policy) have main aims to expand access to strategic technologies and to reduce the vulnerability of the public health system (SUS) by strengthening the health industry. The first PDPs were created in 2009 as part of a broad policy linking health with development for the welfare of the population and to aid consolidate the national production of strategic technologies for the SUS (CARTAXO, 2011).

In Figure 3, synthetically it can be seen the evolution of health policies in Brazil.

Figure 3. Evolution of some Policies in Brazil for Public Health.
Source: http://www.mct.gov.br/ (Access: September 26, 2014) organized by (MACEDO, 2014b).



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3. A BLUEPRINT TO MEASURE THE KNOWLEDGE TRANSLATION

Public Policy are in the context of the architecture of knowledge. Therefore, is pressing a management analysis tools to integrate actions and to provide the effectiveness actions to generate technological innovation and consequently wealth of the country. Thus, a better management for information architecture, also known as business architecture, encourage a new understanding (Ross, Weill, & Robertson, 2006).

Certo & Peter (2005), regards analysis of the environment, which indicate that this context (business architecture requires information architecture) is monitoring by entire organizational environment to identify opportunities, challenges and threats regarding assessing current and future risks (Certo; PETER, 2010).

Under this perspectvie, it can be concluded that the information architecture linked to business for innovation in given segment is also linked to the organizational logic for business processes, technology transfer and infrastructure of the Information Technology (IT). This, reflects the integration and standardization required for operation of an organization model. So, this "architecture" requires a long-term view of the processes, systems and technologies, in order to be built in the interim organizational capabilities that permeate three stages of evolution, namely (Centro de Gestão e Estudos Estratégicos & Ministério da Ciência, Tecnologia e Inovação, 2013; CERTO & PETER, 2010):

1. Architecture with business silos, where the functional needs or the needs of individual business units are maximized;
2. Architecture with standardized technology, which aims to provide IT efficiency through standardization and technology via increasing centralization of management technology;
3. Architecture with modular business, where preserving global standards while enable local differences with customization.

Considering the global technological advancement in the knowledge era and even the public health arise the need to find better treatments and quality of life to people. Then, cogitate technology transfer in healthcare by PDP can be understood as a customization for the local reality of a nation second model practiced by the Special Programme for Research and Training in Tropical Diseases (TDR) of WHO. This model promotes the knowledge translation which redefines the scope of the search as shown in Figure 4 (A. I. Carvalho, Bodstein, Hartz, & Matida, 2004; WHO | TDR, 2013; Zicker, 2007):

1. Endemic countries involved in setting the research agenda and also on how to respond to their priorities;
2. Strengthen the research capacity of individuals, institutions and networks in the countries whether endemic or low-income;
3. Promote the application of innovations and strategies in political and health practices; and,
4. Serve as a platform to establish consensus on priorities, funding and management processes in research.

There are several Public Policies in healthcare. All this policies provide an NHS that meets your goals as well as for the production of drugs & medicines in the country. Nowadays, the incorporation of new technology with efficient tools to assess the implementation from Policy to impact is the "Knowledge Translation" (KT) (A. I. Carvalho et al., 2004; De Negri & Kubota, 2008).

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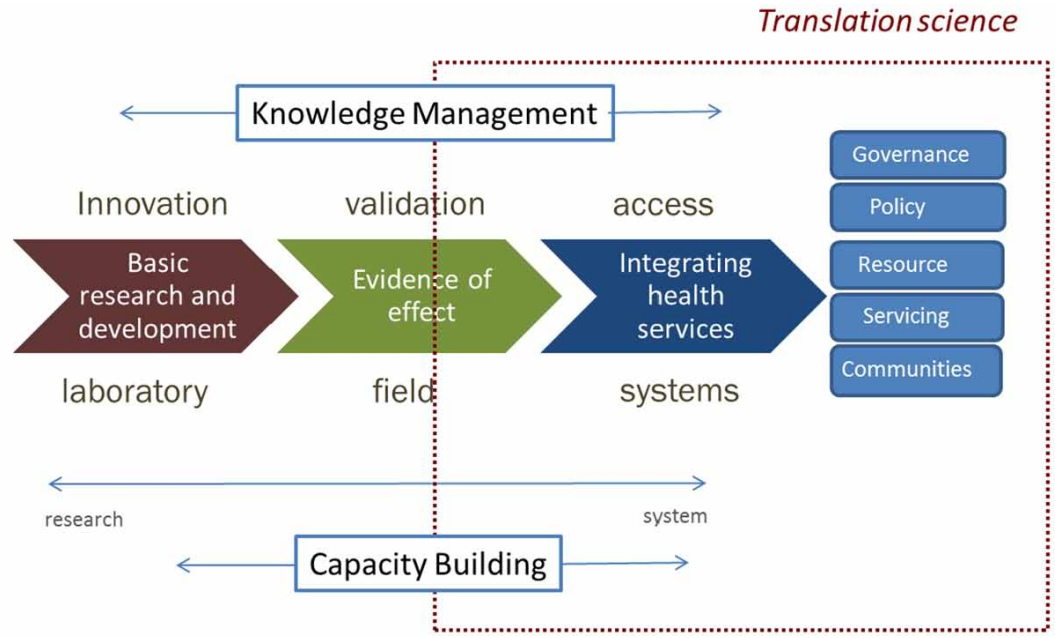
Figure 4. Redefining Search Scope - TDR model - WHO
Source: Special Programme for Research and Training in Tropical Diseases (TDR) WHO – Geneva.



This Policy in Brazil, included are not only new generic products but also the internalization of new technologies. Actually, Brazil is totally dependent on imports making it vulnerable for the National Defense Drugs & Medicines. In this context the PDP can contribute to minimize this fact. Note, in the 90's, Brazil lost nearly 2000 factories pharm chemical after opening Markets. In this sense, became dependent on trivial products such as acetylsalicylic acid (aspirin) and Amoxicillin (antibiotic) with imports from China and India (Antunes & Mercado, 2000; Magalhaes, JL et al., 2012b).

These analyzes are not used properly by scarcity of information either by research about methodologies of KT or by prospecting and monitoring in health care whose value is to assess the effectiveness of the policy since its implementation to impact on society (appropriation of value to society and innovation) (Hartz, 2012; Zicker, 2007).

Evaluation studies of government policies and programs allow researchers and implementers of this program which are able to objectively make decisions with better quality and optimizing public spending on various activities. Thus, it's possible to identify and overcome bottlenecks or points that lead to success. Consequently, there are new perspectives to implement rational policies with greater capacity such as better results for the political in Science, Technology and Innovation in Health (De Negri & Kubota, 2008; Ross et al., 2006; Santos, Toledo, & Lotufo, 2009).

Fostering for research is understood as programmed actions to improve and innovate policies to promote and protect health. The evaluation should provide better understanding and organizational learning on the scope of these results for decision making and greater transparency in the management of public resources (De Negri & Kubota, 2008).

In this overview, initiatives to identify, classify, measure, disseminate and train human resources methodologies are essentials to help strengthen the R,D&I in Management of Science, Technology and Innovation in health. According Hartz (1997), "Evaluation and Health" is characterized by phases. The

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first is the "systemize" and refers to a "structuralism and cybernetic" practice supported on mathematical theories which stands the analysis of hard-systems (Le Moigne, J.L., 1994). This approach is still "analytic in nature and positivist in attitude (...). Things were reduced the whole (holism) for parties (atomism), revealing himself actively reductionist".

Melese (1990) also demonstrates the need to redefine "the system" because there are those wanting to escape the crippling reductionism, who use the term in this restricted form and run the risk of forgetting that it is possible to reduce both the "whole" for the part. This approach is one that considers "the system" a concept of three faces (MELESE, 1990; MORIN, 1982a):

1. This "whole" combined with the macro unit where the parties have their own identity and a common identity;
2. Interactions or set of relationships that are created in the system;
3. The organization and the partners expressing a constitutive nature of the interactions and with idea of giving your core system.

4. A DOUBLE-QUICK EVALUATION OF THE PARTNERSHIP FOR PRODUCTIVE DEVELOPMENT IN BRAZIL

The quality of life of the Brazilian people is on the government's agenda. Its public health programs are designed to foster the healthy ageing of the population, with economic development being linked to improved health conditions fostering a sustainable lifestyle. Brazil is seeking to reduce its health sector deficit and to boost its technology and RD&I, including a variety of initiatives and investments targeting academia, the private sector and government. These include a government effort to build technological competency in the production of drugs and medicines back to the relative levels seen in the mid-1980s (Magalhaes, JL, Antunes, AMS, & Boechat, N, 2012a).

One of the key policies in this area is the Production Development Policy launched by the government in mid May 2008, which replaces the Industry, Technology and Foreign Trade Policy (PITCE, acronym in Portuguese), introduced in March 2004. The 2008 policy had a broader scope, greater depth, and focuses on increasing coordination, controls and targets. Similar to its predecessor is structured in a way to align the public and private sectors, with the former being responsible for facilitating business ventures through tax/fiscal incentives, credit lines, reduced bureaucracy, and regulatory adjustments.

Production Development Policy is a more complex set of measures designed to expand access to strategic technologies and reduce the vulnerability of the country's public health system by strengthening the health industry. The objectives, which are designed to foster could, if put into practice, raise the production capacity and competitiveness of Brazilian industry, producing a ripple effect throughout society (Ministério da Saúde, 2014a).

However, it should be recalled that although the PITCE did not fully attain all the desired outcomes, it left a legislative legacy that favors certain sectors of the economy, providing them with certain specific lines of credit from the Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social, BNDES). Meanwhile, PDP aim to foster technology transfer between public and private institutions and technologies capable of meeting the public health system's (SUS) need for strategic products as set forth in MoH directive 3039/2013, which was derived from directive 1284/2010.

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The directive in question lists several priority products for use in health programs, such as vaccines and medicines for cancer, women's health, mental health, and chronic diseases. For instance, Imatinib Mesylate was the first Brazilian cancer drug produced by a PDP for chronic myeloid leukemia which alone produced a real saving of US$ 15.5 million in 2013 vis-à-vis 2012. In the middle of 2014 there were 102 PDPs for over 75 products. There are over 17 public pharmaceutical laboratories and 53 private ones involved in these PDP (C. A. G. Gadelha et al., 2012; MACEDO, 2014a; Ministério da Saúde, 2014a, 2014b).

The Secretariat of Science, Technology and Strategic Supplies, under the MoH, is responsible for managing the PDP in the pursuit of making Brazil a leading player in innovation and strategic development. The list in directive 3039 does not only contain products the MoH has determined as strategic, but also indicates to the country's leaders what products should be prioritized in individual projects designed to boost production, innovation and technology transfer in the country, as well as regulatory mechanisms. By this means it provides strategic support for the health industry (C. A. G. Gadelha & Costa, 2012a; C. A. G. Gadelha et al., 2012).

Some PDP objetives ("Parceria para o Desenvolvimento Produtivo - PDP", 2014):

1. To streamline the State's purchasing power by selectively centralizing health expenditures in order to reduce the acquisition costs of the SUS and enable the production in the country of innovative products of extreme importance to health, focusing on improving the population's access to strategic supplies;
2. To foster joint technological development and knowledge exchange for innovation;
3. To prioritize the local manufacture of products of a high cost or of particular public health and social impact; and
4. To significantly and progressively reduce prices as technology is transferred and developed in Brazil.

Plan for the execution of the Production Development Policy contains targets known as "systemic actions", which, once implemented, will have an impact on costs in Brazil thanks to their broad scope. The aim is to:

1. Increase annual fixed investments/GDP;
2. Increase private RD&I expenditure/GDP;
3. Increase the market share of Brazilian exports;
4. Support small and medium-sized businesses by fostering capacity building for competition in foreign markets, thereby increasing the number of such businesses which export goods.

The absorption and integration of knowledge fostering more aligned actions and strategies is designed to replicate in the field of health the success achieved in other sectors of the economy. Some examples ("Parceria para o Desenvolvimento Produtivo - PDP", 2014):

1. **World Leadership:** Goal achieved in mining and steel, aeronautics, and ethanol production;
2. **Penetration of Markets:** Durable consumer goods and standardized capital goods. However, for health the aim is also to position or maintain the production system amongst the leading global exporters;

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3. **Specialization:** To build and consolidate competitiveness in technology-intensive areas. The strategy covers not just the health industry, but also information technology and custom-made capital goods;
4. **Brand Differentiation or Enhancement:** To position Brazilian brands and businesses amongst the top five in the world;
5. **Greater Access by the Population to Goods and Services:** Not only health services, but also broadband internet, durable and non-durable consumer goods, and civil construction.

This superstructure of broad goals and specific targets is set by the Production Development Policy where one sector has been benefitted can interlink and interact with others. Thus, support health industry and other industries. Action lines of the Production Development Policy are designed to enhance competitiveness and encompass a variety of technologies, including nanotechnology and biotechnology.

Another consequence of the Production Development Policy is to attract multinationals to make investments in health in the Brazil. One example is an agreement between multinational Merck Serono and Brazilian firm Bionovis, mediated by the MoH. The aim of furthering the PDPs underway for the Brazilian production of biological drugs. Merck Serono as a partner provides to build a new factory to produce six biological medicines. The current partnership allows investments worth US$ 250 million for construction, technological product development and technology transfer. Meanwhile, Bionovis will invest US$ 0.5 billion in the production of biological medicines in Brazil in the coming five years (Brasil/MS/Fiocruz/IPEA, 2012; Brasil/TCU, 2014; "Parceria para o Desenvolvimento Produtivo - PDP", 2014).

This example has a high-cost, but in counterpart cutting-edge products will be developed and produced by a private Brazilian company, Bionovis, and public institutions (Fundação Oswaldo Cruz and Instituto Vital Brasil) for the treatment of cancer, rheumatoid arthritis and other conditions, namely: etanercept, rituximab, bevacizumab, cetuximab, infliximab and trastuzumab. Like the other PDPs the aim is to make Brazil autonomous in the production of these medicines, while helping to reduce the country's trade deficit ("Parceria para o Desenvolvimento Produtivo - PDP", 2014).

Some other products have been registered in Brazil by PDPs: a two-in-one antiretroviral, tenofovir disoproxil fumarate 300 mg + lamivudine 300mg; and cabergoline 0.5 mg (treatment of the excess production of the female hormone prolactin or hyperprolactinemia). The antiretroviral alone should bring about a saving of around US$ 110 million for the MoH in five years. When, all the PDPs now signed are implemented, Brazilian government expenditure will be cut by around US$ 2 billion a year, while the impact on imports by the end of the fifth year will reach around US$ 1.8 billion.

The procedures to be followed in signing a PDP are established in the criteria and guidelines in the following directives issued by the MoH: GM/MS 837/2012, SCTIE/MS 50, 51 and 52/2012.

As a successful example completed of one of the 102 PDP is Imatinib Mesylate, mentioned previously. The cancer drug generated an annual expenditure for the Ministry of Health of Brazil in more than US $ 200 million. In this point are not considered the direct consumer sales in private pharmacies which are presented in graph 01. The sales reached more than US $ 8 million. After completion of the PDP (five years) the technology has been incorporated into the country in companies (public and private) decrease spending and foster new training in human resources.

Imatinib Mesylate provided to the Ministry of Health by the multinational Novartis Biosciences S/A (trade name Gleevec ©). The patent expired in 2012 and this medicine was subject to conducting a PDP with participation of 02 Official Pharmaceutical Laboratory (LFO - Brazilian term) and 05 domestic laboratories, namely:

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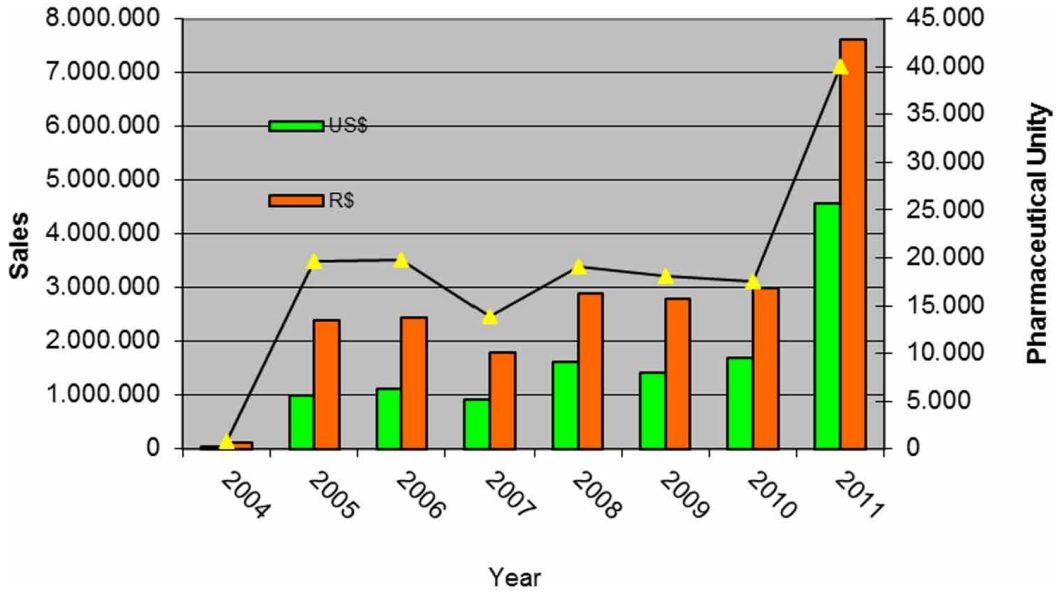
Figure 5. Mesylate Imatinib sales in Private Pharmacies
Source: Created by the authors – data IMS Health, 2012.



1. Instituto Vital Brazil – LFO;
2. Farmanguinhos – LFO;
3. EMS S/A – Pharmaceutical Private Laboratory;
4. Laborvida Laboratórios Farmacêuticos – Pharmaceutical Private Laboratory;
5. Cristália Produtos Químicos Farmacêuticos – Pharmaceutical Private Laboratory and Active Pharmaceutical Ingredient (API) Laboratory;
6. ALFA Rio Química – API Lab;
7. GLOBE Química Ltda – API Laboratory.

Figure 6 shows steps of the production chain. They occurred in a vertical structure between the government agent and private actors. In the first phase on transfer of technology arising from Novartis it was the development and supply of API (synthesis intermediates). The companies involved are Alfa Rio, Globe and Cristália. The second phase of the PDP, the production of medicine, is under the responsibility of the EMS and Cristália. Finally, the detention of technology is already with LFO.

It is noteworthy in this stage the LFO. They has received the registration of the medicine by National Agency for Sanitary Surveillance (ANVISA - Brazilian term) - regulatory authority in Brazil. Thus, it remains the internalization of technology as a KT. Among the results derived from the PDP, beyond the internalization of technologies, promotion of R, D&I in the country, there are the creating of new opportunities jobs, training of managers, researchers, increasing the portfolio of LFO and the consequent formation of new skills in new technology.

In addition to the items mentioned above, the PDP contribute to foster modernization investments in manufacturing facilities of LFO in the order of US $ 650 million and funding for other Brazilian companies at about US $ 3.5bn. The subject were by funding agencies as Financing Research and Projects (FINEP - Brazilian term) and BNDES.

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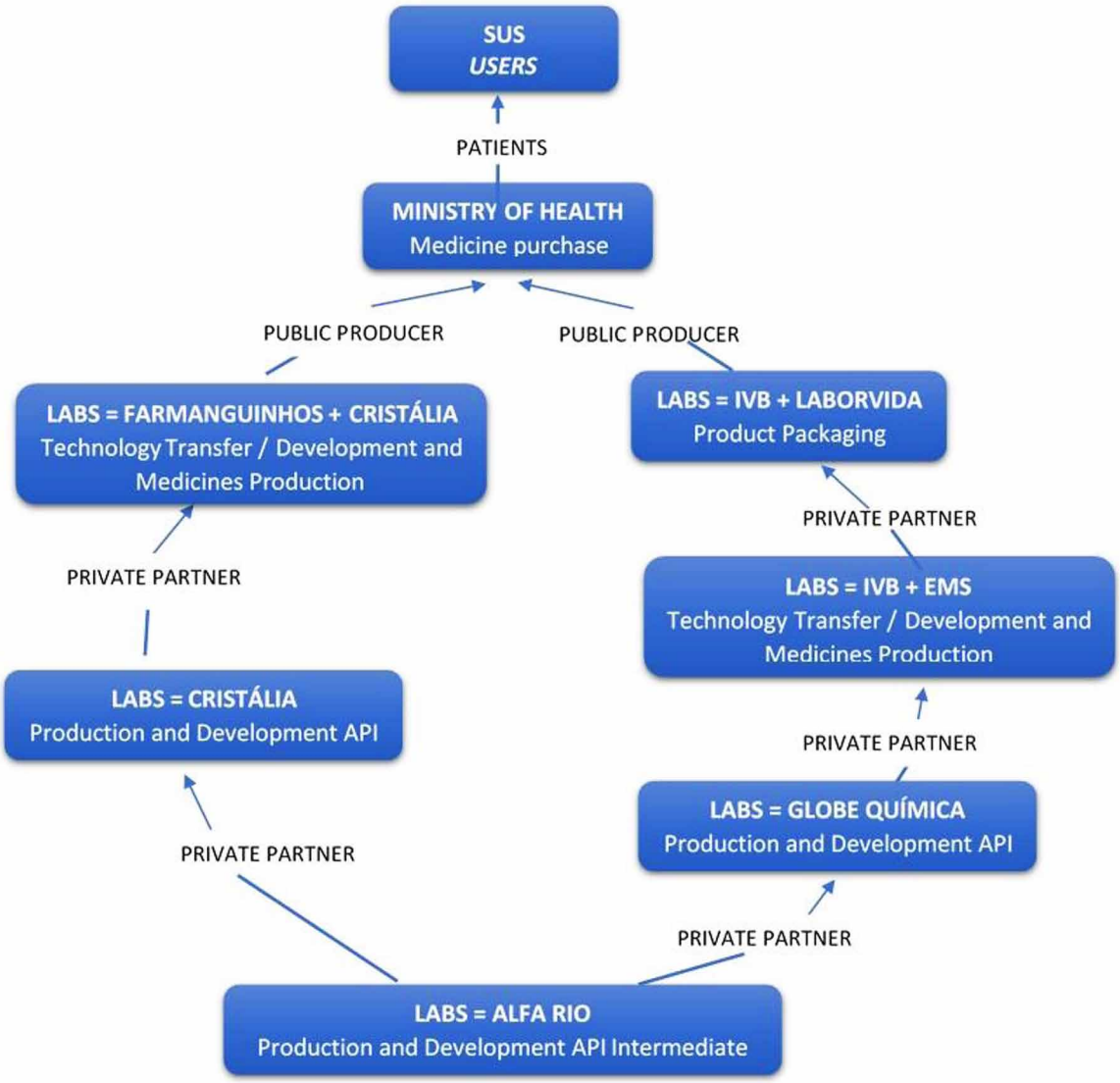
Figure 6. Flow chart of the production chain Imatinib Mesylate for PDP.
Source: (MACEDO, 2014a).



Since the implementation of the PDP in 2009 until September 2014, 102 were formalized PDP LFO involving 19 laboratories and 57 private Pharmacists. This quantitative, 15 products have been registered with ANVISA and 09 products are being delivered regularly to the MoH (Ministério da Saúde, 2014b).

Given that the success of the PDP as a successful management, one can state that there was a good mastery of the architecture of the existing information throughout PDP process. Accordingly, the information architecture based on knowing the state of the art and science applied to the product arising from PDP. Subsequently, all data organized and cataloged provides the information generate knowledge.

It is worth noting that as information proliferates exponentially, it becomes usable thus becomes a critical success factor for general applications. A good information architecture, provides all the necessary ground work for an information system has meaningful for your users and decision makers.

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Information architecture is a science that involves many studies and analyzes to discover all the details that the organization needs to know to make decisions in their products and actions. So it is essential for the professional information architecture be able to: investigate, search and find exactly all the details involving the product or service concerned.

During the implementation of the PDP, good practices in information architecture gave supported the development of new interfaces that aided useful and relevant information flow to all actors involved in the Project.

5. CONCLUDING REMARKS

Considering the political, industrial and academic context surrounding the field of health, there is clearly potential for continuous success for PDP. The SUS list of strategic medicines published in directive 3089 can be transformed into opportunities for national investments and the introduction of measures for the short, medium and long term for knowledge translation, and consequently ownership of innovation by the Brazilian population.

It is understandable that pharma chemical and pharmaceutical companies should be wary of investing generally in the products on the list, even considering the capital at the disposal of the sector's biggest multinationals. However, using the PDP is one way of significantly minimizing risks and obtaining more assured results.

PDP contribute to the strengthening of the LFO and national private companies. They also allow the growing of the pharmaceutical manufacturing sector in Brazil with best way technologies more innovative and competitive. This process become being able to generate new processes and innovative products for society.

Strategic alliances resulting from PDP can be used as a way to stimulate the promotion of R, D&I in another areas. So, the time is ripe for new partnerships and investments in healthcare.

It can be seen the "Evaluation" as a way to measure the positive impact for society as an appropriate and effective program. Note that in five years PDP in the Imatinib Mesylate has provided direct investments in portfolio of LFO, in Brazilian companies and also in the training in skills in the area of oncology. Regarding the best access for population, the medicines gets cheaper with the same quality and efficacy provided by ANVISA.

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KEY TERMS AND DEFINITIONS

Intellectual Property: To protect in law by, for example, patents, copyright and trademarks, which enable people to earn recognition or financial benefit from what they invent or create.

Knowledge Management: Is a concept and a term that arose approximately two decades ago, roughly in 1990. Quite simply one might say that it means organizing an organization's information and knowledge holistically.

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Knowledge Translation: Is a broad term for all of the activities involved in moving research from the laboratory, the research journal, and the academic conference into the hands of people and organizations who can put it to practical use. The term is most often used relative to the health professions, including medicine, nursing, pharmaceuticals, and public health.

Patent: Does a government grant the exclusive right to an inventor to manufacture, use, or sell an invention for a certain number of years.

Pharmaceutical Products: Are technically obtained or products developed by a pharmaceutical company with prophylactic, curative, palliative or diagnostic purposes.

Public Health: Science and art of preventing disease, prolonging life and promoting health.

Public Private Partnership: Means an arrangement between a government / statutory entity / government owned entity on one side and a private sector entity on the other, for the provision of public assets and/or public services, through investments being made and/or management being undertaken by the private sector entity, for a specified period of time.

Technological Management: Systematic efforts employed in the timely deployment of a process or system, and in balancing its cost, effectiveness, and supportability over its life cycle.

ENDNOTES

[1] According to the Industrial Property Law #9279 of 1996, a patent is "a privilege conferred by the State that assures its holder exclusivity in exploiting the patented technology, safeguarding the holder's right to prevent third parties from exploiting (producing, selling, buying, stocking) the protected object." Filers of patent applications do so with the expectation of being awarded rights over the object of the application, but these rights can only be fully exercised after they are effectively awarded the patent. (Brasil, Presidência DA República, 1996).

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Chapter 32
Successful Integration of Knowledge for Innovation:
A Case Study of Opportunities for Product Development Partnerships in Brazil

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ABSTRACT

The challenges of the new century have put emerging countries center stage in the global economy. Public health is a priority for governments the world over and Brazil is one of them. Policies prioritizing essential medications like Ministry of Health Directive 1284 indicate existing trends and potential opportunities for investments in the Brazilian pharmaceuticals production chain. This chapter gives an overview of Product Development Partnerships in Brazil as part of a government incentive policy for the Brazilian pharmaceutical sector. The authors propose a methodology to prioritize the best choice among the 87 products listed as strategic by the Brazilian MoH. The proposed methodology indicates 11 products with high potential for production in Brazil and opportunities for the country's private sector.

INTRODUCTION

The twenty-first century is taking shape as the era of the information revolution and the expansion of knowledge, with intellectual capital playing a key role in the economies and business activities of nations. One crucial ingredient for competitiveness, and thence economic development, is technology. In technology-intensive areas like the pharmaceutical, aerospace and telecommunication industries, as well as others with equal weight and impact, knowledge has become the most important asset (Lastres & Sarita, 1999).

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However, the issues and problems affecting public health are considerable and need to be tackled using a multidisciplinary approach. They should be addressed and analyzed from the perspective of the real conditions in each culture, developed using research, development and innovation (RD&I), and should harness cooperation networks in order to spread the knowledge generated to foster local development and effectively attain innovation. Any application of information science invariably involves highly structured networks. In view of the fact that the processes involved in the research, development and innovation of drugs are increasingly complex, the first step is to set up interdisciplinary teams to obtain a systemic view of the issues at stake (Quoniam & Lucien, 2010). This is knowledge-intensive work, and requires combining information science with competitive intelligence, the specific area of knowledge, and knowledge management.

By integrating knowledge in an interdisciplinary approach, the power of science, technology and innovation can be harnessed to leverage economic progress. However, the need to obtain full integration between the players in the national innovation system (NIS), namely academia, the private sector and governments, may represent a hurdle for developing countries. The involvement of these three players is crucial for the success of any effort to foster knowledge integration for innovation (Lundvall, 2010; Nelson, 1993).

The success of public policies designed to strengthen the NIS can better be understood as enhancing integration between academia, the private sector and government, because cooperation between universities, government research centers and funding agencies is so crucial. Meanwhile, it is in the interests of businesses to speed up the introduction of innovations to their production processes. Synergies of this kind can boost growth by developing national capabilities (Etzkowitz, 2002; Gadelha, Machado, Lima, & Baptista, 2011; Magalhães, Boechat, & Antunes, 2012).

Brazil is a country where research is pursued but whose NIS is still immature and where the coordination between some institutions is still very limited. In a technology economy, one critical success factor is the incorporation of science into business in a way that respects the features of each industry, as they each have different technology trajectories (Lundvall, 2010; Mytelka, 2000).

According to the International Monetary Fund's *World Economic Outlook Database* and Instituto Brasileiro de Geografia e Estatística (IBGE), Brazil is one of the emerging countries set to make the biggest impact internationally in its development and economic growth (Fundação Getúlio Vargas, 2011; IBGE, 2011). Its gross domestic product (GDP) grew 2.5-fold between 2006 and 2012, reaching around US$ 1.3 trillion. Despite the promise of this scenario, closer observation of its domestic consumption and development indicators reveals that the "family" of health-related items stands out in the Brazilian balance of trade for the deficit it recorded in 2013 of over US$ 6 billion. This sector includes drugs, medications, equipment and diagnostic materials for public health (Gadelha & Costa, 2007; Gadelha, Costa, & Maldonado, 2012a).

The quality of life of the Brazilian people is on the government's agenda. Its public health programs are designed to foster the healthy ageing of the population, with economic development being linked to improved health conditions fostering a sustainable lifestyle. Brazil is seeking to reduce its health sector deficit and to boost its technology RD&I, including a variety of initiatives and investments targeting academia, the private sector and government. These include a government effort to build technological competency in the production of drugs and medications back to the relative levels seen in the mid-1980s (Magalhaes, JL, Antunes, AMS, & Boechat, N, 2012a).

One of the key policies in this area is the Production Development Policy launched by the government in mid May 2008, which replaces the Industry, Technology and Foreign Trade Policy (PITCE, acronym

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in Portuguese), introduced in March 2004. The 2008 policy has a broader scope, greater depth, and focuses on increasing coordination, controls and targets. Both it and its predecessor are structured in such a way as to align the public and private sectors, with the former being responsible for facilitating business ventures through tax/fiscal incentives, credit lines, reduced bureaucracy, and regulatory adjustments.

The Production Development Policy is a more complex set of measures designed to expand access to strategic technologies and reduce the vulnerability of the country's public health system (Sistema Único de Saúde, SUS) by strengthening the health industry. The objectives it is designed to foster could, if put into practice, raise the production capacity and competitiveness of Brazilian industry, producing a ripple effect throughout society (BRASIL. MS., [s.d.]).

However, it should be recalled that although the PITCE did not fully attain all the desired outcomes, it left a legislative legacy that favors certain sectors of the economy, providing them with certain specific lines of credit from the Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social, BNDES). Meanwhile, Product Development Partnerships (PDPs) aim to foster technology transfer between public and private institutions and technologies capable of meeting the public health system's (SUS) need for strategic products as set forth in Ministry of Health directive 1284/2010, later amended by directive 3039/2013.

The directive in question lists 87 priority products for use in health programs, such as vaccines and medications for cancer, women's health, mental health, and chronic diseases. For instance, imatinib mesylate, the first Brazilian cancer drug produced by a PDP for chronic myeloid leukemia, alone produced a real saving of R$ 31.5 million in 2013 vis-à-vis 2012. By the beginning of 2014 there were 104 PDPs for over 77 products. There are over 17 public pharmaceutical laboratories[1] and 53 private ones involved in these PDPs (Costa, Gadelha, & Maldonado, 2012; Gadelha, Costa, & Maldonado, 2012b; Magalhães, Antunes, & Boechat, 2011a; "Parceria para o Desenvolvimento Produtivo - PDP", 2014).

The Secretariat of Science, Technology and Strategic Supplies, under the Ministry of Health, is responsible for managing the PDPs in the pursuit of making Brazil a leading player in innovation and strategic development. The list in directive 1284 does not only contain products the Ministry of Health has determined as strategic, but also indicates to the country's leaders what products should be prioritized in individual projects designed to boost production, innovation and technology transfer in the country, as well as regulatory mechanisms. By this means it provides strategic support for the health industry (Costa et al., 2012).

This chapter investigates the power of Product Development Partnerships to successfully integrate knowledge management between academia, the public sector and government with the purpose of developing and innovating drugs and medications in Brazil. For this, alongside the bibliographical research of an indexed database and consultations of official government bodies (ministries and regulatory agencies), a methodology was developed to select which products from those listed in Ministry of Health directive 1284/2010, amended by directive 3039/2013, should be prioritized; in other words, to identify those that present the best opportunities for innovation in products and processes for public and private managers, while helping to reduce the Brazilian health industry trade balance.

THE PHARMACEUTICAL INDUSTRY AND PUBLIC HEALTH

Magalhães et al (2012) describe the pharmaceutical industry as existing in two different scenarios. The first, in the developed world, has an ageing population and therefore a greater need for medications to

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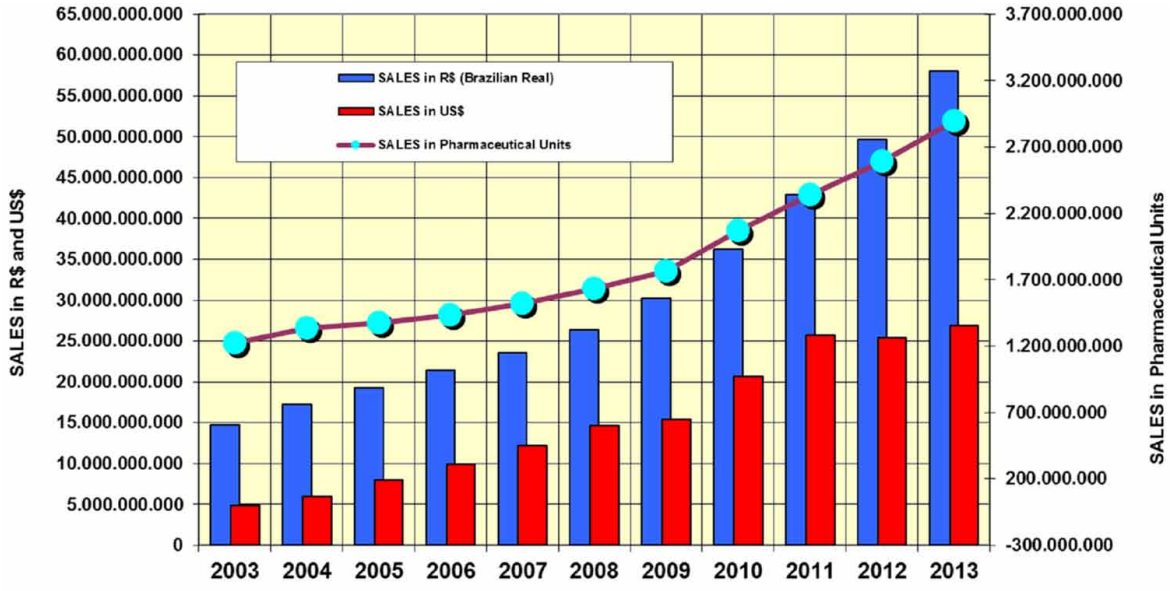
treat conditions such as cancer, Alzheimer's disease, Parkinson's disease and others. There is also a demand for lifestyle drugs, which include medications for hair loss, male and female sexual enhancement, cholesterol control, with a minimum of side effects, etc. (Magalhaes, JL, Antunes, AMS, & Boechat, N, 2012b).

Meanwhile, in some developing countries there is a need for drugs to fight infectious and parasitic diseases, including antivirals, to meet the needs of poorer population groups. One of the most emblematic examples of this is the fight against acquired autoimmune deficiency syndrome (AIDS) in Africa, although tuberculosis, Hansen's disease, malaria, filariasis, and many other so-called neglected diseases are still awaiting more effective treatments (Magalhaes, JL, Antunes, AMS, & Boechat, N, 2012c; Moon, Bermudez, & 't Hoen, 2012).

The global pharmaceutical industry is one of the most innovation-intensive industries in the world and makes a significant contribution to the health of the global population. Even with the global financial crisis that hit the markets in the first decade of the millennium, sales of pharmaceuticals have grown consistently both in terms of volumes and in financial terms. In 2012 the market was worth US$ 962.1 billion, and is set to top US$ 1 trillion in 2013 and US$ 1.2 trillion in 2016. One of the drivers of this growth is the transformation in how diseases are treated, while the expansion of pharmerging markets has driven much of the growth seen, with spending on medicines expected to rise by US$ 150-165 billion in the five years until 2016 (IMS Institute for Healthcare Informatics, 2012a).

Brazil ranks sixth in global sales of pharmaceuticals, and is the biggest market in Latin America, with sales of around US$ 27 billion (Figure 1). The top five pharmaceutical laboratories in the country are Sanofi Aventis (which includes the acquisition of Medley), EMS, Aché, Novartis and Eurofarma (IMS Institute for Healthcare Informatics, 2012b).

Figure 1. Brazilian Pharmaceutical Market: Sales in R$, US$ and Units
Source: IMS Health – extracted by Sindusfarma, 2014.



NOTE: Pharmaceutical Units = tablets, syrups, ointments, etc.

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The global scenario is marked by regional concentration (in developed countries) and the presence of large multinationals, as well as a concentration of sales of medications from certain therapeutic categories. The bulk of sales are for nine therapeutic indications, namely rheumatoid arthritis, psychosis, schizophrenia, depression, thrombosis, ulcers, asthma, cholesterol and cancer. This demonstrates the competition in the therapeutic categories between the big drug companies. In Brazil, the ten top selling medications are Dorflex (analgesic / anti-inflammatory), Cialis (erectile dysfunction), Crestor (cholesterol), Neosaldina (analgesic), Lipitor (cholesterol), Diovan HCT (high blood pressure), Nexium (ulcer), Tylenol (analgesic), Viagra (erectile dysfunction), and Diovan (high blood pressure) (IMS Institute for Healthcare Informatics, 2012b; Sindicato da Indústria de Produtos Farmacêuticos no Estado de São Paulo, 2012).

Overview of Industrial Property in the Pharmaceutical Industry

As the time, costs and risks involved in developing a new substance are so high, pharmaceutical companies must coordinate their actions internationally to assure returns on their investments (Antunes & Mercado, 2000; Chaves, Oliveira, Hasenclever, & Melo, 2007). They attempt to win and assure technological advantages in certain therapeutic areas by appropriating new and specific knowledge. The technology resulting from the knowledge processes is protected by industrial property (IP) rights, of which patents are the most representative instruments in this industry. In the literature, the pharmaceutical industry is characterized as being one of the sectors in which IP plays the biggest role in incentivizing technological innovation (Antunes, AMS & Magalhaes, JL, 2008b; Quick, 2003).

According to Brazilian industrial property law 9279 of 1996, a patent is "a privilege conferred by the State that assures its holder exclusivity in exploiting the patented technology, safeguarding the holder's right to prevent third parties from exploiting (producing, selling, buying, stocking) the protected object." Filers of patent applications do so with the expectation of being awarded rights over the object of the application, but these rights can only be fully exercised after they are effectively awarded the patent (BRASIL, Presidência da República, 1996).

The industry's counter-argument is that patents cover less than 2% of the essential medications listed by the World Health Organization (WHO) and cover just 30-40% of brand drugs, while each patented product faces competition from two to ten replacement molecules destined for the same treatment. The industry further argues that the effective term of patent protection is less than its legal term because such a long time elapses between the patenting of the product and its launch on the market. This is because of the length of time taken to conduct the tests required by law. Effectively, the benefit granted by patenting is no more than about six and a half years (IFPMA, 2004).

Protection by patent is especially important for specific applications, since new products resulting from heavy investments in research can be copied or imitated at a low cost in the absence of such protection (Tidd, J, Pavitt, K, & Bessant, J, 2005).

Much of the pharmaceutical research in Brazil is done at public research institutions. It is therefore important to understand how these institutions interact with the business world, and what evaluation criteria are used for the academic system in the country. One of the goals of the Innovation Law is to make it easier for public institutions and universities to grant licenses for their patents to private companies, while encouraging greater efficiency in this system by means which include making it an evaluation criterion (BRASIL, Presidência da República, 1996; Costa et al., 2012; Gonçalves, 2006; Zaninelli, 2013).

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In the early 1990s, radical changes were seen in Brazilian society and its institutional structure. These marked the end of a period of growth geared towards the domestic market, with a highly protected industrial structure and many competition-related weaknesses. The new changes allowed greater foreign competition and required all the actors involved in the creation and development of technology to take a more proactive attitude in a bid to boost their competitive capacity (Antunes & Mercado, 2000).

The Brazilian state argues that its policy for medications cannot be linked to the economic and financial interests of industry, nor does it expect the market to regulate itself. As such, it has aligned this policy closely with the national health policy. The WHO, for its part, argues that countries need a national pharmaceutical policy that fosters access and assures the quality of medications (Antunes, AMS & Magalhaes, JL, 2008a; BRASIL, Presidência da República, 1996; Fundação Getúlio Vargas, 2011; Gadelha, 2006; Magalhaes, JL, 2010; Martins & Pieranti, 2006).

Brazil understands that democratic governments have two obligations: to assure their people comprehensive access to medications, and to assure that patients are protected against abusive pricing caused by industry competition. This is the context in which the challenge of incorporating the pharmaceutical assistance policy into the broader health policy in line with social guidelines must be met.

Overview of Pharmaceutical Sector Policies in the New Millennium: The SUS List and its Ramifications

In 2003, the federal government gave concrete expression to its interest in developing the pharmaceutical sector by introducing the Forum for Competitiveness in the Pharmaceutical Production Chain. It was set up as a space for discussing government policies for the pharmaceutical production chain and was jointly coordinated by the Ministry of Development, Industry and Foreign Trade and the Ministry of Health.

This was followed in 2004 by the Industry, Technology and Foreign Trade Policy (PITCE), which targeted the pharmaceutical industry as one of its strategic objectives, recognizing the importance of the sector globally, its dynamic, knowledge- and innovation-intensive nature, and the high demand for global investments in RD&I. The PITCE was conceived with the aim of strengthening and expanding Brazilian industry by improving businesses' innovative capacity. With its long-term strategic vision, the central pillar of PITCE was to innovate and add value to the processes, products and services of national industry. It operated on three fronts: horizontal action lines (technological innovation and development, exports / entry to foreign markets, industrial modernization, institutional environment), strategic sectors (software, semiconductors, capital goods, drugs and medications) and future-oriented activities (biotechnology, nanotechnology and renewable energy) (Gadelha & Costa, 2012a).

BNDES's Profarma program was developed to contribute to the implementation of the PITCE and is now used to finance PDPs. It is divided into three sub-programs which provide funding for investments in production, RD&I, and the strengthening of Brazilian companies.

The government also created the Innovation Economy Funding Program, aimed at boosting innovation and improving the competitiveness of Brazilian companies and the economy as a whole. The program is funded by FINEP funding agency, linked to the Ministry of Science, Technology and Innovation, and operates by awarding public funds in the form of grants to companies with which they share the costs and risks inherent to these activities (Furtado & Urias, 2009).

Brazil's industrial policy was reformulated in 2008 into the Production Development Policy. It involves different ministries and has integrated goals and actions, clear financing, and concrete mid-term responsibilities. The Production Development Policy's actions are divided into three levels: systems,

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structuring programs, and strategic highlights. There are programs for a variety of industries, including the health industry (Costa et al., 2012; Gadelha & Costa, 2012b).

2008 also saw the creation of the Health Industry Executive Group under the Ministry of Health. Its purpose is to take concrete actions and measures to further the creation and implementation of regulations for the government's development strategy for the health sector, based on the national guidelines for strengthening the health industry, as well as other related measures.

The Innovation Law (#1097 from December 2, 2004) provides incentives for science and technology research and innovation in industry, with a view to capacity building, technological autonomy and industrial development. The law recognizes the different social actors involved, and encourages the participation of science and technology institutions in the innovation process, regulating partnerships and alliances and the sharing of infrastructure and intellectual property.

It is worth noting that patenting is a strong stimulant for RD&I in the health industry[2]. Much of Brazil's research is done at public research institutions, so the way they interact with the business world, and the evaluation criteria of the nation's academic system must be taken into account. Within the scope of the Industry, Technology and Foreign Trade Policy (PITCE), the Innovation Law aims, among other things, to make it easier for public institutions and universities to grant licenses for their patents to private companies, while while encouraging greater efficiency in this system by means which include making it an evaluation criterion. These characteristics have been replicated in the Production Development Policy, which is part of the government's industrial policy entitled "Greater Brazil" ("Brasil Maior") - http://www.brasilmaior.mdic.gov.br/ (Antunes & Mercado, 2000; BRASIL. MS., [s.d.]; Magalhaes, JL et al., 2012c).

The public health system (SUS) was constituted in the 1988 Federal Constitution to serve the whole population, from the poorest to the wealthiest, in equal measure. Socially speaking, it was a great step forward for a developing country like Brazil. However, it still falls short in its goal of providing comprehensive healthcare, with months-long waiting lists for doctor's appointments, and shortages or lacks of essential medications for free distribution.

Nonetheless, the sector for medical and in-vitro diagnostic materials and equipment (also known as health products) is one of the most dynamic. Brazil is the second largest market of the emerging countries, with sales of US$ 12 billion of these products, or 5% of world demand. Global sales are estimated at around US$ 250 billion, and are growing at around 6% a year. The Brazilian market exceeds this growth rate, rising at 10% a year. However, the full potential of this market in Brazil is not being harnessed because, depending on the product, purchases for the SUS account for 35-65% of the existing market (BRASIL/MS/FIOCRUZ/IPEA, 2012; BRASIL/TCU, 2014).

In 2013, Brazil recorded a US$ 10 billion deficit in products from the pharmaceutical production chain (pharmaceutical supplies and medications) which supply the SUS. This deficit was 4.8% higher than in 2012. Figure 2 shows the growth of the Brazilian pharmaceutical industry trade deficit from 2009 to 2013. In response to this, the Brazilian government has introduced new policies for the sector, especially since 2000 (ABIQUIFI, 2013).

One of the goals of the new policies is to reduce this deficit by fostering links between production and management in the SUS health system, integrating its demand with a new offer of nationally produced drugs and/or medications. The government has also made efforts to forge new PDPs. There are also some official pharmaceutical laboratories[3] run by the government which produce medications, serums and vaccines for some of the SUS programs, since many of these products are of no interest to private companies. These laboratories are strategic for assuring the transfer of technologies to Brazil through PDPs (BRASIL. MS., [s.d.]; Magalhães et al., 2011).

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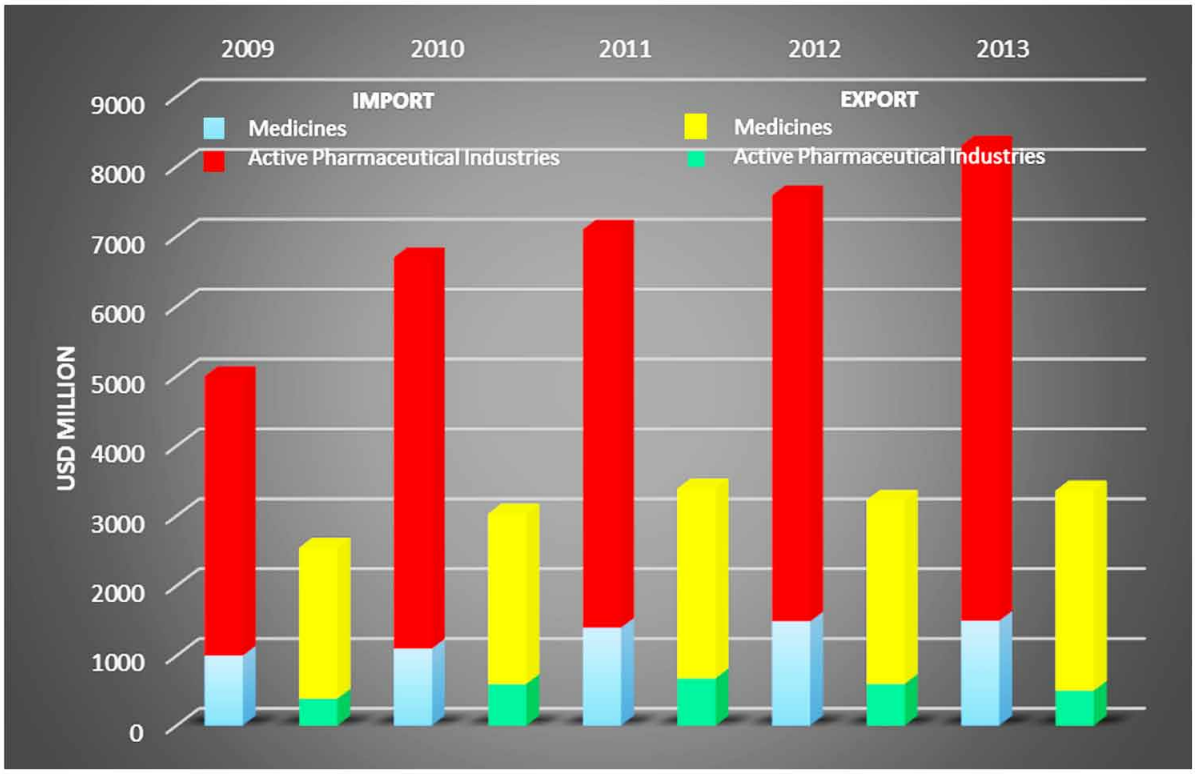
Figure 2. Pharmaceutical production chain trade balance
Source: (ABIQUIFI, 2014).



**For a more accurate representation of this figure, please see the electronic version.*

One of the Brazilian government's key incentive policies is the Greater Brazil Plan (Plano Brasil Maior) for 2011-2014 (replacing the PITCE), which organizes inter- and intra-sectoral initiatives. The former are designed to improve the efficiency of domestic production. Meanwhile, the intra-sectoral measures are devised according to the key features, challenges and opportunities of the industries in question, and are organized into five blocks for the formulation and implementation of programs and projects. These cover areas such as strengthening production chains, building new technological and business competencies, energy supply chains, export diversification and internationalization, and competencies in the natural knowledge economy (BRASIL/MS/FIOCRUZ/IPEA, 2012).

Product Development Partnerships (PDPs) as Opportunities for Integrating Knowledge for Innovation in Drugs and Medications

The policies introduced in recent decades have sparked the need to integrate the knowledge produced in alignment with the previously defined strategies. To assure success and the effective absorption of knowledge in Brazil for the production of strategic medications from the SUS list, the government, through the Ministry of Health, has prepared partnership agreements under the Production Development Policy. The partnerships must include at least one foreign pharmaceutical laboratory, one official pharmaceutical laboratory, and one Brazilian pharmaceutical laboratory or pharmaceutical company.

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The Production Development Policy became the government's new industrial policy under the legal provisions of the Innovation Law (10.973/2004), law 11.196/2005 (providing tax benefits for technology RD&I), the Biosecurity Law (11.105/2005), and the Biotechnology Development Policy (6.041/2007). Its main aims are to expand access to strategic technologies and to reduce the vulnerability of the public health system (SUS) by strengthening the health industry. The first PDPs were created in 2009 as part of a broad policy linking health with development for the welfare of the population and to help consolidate the national production of strategic technologies for the SUS. Its objectives (BRASIL. MS., [s.d.]) are:

1. To streamline the State's purchasing power by selectively centralizing health expenditures in order to reduce the acquisition costs of the SUS and enable the production in the country of innovative products of extreme importance to health, focusing on improving the population's access to strategic supplies;
2. To foster joint technological development and knowledge exchange for innovation;
3. To prioritize the local manufacture of products of a high cost or of particular public health and social impact; and
4. To significantly and progressively reduce prices as technology is transferred and developed in Brazil.

The plan for the execution of the Production Development Policy contains targets known as "systemic actions", which, once implemented, will have an impact on costs in Brazil thanks to their broad scope. The aim is to:

- Increase annual fixed investments/GDP;
- Increase private RD&I expenditure/GDP;
- Increase the market share of Brazilian exports;
- Support small and medium-sized businesses by fostering capacity building for competition in foreign markets, thereby increasing the number of such businesses which export goods.

Generally speaking, the absorption and integration of knowledge, fostering more aligned actions and strategies, is designed to replicate in the field of health the success achieved in other sectors of the economy. Some examples worthy of note are (BRASIL. MS., [s.d.]):

1. **World Leadership:** Goal achieved in mining and steel, aeronautics, and ethanol production;
2. **Penetration of Markets:** Durable consumer goods and standardized capital goods. However, for health the aim is also to position or maintain the production system amongst the leading global exporters;
3. **Specialization:** To build and consolidate competitiveness in technology-intensive areas. The strategy covers not just the health industry, but also information technology and custom-made capital goods;
4. **Brand Differentiation or Enhancement:** To position Brazilian brands and businesses amongst the top five in the world;
5. **Greater Access by the Population to Goods and Services:** Not only health services, but also broadband internet, durable and non-durable consumer goods, and civil construction.

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This superstructure of broad goals and specific targets is set by the Production Development Policy where one sector, having benefitted, can interlink and interact with others and support the health industry and other industries. The action lines of the Production Development Policy are designed to enhance competitiveness and encompass a variety of technologies, including nanotechnology and biotechnology.

Another consequence of the Production Development Policy is to attract multinationals to make investments in health in the country. One example is an agreement between multinational Merck Serono and Brazilian firm Bionovis, mediated by the Ministry of Health, with the aim of furthering the PDPs underway for the Brazilian production of biological drugs. With Merck Serono as a partner, a factory can be built where six biological medications will be produced. The current partnership allows for investments worth US$ 250 million for construction, product development and technology transfer. Meanwhile, Bionovis will invest US$ 0.5 billion in the production of biological medications in Brazil in the coming five years (BRASIL. MS., [s.d.]; BRASIL/MS/FIOCRUZ/IPEA, 2012; BRASIL/TCU, 2014).

In this new PDP, high-cost, cutting-edge products will be developed and produced by a private Brazilian company, Bionovis, and public institutions (Fundação Oswaldo Cruz and Instituto Vital Brasil) for the treatment of cancer, rheumatoid arthritis and other conditions, namely: etanercept, rituximab, bevacizumab, cetuximab, infliximab and trastuzumab. Like the other PDPs the aim is to make Brazil autonomous in the production of these medications, while helping to reduce the country's trade deficit (BRASIL. MS., [s.d.]).

Some other products have been registered in Brazil thanks to PDPs: a two-in-one antiretroviral, tenofovir disoproxil fumarate 300 mg + lamivudine 300mg; and cabergoline 0.5 mg (for the treatment of the excess production of the female hormone prolactin or hyperprolactinemia). The antiretroviral alone should bring about a saving of around US$ 110 million for the Ministry of Health in five years. If all the PDPs now signed are implemented, Brazilian government expenditure will be cut by around US$ 2 billion a year, while the impact on imports by the end of the fifth year will reach around US$ 1.8 billion.

The procedures to be followed in signing a PDP are established in the criteria and guidelines in the following directives issued by the Ministry of Health: GM/MS 837/2012, SCTIE/MS 50, 51 and 52/2012, and 3039/2013, an amendment of 1284/2010, the latter of which was what established the Product Development Partnerships.

NEW OPPORTUNITIES FOR INNOVATION FOR INDUSTRIAL DEVELOPMENT IN BRAZIL

Analysis of the List of Drugs and Medications of Priority to Brazil

As mentioned earlier, the Ministry of Health has published a list of the strategic products for the country, but they are not ranked in any order of priority in terms of the need of having the technology for their production available in the country. There is simply a list of the products that have a significant impact on the public budget and which will be of strategic use in the country for a long time.

The strategic products listed in Ministry of Health directive 1284/2010, amended by 3.039/2013, are divided into two sections:

- **Section 1:** Pharmaceutics, divided into six groups, such as those of high social significance, like neglected diseases, and those of high technological and economic value, such as biotechnological

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products; products that cost the government over R$ 10 million to procure (see Ministry of Health directive GM/MS 2981 of November 26, 2009) or which have recently started to be used by SUS and have new clinical protocols. Those medications and products whose production in Brazil is now consolidated have been removed from the list, and fixed-dose combination products have been included. The six main groups are:

  - **Group 1:** Antivirals (including antiretrovirals): strategic products used in the treatment of viral diseases, sexually transmitted diseases and AIDS;
  - **Group 2:** Neglected Diseases: products for prevalent diseases, such as Chagas disease, Hansen's disease, malaria, leishmaniasis, tuberculosis, dengue fever, and schistosomiasis;
  - **Group 3:** Chronic, Noncommunicable Diseases: products for degenerative diseases, mental diseases, oncology, etc.
  - **Group 4:** Biological Pathways: technology-intensive products, such as recombinant DNA or monoclonal antibodies, etc.
  - **Group 5:** Vaccines and Hemoderivatives: for their importance to public health and technology development.
  - **Group 6:** Medications and products for treating conditions arising from nuclear accidents.
- **Section 2:** Medical devices and general devices for health.

Proposed Methodology for Prioritizing the Strategic Drugs Listed by the Ministry of Health for Innovation in Knowledge Integration (CARTAXO, R.J.A., 2011)

A four-stage methodology is proposed for prioritizing new PDPs and/or investments in Brazil for the production of drugs and/or medications from the list of products contained in groups 1 to 4 (pharmaceuticals) of section 1 of the SUS strategic list. The idea is to identify the most feasible opportunities for knowledge absorption and consequently successful integration for innovation.

Stage 1

This stage consists of building a database using variables to obtain as much information on the latest developments concerning the 87 products in groups 1 to 4 of section 1 of the SUS strategic list. Fifteen variables were chosen to analyze each product on the list:

1. Name of the drug and respective Chemical Abstracts Service (CAS) registry number – division of the American Chemical Society;
2. Retailer and/or distributor in Brazil by consulting *Dicionário de Especialidades Farmacêuticas*;
3. Producer of the main active ingredient (drug or active pharmaceutical ingredient, API) in Brazil by consulting the industry handbook (ABIQUIFI) and the Decent Work Country Programmes (DWCP) Guidebook published by the International Labour Organization;
4. Producer of the API in the world (from the DWCP Guidebook);
5. Producer of the API per region of the world;
6. ANVISA registration number (if registered as a generic drug);
7. First patent for the drug (patent number, holder, year);
8. Number of patents filed around the world (using SciFinder®-CAS database);

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9. Main patent holders around the world (company and number of patents filed);
10. Number of patents filed in Brazil (from the Instituto Nacional de Propriedade Industrial database);
11. Mercosur Common Nomenclature classification number;
12. Imports of the API in US$;
13. Imports of the medication in US$;
14. Countries from which Brazil imports the drug and/or medication;
15. Presence on the National List of Essential Medications (Relação Nacional de Medicamentos Essenciais, Rename).

Having prepared a database of these 15 variables, those products with an import value of US$ 1 million/year for the API or medication were selected. This reduced the original list to 54 products, 62% below the original number. The reduced list was:

- **Group 1 (9):** Atazanavir, darunavir, efavirenz, enfuvirtide, entecavir, lopinavir, raltegravir, ritonavir and tenofovir.
- **Group 2 (3):** Chloroquine, praziquantel and amphotericin B.
- **Group 3 (26):** Rivastigmine, budesonide, formoterol, cabergoline, Entacapone, pramipexole, clozapine, olanzapine, quetiapine, Topiramate, ziprasidone, leflunomide, mesalazine, mycophenolate mofetil, tacrolimus, sirolimus, calcitonin, calcitriol, raloxifene, pravastatin, atorvastatin, simvastatin, sildenafil, sevelamer, glatiramer and riluzole.
- **Group 4 (16):** Adalimumab, dasatinib, imatinib, infliximab, nilotinib, rituximab, trastuzumab, filgrastim, goserelin, insulin, leuprorelin, somatotropin, etanercept, interferon, octreotide and botulinic toxin.

Stage 2

A structured questionnaire was prepared and submitted to 22 experts from academia (universities), government, business, and funding agencies in Brazil. The questions were related to the database created in item 3.2.1, and required the respondents to give their opinion on the importance to Brazil of producing certain drugs and/or medications.

Based on the opinions given by the experts consulted, the list of products was narrowed down to 26. In their evaluations, they considered:

1. **Production:** They expressed the belief that Brazil can produce different antivirals, some statins and hormones, especially human insulin; they noted the need for improved data on the current production and development capacity of Brazil's pharmaceutical industry;
2. **Patents:** They commented that all the products could be produced as generics;
3. **Imports:** There is a need to support the creation of fine chemical plants, especially for intermediates, prioritizing those derived from the petrochemicals industry; the need to set up specific programs to enable "national sovereignty in drugs and medications" was expressed, to be achieved by the coordinated efforts of government, universities and business through RD&I funding for priority products defined by the government;
4. **Rename:** The impact of the Ministry of Health budget was analyzed in comparison with the number of patients receiving treatment.

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Stage 3

The authors drew up their own list of factors for selecting the priority products from the SUS list, as follows:

1. Cost of importing each drug or medication of over US$ 1 million;
2. Existing production of drugs and medications in Brazil;
3. High innovation potential, meaning the number of patent applications filed around the world in the last 15 years is higher than 300;
4. Ease of production of the drug, ascertained by observing the number of international producers – in this case, over ten producers worldwide;
5. Whether the first patent for the drug is in force and whether it is protected by patent in Brazil.

Stage 4

Finally, the replies received from the 22 specialists were compared with the results obtained by the authors in stage 3. The 54 products previously obtained were subject to four "conditions" to rank them and reduce the number of items on the list.

The first condition was whether or not there were already producers of the API in Brazil. In the absence of domestic production, the product would remain on the priority list. This reduced the list to 42 products, namely:

- **Group 1 (6):** Atazanavir, darunavir, enfuvirtide, entecavir, lopinavir, raltegravir.
- **Group 2 (1):** Amphotericin B.
- **Group 3 (21):** Rivastigmine, budesonide, formoterol, cabergoline, entacapone, pramipexole, clozapine, olanzapine, quetiapine, topiramate, ziprasidone, leflunomide, mycophenolate mofetil, tacrolimus, sirolimus, calcitonin, calcitriol, sildenafil, glatiramer, riluzole, atorvastatin.
- **Group 4 (14):** Adalimumab, dasatinib, imatinib, infliximab, nilotinib, rituximab, trastuzumab, goserelin, leuprorelin, somatotropin, etanercept, interferon, octreotide, botulinic toxin.

The second condition involved ascertaining the number of patents filed in the world. The products for which over 300 patents had been filed were regarded as more significant. This reduced the list to 32 items:

- **Group 1 (1):** Lopinavir.
- **Group 2 (1):** Amphotericin B.
- **Group 3 (17):** Rivastigmine, budesonide, formoterol, pramipexole, clozapine, olanzapine, quetiapine, topiramate, ziprasidone, leflunomide, mycophenolate mofetil, tacrolimus, sirolimus, calcitonin, calcitriol, sildenafil, atorvastatin.
- **Group 4 (13):** Adalimumab, dasatinib, imatinib, infliximab, rituximab, trastuzumab, goserelin, leuprorelin, somatotropin, etanercept, interferon, octreotide, botulinic toxin.

The third condition was to ascertain whether there are over ten producers of the API in the world. This reduced the list to 23 items:

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- **Group 1 (1):** Lopinavir.
- **Group 2 (1):** Amphotericin B.
- **Group 3 (16):** Rivastigmine, budesonide, formoterol, pramipexole, clozapine, olanzapine, quetiapine, topiramate, ziprasidone, leflunomide, mycophenolate mofetil, tacrolimus, sirolimus, calcitriol, sildenafil, atorvastatin.
- **Group 4 (5):** Dasatinib, imatinib, goserelin, leuprorelin, octreotide.

The fourth and final condition was to identify whether the first patent filed for the drug was still in force and whether it had been filed in Brazil. This removed 13% of the items from the list, reducing it to 20 items, proposed as priority for production in Brazil through PDPs. These are:

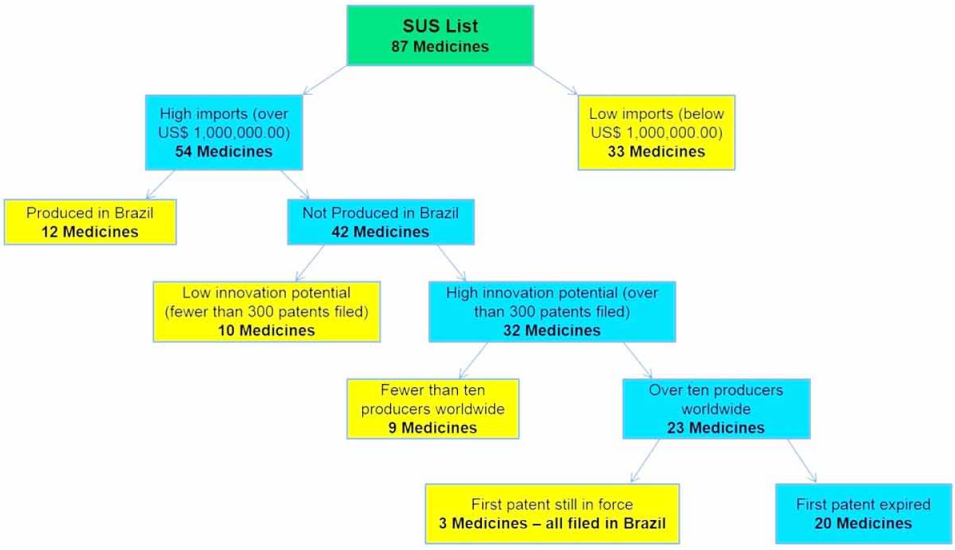
- **Group 1 (0):** No product selected.
- **Group 2 (1):** Amphotericin B.
- **Group 3 (16):** Rivastigmine, budesonide, formoterol, pramipexole, clozapine, olanzapine, quetiapine, topiramate, ziprasidone, leflunomide, mycophenolate mofetil, tacrolimus, sirolimus, calcitriol, sildenafil, atorvastatin.
- **Group 4 (3):** Goserelin, leuprorelin, octreotide.

The methodology explained in item 3.2 is shown graphically in Figure 3.

By using this methodology, the original SUS list was reduced by 77%. It could be inferred that only 20 of the products of high innovation value are worth focusing efforts on producing, rather than all 87 on the original list.

The proposed method for prioritizing the products has the potential to identify what products could be introduced to the Brazilian pharmaceutical market with a view to improving the performance of PDPs, achieving earlier results based on knowledge absorption for innovation.

Figure 3. Flow chart of the procedure for prioritizing medications from the SUS list for production in Brazil
Source: (CARTAXO, R.J.A., 2011)



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Intersection of Priority Products: Experts' Analysis vs. Authors' Methodology

For the purposes of comparison, the 20 products selected using the proposed methodology were compared with the 26 products selected by the experts.

This comparison resulted in a list of 11 products, which could be called the core products on the SUS list. These are: amphotericin B, rivastigmine, budesonide, atorvastatin, olanzapine, quetiapine, sirolimus, calcitriol, formoterol, leflunomide, leuprorelin.

CONCLUDING REMARK

Considering the political, industrial and academic context surrounding the field of health, there is clearly potential for success for Product Development Partnerships. The SUS list of essential medications published in directive 1284 and amended in directive 3089 can be transformed into opportunities for national investments and the introduction of measures for the short, medium and long term.

It is understandable that pharmachemical and pharmaceutical companies should be wary of investing generally in the products on the list, even considering the capital at the disposal of the sector's biggest multinationals. However, using a shorter-term strategy by identifying the highest potential products on the SUS list (essential products) is one way of significantly minimizing risks and obtaining more assured results. The methodology set forth in this chapter shows one way of identifying such products.

We have identified 11 core products that could be the target of investments for immediate production, since they were found to be significant not only by the research methodology but also by government, academic, business and funding agency experts. These products have a strong impact on the pharmaceutical industry trade balance because they are not produced in Brazil, their patents have already expired, and over 300 patents have been filed for them worldwide.

Apart from these 11 priority products, in the mid to long term the other products from the 20 selected using the methodology prepared by the authors could be considered for investment, as well as the other products selected by the experts.

The selection of the products indicated by the experts corresponds to 54% of the products that the Ministry of Health has earmarked for potential new PDPs for the coming years, demonstrating the coherence of inter-sectoral actions.

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KEY TERMS AND DEFINITIONS

Innovation: The act of innovating; introduction of new things or methods.

Intellectual Property: To protect in law by, for example, patents, copyright and trademarks, which enable people to earn recognition or financial benefit from what they invent or create.

Knowledge Management: Is a concept and a term that arose approximately two decades ago, roughly in 1990. Quite simply one might say that it means organizing an organization's information and knowledge holistically.

Patent: Does a government grant the exclusive right to an inventor to manufacture, use, or sell an invention for a certain number of years.

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Pharmaceutical Products: Are technically obtained or products developed by a pharmaceutical company with prophylactic, curative, palliative or diagnostic purposes.

Public Health: Science and art of preventing disease, prolonging life and promoting health.

Public Private Partnership: Means an arrangement between a government / statutory entity / government owned entity on one side and a private sector entity on the other, for the provision of public assets and/or public services, through investments being made and/or management being undertaken by the private sector entity, for a specified period of time.

Technological Management: Systematic efforts employed in the timely deployment of a process or system, and in balancing its cost, effectiveness, and supportability over its life cycle.

ENDNOTES

[1] There are over 20 public pharmaceutical laboratories in Brazil, known as official pharmaceutical laboratories. They are owned directly by either the federal government or by state governments. http://www.alfob.org/

[2] According to the Industrial Property Law #9279 of 1996, a patent is "a privilege conferred by the State that assures its holder exclusivity in exploiting the patented technology, safeguarding the holder's right to prevent third parties from exploiting (producing, selling, buying, stocking) the protected object." Filers of patent applications do so with the expectation of being awarded rights over the object of the application, but these rights can only be fully exercised after they are effectively awarded the patent. (BRASIL, PRESIDÊNCIA DA REPÚBLICA, 1996).

[3] Brazil has over 20 official pharmaceutical laboratories owned by the federal government or state governments. They have a strategic role in meeting the needs of specific government programs and are involved in RD&I, price regulation, etc. They specifically meet the government's needs for the medications on the SUS list for primary care and neglected diseases (malaria, TB, etc.) www.alfob.gov.br.

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Chapter 33
Environmental Cost Studies and Their Application in Environmental Protection Planning for Electricity Production

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ABSTRACT

Different approaches may be used for estimating environmental costs of electricity generation, and the way they are applied may vary from situation to situation. The extent to which environmental costs should be considered as external costs (i.e. not borne directly by electricity producers) depends partly on the environmental protection policy of the country and on the control instruments that are implemented. Damage costs can be assessed by two approaches: "top-down" (which relies on aggregated data) and "bottom-up" (requires the use of site-specific data). This chapter describes external costs of electricity and impact pathway method for their calculation. This method links burdens to the environment caused by power generation chains with physical impacts they cause and assigns monetary values to those impacts. Calculated external costs can be applied in various environmental policy case studies. Two such applications are illustrated: cost-benefit analysis of imposing stricter NOx emission standard and inclusion of external costs in power system expansion planning.

INTRODUCTION

Different approaches may be used for estimating environmental costs of electricity generation, and the way they are applied may vary from situation to situation. The extent to which environmental costs should be considered as external costs, i.e. not borne directly by electricity producers, depends partly on the environmental protection policy of the country and on the control instruments that are implemented.

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Under a 'command and control' regime involving emission limits, the costs of residual discharges are not internalized and should appear as adders. On the other hand, where a system of emission trading is in force, the environmental costs already are internalized, at least partly, through the trading costs, and the calculation of additional costs depends on the extent to which the rules that permit emission trading reflect variation in marginal damage from source to source. Adders for pollutants subject to emission taxes should take into account the difference between marginal damage costs and marginal revenues raised by the tax.

Assuming that all impacts from electricity generation chains could be quantified, the overall environmental cost of discharges could, in theory, be calculated by estimating the associated damage costs. However, most studies carried out so far highlight the wide range of uncertainties prevailing in assessing physical impacts as well as in placing values on those impacts. Owing to those uncertainties, and to the lack of reliable data, the costs of emission abatement are sometimes used as proxies for external environmental costs, although this approach generally is opposed by economists.

While it is difficult, and perhaps even impossible, to quantify all the impacts from an energy chain, its environmental costs may be calculated with a reasonable degree of accuracy by estimating a few dominant impacts. However, the identification of the dominant impacts is based partly on judgmental assessment, and the main impacts differ according to local conditions such as population density, economic development and characteristics of the sites, e.g. presence of historical monuments, recreational areas or natural parks.

The use of damage costs to estimate environmental adders was applied in several countries.

Damage costs can be assessed by two approaches: 'top-down' and 'bottom-up'. The 'top-down' approach, which relies on aggregated data, has been the dominant technique up to now, because it is easier to apply. It gives reasonable estimates for average damage costs, but it has some limitations with respect to application of the results to a specific location. Moreover, the use of aggregated data may conceal gaps in the detailed scientific and economic data. On the other hand, the 'bottom-up' approach requires the use of site specific data, and its results might not be representative of average situations.

Described analyses of environmental externalities are based primarily on the methodical approach that was developed in connection with the international research project ExternE.

The ExternE has made thorough analyses of various fuels and technologies in the electricity sector with methodology and results published in 1995, 1999 and 2004 (NewExt: Externe 2004). ExternE is funded by the European Commission and in its first phase also by the US Department of Energy, DOE. The methodology of ExternE is widely accepted by the scientific community and is according to ExternE considered as "the world reference in the field".

To the extent possible, ExternE applies a life-cycle approach assessing environmental impacts in all stages of the "fuel chain" – from fuel extraction, over fuel transport, conversion at the power plant and decommissioning of plants and waste handling. In the ExternE analyses all important environmental impacts are quantified, including climate change issues, health impacts from air pollution, accidents (including occupational accidents), impacts on agricultural yield of air pollutions, corrosion of building, noise and visual impacts. Some impacts however like acidification and eutrophication of ecosystems are not monetized due to lack of satisfactory data.

The results from ExternE indicate that climate changes and air pollution constitute the most important environmental costs, and that the costs are primarily related to the energy production phase (stack emissions). To this should be added a number of issues specific to nuclear power: health impacts related to the emissions from radioactive mine tailings may constitute a significant externality. Moreover, the

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costs related to possible nuclear accidents (reactor meltdown) deserve attention and so does costs related to the decommissioning of nuclear power plants.

Unified bottom-up methodology was developed to calculate externalities of various power generation technologies and their fuel chains. The approach, called the Impact Pathway Methodology is a comprehensive and scientifically grounded procedure to quantify damages to human health and the environment. It follows the chain of linkages between the burden emitted into the environment, its dispersion in the receiving media, its physical impact on human health and/or environment, and finally valuation of impacts in monetary terms. Accounting framework developed to support the impact pathway method is included in the EcoSense model, a software package for evaluation of externalities, created in IER, Germany.

The calculated external costs can then be used in a range of issues:

- Cost benefit analysis of pollution abatement measures,
- Optimization of site selection processes,
- Internalization of the external costs of energy,
- Comparative assessment of energy systems.

Chapter describes external costs of electricity and impact pathway method for their calculation. This method links burdens to the environment caused by power generation chains with physical impacts they cause and assigns monetary values to those impacts.

The chapter describes:

- How to implement the methodologies for evaluation of environmental impact of electricity generation chains and estimation of associated external costs. Calculate the external costs of existing plant by using Ecosene model. Identify ways to internalize the estimated external costs of various electricity generating technologies; i.e. include them in the total costs of electricity.
- How to internalize the estimated external costs of various electricity generating technologies, i.e. include them in the total costs of electricity
- How internalization of external costs would affect the optimal mix of energy sources and the optimal long-term capacity expansion plan of generation system.

Calculated external costs can be applied in various environmental policy case studies. Two of such applications are illustrated. One is a simple cost-benefit analysis of imposing stricter NO_x emission standard. The other, more sophisticated one was inclusion of external costs in power system expansion planning. The latter showed that external costs due to airborne emissions (particulate matter, SO_2 via sulphates and NO_x via nitrates) can influence both the optimal capacity mix and operation of the power system. If the higher estimate of calculated damage cost for the candidate coal and gas power plants is added to their private cost of operation and if the appropriate external cost for nuclear power plants is added too, optimal capacity mix shifts to nuclear power plants. .

The example of the analysis is how to apply impact pathway methodology to calculate health damages caused by electricity generation in one example called "*Country*" and *region*. The idea is to first calculate local impacts and the associated local external costs for several fossil fuelled technologies. Local external costs could serve to compare damages caused by different technologies on the same location, as well as to compare impacts of the same technology depending on the location. In this respect they could be used to design environmental regulations and optimize the power plant location.

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BACKGROUND: ENVIRONMENTAL COST STUDIES AND THEIR APPLICATION

Different approaches may be used for estimating environmental costs of electricity generation, and the way they are applied may vary from situation to situation. The extent to which environmental costs should be considered as external costs, i.e. not borne directly by electricity producers, depends partly on the environmental protection policy of the country and on the control instruments that are implemented (Freeman, Burtraw, Harrington & Krupnick, 1992). Under a 'command and control' regime involving emission limits, the costs of residual discharges are not internalized and should appear as adders. On the other hand, where a system of emission trading is in force, the environmental costs already are internalized, at least partly, through the trading costs, and the calculation of additional costs depends on the extent to which the rules that permit emission trading reflect variation in marginal damage from source to source. Adders for pollutants subject to emission taxes should take into account the difference between marginal damage costs and marginal revenues raised by the tax.

Assuming that all impacts from electricity generation chains could be quantified, the overall environmental cost of discharges could, in theory, be calculated by estimating the associated damage costs. However, most studies carried out so far highlight the wide range of uncertainties prevailing in assessing physical impacts as well as in placing values on those impacts. Owing to those uncertainties, and to the lack of reliable data, the costs of emission abatement are sometimes used as proxies for external environmental costs, although this approach generally is opposed by economists Joskow (1992); Wiel (1992) and Markandya (1995).

While it is difficult, and perhaps even impossible, to quantify all the impacts from an energy chain, its environmental costs may be calculated with a reasonable degree of accuracy by estimating a few dominant impacts. However, the identification of the dominant impacts is based partly on judgmental assessment, and the main impacts differ according to local conditions such as population density, economic development and characteristics of the sites, e.g. presence of historical monuments, recreational areas or natural parks.

Top-Down Approach

Table 1 provides a summary of external cost values calculated for various electricity generation chains, as derived from a number of studies in the USA, in Ottinger & Ward-Willis (1991). The two values shown for California, which differs by up to a factor of seven in some cases, were calculated by assuming, respectively, that the power plant is located in a densely populated area (in-state) and in a lightly populated area (out-of-state). The large difference in results, up to a factor of seven in the extreme case, illustrates the danger involved in transferring estimates from place to place.

An analysis of the social cost of energy chains in the United Kingdom has been carried out for the UK Department of Trade and Industry by the Centre for Social and Economic Research on the Global Environment (CSERGE) (Pearce, Ban, & Georgiou, 1992).

Table 2 summarizes the environmental cost adders resulting from this analysis, which was based to a large extent on USA studies. The authors emphasize the illustrative nature of the figures presented and stress the need to undertake more research to enhance the accuracy of the estimated cost adders. The numbers given in the report are not site specific but are intended to provide a 'broad-brush' indication of the relative scale of environmental costs. It should be pointed out that the report does not provide total

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Table 1. External costs of electricity generation for the USA (US cents/kWh)

Study Identification	Type of Energy Chain					
	Existing Coal Plant without Scrubber	Existing Coal Plant with Scrubber	Combustion Turbine #2 Oil 0.3% S	Natural Gas Combined Cycle	Atmospheric Fluidised Bed Coal 0.5% S	Gasified Coal Combined Cycle 0.45% S
Pace university	10.3	4.0	2.6	0.77	2.6	2.1
Massachusetts DPU	7.7	5.2	4.0	1.4	3.6	3.0
California EC in-state	30.3	10.9	5.3	0.6	5.9	3.8
California EC out-of-state	3.8	2.2	1.5	0.4	1.4	1.0
New York PSC	2.5	1.3	0.8	0.3	0.7	0.5
Nevada PSC	7.9	5.3	3.9	1.4	3.7	3.0

DPU: Department of Public Utilities
EC: Energy Commission
PSC: Public Service Commission

environmental costs, owing to the fact that a number of impacts have not been valued. Furthermore, the use of different valuation methodologies to derive costs for the various environmental impacts entails some limitations in using the results from the study.

The authors included the following remarks about the results shown in Table 2:

- Impacts on biodiversity, noise, visibility, water and land were not estimated.
- For GHGs, a risk premium should be added but has not been quantified.

Table 2. Environmental cost adders of electricity chains for the UK (P/kWh 1990/91 prices)

Environmental Externality	Type of Energy Chain								
	Existing Coal	New Coal	Oil	Gas	PWR	Solar	Wind	Hydro	CHP
Health Mortality Morbidity Disaster	 0.32 0.12 NE[2]	 0.32 0.12 NE[2]	 0.29 0.12 NE[2]	 0.02 0.04 NE[2]	0.01 0.01 0.02[3] 0.05[4] 0.27[4]	 0.07 0 0	 0.04 0 NE[2]	 0.03 0 NE[2]	 0.15[1] 0.06 NE[2]
Crops	0.10	0.05	0.05	0.02	NE[2]	NE[2]	NE[2]	NE[2]	0.02
Forest'	84	0.07	0.98	0.03	NE[2]	NE[2]	NE[2]	NE[2]	0.03
Buildings	3.22	0.28	3.77	0.11	0	0	0	0	0.14
GHGs[6]	0.40	0.34	0.35	0.16	0.01	0	0	0.01	0.17

Notes:

1. It is assumed that combined heat and power production uses new coal plants; therefore, impacts are estimated at half the value for new coal power plants.
2. Not estimated and probably positive.
3. Taking into account risk aversion estimated using the Rocard-Smets function.
4. Taking into account risk aversion estimated using the square function.
5. Upper bound of damage estimation.
6. GHGs = Greenhouse Gases; average of the range of estimated damage costs resulting from a doubling of CO2 concentration in the atmosphere.

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- More qualitative estimations for other chains, not reported in the table, include:
- For landfill gas, the environmental externalities will tend to correspond to the values for natural gas.
- For tidal, a potential biodiversity adder of 0.8 p/kWh may be considered, although there is considerable uncertainty about this value.
- For energy conservation, there is some evidence to suggest an adder of 0.01 to 0.02 p/kWh for the externalities associated with insulating materials and indoor pollution exposure problems.
- For geothermal and wave power, it did not prove possible to assess a relevant overall adder profile within the time frame of the study.

The major uncertainties identified by the CSERGE report concern the environmental costs associated with global warming and severe accidents. Another important omission may be the lack of valuation of intrusion in the landscape, especially for renewable energy systems that may occupy large areas of land in scenic areas. This might add significantly to the low estimates presented in the report for the external costs of renewable energy sources in work of Ferguson (1992). Some other issues, such as conservation of wildlife, are excluded from the analysis, since the studies upon which the report is based relied mainly on valuing damage to activities associated with the main economic components of the gross domestic product (GDP).

The report considers a range of values for the impacts of severe accidents in the nuclear energy chain, but omits large accidents in the valuation of external costs for other energy chains. The wide range of cost estimates reported for nuclear accidents reflects, in particular, the effect of incorporating (or not) a 'social cost' of risk aversion, the value of which is based upon judgmental assessments.

With regard to global warming, although there is a consensus among experts and policy makers on the need to recognise the risks of climate change, the authors of the study estimated that present scientific knowledge does not allow reliable estimations of the associated external costs. The probability of severe consequences, such as disease epidemics, large scale famine and flooding, resulting from global climate change is not quantified and, therefore, the impacts of global climate change cannot be estimated nor valued within a reliable range. The authors acknowledge that, under these circumstances, it would be sensible to add some form of risk premium, as an environmental adder for greenhouse gas emissions, if one could be calculated.

Bottom-Up Approach

The alternative 'bottom-up' approach avoids many of the difficulties of transferability, by carrying out site specific assessments for different types of electricity generation chains located in different countries. This method requires that careful consideration be given to the choice and use of pollution dispersion models and dose response functions. In particular, local and regional impacts need to be assessed for a wide range of locations, taking into account a number of factors such as the proximity of protected sensitive areas in the terrestrial or aquatic environment.

The ExternE project carried out by the European Commission (EC), the first phase in co-operation with the USA Department of Energy (USDOE), used the 'bottom-up' approach to assess the external costs of different fuel cycles. An accounting framework for quantifying the environmental impacts and social costs associated with the production of electricity from different fuel cycles was developed and applied to a wide range of fossil, nuclear and renewable energy chains for electricity generation. A summary of

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the main results from the project, published by EC/DG XII in December 1994, European Commission, Directorate (1995), is given in Table 3, Table 4 and Table 5. The main findings from the ExternE project point out issues and difficulties similar to those discussed above for the 'top-down' analysis.

The external costs related to global warming impacts and to severe nuclear accident risk aversion may well be dominant externalities for the relevant fuel cycles. These two issues were considered and analysed in the project. However, owing to large uncertainties in the estimation of their value, the corresponding external costs were not incorporated in the results.

It is especially difficult to place valuations on the estimated damages of global warming damages, in the light of:

- The large uncertainty in physical impact estimates (there is barely a consensus on key indicators such as the Global Warming Potential of different gases);
- The likelihood of significant interactions between impact categories that generally are considered separately (e.g. agriculture and water resources);
- The uncertainties and methodological issues associated with valuing very long term impacts (e.g. establishing credible world population and life style scenarios up to 2100 and beyond, and applying a relevant discount rate to very long term impacts).

Table 3. Damage estimates for fossil fuel cycles

Damage Category	**Estimated Value (mECU/kWh)**					
	Coal		**Lignite**	**Oil**		**Gas**
	UK	**Germany**	**Germany**	**GT**	**CCGT**	**UK**
HEALTH						
Public	4*	13	10	11	10	0.5*
Occupational						
Diseases	0.1	0.3	neg.	neg.	neg.	neg.
Accident	0.8	2.0	0.1	0.5	0.3	0.1
ENVIRONMENT						
Agriculture	0.03	0.04	0.02	0.04	0.03	NQ
Timber	0.04	IQ	0.004	0.013	0.008	-
ECOSYSTEMS						
Terrestrial	NQ	NQ	NQ	NQ	NQ	NQ
Marine	NQ	NQ	NQ	0.2	0.2	0.001
Fisheries	IQ	NQ	NQ	NQ	NQ	NQ
Materials	1.3	0.1	0.1	0.2	0.1	0.1
Noise	0.2	NQ	NQ	NQ	NQ	0.03

Notes:

GT: Gas turbine
IQ: Impacts have been quantified but not costs have not been valued
CCGT: Combined cycle gas turbine
neg.: Negligible
NQ: Not quantified
*Public health impact assessed over the UK population only

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Table 4. Damage estimates for the nuclear fuel cycle in France (MECU/kWh at 0% discount rate)

Fuel Cycle Step	Local			Regional			Global		
	S	M	L	S	M	L	S	M	L
Mining	$1x10^{-2}$	$3x10^{-2}$	$3x10^{-4}$	0	$2x10^{-2}$	$2x10^{-4}$	0	$2x10^{-5}$	0
Conversion	$6x10^{-4}$	$3x10^{-4}$	$4x10^{-6}$	0	$3x10^{-7}$'	$2x10^{-6}$	0	$2x10^{-7}$	0
Enrichment	$1x10^{-3}$	$1x10^{-6}$	$4x10^{-6}$	0	$1x10^{-7}$	$7x10^{-7}$	0	$7x10^{-8}$	0
Fabrication	$8X10^{-4}$	$1x10^{-3}$	$6x10^{-8}$	0	$2x10^{-6}$	$1x10^{-8}$	0	$1x10^{-9}$	0
Power plant									
Construction	$3x10^{-2}$	$2x10^{-4}$	0	0	0	0	0	0	0
Operation*	$1x10^{-2}$	$5x10^{-2}$	$1x10^{-8}$	0	$3x10^{-3}$	$2x10^{-9}$	0	$3x10^{-2}$	$3x10^{-1}$
Decommissioning	$1x10^{-2}$	$3x10^{-3}$	0	0	0	0	0	0	0
Reprocessing	$3x10^{-3}$	$3x10^{-4}$	$3x10^{-6}$	0	$1x10^{-2}$	$2x10^{-3}$	0	$2x10^{-1}$	2**
LLW	0	$2x10^{-5}$	$2x10^{-6}$	0	0	0	0	$1X10^{-4}$	$5x10^{-3}$
HLW	0	$9x10^{-8}$	$3x10^{-2}$	0	0	0	0	0	0
Transportation	$4x10^{-4}$	$4x10^{-4}$	0	0	0	0	0	0	

Notes:

* Not including reactor accident damage, estimated at less than 0.1 mECU/kWh based on probabilistic data

** Resulting from very small doses from ^{14}C emissions that are summed over 100,000 years and assumed to be received by a world population of some 10 billion people

S Short term

M Medium term

L Long term

LLW Low level radioactive waste management and disposal

HLW High level radioactive waste management and disposal

However, the ExternE study states that, while very large uncertainties pervade the estimation of global climate change impacts, these uncertainties do not justify the exclusion of the impacts from the analysis of external costs. The study also concludes that, although uncertain, the damages due to global warming probably are the largest external cost of the coal fuel cycle.

Major issues were raised also by attempting to estimate the external cost of low probability/high consequence nuclear accidents. These issues relate to two stages of the estimation. The first is associated with the assessment of the risks (i.e. whether to rely on the limited, statistically non-significant, data available from past experience or on estimates derived with the probabilistic risk assessment method for estimating the risk and consequences of severe nuclear accidents). The second issue is associated with the valuation of the impacts, irrespective of which technique is used to estimate risks (e.g. recognizing risk aversion and the fact that the 'willingness to pay' for avoiding low probability risks may not be a linear function of the probability).

Attempts were made to value these factors as part of the ExternE project, and figures were presented and discussed in the detailed reports (based on probabilistic data, the potential impact of the most likely severe accidents was estimated at no greater than 0.1 mECU/kWh). However, the uncertainties were so great that nuclear accidents were excluded from the overall framework of scientific assessment and economic valuation presented in the ExternE summary report.

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Table 5. Damage estimates for wind turbines and hydropower

Damage Category	Estimated Value (mECU/kWh)			
	Wind Turbines		Hydropower	
	Delabole	Penrhyddlan	Sauda	La Creuse
	UK	UK	Norway	France
Noise	1	0.7	-	-
Visual amenity	NQ	NQ	2*	NQ
Impacts of acid emissions * *	0.7	0.7	NQ	NQ
Global warming **	0.2	0.2	NQ	NQ
Public accidents	0.09	0.09	NQ	NQ
Occupational accidents	0.3	0.3	>0.003	NQ
Ecosystem impacts	neg.	neg.	2*	NQ
Direct agricultural impacts	neg.	neg.	0.01	NQ
Direct forestry impacts	0	0	0.0003	-
Impacts on water supply	0	0	0.008	NQ
Recreational impacts	NQ	NQ	2*	NQ

Notes:
NQ Not quantified
neg. Negligible
* Results from a study valuing the ecosystems, cultural sites and recreational and aesthetic impacts
** Impacts of emissions associated with materials production, manufacturing and construction

Although the ExternE project used the same basic methodology and accounting framework to assess the impacts from all fuel cycles, it was recognized that the nature of these impacts vary between fuel cycles and that it was not possible to include the same impacts for all the different technologies, nor to make meaningful direct comparisons between fuel cycles.

Public health impact coefficients used in the ExternE study are higher than those estimated in previous work, because they reflect results from a number of recent epidemiological studies on the impacts of particulate emissions, coupled with a regional scale analysis of acid aerosols. Although the estimated large mortality damages are uncertain, they show that assessment of power station environmental impacts need to be more comprehensive than in the past. It should be noted that the damage estimates of the ExternE study are valid only for the technologies and plants considered which, being located within the European Union, are equipped with abatement devices in order to meet the pollution control regulations in force in Europe.

The analysis carried out by the ExternE project highlights the sensitivity of damage cost estimates to discount rate. This is a major issue in the economic valuation of long term environmental impacts (e.g. effects of low radiation doses over thousands of year), which has yet to be satisfactorily solved.

The results from the ExternE project show the importance of global scale impacts, which often have not been taken into account in other studies, in comparison to the local and regional scale impacts which usually are analysed well. For the fuel cycles considered in the project, all the estimated costs associated with local pollution impacts were small. However, the study indicates that residual local impacts need to be taken into consideration, even if their estimated damage cost is rather low in absolute terms, because

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they are focused on specific geographic locations and on few receptors. For renewable energy chains, local impacts are dominant and require detailed site specific analysis at the planning stage, in order to ensure comprehensive environmental impact assessment and economic evaluation.

While not producing definitive valuations for the environmental impacts of the major energy chains for electricity generation, the results of the ExternE study are very valuable and informative. They demonstrate the importance of long term and global damages for fossil and nuclear chains and point out the need for further research in order to reduce the uncertainties on physical impacts and, moreover, to establish better methodological frameworks for valuing long term effects. Based upon the damages valued by the study, there is no evidence that external costs from any of the fuel cycles considered would be large enough neither to modify significantly the total costs of electricity generation nor to change drastically the relative economic competitiveness among energy chains.

Analyses of Environmental Externalities

The analyses of environmental externalities are based primarily on the methodical approach that was developed in connection with the international research project ExternE.

The project ExternE has made thorough analyses of various fuels and technologies in the electricity sector with methodology and results published in 1995, 1999 and 2004 - NewExt 2004. ExternE was funded by the European Commission and in its first phase also by the US Department of Energy, DOE. The methodology of ExternE is widely accepted by the scientific community and is according to ExternE considered as "the world reference in the field".

The analyses by ExternE were carried out for concrete European power plants mainly commissioned in the beginning or mid 1990'es. Therefore calculation results cannot be directly applied for the present project examining best available technology in 2010 and 2025. However, the results may work in an initial screening identifying which externalities are the most important to focus on in the present project.

The results from ExternE indicate that climate changes and air pollution constitute the most important environmental costs, and that the costs are primarily related to the energy production phase (stack emissions). To this should be added a number of issues specific to nuclear power: health impacts related to the emissions from radioactive mine tailings may constitute a significant externality. Moreover, the costs related to possible nuclear accidents (reactor meltdown) deserve attention and so does costs related to the decommissioning of nuclear power plants.

NEEDS - New Energy Externalities Development for Sustainability is a project funded by the European Commission in order to have further innovative research and dissemination of knowledge (NEEDS, 2006, 2007). NEEDS had plans to develop, improve and expand the methodology for calculating the externalities of energy technologies. NEEDS project continue work ExternE methodology with the aim to develop, implement and test the original framework of analysis for the assessment of options long-term sustainability of energy technologies.

As the method is used "Life cycle approaches to assess emerging energy technologies" - LCA. New methods for nonlinear relationships between emissions and external costs are developed.

Project wants to improve the methods of the impact, then the new influences (e.g. loss of biodiversity, impacts of the hemisphere, internal sources, etc.), to improve current method, tools and basic data e.g. Exposure/Response functions, exposure patterns, estimates of mortality and morbidity, transportation pollutants, etc.), seeks to reduce uncertainty and complement the existing gaps.

Progress by Project NEEDS:

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- More comprehensive and detailed report on the life cycle of a series of new generation technologies that previously or were or are poorly documented and accompanied ;
- Time and scenario depend on the life cycle based on the prediction of energy technologies, or estimate the dynamics of energy technologies for a very long period (eg 2030th-2050th);
- The inclusion of external costs in the cost of new influences (eg biodiversity NEEDS (2006b)) improves the accuracy of the estimate of all other influences.

Figure 1 and Figure 2 from NEEDS (2009); Ricci & NEEDS project partners (2009) show the value of external costs (social cost) for selected technology to produce electricity from the 2009th. In the figures are not listed risk aversion and potential harm of terrorism, which raised a heated debate inside and outside the community NEEDS.

NEEDS project had made significant progress. It achieved great biodiversity assessment based on experimental development and application of the most promising approaches, based on an assessment of the potential vanishing fraction. Externalities biodiversity are estimated at € 2.66/m^2. Increase the robustness of knowledge of one of the most controversial issues and difficult topics for external evaluation, and climate change. NEEDS creates new knowledge and information for the evaluation of a person's death, produced a new questionnaires and surveys. According to new surveys in the project NEEDS value VOLY (Value of Life Year) is reduced to € 40k for the old EU member states (15), i.e. € 33k for the new member states. It also conducted to estimate the external costs of extraction and transportation of energy

Figure 1. Quantifiable External Costs (year 2009) of Electricity Generation Technologies (for cities in Central EU, except solar thermal, risk aversion, terrorism not included)

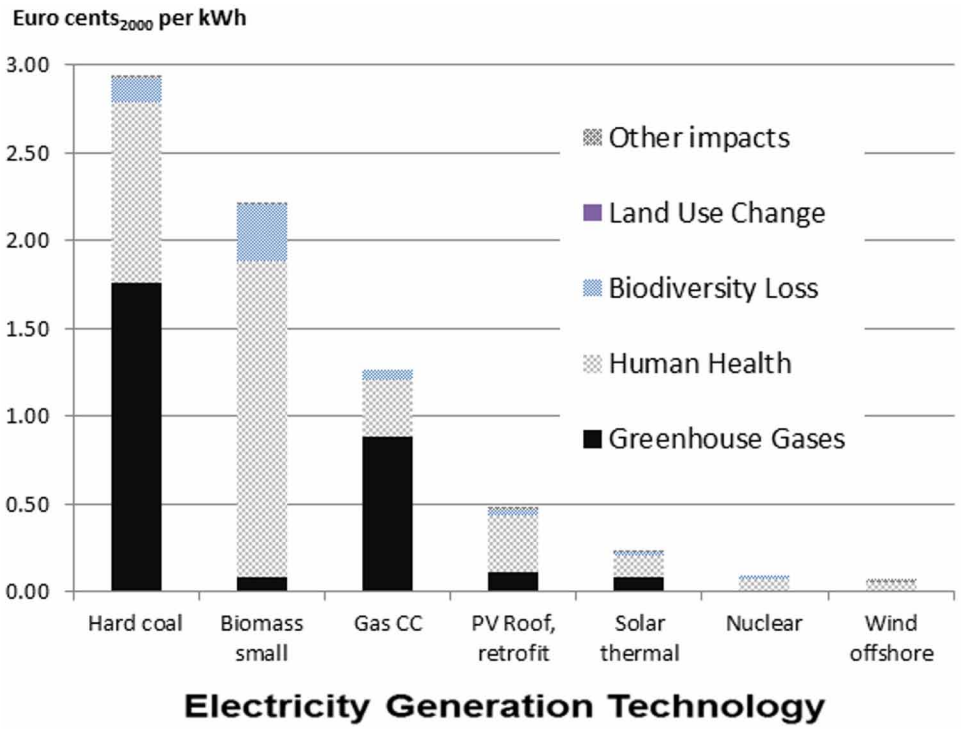

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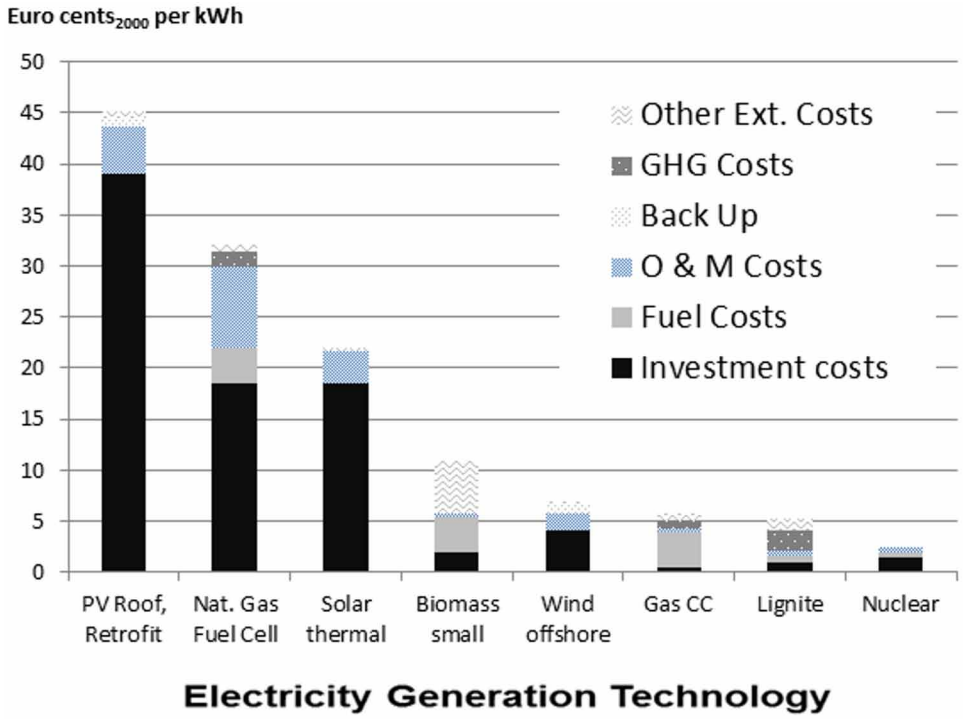
Figure 2. Social Costs (year 2009) for selected Electricity Generation Technologies (for cities in Central EU, except solar thermal, risk aversion, terrorism not included)



products, which were previously inaccessible, and the total cost of bringing oil have been reduced to € 2.5 per ton of crude oil, which is a very low value at 5% of the direct costs and about 1% current oil prices.

NEEDS project supported development study of external costs in a number of countries, especially in Eastern and Mediterranean countries, created a fresh database, enable the development of technical capacity in these countries.

EXTERNAL COSTS OF ELECTRICITY

Introduction

The use of electricity is, apart from the benefits it brings, linked to numerous environmental and social problems such as effects of air pollution on health, buildings, crops, forests and global warming; occupational disease and accidents; and reduced amenity from visual intrusion of plant or emissions of noise. Such damages are referred to as external costs, as they are typically not reflected in the market price of electricity or taken into account by energy planners. Since they are not monetized, such damages tend to be ignored in policy making.

A variety of methods are available for reducing externalities, ranging from the development of new technologies, imposition of emission limits to the use of economic instruments such as emission charges.

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However, it is necessary to quantify the damages in order to weight the benefits of abatement measures against their costs, and based on that optimally design environmental policy.

Within the European Commission's ExternE Project (European Commission, Directorate, 1995, 1998), a unified bottom-up methodology was developed to calculate externalities of various power generation technologies and their fuel chains. The approach, called the Impact Pathway Methodology is a comprehensive and scientifically grounded procedure to quantify damages to human health and the environment. It follows the chain of linkages between the burden emitted into the environment, its dispersion in the receiving media, its physical impact on human health and/or environment, and finally valuation of impacts in monetary terms. Accounting framework developed to support the impact pathway method is included in the EcoSense model, a software package for evaluation of externalities, created in IER, Germany (IER Stuttgart, 1997), and updated later (IER Stuttgart, 2004, 2007).

One of the biggest achievements of the ExternE Project is the compilation of a database of physical data on the burdens and impacts of energy systems. Apart from that, monetary values of human health and environmental impacts have been established, allowing transferring impacts into external costs. The calculated external costs can then be used in a range of issues:

- Cost benefit analysis of pollution abatement measures,
- Optimization of site selection processes,
- Internalization of the external costs of energy,
- Comparative assessment of energy systems.

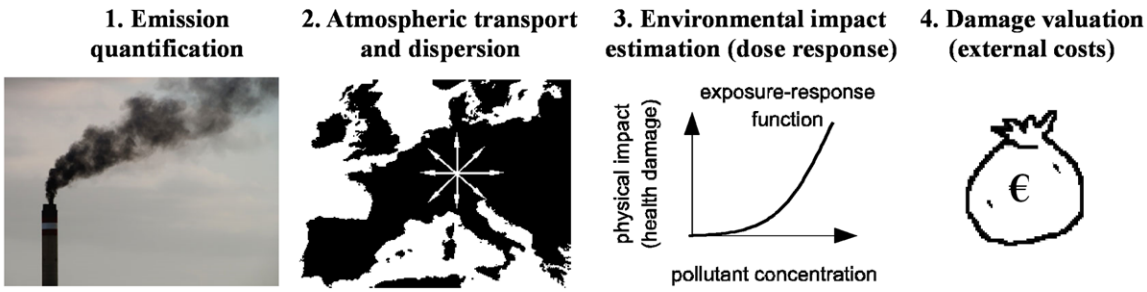
Method Description

Impact assessment and valuation are performed using the 'damage function' or 'impact pathway' approach, which relates to a sequence of links between the burden and its impact. This approach assesses impacts in a logical and transparent manner, going stepwise as shown in Figure 3.

The impact pathway methodology consists of the following steps:

1. Quantification of emissions,
2. Calculation of the associated ambient concentration increase by means of atmospheric dispersion and transport models,

Figure 3. Impact pathway methodology (European Commission Directorate, 1995)



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3. Estimation of physical impacts using various exposure-response functions, and
4. Finally monetary evaluation of damages. Such detailed bottom-up approach should allow the calculation of site specific and technology specific damage costs for new increments of power generation. Marginal damage costs per kWh derived for a certain technology and location could be important for environmental regulations. It has to be stressed that environmental damage does not necessarily constitute in its entirety an external effect, so external cost might be different from the calculated damage cost.

Impact pathway method requires a detailed description of the reference environment, which in this case includes meteorological conditions affecting dispersion and chemistry of atmospheric pollutants, functions linking exposure to a particular pollutant (i.e. pollutant ambient concentration) with the health effect it causes, population density and age structure in the observed area (locally and for the whole of *region*), and costs of the estimated health effects. Each of these steps inevitably incorporates a dose of uncertainty, due to atmospheric model imperfections, transferability of data from one context to another (e.g. extrapolation of exposure-response functions from the laboratory to the field and from one geographical location to another, transferability of monetary values from one country to another), the fact that some impacts cannot be quantified or monetized at all, etc. However, there is a consensus among experts that transference of input parameters and results is to be preferred to ignoring some impact categories.

Focus of this analysis has been put on the effects of ambient air pollution on human health, as one of the priority impacts of electricity generation. The analysed burdens relate only to routine emissions, while accidents are not taken into account. Since air pollutants are transported over large distances crossing national borders, their impacts are quantified not only on the local level, (i.e. within 50 km from the source, but also for the whole of region).

The EcoSense Software

The software used in the ExternE Study for calculation of externalities associated with electricity generation was EcoSense, developed within the European Community project ExternE. EcoSense (IER, 1997) was developed to support the assessment of priority impacts resulting from the exposure to airborne pollutants. It constitutes of several databases: technology, exposure-response and reference environment databases. The reference technology database holds a small set of technical data describing the emission source (power plant) that are mainly related to air quality modelling, including e.g. emission factors, flue gas characteristics, stack geometry and the geographic coordinates of the site. The impact assessment module calculates the physical impacts and the resulting damage costs by applying the exposure-response functions, based on receptor distribution and concentration levels of air pollutants from the reference environment database.

EcoSense also provides two air transport models (local and regional), to cover different pollutants and different scales. One is The Industrial Source Complex Model (ISC, developed by the US-EPA), which a Gaussian plume model is used for transport modelling of primary air pollutants (SO_2, NO_x, particulates) on a local scale. The other is The Windrose Trajectory Model (WTM, developed in Harwell Laboratory, UK) used to estimate the concentration and deposition of acid species on a *region*-wide scale.

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Emissions

The most important pollutants emitted from fossil-fuelled power plants are carbon dioxide (CO_2), particulate matter (especially relevant for health effects are fine particles less than 10 and 2.5 microns in diameter respectively, so called PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2) and nitric oxides (NO_x, i.e. mainly NO later oxidized to NO_2). Apart from that, SO_2 and NO_x are subject to chemical transformations in the atmosphere, forming the so-called secondary pollutants: sulphuric and nitric acid (H_2SO_4 and HNO_3), sulphate and nitrate aerosols and tropospheric ozone (O_3). Both primary and secondary pollutants cause certain health effects, but here are considered only those for which the atmospheric modelling and the exposure-response functions are provided. Since modelling of ozone formation involves considerable complexity in both plume dynamics and chemistry, health effects associated with ozone are not quantified here. Impacts of global warming are not covered either because of the very different mechanism and global nature of impact.

Atmospheric Dispersion and Transport Models

On the local scale, i.e. within 50 km from the source, chemical transformations of pollutants can be neglected and thus their concentrations predicted using Gaussian plume dispersion models. These models assume source emissions are carried in a straight line by the wind, mixing with the surrounding air to produce pollutant concentrations with a Gaussian spatial distribution. One of them, used in EcoSense, is the Industrial Source Complex Short-Term model, version 2 (ISCST2) developed by the U.S. EPA. The area analysed in the local dispersion is represented by 10 x 10 grids of quadratic cells each 100 km^2 in size, with the power plant positioned in the grid centre. The model calculates hourly concentration values of SO_2, NO_x and particulate matter averaged over one year at the centre of each cell. Gaussian models require detailed description of meteorological data at the plant location provided by the user. They are valid up to 50 km from the plant.

However, pollutant transport extends over much greater distances, when chemical reactions and formation of secondary pollutants can no longer be neglected. Therefore, different models are required for assessing long-range (regional) transport of pollutants; the most common are the Lagrangian trajectory models. Receptor-oriented trajectory model examines incoming trajectories of air parcels arriving from different directions to the receptor point (which is characterized by its mean annual windrose), moving at a representative wind speed and constant mixing height. *region* -wide transport of pollution is in the EcoSense software handled by the Windrose Trajectory Model. *Region* is represented by a 42 x 27 matrix of large cells, each 10000 km^2. The outputs from the model are atmospheric concentrations and deposition of emitted species and secondary pollutants in each grid cell. All input data required to run the Windrose Trajectory Model are provided by the EcoSense database.

Public Health Effects

Combustion processes cause an increase in the concentration of certain atmospheric pollutants that might be causing adverse health effects within the general public. There is now a broad-based body of evidence showing small but definite increases in risks associated with increases in air pollution, with no convincing evidence of threshold. Acute health effects, which occur on the same day as increases in air pollution or very soon thereafter, should be distinguished from the chronic or delayed effects of pos-

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sible long-term exposure. There are less exposure-response functions for chronic effects since they are more difficult to estimate than the acute ones. It should be stressed that the acute mortality effects occur predominantly in older people, almost certainly with serious pre-existing health problems, though the precise mechanism of action is not yet resolved. Length of life lost in those who die prematurely following higher pollution days is also unknown, but is likely to be short – a few weeks or months. Averaged reduced life expectancy among those who die prematurely from chronic effects of air pollution is likely to be much greater and is measured in years.

The incremental air pollution attributable to power generation is a mixture of pollutants emitted from a power plant and those formed subsequently in atmospheric chemical reactions. Complex studies were made to disaggregate that mixture and determine separate exposure-response functions for each pollutant (particles, SO_2, NO_x and ozone). Most of the exposure-response functions used in the EcoSense model are chosen from studies which showed statistically significant relationship between pollutant and health endpoint and which eliminated possible confounding factors due to other pollutants. For ease of implementation, the exposure-response functions are linearized, assuming independence of background levels and no threshold existence.

Quantitative relationships have been established linking air pollution with a number of health endpoints. Health impacts are divided into three categories: mortality, morbidity and accidents. Only first two categories are observed here since they refer to normal operation of a power plant. It is dealt with premature mortality (acute and chronic), restricted activity days, hospital admissions due to respiratory and cerebrovascular problems, as well as emergency room visits due to exacerbation of asthma and chronic obstructive pulmonary disease (COPD). Here is how additional mortality and restricted activity days due to air pollution can be calculated based on the given exposure-response functions:

Mortality (number of cases) = exposure-response slope/100 × baseline mortality × population of the observed area × pollutant concentration increase ($\mu g/m^3$).

Restricted activity days (number of days) = exposure-response slope/100 × population of the observed area × percentage of adults × pollutant concentration increase ($\mu g/m^3$).

Table 6 presents summary of exposure-response functions and monetary values used in example calculations.

Monetary Valuation of Health Effects

Health impacts are generally valued more highly than the conventional economic approach would suggest. Mortality impacts can be valued based on the willingness to pay (WTP) for reduction of the risk of death, or on the willingness to accept compensation (WTA) for an increase in risk. WTP or WTA is converted into the value of statistical life (VSL) dividing it by the change in risk. For example, if the estimated WTP is € 100 for a reduction in the risk of death of 10^{-4}, the value of statistical life is estimated at 1 million €. However, increased air pollution cannot actually cause 'additional' deaths – it can only reduce life expectancy slightly. For deaths arising from illnesses linked to air pollution it is recommended to use years of life lost (YOLL) calculation, while VSL approach only for valuing fatal accidents and cases where general population is affected and not only risk groups. Value of one year of life lost (v_{YOLL}) can be determined from the VSL estimate, applying the formula below, if one knows the age of the reference group and the discount rate to be applied to present vs. future years of life.

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Table 6. Summary of exposure-response functions and monetary values used by Freeman, Burtraw, Harrington. & Krupnick (1992)

Impact Category	Monetary Value (€)[1]	Pollutant	e-r Slope [2]
Receptor: Total Population			
Acute mortality[3]	155 000	PM_{10} and nitrates	0.040%
		$PM_{2.5}$ and sulphates	0.068%
		SO_2	0.072%
		NO_x	0.034%
Chronic mortality[3]	83 000	PM_{10} and nitrates	0.390%
		$PM_{2.5}$ and sulphates	0.640%
Hospital admissions	7 870	PM_{10} and nitrates	2.07×10^{-6}
respiratory		$PM_{2.5}$ and sulphates	3.46×10^{-6}
		SO_2	2.04×10^{-6}
		NO_x	2.34×10^{-6}
Hospital admissions	7 870	PM_{10} and nitrates	5.04×10^{-6}
cerebrovascular		$PM_{2.5}$ and sulphates	8.04×10^{-6}
Emergency room visits	223	PM_{10} and nitrates	13.7×10^{-6}
for asthma and COPD		$PM_{2.5}$ and sulphates	22.8×10^{-6}
Receptor: Adults[4]			
Restricted activity days	75	PM_{10} and nitrates	0.025
		$PM_{2.5}$ and sulphates	0.042

Remarks to the above table:

1. Mortality values given at a discount rate of 3%, based on YOLL.

2. Slope of the exposure-response function is expressed in percentage change in annual mortality rate per unit of pollutant concentration increase (% change per μg/m^3) for mortality, while in number of events per person per μg/m^3 for morbidity.

3. Baseline mortality in *Country* is 11 per 1000.

4. (Age group 14-65), in *Country* 68% of total population.

$$VSL = \sum_{t=0}^{T_l} \frac{v_{YOLL}}{(1+r)^t},$$

where r is discount rate (usually 3%), and T_l is number of years of life lost.

If, for example, life expectancy for a prime age male is assumed 32 years and if VSL equals 3,1 million €, value of YOLL turns out around 100 000 € with zero discount rate, i.e. 155 000 € with discount rate of 3%.

Morbidity impacts valuation is based on the cost of illness, which comprises the value of time lost due to the illness (valued through lost wages), the value of the lost utility because of pain and suffering and the costs of any expenditures on averting and mitigating consequences of illness.

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Calculation of External Costs of Power Generation

The example of the analysis made here is to apply impact pathway methodology to calculate health damages caused by electricity generation in *Country*. The idea here is to first calculate local impacts and the associated local external costs for several fossil fuelled technologies. Local external costs could serve to compare damages caused by different technologies on the same location, as well as to compare impacts of the same technology depending on the location. In this respect they could be used to design environmental regulations and optimize the power plant location.

However, since local external costs are too location specific, they cannot be taken as representatives for the whole country.

Since long-range transport and dispersion of pollutants are important contributors to external costs, here it was decided to calculate how the two observed power plants would affect the receptors in *Country* and how high the external costs of such impact would be.

Local Analysis

Local analysis was made for one location, again as illustration. Two types of fossil-fired power plants are observed, one coal and one natural gas fired facility, since they are among candidates for future power system expansion. Basic technical end environmental data are given in Table 7.

Both facilities have the same rated capacity of 350 MW and the same yearly generation of 2300 GWh. Fossil fired facility has a conventional steam cycle with 37% efficiency, while gas fired facility operates in a combined cycle with the efficiency of 46%. The volume of flue gases at the coal power plant amounts to 1.2 million m^3/h, while for the gas CC plant it equals 2.1 million m^3/h.

Both power plants are assumed to comply with domestic emission standards, so the emission rates equal the upper emission limits. To stay within the limits, coal power plant is equipped with the electrostatic precipitator for removal of particles, with wet scrubber for desulphurization, and has a modified

Table 7. Technical data and emission rates of the analysed power plants

	Coal Facility		**Natural Gas Facility**	
Gross/net capacity	380/350 MW		370/350 MW	
Hours on full load	6570 h/yr		6570 h/yr	
Flue gas volume	1.2E+6 m^3/h		2.1E+6 m^3/h	
Flue gas temperature	403 K		403 K	
Stack height	200 m		200 m	
Stack diameter	6 m		6 m	
Emissions	**mg/m³**	**g/kWh**	**mg/m³**	**g/kWh**
Particulates (TSP)	50	0.168	0	0
SO_2	400	1.343	0	0
NO_x	650	2.182	100	0,6
CO_2	2.45E+5	822.9	0.43E+5	258.55

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burner (so called low-NO_x measures) to achieve lower NO_x emissions. With those abatement measures in place, the mass of pollutants emitted from the coal power plant during an hour is 470 kg of SO_2, 760 kg/h of NO_x and 60 kg/h of particulates.

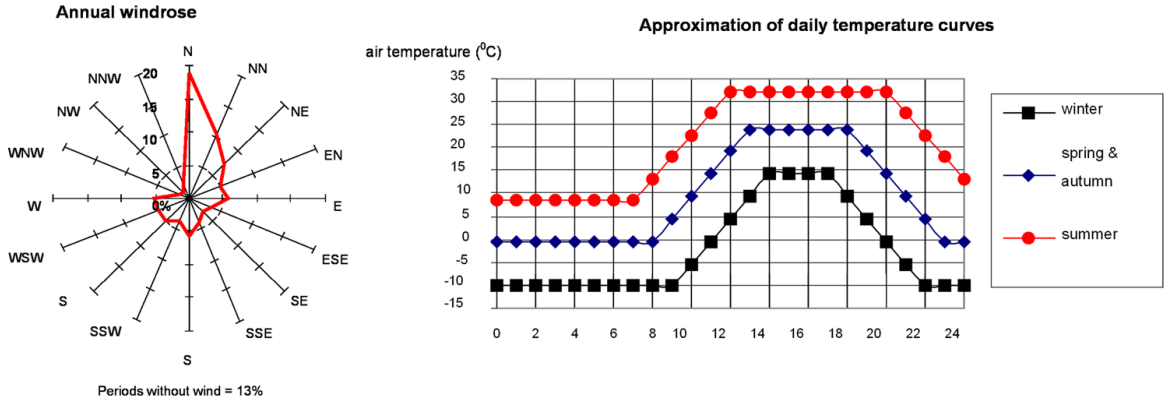
It is supposed that the gas fired facility emits only NO_x, since the utilized natural gas has a negligible percentage of sulphur dioxide. NO_x emission equals 100 mg/m^3, so the mass of NO_x emitted during an hour of operation is 210 kg. To achieve such a low emission rate, combined cycle would probably have to be equipped with SCR device, with 75% abatement factor. Namely, the uncontrolled emission from a typical gas fired combined cycle amount to around 250 mg/m^3.

Both facilities are assumed to be located in the densely populated urban area. Impact analysis on the local level, i.e. within 50 km from the source, displays a local, so called fine grid with 10x10 km^2 sized cells, the average pollutant increment (μg/m^3) in each cell and the total number of health events in the whole local grid. To calculate atmospheric dispersion on the local level, hourly meteorological data for the plant site are required, while for estimation of health impact population density in each cell of the local grid is needed.

The basic meteorological data for location – monthly temperature extremes and frequency of wind speeds and wind directions (so called windrose) in the 15-year sequence – can be obtained from the *Country* meteorological and hydrological service. Since no continuous measurements of wind and temperature were available, and because some additional parameters describing atmospheric conditions are needed for local dispersion modelling, meteorological data set had to be constructed before imported into the EcoSense. Average annual windrose for location and an approximation of daily temperature curve for each season are given in Figure 4.

Location is not a very windy area, which can be concluded from rather high frequency of calms (13%). The prevailing wind directions are northern (19%) and northeastern (11%). The largest average wind speeds, occurring in northeasterly and southwesterly directions, do not exceed 3 m/s (at 10 m above ground). According to the demographic data for location and *Country*, population density in the outer city area (comprising 4 cells around the plant, altogether 400 km^2) is set to 3000 people per km^2, while in the remaining 96 cells to 100 people per km^2. Average population density in *Country* equals 85 inhabitants per km^2.

Figure 4. Annual windrose and approximated temperature daily flow at location site



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Results of the Local Analysis

Based on power plants' emission rates and local meteorological data, average annual concentrations of SO_2, NO_x and particulates on the local level were calculated, using the ISCST2 local dispersion model incorporated in EcoSense. The highest concentrations occur in the very grid cell where the plant is situated and in the cells downwind the stack, i.e. southwest from the plant. They are given in the Table 8.

The highest average yearly concentrations caused by coal power plant emissions are as follows. For particulate matter the highest concentration amounts to 0.08 µg/m^3, for NO_x it is 1.08 µg/m^3 while for SO_2 it is 0.66 µg/m^3 (Figure 5). Gas fired power plant emits only NO_x, its highest concentration equalling 0.22 µg/m^3. Spatial distribution of pollutant increments within 50 km of the coal power plant are shown in the figures below.

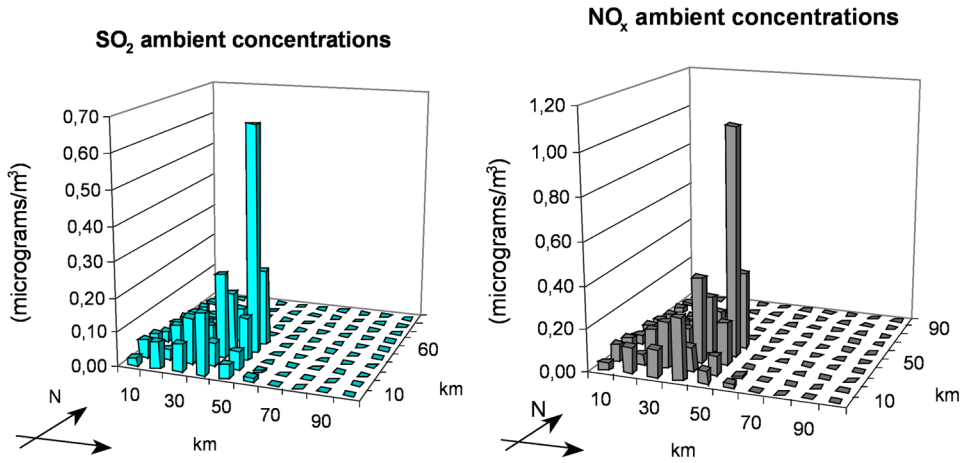
The total impact within 50 km of the plant depends on the whole concentration field, not only on the maximal concentration. Results of local dispersion show the concentrations in the most distant grid cells (50 km from the source) amount to 10-15% of the maximal value in the prevailing wind direction, while less in other directions. Concentrations in all grid cells are proportional to the emission level, so it is not difficult to calculate concentration distribution if the emission levels are varied.

Increased levels of air pollution cause a number of health effects that are evidenced through increased mortality rates, hospital admissions and emergency room visits due to respiratory problems, hospital

Table 8. Maximal concentrations in the local analysis, yearly averages

	Fossil Fired Power Plant		Gas Fired Power Plant	
	Emission (mg/m^3)	Max. Conc. (µg/m^3)	Emission (mg/m^3)	Max. Conc. (µg/m^3)
TSP	50	0.08	0	0
SO_2	400	0.66	0	0
NO_x	650	1.08	100	0.22

Figure 5. Ambient concentration increase of SO_2 and NO_x due to coal power plant



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admissions due to cardiovascular problems and restricted activity days. However, air pollution can only cause death in susceptible population groups, i.e. people whose life expectancy is less than average due to reasons unrelated to air pollution. Acute mortality is considered to decrease the average life expectancy by 9 months, while chronic mortality by 16.5 years. The latter causes highest external costs in the air pollution-health pathway. It is caused by particulate matter, either primary (PM_{10}) or secondary (sulphates and nitrates). Gases SO_2 and NO_x are considered to influence acute mortality and increased number of hospital admissions due to respiratory problems.

To calculate health impacts in the analysed area, the concentration field for each pollutant has to be multiplied by the population field and the appropriate exposure-response coefficient. Health impacts have no common measure, mortality is expressed either in number of cases or in years of life lost, while morbidity in number of events or number of days. To sum them all up in a single number, health effects should be monetized, i.e. multiplied by their monetary values. Spatial distribution of the monetized health damage due to particulates-caused pollution, per unit of electricity generated, is shown on the right-hand side of Figure 6. Mortality impacts are here valued using the preferred YOLL approach.

Health effects in the local grid are calculated using previously given exposure-response functions that connect the "health events" with unit increments of atmospheric pollutant concentrations. The extent of health effects decisively depends on the number of people affected. Since the analysed power plants are supposed to be located in the city centre, by far largest health damages occur in the four grid cells around the power plant, where the population density is 3000 people/km^2. Health damages in other grid cells are almost negligible compared to those in the central cells, due to 30 times lower population density and lower pollution increments at larger distances from the source.

Health effects in the total affected population of 2.16 million are given in Table 9. Operation of the coal fired power plant would cause 5.28 acute deaths yearly, which would reduce life expectancy of the affected population by 3.96 years. Additional 1.33 deaths would be caused by chronic illnesses, which mean another 22.26 years of life less. Morbidity events would include 2.44 hospital admissions, 0.62 emergency room visits and 723 restricted activity days. These figures are obtained summing up the effects of TSP, SO_2 and NO_x.

Figure 6. Spatial distribution of particulates concentration and monetized health damages

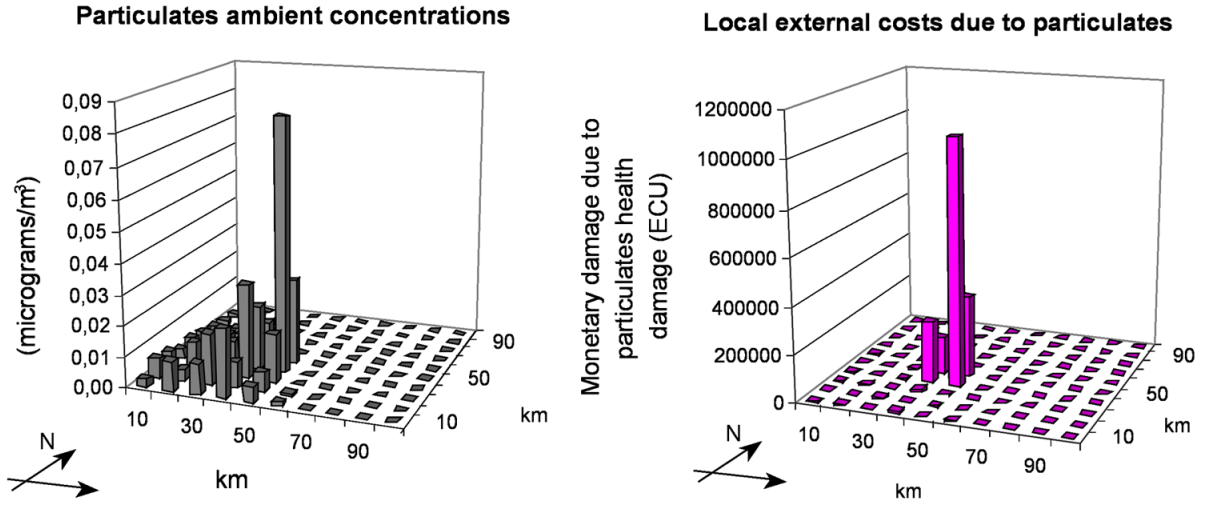

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Table 9. Health effects at location of power plant and the surroundings (local analysis)

Popul. Affected: 2.16 Million	**Fossil Fired Power Plant**			**Gas Fired Plant**
El. Generation: 2.3 TWh/a	**TSP (=PM_{10}) [a]**	**SO_2**	**NO_x**	**NO_x**
Number of deaths [b]				
acute	0.20	2.88	2.20	0.28
chronic	1.33	-	-	-
Hospital admissions	0.32	0.74	1.38	0.23
Emergency room visits	0.62	-	-	-
Reduced activity days [c]	723	-	-	-

[1.]It is supposed that all flying particles (TSP) are less than 10 micrometres in diameter, i.e. belong to the PM_{10} category, the most dangerous for people's health.

[2]Base mortality in Country is 11 people in 1000.

[3.]Adults only (age 15-64), 68% of population in Country.

Gas fired facility would in the same population cause 0.28 acute deaths i.e. 0.21 years of life lost yearly, and 0.23 hospital admissions.

Finally, health damages should be valued and expressed in a common unit of measure, since their various characters does not allow for a direct comparison. To evaluate mortality effects, both acute and chronic ones, life years lost and value of a single year are calculated, and not the value of statistical life. That is because air pollution can only speed up a fatal outcome, but cannot be the single cause of death. It is supposed that a life year lost has a monetary value of 98 000 €, if the discount rate is equal to zero. With the discount rate of 3%, which is commonly recommended for valuation of environmental and health impacts, life year lost in case of acute mortality equals 155 000 €, while for chronic mortality it amounts to 84 330 €. Mortality damages are here calculated using a 3% discount rate. The cost of hospital admission is 7 870 €, while of emergency room visit 223 €. A day with restricted activity costs 75 €.

Table 10 gives local damage costs per unit of electricity produced and of pollutant emitted from the analysed coal and gas fired power plants. Total local costs due to airborne emissions (particulates, SO_2

Table 10. Damage costs of air pollution caused by electricity generation

	Fossil Fired Power Plant			**Gas Fired Plant**
	TSP (=PM_{10})	**SO_2**	**NO_x**	**NO_x**
Mortality (YOLL based)				
acute	0.010	0.145	0.111	0.019
chronic	0.800	-	-	-
Hospital admissions	0.001	0.003	0.005	< 0.001
Emergency room visits	≈ 0	-	-	-
Reduced activity days [c]	0.025	-	-	-
Subtotal (m€/kWh)	0.836	0.148	0.116	0.020
Subtotal (€/t)	4997	110	53	33
Total per plant (m€/kWh)*	***1.10***			***0,02***

* Health damage due to tropospheric ozone and global warming is not included.

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and NO_x), amount to around 1.1 m€/kWh via YOLL. If the population density in the whole observed area equalled the average value for *Country* (85 inhab/km^2), the damage costs would be 0.08 m€/kWh. Health impacts of the gas-fired power plant originate only from NO_x emissions. Total health damages on the local level amount to only 0.02 m€/kWh. With the average population density of 85 inhab/km^2, health impacts and the associated damage costs would be only 0.001 m€/kWh.

If damage costs are expressed per ton of pollutant, the following values are obtained: particulates around 5000 €/t, SO_2 110 €/t, and NO_x 53 USD/t for the coal power plant, i.e. 33 €/t NO_x for the gas power plant. Expressed per person (observed population is 2.16 million) the calculated health damages equal 1.1 € per person for the coal power plant, while 0.021 € per person for the gas fired facility. To switch to USD, values in € should be multiplied by 1.25.

The calculated external costs refer to the two analysed power plants if those are placed in location with the highest population density in *Country.* They cannot be applied to other locations in *Country*, or generalized to the whole power system. However, locations by the seaside are much different, not only due to different climate, but because of terrain features.

Some Limitations of the Local Analysis

In the Ecosense version 2.0 the ISC short-term model is used for modelling local dispersion and estimating yearly average concentrations of pollutants. Since it was originally designed to calculate short-term averages (e.g. 24-hour peak concentration), it requires hourly meteorological data as input to the model. Hourly data could only be obtained by constant measuring that was not provided. However, in the analysis of external costs one is interested in yearly averages. Long-term dispersion models would be more appropriate to calculate yearly incremental concentrations. Such models need no hourly values, but require a special set of aggregated meteorological data, so called STAR data: frequencies of wind speed and direction for a certain stability class on a yearly basis.

Because such data set was not at hand for the purpose of this analysis, nor it could be produced since stability class was lacking, short term model had to be used and some input data approximated. In the next step it will be necessary to improve the local analysis, most probably by providing the STAR data and switching to a long-term dispersion model. Moreover, when extending local-scale analysis to the whole of *Country*, coastal locations with the mountains in the background will probably have to be handled by models that take into account terrain complexity.

Country-Level Analysis of Existing Power Plants' Impacts

The example of analysis for the eight *Country* thermal power plants. Total emissions in and emissions per unit of electricity produced in the analysed power plants are given in Figure 7.

Modelling of Dispersion Originating from Country Power Plants

Dispersion has been modelled by the EcoSense program package. In the EcoSense package data base, Europe has been presented by the EUROGRID co-ordinate system. The entire area is divided into grid cells. Each grid cell has an area of 10 000 km^2 and all properties of a grid cell are assumed to be constant in the entire grid cell. Output data of the modelling process are ambient concentrations of SO_2, NO_X, particulates, sulphate and nitrate aerosols. Twenty-three grid cells from the EUROGRID co-ordinate

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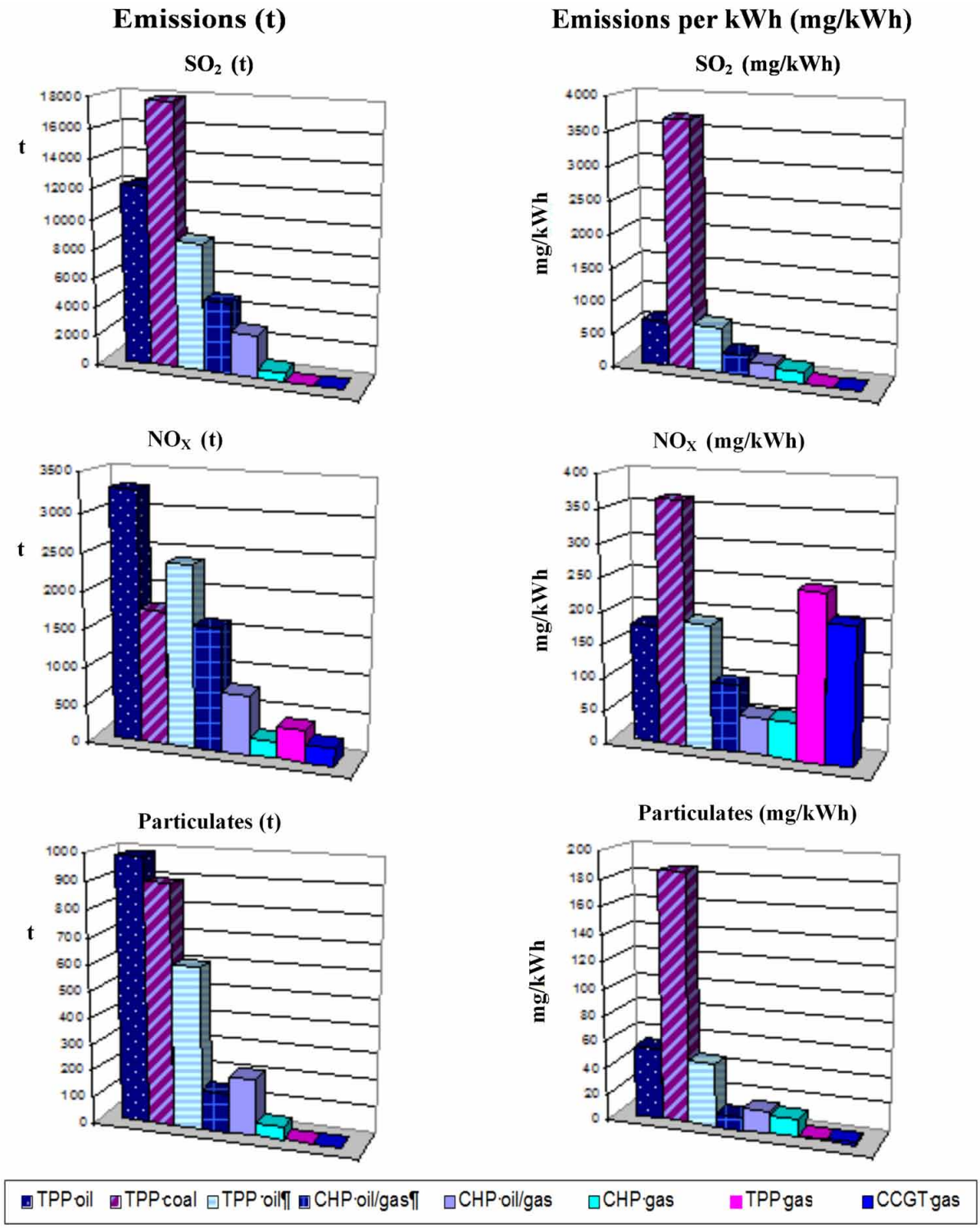
Figure 7. Emissions originating from Country thermal power plants



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system contain the complete *Country* territory. Because of the model's limitations, calculated ambient concentrations are constants throughout each grid cell.

Input data about the analysed thermal power plants, necessary for atmospheric modelling, are presented in Table 11. The meteorological data that are needed for dispersion modelling are included in the EcoSense program package data base.

Ambient concentrations of the five observed pollutants originating from the described power plants have been calculated and joint impacts have been assessed.

Based on the assumption that background levels are constant, the concentrations of five analysed pollutants originating from the *Country* power plants have been calculated by summing the concentrations from each plant.

The highest concentrations have been observed in the areas with the highest population density, which is highly unfavourable in terms of human health impacts and associated external costs. Because the secondary pollutants (sulphate and nitrate aerosols) are formed in the atmosphere in SO_2 and NO_X chemical transformation, their concentrations are distributed much more evenly than primary pollutants concentrations. This fact should be stressed out because aerosols significantly influence human health.

Public Health Effects of the Calculated Incremental Air Pollution in Country

Numerous epidemiological studies show a significant correlation between air pollution and human health disorders.

Nine various health endpoints have been assessed:

- Acute mortality;
- Hospital treatment of respiratory diseases;
- Hospital treatment of cerebrovascular diseases;
- Restricted activity day;
- Chronic mortality;
- Chronic cough in children;
- Chronic bronchitis in children;

Table 11. Input data for the dispersion modelling

	1	2	3	4	5	6	7	8
Fuel	oil/gas	coal	oil	gas	oil/gas	oil/gas	oil/gas	gas
Rated capacity, MW	420	105	320	85	135	96.5	45	50
Net capacity, MW	396	98	303	83	130	90	42	48
Full load hours per year	4 626	4 929	4 200	1 361	3 133	1 611	2 857	2 333
SO_2, mg/m^3	1,487	8,644	2,435	1	1,220	918	418	1
NO_X, mg/m^3	402	858	670	221	403	246	150	302
Particulates, mg/m^3	121	435	169	2	37	67	35	1
Stack height, m	200	340	250	73	200	200	120	60
Flue gas volume, m^3/h	1 769 340	418 049	828180	778 578	1283077	966351	519640	587783

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- Chronic bronchitis in adults;
- Congestive heart failure in elderly individuals.

For each of the mentioned health endpoints the so-called exposure – response functions have been established. An exposure – response function presents a relationship between an incremental change in ambient concentrations of the observed pollutant and additional number of health disorder occurrences. The exposure – response functions for the analysed health endpoints both for PM_{10} and $PM_{2.5}$ are presented in Table 12. It can be seen that $PM_{2.5}$, e.g. sulphates, is more dangerous to public health than PM_{10}, e.g. nitrates and primary particles.

It should be noted that both acute and chronic mortality have been given as percentage change of background mortality whereas other impacts are given as additional number of occurrences per $\mu g/m^3$ of particulate matter.

To calculate additional health effects of an incremental PM concentration, number of people exposed should be given. To be able to combine data on population density and calculated ambient concentrations of PM, the Geographic Information Software (GIS) has been used. GIS is a tool which allows for manipulation with geographic information and connection to data bases containing relevant data (number of people exposed, ambient concentrations of PM).

Based on exposure – response functions and incremental concentrations of PM associated with each of the analysed power plants, increase in observed health disorders can be calculated. Additional health disorders caused by an increase in atmospheric concentrations of particulate matter have been calculated according to the following equation:

additional disorders = *conc* x *density* x *area* x *exp_res*

Conc: incremental concentration of PM, $\mu g/m^3$;
Density: population density in the observed area, km^{-2};
Area: area, km^2;
Exp_resp: number of incidents caused by PM increase of 1 $\mu g/m^3$, $(\mu g/m^3)^{-1}$.

Table 12. Additional number of health incidents per $\mu g/m^3$ PM_{10} and $PM_{2.5}$

	Number of Health Incidents per $\mu g/m^3$	
	PM_{10}	**$PM_{2.5}$**
Respiratory diseases hospital admition (RDA)	2.07×10^{-6}	3.46×10^{-6}
Congestive heart failure, elderly (CHF)	1.85×10^{-5}	3.09×10^{-5}
Cerebrovascular diseases hospital admition (CVA)	5.04 x 10-6	8.42 x 10-6
Chronic bronchitis, children	1.61×10^{-3}	2.69×10^{-3}
Chronic cough, children	2.07×10^{-3}	3.46×10^{-3}
Acute mortality*	0.040%	0.068%
Restricted activity day, adults (RAD)	0.025	0.042
Chronic bronchitis, adults	4.9×10^{-5}	7.8×10^{-5}
Chronic mortality*	0.39%	0.64%

* Percentage change

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Increase in the health endpoints associated with each of the power plants is presented in Table 13.

Monetary Valuation of Public Health Impacts in *Country*

A monetary value can be attached to each of the analysed health disorders. The values used in this study have been established in various studies carried out mainly in the USA. Similar studies have not been undertaken in *Country*. The values have been scaled down using a coefficient established by comparison of gross domestic product based on purchasing power parities.

The costs attached to the analysed health disorders are presented in Table 14.

The morbidity costs have been calculated by establishing the costs those individuals is willing to pay in order to avoid a certain risk, e.g. disease.

The mortality costs are even more controversial. A measure of individual's willingness to pay (WTP) for reducing the risk of premature death is based on the value of statistical life. However, many people whose deaths were linked to air pollution were suspected of having only a short life expectancy. Based on this argument, valuation on the basis of life years lost has been conducted in this paper. The value of

Table 13. Increase in health disorders caused by incremental PM_{10} and $PM_{2.5}$ concentrations

Plant	1	2	3	4	5	6	7	8
Acute mortality	1.19	0.81	0.47	0.01	0.45	0.28	0.03	0.01
Chronic mortality	11.28	7.67	4.46	0.10	4.28	2.66	0.32	0.12
Respiratory diseases	0.54	0.37	0.22	0.00	0.21	0.13	0.02	0.01
Cerebrovascular diseases	1.33	0.90	0.52	0.01	0.50	0.31	0.04	0.01
Congestive heart failure	0.73	0.50	0.29	0.01	0.28	0.17	0.02	0.01
Chronic bronchitis, children	10.33	6.99	4.09	0.10	3.91	2.43	0.29	0.11
Chronic bronchitis, adults	71.99	49.11	28.48	0.66	27.32	16.95	2.03	0.73
Chronic cough, children	92.58	63.16	36.63	0.84	35.14	21.80	2.61	0.93
Restricted activity day	5420.25	3700.76	2144.88	49.24	2057.53	1276.21	152.51	54.48

Table 14. Monetary values attached to the analysed health disorders

	Cost in the €	Costs in *Country*, €
Acute mortality	43 194	9 782
Chronic mortality	411 864	93 184
Respiratory diseases	3 072	686
Cerebrovascular diseases	3 072	686
Congestive heart failure	3 072	686
Chronic bronchitis, children	86	19
Chronic bronchitis, adults	41 186	9 267
Chronic cough, children	86	19
Restricted activity day	29	7

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a life year lost depends on a number of factors, primarily how long it takes for the exposure to result in the illness and how long a survival period the individual has after contracting the disease. It has been assumed that acute mortality resulting from excessive air pollution shortens the average life expectancy by 9 months, and chronic mortality by 12 years. Based on these assumptions and the 3% discount rate, the costs associated with acute and chronic mortality given in Table 14 have been established.

For ease of implementation, the exposure - response functions are linearized and annualized, assuming an independence of background levels and not taking into account any thresholds.

The costs of public health impacts associated with *Country* power plants, both total and per unit of electricity produced are presented in Table 15. All values are based on the costs scaled down to reflect economic situation in *Country*.

REGIONAL ANALYSIS

It is well known that health and environmental damages are caused not only by primary pollutants (PM_{10}, SO_2, NO_x) modelled by the local analysis, but also by secondary pollutants (sulphates and nitrates) that are formed in chemical reactions of primary pollutants during their long-range transport through the atmosphere. Due to long-range transport receptors are affected several hundreds of kilometres away from the emission source. Since the population affected by long-range dispersion is much larger than in the local analysis, external costs of health damages on the regional level can be substantial and thus need to be addressed.

In the following analyses the external costs will be calculated for the same two power plants, but this time on the regional level. The term regional denotes that atmospheric dispersion is calculated using the trajectory models, as contrast to Gaussian plume models used in the local analysis. It will be observed how each of those two power plants, if placed at a certain location in *Country*, would affect receptors both within *Country* and on the whole of *region*. In the regional analysis with the EcoSense model it is possible to switch locations easily, since all needed meteorological data are already stored in the EcoSense databases.

Table 15. Costs of public health impacts associated with the thermal power plants

Plant	Total Costs in 1998, Euro	Costs per kWh Produced, mEuro
1	6 439 310	2.90
2	4 003 328	7.45
3	2 532 493	1.65
4	2 378 564	0.73
5	1 501 476	0.94
6	183 833	0.38
7	86 906	0.33
8	81 778	0.43
	TOTAL: 17 207 688	**AVERAGE: 1.85**

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As the first exercise in the series, regional dispersion was conducted for the one location. Regional dispersion calculates spatial distribution of primary and secondary pollutants in *region*. According to the latest medical evidence (International Atomic Energy Agency 1998), it is supposed that nitrates have the same impact on human health as PM_{10}, while sulphates cause 67% larger damages. This fact is reflected in the exposure-response functions for nitrates and sulphates. The analysed health endpoints (acute and chronic mortality, hospital admissions, emergency room visits and restricted activity days) are the same as in the local analysis, only here they are calculated for the receptors in *Country* and the whole of region.

Region is mapped onto a grid comprised of 100x100 km^2 sized cells. To determine the health impacts on population in *Country* only, grid cells belonging to *Country* were isolated in the matrix of results. Population density in the cells that completely belong to *Country* was set to 85 inhab/km^2 (*Country* average), while adjustments were made in the cells bordering other countries or those is covering the sea. The total affected population in *Country* is around 5 million, while in the whole of region around 540 million.

Maximal concentration of pollutants on the regional scale, for the two observed power plants are given in Table 16. It has to be noted that in the regional analysis concentrations are averaged across large grid cells (100x100 km^2), and therefore the maximal concentrations of primary pollutants are around 10 times smaller than in the local analysis. Maximal concentrations of particulate matter (0.007 μg/m^3), sulphur dioxide (0.052 μg/m^3) and nitrogen oxides (0.069 μg/m^3) occur in the same grid cell where the power plant is located. That is understandable since those pollutants are relatively quickly removed from the atmosphere. Sulphates and nitrates are formed at larger distances, so their maximal concentrations occur at 100-150 km from the source i.e. in the neighbouring grid cell. Maximal concentration of sulphates equals 0.008 μg/m^3, while of nitrates 0.028 μg/m^3. For the gas fired power plant the maximal concentration of NO_x amounts to 0.019μg/m^3, and nitrates 0.008 μg/m^3.

Spatial distribution of primary and secondary pollutant concentrations, combined with the appropriate exposure-response functions are used to calculate health impacts on the population in *Country* and *region* and the associated external costs due to operation of the observed two power plants. The results are given in Table 17 and Table 18.

Health damage costs due to operation of coal power plant on the population in *Country* equals 3.2 m€/kWh. The affected population in Country is 5 million people. External costs caused by the same power plant on the population of *region* (540 million) equals 36.7 m€/kWh.

The same calculation is conducted for the gas fired power plant. Damage costs due to health impacts of the gas fired facility on receptors in *Country* amount to 0.43 m€/kWh, while for receptors in *region* damage costs amount to 6.59 m€/kWh.

Table 16. Maximal pollutant concentrations on the regional scale, emission source from location

	Coal Fired Power Plant		**Gas Fired Power Plant**	
	Emission (mg/m^3)	**Max. Conc. (μg/m^3)**	**Emission (mg/m^3)**	**Max. Conc. (μg/m^3)**
TSP	50	0.007	0	0
SO_2	400	0.052	0	0
NO_x	650	0.069	100	0.019
Sulphates	-	0.008	-	0
Nitrates	-	0.028	-	0.008

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Table 17. External costs in Country due to operation of power plants located in location

Receptor: Population of *Country* (5 million people)	**Coal Fired Power Plant**		**Gas Fired Power Plant**	
	m€/kWh	**€/t ***	**m€/kWh**	**€/t ***
TSP	*0.53*	*3168*	*0*	*0*
SO_2	0.16	116	0	0
Sulphates	0.96	713	0	0
SO_2 total (SO_2 + sulphates)	*1.12*	*829*	*0*	*0*
NO_x	0.22	103	0.06	103
Nitrates	1.33	607	0.37	624
NO_x total (NO_x + nitrates)	*1.55*	*710*	*0.43*	*727*
Total (m€/kWh)	***3.20***	**-**	***0.43***	***727***

* for sulphates per ton of SO_2, for nitrates per ton of NO_x

Table 18. External costs in region due to operation of power plants located in location

Receptor: Population of *Region* (540 million people)	**Coal Fired Power Plant**		**Gas Fired Power Plant**	
	m€/kWh	**€/t ***	**m€/kWh**	**€/t ***
TSP	*2.02*	*12 041*	*0*	*0*
SO_2	0.64	475	0	0
Sulphates	11.94	8 888	0	0
SO_2 total (SO_2 + sulphates)	*12.58*	*9 363*	*0*	*0*
NO_x	0.69	318	0.19	317
Nitrates	21.42	9 816	6.40	10 670
NO_x total (NO_x + nitrates)	*22.11*	*10 134*	*6.59*	*10 987*
Total (m€/kWh)	36.71	-	6.59	10 987

* for sulphates per ton of SO_2, for nitrates per ton of NO_x

External costs per kWh are proportional to emissions, so if e.g. NO_x emissions from the gas power plant are 300 mg/m^3, external costs would be three times higher.

Damage costs can be expressed per ton of pollutant as well. For receptors within *Country* they amount to around 3.170 € per ton for particulates, 830 € per ton of SO_2 and 710-730 € per ton of NO_x. Damage costs on the *region* scale amount to 12 040 € per ton of particulates, 9 360 € per ton of SO_2 and 10 130-10 990 € per ton of NO_x.

Due to initial assumptions of the impact pathway model, external costs are proportional to emission levels, both in local and regional analysis (Figure 8, Figure 9). However, there are indices that formation of sulphates and nitrates in regional dispersion depends on background emissions of SO_2, NO_x and NH_3, i.e. emissions of other sources that can affect the air parcel trajectory.

It has to be stressed that the obtained external costs comprise only health impacts due to airborne emissions (particulates, SO_2, NO_x). Impacts of ground-level ozone, which is caused by NO_x, and of global warming, caused by greenhouse gases, are not included. Due to lack of reliable ozone models, external costs of NO_x via ozone are set to the uniform value of 1 500 € per ton of NO_x for the whole of *region*.

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Figure 8. Proportionality of emissions and local external costs, local analysis 50 km around plant (affected population 2.1 million)

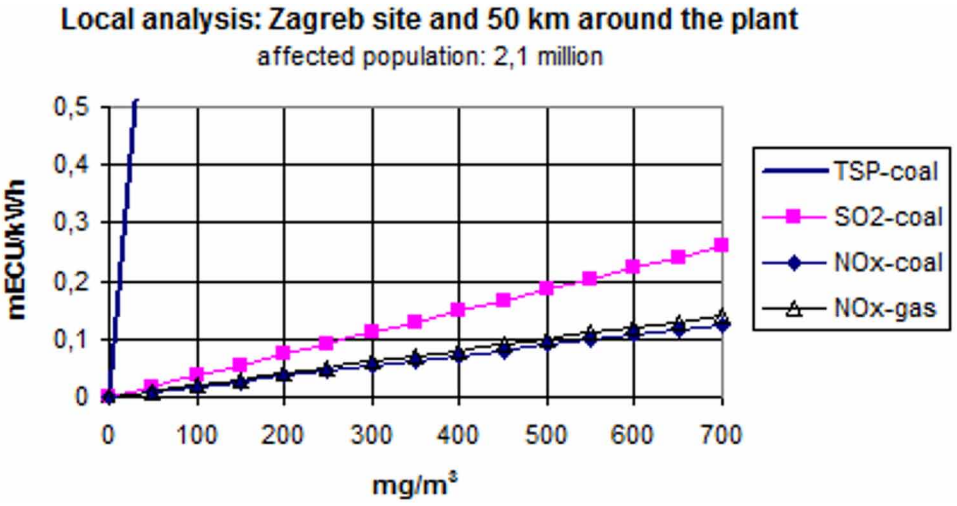

Figure 9. Proportionality of emissions and regional external costs, regional analysis for plant

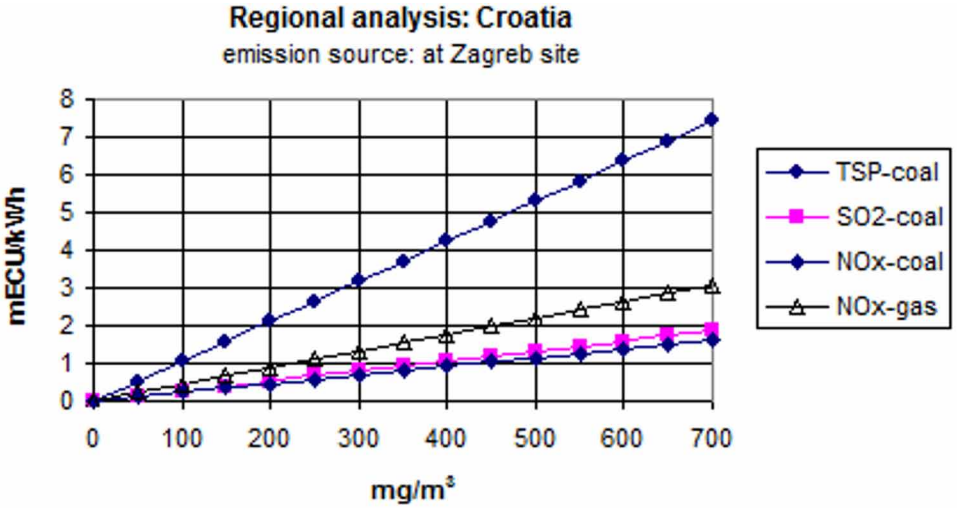

*Table 19. Country-scale external costs caused by coal and gas fired power plants**

(1 €=1,25 USD)	m€/kWh			€/t	
	min	max		min	max
Coal Power Plant [(1)]	0.67	3.6	TSP	350	2 330
			SO_2	140	765
			NO_x	190	1 000
Gas Power Plant [(2)]	0.19	0.61	NO_x	200	1 025

* Damage costs of NO_x via ozone and damage costs of global warming are not included.
[(1)]TSP = 50 mg/m³; SO_2 = 400 mg/m³; NO_x = 650 mg/m³.
[(2)]NO_x = 100 mg/m³.

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External costs of global warming are subject to large uncertainties, so they vary from 3.8 to 139 € per ton of CO_2. This broad range was narrowed by expert judgment to 18-46 €/t, and its geometrical mean value was taken as the best estimate for global warming damages: 36 €/t.

Thus, external costs of power generation in fossil fuelled power plants are calculated as the sum of (i) airborne emissions damages, which are site specific, (ii) ground-level ozone damages that are for now considered uniform for the whole of *region*, and (iii) global warming damages that are considered uniform in the whole moderate climate zone. However, since ozone and global warming damages are rather unreliable and not country specific, here we decided to deal only with airborne emissions damages in further analyses, i.e. health impacts of particulates, SO_2 and NO_x excluding ozone.

The obtained external costs can serve as a basis for various analyses. For example, for cost-benefit analysis of various pollution abatement measures, determining the height of emission charges and taxes, selection of optimal power plant location, comparison of fossil fired technologies among each other and with other energy technologies. More sophisticated analyses can be conducted as well, such as optimal power system operation (dispatching of units to cover daily load curve at lowest cost) if external costs are added to operation costs. External costs can be also included in power system expansion planning, i.e. finding the optimal capacity mix over a certain planning period. External costs are in that case added to production costs of candidate generation units and that way incorporated in the goal function of optimization. Some of external costs applications will be illustrated below.

Inclusion of External Costs in Power System Expansion Planning

Calculated external costs can be applied in various environmental policy case studies. One of such applications is inclusion of external costs in power system expansion planning. The examples from (Feretic, Tomsic, Kovacevic & Bozicevic, 2001) show that external costs due to airborne emissions (particulate matter, SO_2 via sulphates and NO_x via nitrates) can influence both the optimal capacity mix and operation of the power system. If the higher estimate of calculated damage cost for the candidate coal and gas power plants is added to their private cost of operation and if the appropriate external cost for nuclear power plants is added too, optimal capacity mix shifts to nuclear power plants. However, results indicate that adding external costs only to candidate power plants does not guarantee better environmental performance of the system, since it might happen that the existing, typically less efficient and higher polluting facilities, are more frequently dispatched because they gain priority in the economic loading order.

One example of the use of external costs in the process of electricity system planning by utilities is given in the USA case study (United States Department of Energy, Energy Information Administration, 1995). This study examined the policies that had been adopted in three States in the USA, requiring the incorporation of external costs into the resource planning process of electrical utilities. The study concluded that, although the requirement to include externalities in the planning process had forced utilities to change their planning approaches, there had been little impact on the resulting choice of energy sources for electricity generation in any of the States considered. It was found that the externality values prescribed by the regulatory bodies had no effect on increasing the penetration of renewable energy sources nor on the deployment of demand side management options. The study demonstrates that there still is a need for further research in this field. Both the regulatory authorities and the utilities are sensitive to the risks of environmental damage, and there is recognition of a need for innovative and effective techniques for effectively treating externalities in the planning and decision making process.

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Further Research Directions

The results are sometimes criticised by pointing at the uncertainties involved. And indeed uncertainties are large. But we should distinguish these uncertainties from deviations of current results compared to earlier results as well as from ExternE project. There has been a substantial methodological development in the last ten years, e.g. from a top-down to a site-dependent bottom-up approach or with regard to the monetary valuation of health effects. In model should be included state of the art methods and new knowledge e.g. about health impacts.

Further Research for Extending and Improving the Methodology should go in few directions:

- **Epidemiology:** The dose-response functions must be updated to take into account the enormous amount of research on air pollution epidemiology in recent years. The assumptions about the health effects of the different types of primary and secondary particulate matter should be re-examined.
- **Atmospheric Dispersion:** Models for atmospheric dispersion and chemistry are improved and should be included in model.
- **Monetary Valuation:** New contingent valuation studies are needed to improve the monetary valuation of the dominant contribution to the external costs (loss of life expectancy and chronic bronchitis) to be able to calculate reliable damage costs, in particular for acidification and eutrophication, other ecosystem impacts, damage to cultural values, reduced visibility, and impacts of transmission lines. For ecosystems, the estimation of physical impacts is problematic because the slope of the dose-response functions is needed, whereas so far only thresholds are known.
- **Security of Energy Supply:** The growth of energy demand in recent years, coupled with the current political situation, raises the spectre of new energy shortages. The security of supply implications of different energy technologies should be examined. Other positive externalities like "jobs creation" could also be studied.
- **New Energy Technologies:** Energy technologies are evolving, and their externalities should be reassessed periodically. Of particular interest would be a life cycle externalities analysis of fuel cells, including the impacts of hydrogen production. A new life cycle externalities analysis is also appropriate for renewables, because the technologies have been improving and their use is expected to increase.
- **Transfer of Results to Policy:** As was explained external costs can be internalised in a variety of ways, in particular environmental regulations, taxation or tradable permits. To help policy makers to use the results the implications for the economy should be studied, including distributional effects and taking into account the uncertainties.

CONCLUSION

Chapter elaborates on external costs of electricity and impact pathway method for their calculation. This method links burdens to the environment caused by power generation chains with physical impacts they cause and assigns monetary values to those impacts. It is the most comprehensive but also a very site-specific routine. The analysis was at this stage limited to priority impacts, i.e. only power generation level was observed and only health damage through air pollution calculated. Location specific meteoro-

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logical data were only partially available, so local analysis of pollution increments was made only one site, where the largest population is exposed. Regional dispersion analysis was conducted for almost all potential locations of future power plants.

Analysis showed that damages linked to coal power plants are much larger than those linked to gas fired facilities, since the latter are responsible only for NO_x emission and nitrates. The largest share in the damage costs accounts for mortality effects. The highest damages are attributable to particulate matter, on local level directly while on the regional level in the form of sulphates and nitrates. Health damages highly depend on the number of people affected – that is why local damages (within 50 km from the source) are much lower than on the Regional scale. The range of damage costs for the whole *Country* (population 5 million people) varies from 0.7 to 3.6 m€/kWh for the candidate coal power plant i.e. 0.1-0.6 m€/kWh for the candidate gas power plant.

Calculated external costs can be applied in various environmental policy case studies. Two of such applications were illustrated here. One is a simple cost-benefit analysis of imposing stricter NO_x emission standard. The other, more sophisticated one, was inclusion of external costs in power system expansion planning. The latter showed that external costs due to airborne emissions (particulate matter, SO_2 via sulphates and NO_x via nitrates) can influence both the optimal capacity mix and operation of the power system. If the higher estimate of calculated damage cost for the candidate coal and gas power plants is added to their private cost of operation and if the appropriate external cost for nuclear power plants is added too, optimal capacity mix shifts to nuclear power plants. However, results indicate that adding external costs only to candidate power plants does not guarantee better environmental performance of the system, since it might happen that the existing, typically less efficient and higher polluting facilities, are more frequently dispatched because they gain priority in the economic loading order.

Detailed damage cost estimation was made for the existing power plants in *Country*. For each of the investigated health end points an exposure-response function and a monetary cost have been given. In order to assess costs of public health incidents associated with country power plants operation, exposure-response functions established by literature review have been used. The monetary values used have also been established by literature review and adjusted to the current stage of economic development in *Country*; the adjustment has been made by scaling down the costs attached to each of the observed health disorders according to the country gross domestic product per capita using the power purchase parity.

The external costs caused by human health impacts of country power plants are lower than the calculated values attached to the region power plants because the number of people exposed is lower and because the costs attached to the analysed health impacts are lower. The costs of public health degradation could be reduced by improving power plants efficiencies, by locating pollution sources further from densely populated areas and by introducing the control technologies to reduce harmful emissions.

Methods for inclusion of external costs in environmental decisions in energy sector were further elaborated and case studies for country conducted.

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KEY TERMS AND DEFINITIONS

Bottom-Up Approach: Activity that begins at a low level and progressing upward from the lowest levels.

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Cost-Benefit-Analysis: Is a technique used to compare the total costs of a project with its benefits, using a common metric (most commonly monetary units).

External Costs: Also known as an externality, arises when the social or economic activities of one group of persons have an impact on another group and when that impact is not fully accounted, or compensated for, by the first group.

Impact Pathway Analysis: Bottom-up-approach in which environmental benefits and costs are estimated by following the pathway from source emissions via quality changes of air, soil and water to physical impacts, before being expressed in monetary benefits and costs.

Life Cycle Assessment (LCA): Technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave. LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service including energy and material inputs and environmental releases.

Monetary Valuation of Damages: Account for all costs, market and non-market by transfers the indicator values into monetary values.

Power System Planning: Determine a minimum cost strategy for long-range expansion of the generation, transmission and distribution systems adequate to supply the load forecast within a set of technical, economic and political constraints.

Top-Down Approach: Organized or proceeding from the larger, more general structure to smaller, more detailed units, as in processing information.

Top-Down Approach: Starting with a general idea and having details gradually added, working from the general to the specific.

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Chapter 34
Doing Together:
Co-Designing the Socio-Materiality of Services in Public Sector

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ABSTRACT

This article examines a systemic innovation model into which the relational approach of actor-network theory (ANT) has been incorporated. The article examines what the relational approach can contribute to the conceptualization of services and to the co-development and co-design activities of them. The article operates in the context of public welfare and health services, but its analysis might be applied in any other sector and with any other object of development as well. The article presents the systemic innovation model developed in a national Innovillage project in 2009-2013 in Finland. Further, the article studies how the model has been translated into practice in the design activities of a strategic development program of social and health sector run by the Ministry of Social Affairs and Health, Finland. In the discussion analytical and practical challenges of the model are specified and its further development is discussed.

INTRODUCTION

The new innovation approach which emphasizes co-creation, co-development and co-design of products and services as well as open and non-linear innovation process has not only gained attention among innovation researchers or within private sector innovation activities, but also gradually within public sector development activities (Parida et al., 2012; Bason, 2010; Chesbrough, Vanhaverbe & West, 2006; Chesbrough, 2003; Kirschbaum, 2005; Gassmann & Enkel, 2004). Within the approach, the use of various service design methods (Sanders & Stappers, 2008; Yu & Sangiorgi, 2014) and open development platforms (Boudreau, 2007; Sawhney, Verona & Prandelli, 2005) aims at enabling the participation of

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customers and other stakeholders in innovation activities. The ultimate goal of these efforts is to produce products and services which could in a better way answer the needs of customers and other stakeholders.

This new approach is an obvious step forward in innovation practice, but its real success will be seen only in the longer run. From the public service innovation perspective, there are some evident challenges in the approach, both from the research and practice perspective. The bulk of the literature is devoted to large scale firms and the majority of the research is typically on technology firms (Chesbrough, 2005). Research methodology is mainly quantitative and it is based on archetypes and classifications of different kinds of open innovation activities. What seems to be needed in the approach is a deeper analysis on the nature of objects of development and of innovation activities that may help to elaborate the approach and to give some resources for concrete innovation practice.

This article examines what kinds of resources actor-network theory (ANT) can offer to the new approach. This is made by presenting and discussing how some of the core ideas of ANT have been incorporated into an innovation model and how the model has been translated into everyday public sector innovation practice in Finland. During the recent decades, ANT-oriented research has been focusing on the co-production activities of technology and context or science and society (see Habers 2005) and it has evident similarities with the new co-creation approach. The downside of this is that the aims of ANT have been mainly theoretical and academic. This article illustrates how the relational approach of ANT can be applied in the concrete innovation activities.

This article operates in the context of public welfare and health services, but its analysis might be applied in any other sector and with any other object of development as well. First, it conceptualizes welfare and health services as collaborative and socio-material practices which are constituted by heterogeneous elements, such as human actors, their tasks, resources (tools, artefacts, money…), rules and principles, laws and statutes. Second, the article studies what ANT might have to offer to the co-development and co-design activities of welfare and health services. This is made by presenting a systemic innovation model which has been developed by utilizing some of the core ideas of ANT. The model consists of three iterative and mutually constitutive sections, *Stimulate, Incubate and Enact,* which should be (co-) performed to achieve successful solutions and sustainable change in a local site. Third, the article studies how the model has been translated into practice by illustrating the concrete co-design activities of services where an open web-based development environment is utilized. The environment has been developed on the basis of the systemic model. The study material is collected from the workshops and their design activities of a National Development Programme for Social and Health Care. The programme is a strategic development program run by the Ministry of Social Affairs and Health, Finland. It is the main programme of the ministry for managing and reforming the national social and health policy and services. In the discussion analytical and practical challenges of the model are specified and further development of the model is discussed.

SERVICES AS SOCIO-MATERIAL PRACTICES

In the mainstream research and development activity, welfare and health services have been traditionally conceptualized as transferable interventions where the client/patient is an object of action. The traditional model is based on a linear, one-directional conception of causality. It assumes a causal order between variables: an independent variable – a service – has 'effects' (impact) on clients/patients. On this basis, services are evaluated as more or less effective (see Koivisto et al., 2010).

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The presumptions of this mainstream paradigm can be characterized by a model that Latour (1986, 1987) referred to in the 1980's as a diffusion model (see also Kristensen et al., 2001; Kristensen & Sigmund, 2008). It supposes that a service has an inner causal power, a kind of 'inertia' that can resolve the health or welfare problems of patients/clients. According to the diffusion model, it can be asked: 'what kind of effect, good or bad, will this service have?' The diffusion model supposes that the services stay constant and it is the same service that is transferred from the original site where it has been developed to different sites, for example to different healthcare centers.

Contrary to the linear causality, ANT's relational ontology (Law, 2007; Latour, 2005; Callon, 1991) conceptualizes welfare and health services as collaborative socio-material practices (assemblages, systems, networks) which are constituted by human actors (such as clients, social workers, practitioners, managers), by activities and interactions, and by resources (such as tools, principles, technical artefacts, laws, money), which the human actors mobilize and enact in their purposeful activities. Services are enacted and re-enacted. The human and non-human elements of services are studied as relational effects that are generated in the socio-material relations. They are produced and reproduced; there is no reality outside these processes (Law, 2004). Any kind of object of development - product, technology, service - can be analyzed and studied as a socio-material practice.

Latour (1986, 1987) has called this relational approach the translation model. According to the model, it can be asked: 'how many and what kinds of resources (material entities, time, money, people, skills, knowledge, activities) have to be enacted, mobilized and organized in order to achieve the goals that are pursued. Translations are the tactics and strategies for organizing, mobilizing and enacting the socio-materialities.

The socio-materiality of practices can be illustrated with an example of a doctor's appointment in a health center. First, the practice is constituted by human actors, such as a general practitioner, a receptionist, a nurse, and a patient. Every actor has his/her own tasks in the practice. A patient books an appointment with the doctor in the internet or by calling the appointment number. The receptionist maintains the booking system and handles the registration of the patients. The patients arrive at the appointment at a fixed time. In the appointment, the general practitioner conducts the diagnosis by interviewing the patient. In doing the diagnosis, the general practitioner mobilizes certain tools and directs the patient to take laboratory tests, which are conducted by the nurses. Second, the practice is constituted by different artefacts that people mobilize in their activities, such as a telephone, patient record, physical architecture and tools. Third, the practice is constituted by the manifold tasks and interactions of the humans that are mediated by the artefacts. The elements and their attributes of this practice are generated and constituted in these socio-material relations and interactions; they are not given in the nature of things. A citizen becomes a patient when s/he enters into an interaction with health care personnel; a technical artefact becomes an instrument when a human mobilizes and enacts it in his/her activity.

Practices can be defined as stable ways of doing things in the similar manner. They are usually developed for some purpose, i.e., to achieve certain goals. In the course of our daily activities, we enact and re-enact the practices to achieve goals. However, every action or activity is not a practice. They are characterized particularly by stability, mutuality and repeatability though practices also change or cease to exist for different reasons. There is always the possibility that activities are performed differently than usually.

The locality of practices means that they are always in some sense relational to the site where they are enacted. The example of a doctor's appointment discussed above should also be understood as relational to the site where it is enacted. Although a specific practice of a doctor's appointment might have strong

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similarity to appointments in different health centers, it is always relational to the site. The physical architecture partly constitutes the way it is structured. Further, issues such as available personnel, tools and instruments as well as the demographic of patients constitute the activities conducted in the practice. Therefore it is argued that a practice cannot be transferred to another site as a simple technical artefact; it is always tailored in different sites on the basis of various scripts, such as texts, flow charts, and peer experiences, which define the human actors of the practice, their roles and tasks, the resources to be mobilized, etc. (see Akrich, 1992).

This does not mean that each practice is a totally unique and individual practice. Rather, the same solution can be translated into practice in different sites and the solution typically achieves different variants and modifications, depending on the local possibilities to organize and mobilize socio-materialities, for example, goals, knowledge, abilities, client groups, and the other practices that are preconditions for the new practice. The more complex the solution or model adopted is, the more probable it is that the practice will have differences and variations in different sites.

When translating the same idea or model into practice in different sites, for example, a preventative model of youth's excessive alcohol use, the goal is usually to translate the core idea into every school: the same basic activities, information packages, process phases, etc. However, regardless of the core idea, the practices in the different schools will have their own characteristics. This happens because the schools, their resources, their other practices, and the people to be mobilized are different.

The relational character of practices has certain implications for how we understand or should understand the workability of practices. According to the relational approach, a practice does not have such inner attributes as goodness, effectiveness, quality or workability. Rather, these attributes are performed in the socio-material relations; they are relational and provisional (see Çalışkan & Callon, 2010; Callon, Méadel & Rabeharisoa 2002). This means that a practice can be effective or good only when embedded and enacted in a wider system where the goals to be achieved by the practice are defined. Instead of searching for the ultimate best practices, we need to investigate the adaptability, applicability and workability of a practice in relation to the site. We have to investigate what kind of human actors, activities and interactions as well as resources have to be mobilized and enacted so that the goals defined can be achieved. The goals can be, for example, the health of a patient, the work welfare of practitioners, and the economy of an organization. Only in relation to these goals and the site can a practice be workable.

CO-CREATION OF SOCIO-MATERIAL PRACTICES

The systemic innovation model developed in the Innovillage project during 2009-2013 has been designed principally for the public sector innovation activities, but it might work in any other sector as well. It is a model for co-developing and co-creating practices (products, technologies, services, etc.), whereas Innovillage is an open national innovation environment which bases on the systemic model and which consists of both web-based and face-to-face tools for co-development and co-creation in the welfare and health fields (Koivisto et al. 2014).

The use of ANT in relation to co-design, co-creation and co-development has so far focused mainly on researching the design activities, on outlining its possibilities as a design theory, and in some cases it has been utilized as a guiding frame in the design of ICT or other technological innovations (Nickelsen & Binder, 2008; Storni, 2012; Storni & Venturini, 2012; Yaneva, 2009; Kraal, 2007). The use of ANT in the development of this innovation model does not aim at an extensive contribution to the theo-

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retical discussion about the variations and disagreements concerning ANT. Rather, it takes the certain core conceptions of ANT combined with other theoretical resources to provide more robust model for co-development and co-creation. ANT gives principally an analytical frame to analyze the objects of development as relational socio-material practices.

The innovation model should help and guide the developers to design local solutions to meet the needs they are developed for; to take into account and design the different heterogeneous elements and their relations that are needed to meet the needs. The concept of 'script' is useful here. The co-design activities should create local models which define the actors, their roles and tasks, resources etc. to be enacted, mobilized and organized in a site. A local solution can then be generalized into a general enactment model which can be utilized by other developers in other sites.

In addition to the use of ANT, this model promotes the idea of open innovations rather that closed (Chesbrough, 2003; Chesbrough, 2006). As an analytical approach, the open innovation is more sensible to co-creation and co-development than traditional closed innovation models. The theoretical work on open innovations provides more vocabulary and insight to different modes of collaboration in innovation processes, such as inside-out, outside-in and coupled processes (Gassmann & Enkel, 2004). It also discusses the dimensions of collaboration in more specific terms, i.e., the types of vertical and horizontal collaboration (Parida et al., 2012).

The model also includes a perspective on evaluation of solutions and practices. A relational evaluation approach, developed on the basis of ANT's relational approach, has been incorporated into the model (Koivisto, Vataja & Seppänen-Järvelä, 2008; Koivisto 2007).

The innovation model suggests also a relational definition of innovation. The definition is inspired by ANT's relational framework, but it has not been specified in the ANT-literature. A mere idea or invention does not count as an innovation. To be counted as an innovation, an idea or an invention has to be translated successfully into practice in a site, it has to have something new compared with the earlier practice, and it has to meet or solve the problems it was developed for.

The model consists of three iterative and mutually constitutive sections: *Stimulate, Incubate and Enact* (see also Innovation Unit's disciplined innovation model; www.innovationunit.org). According to the model, these sections should be performed to achieve successful solutions and sustainable change in a local site. The sections are not phases that should be performed in a linear order, they rather include different development tasks that are performed simultaneously and interactively; a change in one element may generate change in another element.

According to the model, the co-development and co-creation process focuses continuously on the shared object of development, that is, on the socio-material solution, the development of which the members of the development community are committed to (Paavola & Hakkarainen, 2009; Pohjola et al., 2011). At the same time, the development community continuously enacts and re-enacts itself. Thus the solution and the development community are constantly co-evolving.

The outcome of the development activity can be generalized from the local solution into an enactment model (a script), i.e., a general model of the core elements of the solution that can be utilized by other developers in other sites when translating the solution into practice (see Figure 1).

Stimulate

This section is to stimulate innovation. Innovation activity is always performed to meet a kind of problem, challenge or need defined by someone. A key task in this section is to identify the various actors

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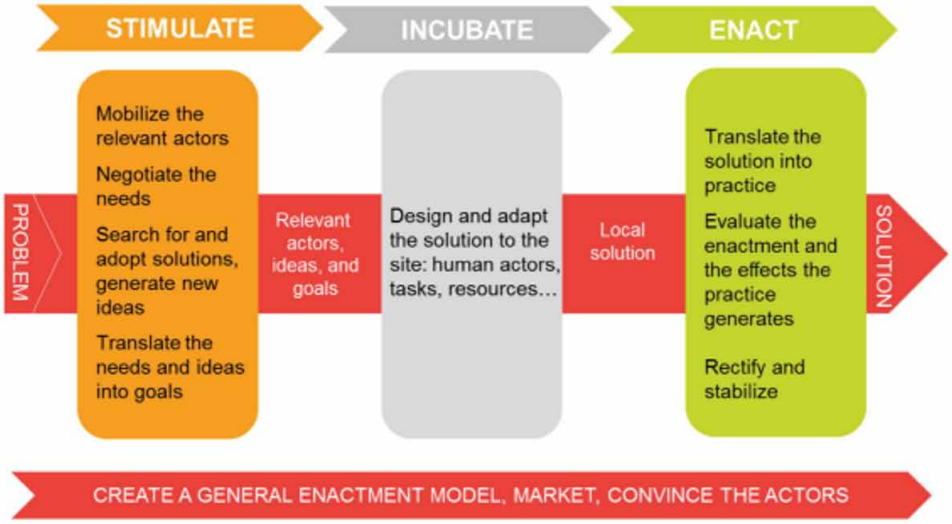
Figure 1. Innovillage's systemic innovation model



who may have some 'unsure' needs or interests concerning the original challenge. When doing this, it is useful to consider the following four aspects: the client/citizen aspect, the practitioner aspect, the organizational aspect, and the policy community aspect (see Table 1). When identifying the actors, it is useful at the same time to start convincing them of the importance of the need(s) and recruiting and involving them in the development activity.

In innovation activity it is above all a question of negotiating and reconciling the needs of the various actors. This means that the actors involved negotiate a shared solution that meets the different needs, but the needs are also molded and re-molded in this kind of process. The needs should be seen as continuous effects generated and regenerated in the interactions, rather than something that the actors a priori have. Further, it is always reasonable first to check whether somebody else has already developed a solution or a model that meets the needs of the development community. If there is no suitable solution available, a totally new solution has to be developed. The needs of the various actors are collaboratively translated into development goals. They define what kind of solution should be the outcome of the innovation process. In this process, the problem, challenge or need that was the starting-point of the activity may be redefined and remoulded.

Incubate

When carrying out the systematic innovation activity, the development community is being designing a shared object of development as a solution into a site. Only when the community has a shared object of development is it possible to co-design the socio-materiality of the solution in a way that it will work in the site while meeting the needs it is developed for. In designing the socio-material constituents, the practical matrix for designing a practice is useful (Table 1). In the matrix, it is possible to co-design the socio-materiality of a solution in a site, i.e., the elements of the solution including actors, tasks and resources. The matrix consists of the four aspects presented above and of six topics. The topics are human actors, tasks and division of work, knowledge, skills and tools, rules and principles, laws and statutes,

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Table 1. A matrix for designing the socio-materiality of a practice

	Client Aspect	Practitioner Aspect	Organizational Aspect	Policy Community Aspect
Human actors				
Tasks and division of work				
Knowledge, skills and tools				
Rules and principles				
Laws and statutes				
Expenses				

and expenses. The matrix is not a apriori theory that defines which the key aspects or topics of every practice are. It rather works as an inspiration to outline the socio-materiality. The design made in the matrix works as a local model; it defines the socio-material elements of the local solution. On the basis of the model, the solution can be translated into a local practice.

Enact

When testing an idea or a more designed solution in a site, the local model is translated into practice and the practice is evaluated in the relational evaluation framework. Then the expected and unexpected change the practice locally generates is evaluated. The evaluation also includes the evaluation of the enactment of the solution. Through evaluating the practice, it is studied whether the practice meets the needs it was developed for.

The relational evaluation is performed in the before, during and after –design. In this design the object to be evaluated (for example, the welfare of clients) is followed and evaluated before the enactment of the practice, during the enactment and after the enactment. Through this design it is possible to locate the change generated (before – after) and the constituents that generated the change (during).

The relational evaluation is performed in the context of one or several aspects (client, practitioner, organizational, policy community) and in real time. However, sometimes it is enough to collect the knowledge after the enactment of the practice and only within one aspect. The evaluation is useful to perform by building it into the development process, as a natural part of the enactment of the practice. Then the evaluation knowledge is collected when enacting the practice – not as a separate process. However, the evaluation design depends a great deal on what kind of practice you are evaluating and what kinds of resources (f. ex. people, time and money) you are able to mobilize in the evaluation.

On the basis of the entire study material collected before, during and after the enactment, evaluation and conclusions will be made on how and to what extent the practice under evaluation has generated the changes and what kinds of other things have possibly generated the changes. In addition, an evaluation will be made about the success and workability of the enactment. On the basis of the evaluations, the improvements that are needed are made in the practice and the final decision concerning the stabilization of the practice is then made.

The local design made in the matrix also helps when a general enactment model of the solution is created. The generalized model defines the core socio-material elements of the solution which should be enacted in every site where the solution is adopted and adapted. It works as a script which is followed and tested when adopting the solution in new sites. This kind of general model can be created during

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the innovation process and it is typically elaborated after the local enactments of the solution in different sites. The general models work as conceptual artifacts through which the practice developed can be communicated, explicated and marketed. They are not theories that try to model the pre-existing world, but rather tools to co-create the world.

The systemic innovation model has also been developed into an open and a collaborative web-based development environment in Innovillage environment (see Koivisto et al., 2014). The environment has been developed to support the collaborative cultivation of ideas into practical solutions and to distribute them in the welfare and health sector in Finland.

The development environment is a platform where practices are collaboratively developed and generalized into enactment models and where information about existing practices and models can be searched for. It has been created primarily for the needs of practice development in the welfare and health sector, but it can also be used in other sectors and across sectors. Nearly all the information entered into and published in the environment is openly available for everyone. The development environment consists of two tools: the virtual workspace for the development of practices that match with the three sections of the systemic model (Stimulate, Incubate, Enact), as well as the tool for creating a general enactment model out of a local practice.

CO-CREATION IN PRACTICE

This section studies the systemic innovation model in practice, that is, the co-design activities of services where the open web-based development environment of Innovillage has been utilized. The study material is collected from the workshops of the design activities of a National Development Programme for Social and Health Care during 2012-2014. The programme is a strategic development program run by the Ministry of Social Affairs and Health, Finland. It is the main programme of the ministry for managing and reforming the national social and health policy and services.

During the years 2012 and 2013, the programme has funded about 30 public service development projects from various fields of social services and health care. These include a project that aims at developing a model for the treatment of chronically ill patients in health care centers, a project for more client-centered adult social services and a project for multi-professional models for promoting welfare, few to mention.

The study illustrates the systemic innovation model-in-action by analyzing the co-design activities of services in the workshops, mediated by the web-based development environment. The environment is utilized by every development project of this programme. Further, it is studied how the enactment models generalized from the locally designed practices have been utilized and enacted in other sites and organizations. This section gives an illustrative analysis of the co-design activities and of scaling the outcomes of these activities in the programme.

Co-Developing in Innovillage

The current development programme was launched at the beginning of the year 2012. The Ministry's strategic guidelines required that each development project in the programme utilizes Innovillage in its development activities. It means that information of each project is found in Innovillage. In addition,

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all the new service models and their enactments should be developed in the web-based development environment in Innovillage.

In order to succeed in this task, the programme has had to mobilize resources to guide and help the projects to utilize Innovillage's web-based development environment. The projects have had tutorials and guidelines for different development tasks, such as the evaluation of the changes a developed and enacted practice generates. These material resources also include the generic systemic innovation model as a guideline for planning the development activities in the projects.

The necessary support to the development projects also consisted of training and different kinds of workshops. The trainings focused on giving the required technical know-how for utilizing the web-based development environment. The workshops, on the other hand, focused more on the actual development activities. In the following, the activities of these workshops are discussed in more detail.

Stimulating Workshops

When the projects participate in the workshops in their early phases, the development activities focus on framing and defining the object of development. In many cases, the projects start with more or less general aims and goals, which they have to specify into more concrete activities and objects of activities.

One project in the programme aimed at developing services for preventing the expansion of the social and health problems of children. One proposed solution was to develop a new kind of family center model and to enact it in five different sites. When entering the workshop, the development team had only a general idea of what this model could be. The workshop focused on specifying the model and to clarifying whether the same model would be enacted in five sites. In the workshop, the developers responsible for the development of it agreed that their work should aim at simultaneously and iteratively developing a general model of the family center and the local solutions of the model.

These kinds of activities that fall mainly into the Stimulate part of the innovation model also have focused on negotiating the needs of development. In order to specify the needs, it is necessary to consider the "relevant" actors who should be involved in the development process. In this, the participants utilize the matrix (see Table 1) to specify the relevant actors.

Incubating Workshops

During the more intense development processes, the projects themselves organize workshops and also participate in the workshops organized by the programme. The development activities of these workshops are mainly what fall into the Incubate part of the innovation model. These workshops usually involve actors from the organization where the new service will be enacted. The actors can be managers or workers of the organization. In some cases also the users or clients of the services can participate in the workshops. Occasionally, these workshops include all the sub-projects of the development project, such as the five sub-projects of the family center project discussed above.

The project developing the family center model has organized workshops periodically for the whole project. These last for one day and the idea is to exchange information and experiences among the different sub-projects. In the workshops, the different actors can also contribute to the development of the shared model of the family center.

Although the client involvement in these workshops is not that usual, there are examples of projects where the clients have been strongly involved throughout the development process.

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In a project where a new kind of model for the treatment plan of chronically ill patients in health care centers was developed, clients were strongly involved. The whole idea of the new kind of practice of making the plan was that the clients are strongly involved in making the plan, so it was natural to involve them also in the development of the practice. This helped the developers to understand how the patients should have a role in making the plan and, moreover, that actually they should be the ones who decide what kinds of treatments, self-care and other activities, will be conducted in executing the plan.

The workshops in this Incubate phase focus on designing the socio-materiality of the practice and on preparing the plan for implementing the practice. It usually involves some kind of pilot testing of the practice. In some cases the growing understanding about the object of development requires the reassessing of the initial goals of the development process. During these workshops, the object of development is being molded and both the socio-materiality of the object and its enactment plan start to have its final form.

Enactment Workshops

The enact phase workshops usually include three kinds of tasks: enacting, evaluation and modelling. The development processes aim at implementing the solutions developed into practice, but first they have to be successful in meeting the needs they are developed for. Implementation requires negotiations about resources as well as training of the professionals who will be enacting it in the everyday practice of the organization. In many cases the implementation of a new way of doing things requires that some other existing activities are replaced with new ones.

In a project developing new kind of patient flow model for health care centers, the last part of the project was mainly focused on negotiations with the managers of different health care centers about how to implement the new kind of way of managing the queue for treatment. The idea was to make the whole service more efficient and to cut the queues. This also required intensive training of health care center personnel so that they could act in the new kind of way in their daily work practice.

Some projects also participate in evaluation workshops. The idea of these workshops is to guide the project to evaluate the changes the new practice generates. This is usually seen as one of the key issues in deciding whether the new practice developed should be implemented into practice.

The evaluation workshops help the projects in making their evaluation plan. The key idea is to help the developers to evaluate whether the new practice meet the needs it is developed for. In these workshops, the more specific evaluation questions and criteria are developed. Also the workshops support the developers in considerations of what kinds of evaluation methods they can utilize. For example, a project could evaluate, whether they have succeeded in reducing the usage of the service with the new practice.

The third kind of workshop in the Enact phase focuses on the modeling of the local solution into a general model, an enactment model. The idea is to scrutinize the key elements of the developed and enacted practice into a model that can be utilized by other actors and developers. Usually, the initial idea of the general model has already developed during the development process. The idea of these workshops is to crystalize the experiences and locally cumulated knowledge into a shared model.

In the project where five different local solutions of a family center have been developed, the enact phase workshop has focused on finalizing the shared enactment model. The idea is that the experiences from the five different local solutions contribute to the development of the model. In the workshop it is discussed what are the mutual and shared features among these different solutions. The model should explicate, what are the key elements that need to be considered when enacting the model.

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Scaling the Results in the Programme

The models and local solutions developed in the projects of the programme can then be scaled into different locations. One example of this in the programme relates to the new service models and practices developed for health care centers. The idea is to collect the outcomes of these projects into one location in the web-based development environment and to organize areal workshops. In these workshops, the development needs of areal health care centers are negotiated and possible existing solutions are then scouted from the outcomes of the development projects.

If the outcomes provide possible solutions to these health care centers, then new workshops are organized where the original developers can guide and support the new health center personnel in the enactment of the service model. Also the personnel of the new health care center consider their specific issues relating to the socio-materiality of their local solution, which are the key elements of the successful translation of the model into practice.

DISCUSSION

This paper has shown how a systemic innovation model, based on the relational approach of actor-network theory, has been translated into everyday innovation activities. The paper has presented a systemic innovation model that has also been built as a web-based, open and collaborative development environment which is in everyday use in the welfare and health field in Finland. This is a concrete and unique example of how originally quite theoretical conceptions have been translated into a national innovation environment and innovation practice. Furthermore, the innovation model is a contribution to the new co-creation innovation approach by showing how the objects of development are analyzed, co-developed and co-designed as socio-material practices.

The systemic innovation model of Innovillage seems to give a workable framework for everyday innovation practices. However, it should not be understood too strictly in a sense that every development task of the model should be performed in every development process. And. there are also other development tasks in the innovation activity that are not included in the model. Moreover, the model certainly should not be understood as linear, which has sometimes been the case. Developers can easily fall into the pattern of following the model task by task, which is not the idea. As it is with any model, the innovation model is translated into practice and the activity tailored by mobilizing and taking into account the local development needs and conditions. Besides, it seems that the division of the model into three sections is more an obstacle than an aid in the concrete development activities. When the developers are performing different development tasks simultaneously and iteratively, there is no need to conceptualize the activity by sections or phases.

The developers have encountered the basic ideas of the innovation model – such as socio-materiality, the relational character of practices, enactment, and a generalized model – in very different ways. On the one hand, there are developers who have strongly adopted the traditional conception of science and development as a linear, rational and objective endeavor and who argue for the strict evidence-based practice movement that bases its studies on randomized controlled trials. They perhaps do not appreciate the role or value of such an open, systemic and collaborative development culture. On the other hand, there are developers who seem to think very much in the same terms with the innovation model of Innovillage.

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Concerning the engagement and the participants in the development activities there is a lot of conceptual and practical work to do to clarify the concepts "relevant actors" and "their needs" and to tackle them in the concrete development activity. Both should be studied, according to the relational approach, ultimately as negotiable things and as consequences generated in the manifold interactions of actors. "Relevant" and "need" are not properties of any kind of actor, human or non-human, they are rather things that are negotiated and generated in the manifold interactions of them.

An insurmountable task in the innovation model is the evaluation of solutions and practices in a site. There is a plethora of evaluation methods that have been developed nowadays to involve the different actors of development in the evaluation. A number of developers still think that someone, an evaluator outside the development community, should perform the evaluation or that there is a kind of objective order of evaluation methods. On the other hand, the projects often end before the evaluation of the practice developed has been performed.

One key obstacle for the involvement and co-development practices in the public sector is the organizing of the development activities into projects, which are usually far away from the everyday work practices. In these kinds of projects, it is usually difficult to involve the clients/citizens and the other actors. Then the project developers typically develop the practices among themselves and the solutions and practices are developed as a ready-made package, and because of that they are difficult to translate into practice, meaning they are unlikely to work very well. Further, evaluation is often restricted to the voices of a few clients that are gathered, for example, by surveys and only during the testing period. In the programme studied in this paper this obstacle was attempted to cross even if the development activities were project-based.

The development activities and their methods and workshops should rather be built into everyday practices. Then the development is continuous and the practices and solutions are always developed, tailored and evaluated alongside the actual clients and other actors.

The systemic innovation model and the web-based development environment is open to use in the other sectors, such as education, culture, leisure time, and medicine, and to apply with any kind of object of development. However, thus far the majority of the content in the environment has been developed within welfare and health field and the objects of development have been mainly different kinds of services. One key task of Innovillage in the future is to broaden the use of the innovation model and the web-based environment to these other sectors and apply them with any kinds of objects, such as, health technologies. As it is, the different sectors use to develop their solutions and model too much in silos though often a solution at a particular site requires co-development and collaboration between different actors and practitioners across sectors and organizations.

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Chapter 35
Culture of Learning Cities:
Connecting Leisure and Health for Lifelong Learning Communities

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ABSTRACT

This chapter contributes a conceptual framework for addressing the health of communities through the synergy of leisure, public health, and continuing education systems at a localized city level. The culture learning cities offers a broader setting and case for implementing solutions that increase the overall health of communities. Key built environments within learning cities, such as parks, can serve as nontraditional continuing education structures, where people can learn and share their differences and experiences that continually improve qualities of the individual, community, and society.

INTRODUCTION

Synergy across professions represents a creative solution to complex problems in society. The culture of learning cities is an authentic example of such synergy and collaboration across diverse communities. Learning cities can describe extensions of education and learning beyond schools, colleges and universities for addressing the overall life, health and well-being of citizens. Two aspects that can be advanced are public health and leisure within a culture of learning cities. A practical U.S. example of learning cities involves strategic land-usage, from the historic land-grant legislation of American colleges and universities to the significant allocation of parks and recreation areas. This chapter will consider a comprehensive role for promoting learning cities for building healthy and healthful communities including

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enhanced relationships among professionals and practitioners, scholars and researchers, also citizens and lifelong learners for improving our community, our health, and our overall quality of life.

Learning cities describe an emerging concept about how communities can collectively support multiple, even conflicting initiatives for the good of all citizens. Such collaboration considers how environmental structures, such as parks, serve as nontraditional systems for leisure, public health, and lifelong learning. Professionals interested in advancing environments should consider diverse leisure activities that account for differences in age, race, and other societal identities, and incorporate such diversities into community education and broader notions of ecological health, social justice, and collective participation. Thus, healthy parks within healthy community synergism exemplify an important function within the context of learning cities.

This chapter contributes a conceptual framework for addressing the health of communities through the synergy of leisure, public health, and continuing education systems at a localized city level. We attempt to highlight the importance of health in advancing environments and contextualizing social concerns. We introduce conceptual models for leisure and recreation issues to account for tensions, conflicts, and negative aspects of shared experiences in communities. Race and culture differences have also been considered through the context of community education and lifelong learning-for-all. Within a comprehensive framework of learning cities, diversity and differences have been surveyed and addressed, which may lead toward every person's quality of life being enhanced.

Thus, learning cities can offer a broader setting and case for implementing solutions that increase the overall health of communities. In this chapter, the framework of learning cities describes parks, as nontraditional continuing education structures, where people can learn and share their differences and experiences that continually improve qualities of the individual, community, and society. Given that there is no one-size-fits-all conception of health, professionals and practitioners, along with park and recreation managers, even public health and continuing education practitioners, must begin reconstructing parks for the multiple concerns and challenges for becoming healthy communities.

THE IMPORTANCE OF HEALTH IN ADVANCING ENVIRONMENTS

Learning cities can harness collaborative synergy when combining public health and built environment perspectives to address complex problems in society. Formed to increase public health, the collaborations across communities and professions are among the best examples of advancing environments through multifaceted approaches. At individual and societal levels, individuals exercise personal care and social responsibility towards healthy outcomes. Figure 1 shows a conceptual framework for the drivers and burdens of health in a learning city. Among some of the most complex problems facing individuals and communities are the environmental burdens of confronting obesity, violence, and health care access. At the community level, education, lifestyle, and the built environment are shared resources driving positive health outcomes. In this framework, community level drivers are necessary to overcome and combat individual level burdens. Increases in community health status, or comparative health status between communities, are conceptualized as a function of the advancement of these drivers. This chapter will use parks and recreational initiatives to exemplify this function in action.

In this age of population health, learning cities incorporate education and justice into a broad notion of ecological health in which the built environment is as important to health status as the provision of care. Public health system goals directly impacted by the various drivers and burdens shown in the

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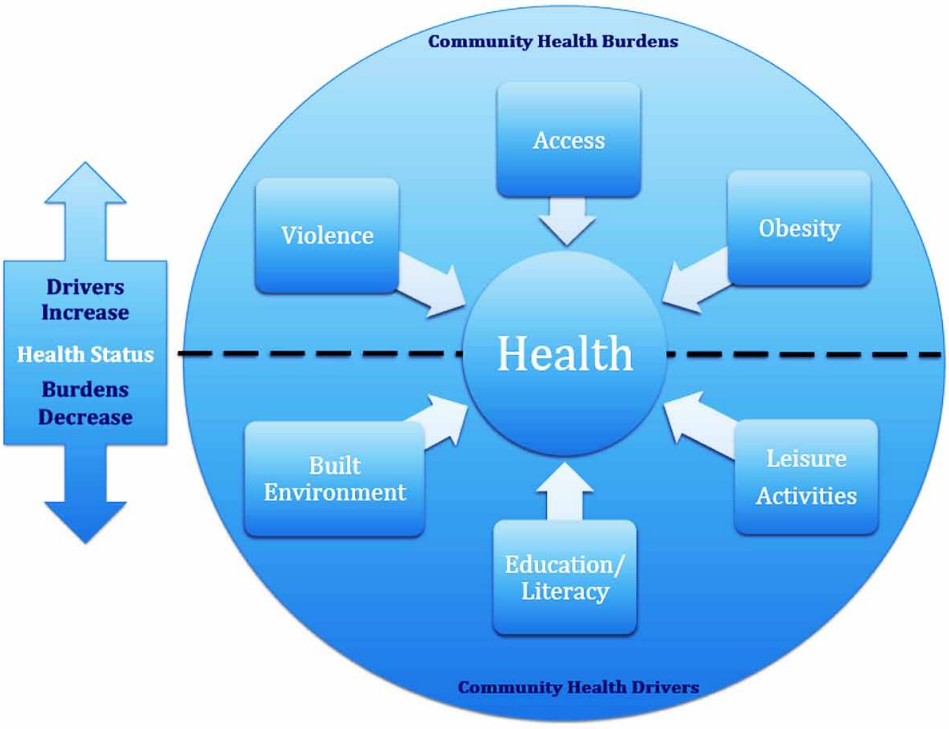
Figure 1. Health status conceptual framework for learning cities



conceptual framework. The development of locally adjusted solutions that are also beneficial to the environment is therefore also dependent on the inclusion of environmental interests and the incorporation of environmentally relevant lay knowledge (Drazkiewicz et al., 2015). For example, urban green space provides a wide range of ecosystem services that could help combat many urban ills and improve life for city dwellers—especially their health (Maas et al., 2006; Wolch et al., 2014; van den Bosch et al., 2015).

To solve societal problems, identifying theoretical levels of engagement is an important concept towards understanding the impact of public health and its role for communities. Initiatives that draw upon ecological models for rationalization emphasize individual characteristics and environmental space as drivers of personal behavior (Sallis et al., 2008). Because environmental levels of influence do not explicitly consider the broader community, organizational, and policy influences on health behaviors, researchers suggest multilevel interventions based on ecological models and targeting individuals, social environments, physical environments, and policies being key to achieving population change in physical activity (Sallis et al., 2006).

This section will focus on the importance of health in advancing environments of learning cities. First, personal care and social responsibility to healthy outcomes will be discussed. Whereas ecological theories dominate behavioral health, institutional theory will be introduced as an alternative theoretical basis from which to better understand health-seeking behavior at the individual and community nexus. Second, obesity, violence, and health care access are described as complex societal issues. Both violence and obesity have downstream effects on individual and community health (Plichta, 2004). Lesser known are the implications that one has on the other, as well as the moderating effects that the built environment has in the context of access to health care.

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PERSONAL CARE AND SOCIAL RESPONSIBILITY TO HEALTHY OUTCOMES

It is a tough assignment for researchers to connect community and individual health statuses with quality of life indicators in the public health arena. It is an unfair proxy because much of the environmental complexity that influences quality factors relating to healthy outcomes are outside the span of control of pubic health professionals and practitioners. Ecological modeling addresses some of the contextual issues that impact individual and community health seeking behavior. We introduce institutional theory as a way to bridge the gap and discuss the impact that organizations within various professions can have on quality of life at the city level. Institutional theory focuses on the behavior of organizations in a field or environment, and emphasizes that organizations are open systems, strongly influenced by their environments. The strength of the theory is the connectedness and structural equivalence of organizational responses to environmental constraints, both individual and community level. In this section, we further discuss constraints as complex issues associated with health outcomes.

Our [health and leisure] environments include socially constructed belief and rule systems that exercise enormous control over organizations, both how they are structured and how they carry out their work (Scott, 2003). Here, social factors manifest themselves as processes that create action or behave in response to environmental changes. Institutional theory, through the process of institutionalization, provides a foundational context to view these factors (Dacin, Goodstein, & Scott, 2002). In institutional theory, structuration is the change process by which organizations seek to exploit the most efficient available form of management, thus constantly making decisions to become more like the dominant set of successful organizations. Organizations facing the same set of environmental constraints, competition, and available resources become rational actors that find similar solutions. The environmental complexity during this decision process and conformity period includes social, economic, and political factors; such factors surface each time the linkage between the environment and interdependence of organizations comes into play.

The synergy between professions focusing on health and leisure can be exemplified in the interplay between organizations supporting health and education. Across learning cities in the United States, there are similarities in the health and educational frameworks for infrastructure and organizational policies, financial and legal resources, and human resource planning (Howard et al., 2015). Institutional theory provides a way to explain these similarities. For example, many existing health systems structure their organizations by anchoring patient care to a flagship hospital with several efficient referral hospitals and clinics within a geographical catchment area. To generate a financially viable patient population, access points straddle affluent and impoverished zip codes. Each of the systems' smaller hospitals and clinics are set up to capture the same categorical patients, with budget forecasting built on poisson distribution patient flow patterns, similar reimbursement, and patient mix schemes.

Comparing health and education, the convergence of school districts and decision-making around school closings mirror historical reductions in hospitals as well proliferation of the flagship-anchoring networked health systems. Several population-dense metropolitan areas in the United States remain carved into a racially and economically segregated mosaic of local public school districts, which in some cases enroll only a few hundred students and lie immediately adjacent to other tiny local public school districts that can seem a world away (Baker, 2014). The access to high performing schools, feeder patterns for resource rich student pools, and the mix of public and private schools are examples of the structuration process in institutional theory. Furthermore, social justice issues have captured political attention, making race, ethnicity, culture, and poverty essential components of these debates.

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In short, one might ask what does this really have to do with health status and quality of life? Well, the ability to accurately predict which hospital is better, based on organizational characteristics or the viability of certain schools within districts, will be the same process organizational planners use to try and determine how health status and quality of life are significantly associated with the built environment. What predictive mechanisms used to address health and educational factors tell about institutional theory is that organizational behavior is based on environmental and interdependent factors. The challenge for social activists, health practitioners, urban planners, and education professionals is that organizational forms do not change often, and when they do change, the environment selects the dominant organizations. And because most organizations are competing for finite geographical resources, the diversity of organizational forms is isomorphic or in similar form to the diversity of environments.

To advance solutions for health in the environment, a learning city will need to explore the opportunities to create strong collaborations between successful organizations in each of its main professional fields. Health systems can learn about stability from school districts. Parks and recreation departments can learn about capacity-building and program efficiency from federally qualified health centers. Institutional theory suggests the iterative processes of learning cities will create convergence on optimal organizational forms. Ideally, this type of mimetic or imitative processes will generate stable convergence around one or a few forms, independent of competitive and efficiency imperatives (Strang & Macy, 2001).

CONFRONTING OBESITY, VIOLENCE, AND HEALTH CARE ACCESS

Confronting complex issues such as the interconnectedness between obesity, violence, and health care access requires both ecological and institutional theories. While it has been long understood that violence has implications for emotional and physical injury, it is only relatively recently that we are beginning to recognize the longer-term effects that reap an extensive toll on the broader health status of individuals, families and communities (Prevention Institute, 2011). The notion that violence is a contagion in public health allows organizations to develop institutionalized solutions to address it. In families, violence between partners increases the risk of violence directed at children and increases the risk of the children behaving violently themselves. Having one violent individual in a family makes it more likely there will be others (Huesmann, 2012).

Violence and chronic disease patterns are also linked. There is a significantly higher likelihood of engaging in behaviors known to contribute to chronic illness behaviors (smoking, eating disorders, substance abuse, decreased physical activity) for those who have been exposed to one or more of the range of types of interpersonal violence (e.g., child abuse, sexual assault, family violence, and community violence) (Prevention Institute, 2011).

Obesity is another synergistic topic in which its complexities also spill into violence and contagion. While genetic factors probably contribute, rapid increases in obesity suggest that individual behavior patterns, including low levels of physical activity, appear to powerfully influence obesity trends (Wolch et al., 2014). Children of women who report chronic intimate partner violence are 1.8 times more likely to be obese than other children; the effect is magnified for families living in unsafe neighborhoods (Kendall-Tackett & Marshall, 1999). Mothers with high exposure to neighborhood violence were twice as likely to report never exercising (Lumeng et al., 2006).

The sheer cost of violence and obesity, not to mention lost productivity, create economic dearth within communities and cities. Considerable portions of the costs of violence are paid by public sources and

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thus represent a cost to society in general (IOM & NRC, 2012). A study at the University of Southern California Medical Center found that 87 percent of the costs of treating gunshot wounds of the trunk were paid with public funds—with average hospital stays of 6.8 days and costs of $10,600 per patient (IOM & NRC, 2012). Chronic illness resulting from unhealthy eating and activity account for a growing percentage of escalating costs in the health care system (Hogan et al., 2003; Huang et al., 2009; Prevention Institute, 2010; Prevention Institute, 2007; Thorpe et al., 2004).

Furthermore, violence and fear of violence are significant barriers to healthy eating and active living for built environment researchers. People are less likely to use local parks or walk to school when they do not feel safe in their neighborhood, and violence reduces investments in communities—for example, grocery stores (Bennett et al., 2007; Shaffer, 2002; Zenk et al., 2005). Women who perceive their neighborhoods to be unsafe are 25 percent more likely to be obese, and children of parents who perceived their neighborhood as unsafe were 4 times more likely to be overweight than those of parents who perceived their neighborhood as safe (Boynton-Jarrett et al., 2010; Burdette et al., 2006; Rohrer et al., 2004).

LEISURE ENGAGEMENTS

Leisure engagement is the second conceptual driver of community health. Much has been written about the benefits of leisure and the overall positive outcomes of leisure participation. Kelly and Godbey (1992) have indicated the positive impact that leisure activities have on the family, individual development, and personal health. They also suggest that much of our leisure is experienced through a myriad of social groups, from the family to special interest clubs. Such social experiences shape not only our life satisfaction and self-definition; they also fundamentally affect family relations, friendships, and the environment. These leisure engagements are vast with different participation patterns, preferences, and politics.

Leisure may be crucial to persons in many periods of life. Research on leisure, stress, and coping is important within a broad spectrum of leisure scholarship, especially since it can be potentially integrated with research constraints and negotiations, lifespan development, diversity, and lifestyle (Iwasaki & Schneider, 2003). In fact, Ponde and Santana (2000) found that participation in leisure activities are a protective factor for women's mental health in Salvador Brazil indicating that the health benefits of leisure is not only an American phenomenon, but also have international implications. Later-life adults often focus on leisure investments and priorities, as well as work and significant relationships, making leisure more often central than peripheral though the journey of life. (Kelly & Godbey, 1992).

This section will focus on the interrelated aspects of leisure engagement activities impacting health in advancing environments of learning cities. First, the negative aspects of leisure will be discussed. Second, we will identify racial differences in leisure activities, and the downstream disparities produced by these differences. And third, the connection to healthy communities will be exemplified again using violence and obesity issues.

Negative Aspects of Leisure

Scholars and practitioners must also remain cognizant of the leisure tensions, conflicts, and potential negative aspects of the leisure experience. Over the course of debate, an a priori belief in the innate goodness of leisure has prevented leisure scholars from exploring its negative aspects (Jacobson & Samdahl, 1998). The classical term "purple recreation" refers to the recreational activities that challenge societal

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norms and expectations (Curtis, 1979), taking on a more socially negative description in recent times, especially among youth and violence researchers (Caldwell & Smith, 2007). For example, Robertson (1994) reported that people who participate in negatively considered activities, such as socially inappropriate actions, may achieve the same positive feelings and benefits. Some of these benefits include self-validation, which is typically associated with more acceptable forms of recreational activity, often referred as so-called, "good leisure." However, studies conducted in the past 20 years suggest that so-called descriptions of both "bad" and "good" leisure benefit all those who engage and participate in them (Robertson, 1999; Shinew & Parry, 2005; Shores et al., 2007).

According to Jacobson and Samdahl (1998), contemporary leisure theorists have emphasized ways that leisure can enhance or reaffirm one's sense of self, but they have not effectively acknowledged that leisure can be a context for negative messages about the self. Further, this possibility becomes particularly germane for individuals or groups who are subject to stigma and negative sanctions in other domains of their lives. Any person or group may experience stigma based on ascribed attributes that society views as important (such as age, gender, race, or ethnicity). Discriminatory practices and oppressive ideologies may typically result in reduced opportunities, in negative impacts on health, and in restricted or blocked access to resources, activities, and other opportunities (Germain, 1991). If these reactions occur in other aspects within the lives of people and groups who are "different," then it is feasible to assume that they will occur in leisure as well (Jacobson & Samdahl, 1998). Therefore, the investigation of disempowered groups, such as ethnic and racial minorities, provides the opportunity to examine, and perhaps challenge, assumptions about the innate goodness of leisure and its impact on health.

Black and White Differences of Leisure Behavior

Various studies have been conducted on Black/White differences in leisure behavior and preferences. For example, Washburne's (1978) seminal work found that Blacks participated in different types of leisure activities than Whites. He found that Blacks preferred sports and fitness-related activities more than Whites. Stamps and Stamps (1985) also compared the leisure preferences of Blacks to Whites. However, they took the examination one step further by looking at the influence of both race and social class on leisure participation. They concluded that race seemed to be more important than class in determining leisure participation and the impact on well-being. Philipp (1995) has looked at the concept of leisure constraints and race and found that Blacks were constrained in various leisure activities because of the lack of comfort and appeal associated with specific activities.

Additionally, Shinew, Floyd, McGuire, and Noe (1995; 1996) examined the association of gender, race, and social class with leisure preferences. This study utilized the multiple hierarchy stratification perspective, which assisted in explaining the findings of varied leisure preferences based on race, gender, and social class. Inasmuch as the leisure, race, and ethnicity literature has provided insights into the leisure habits of European-Americans and African-Americans (Philipp, 1997; Riddick & Stewart, 1994; Shinew et al., 1996; Woodard, 1988), there still remains a paucity of research outlining how all community organizations can collaborate in utilizing leisure to educate our citizens and provide leisure opportunities to promote health for all, even those who have been marginalized. Presently, there are no published studies in the leisure literature that address the emerging and important concept of "learning cities" as a vehicle to promote community learning and foster greater community and societal health. Longworth (1999) offers a basic description of learning cities that implement plans and strategies that function in the following ways: 1) encouraging wealth creation, personal growth, and social cohesion;

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2) developing human potential of all citizens; and 3) creating working partnerships of all organizations. This basic description of learning cities underscores key principles regarding leisure activities as well as broader conceptions of health, education, lifelong learning and collaboration among all citizens.

There have been scholars and practitioners who have made attempts at strong collaborations between community organizations in an effort to improve leisure service access with the goal of creating healthy parks and healthy people. For example, Dustin, McKenney, Hibbler, and Blitzer (2004) advocate for the collaboration between public schools and park and recreation professionals, which is at the core of the learning cities description and idea. The authors suggested that park and recreation professionals be added to the staff (or faculty) of public schools to aid in the education of public school children. This idea may expand across an entire citizenry based on their proposal related to several facts that public schools facilities are grossly under-utilized; that most of life takes place outside the classroom; that park and recreation programs hook and hold attention for educational purposes; that park and recreation professionals have substantial teaching and counseling experience having an understanding about the importance of educating the whole child (or citizen); all of these facts having extensive synergistic possibilities. Dustin et al (2004) have been thinking at the heart of the learning cities concept where all city organizations collaborate to educate all members of the community, which would ultimately impact the overall health of individuals and our society as a whole.

IMPACT OF LEISURE IN HEALTHY COMMUNITIES

When thinking about the impact of leisure, the notional of an overall state of well-being comes into question. Although there is much academic debate over how to define well-being, there tends to be agreement that it is related to overall health and a movement toward life satisfaction. For the purposes of this chapter, well-being is defined as the dynamic process that ensures that people possess a sense of individual vitality; are able to undertake activities that are meaningful, are engaging, and are making them feel competent and autonomous. Moreover, people have a stock of resources to help them become resilient to change circumstances not within their immediate control (New Economic Foundation, 2012).

Social network theory provides a context to understand that individuals who have positive links and ties to others within our society tend to acquire higher levels of well-being and are overall more successful in modern life. This is primarily due to the multitude of resources available to them through their social networks. Also, it suggests that individuals with high levels of well-being and life satisfaction are in a position to contribute more positively to their community and make the world a better place for others to live (Russell, 1996). It is also worth noting social network theory, as a variant of network theory, is also linked to institutional theory. Almost all of the major perspectives in organizational theory, such as resource dependency and institutional theory, have incorporated or independently invented key elements of network theory (Borgatti, 2005).

HEALTHY EXAMPLES OF YOUTH DEVELOPMENT AND CRIME PREVENTION

Violence and obesity are also serious issues in the realm of leisure programming. During the 1990s, the National Recreation and Parks Association launched a “Benefits Are Endless” campaign to demonstrate

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the importance of parks and recreation to individuals, community, and to our environment. The campaign was also an attempt to reposition parks and recreation to a safe, and more significant, level in the minds and hearts of U.S. citizens. The research that resulted from the benefits movement demonstrated that parks, recreation and leisure services play a significant role in personal development (e.g., physical, emotional, intellectual and spiritual). It was also demonstrated that parks and recreation efforts made a community a more attractive place to live by acting as a catalyst for business and employment opportunities. Adding parks made neighborhoods even more desirable to live.

Leisure services have been successful at not only enriching the culture of the community such as providing arts programming, but also it has been successful at improving intercultural and intergenerational relations, which has decreased tensions among various groups. For the purposes of advancing the importance of leisure in the discussion of healthy communities, especially related to learning cities and metropolitan areas, there are a few examples within youth and crime prevention. These include "Play for Peace," "Midnight Basketball," and "Academic Cultural Enrichment."

Play for Peace

Play for Peace is a nonprofit organization that promotes peace, nonviolence, and fosters young leaders through children's play. The program, which receives funding from the U.S. Department of Education and the United Nations, has sites in areas where cross-cultural tensions are common: United States, Guatemala, India, Northern Ireland, South Africa, and the Middle East. With over 1.5 million children having participated so far, Play for Peace is open to children and youth from different cultural backgrounds who work together to create their own play activities. There is only one rule: Every activity is nonviolent and noncompetitive.

Midnight Basketball

Midnight basketball was a 1990s initiative to curb inner-city crime in the United States by keeping urban youth off the streets and engaging them with alternatives to drugs and crime. G. Van Standifer originally founded it in the late 1980s in the United States. Youth were provided with a safe haven to the inner city streets to play basketball after hours. However, basketball was only the marketing hook and promotion. Young people were offered opportunities to receive counseling, education and job training, addiction services, and even tattoo removal in an effort to disassociate them from gang affiliation. Empirically, a 2006 study of the 1990-1994 period during which rates of most crimes in the United States peaked, and when urban midnight basketball programs were first initiated as a crime-prevention strategy, found that—while confounding factors were likely involved—property crime rates fell more rapidly in cities that were early adopters of the original midnight basketball model than in other American cities during that same period.

Academic Cultural Enrichment

In 2000, the Champaign Park District in Illinois sponsored a program called the Academic Cultural Enrichment (ACE) Mentorship Program. It was an after-school program designed to meet the specific

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needs of African American youth. The program provides students with the competencies and skills needed to be involved, resilient, and successful. The ACE program sought to foster positive Black identities in the participants, and develop strong math, reading, oratorical, and analytical thinking skills. The program has a strong African cultural component, as well as academic and recreation components. Three research questions guided the program's evaluation project: 1) Are the program goals being achieved; 2) Do the parents and leaders perceive a positive change in the participant's behaviors and attitudes as a result of their participation in the program; and 3) What are the salient program aspects of the ACE Mentorship Program.

Program evaluation took place over a two-year period. Pretest and posttest survey data were collected from the participants for two consecutive years. At the end of the second year, interviews were conducted with leaders, parents, and participants. Additionally, the participants' academic grades were also examined. The information collected from the surveys indicated that the pretest and posttest scores on the Protective Factors Scale and Harter's Self-Perception Scale were not significantly different. The academic grades did indicate positive changes for most of the participants. Further, the information received from the interviews with the parents, leaders, and participants consistently indicated that the program is meeting its goals and is having a positive impact on the children. The salient program elements that seemingly contribute to the positive outcomes include effective and consistent leadership, parental involvement, and innovative programming.

The key point to remember is that the impact of leisure in changing communities involve personal, professional, and social development, as well as social networks, families, and communities. Existing programs can be further enhanced by taking on the consideration of leisure for healthy communities, and more importantly, the concept of learning cities.

ENVIRONMENTS OF HEALTH THROUGH PARKS

Public health, as a discipline, is taught as a flow chart of environmental issues that impact whole communities, which in turn differentially condition people for better or worse health statuses. Public open spaces, such as parks and green spaces, appear to be a key built environmental setting that provide opportunities for a variety of physical activity behaviors, such as recreational walking and playing sports (Koohsari et al., 2015; Bedimo-Rung et al., 2005; Kaczynski & Henderson, 2007). Given the limited success of individually-based approaches to behavior change, public health researchers have increasingly used socio-ecological models to further understand determinants of physical activity (Sallis et al., 2008). Within active living research, public open space is mainly conceptualized as park and greenspace, with less focus on other types of public open space (e.g., public plazas, nature reserves, and greenways). Building health environments can include park facilities and services through offering various opportunities to fulfill individual, social, economic, and environmental benefits (Bedimo-Rung, 2005).

This section details a few of the key components that tie health, leisure, and education. It first describes the community level characteristics of parts from a public health perspective. Next it layers a quality of life perspective on the availability of parks in communities. Lastly, it invites a broader discussion on how professionals collaborate to solve urban health and built environment issues preventing an interdisciplinary approach at increasing community health.

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COMMUNITY CHARACTERISTICS OF PARKS

Focusing on parks over the past decade, researchers have paid a considerable amount of time establishing a link between park characteristics specifically related to community impact, obesity factors, and healthy living. Even as the health professions and design professions diverged, the built environment remains a key determinant of health (Jackson et al., 2013). It is no coincidence that in 1872 the seven founders of the American Public Health Association, now one of the most prominent associations for public health professions, included both an architect and a housing specialist (Jackson et al., 2013). Now described as biophilic designing, a growing body of research points to the health benefits of parks, green space, and other forms of nature contact for communities (Louv, 2008).

Public health often takes on the responsibility to address societal, environmental, and social initiatives around health. In an organizational set, identifying levels of engagement is an important concept to understand the impact of public health and its role for communities. Theoretically, the development of locally adjusted solutions that are also beneficial to the environment is therefore also dependent on the inclusion of environmental interests and the incorporation of environmentally relevant lay knowledge as discussed above (Drazkiewicz et al., 2015). For example, Checker's (2011) analysis of park development in Harlem found that efforts to address environmental justice issues linked to park availability had stalled because residents recognized that park development was primarily a strategy for real estate development and gentrification (D'Haee et al., 2015). Also, the theoretical perspectives of ecological models emphasize the fact that a person's behavior is not only affected by individual characteristics, but also by the environment in which he or she lives (Sallis et al., 2008).

To promote community engagement, public health practitioners rely upon the built environment to provide activity-based solutions for active/lifestyle issues. Arguably, the success of participation measured in environmental terms depends on various aspects of the wider context within which processes are situated and, importantly, on characteristics of participatory processes themselves, such as inclusion and influence of different interest groups (Drazkiewicz et al., 2015). For example, neighborhood physical resources, environmental threats and collective efficacy associated with children's general health status are mediated by family functioning (Fan & Chen, 2012; Christian et al., 2015).

QUALITY OF LIFE AND PARK ACCESS OF USE

Public health researchers often argue that quality of life is directly related to park access and use. Parks often serve as sites of physical activity, which is associated with enhanced health and reduced risk for all-cause mortality and many chronic diseases (Wolch et al., 2014). Combating obesity, reviews of the correlates of children's physical activity and outdoor play indicate that built environment features such as walk/bicycle paths, presence of cul-de-sac roads, access to parks, recreational facilities, and other local destinations or public transport are positively associated with children's physical activity, while high traffic exposure and crime are negatively associated (Christian et al., 2015). Mounting evidence is available to support a positive association between young children's outdoor play and physical activity and the presence of safe and green neighborhood places to be active (Christian et al., 2015). For example, living near (within 1 kilometer from home) recreation spaces was associated with walking in 5–8 year olds (Frank et al., 2007; Kerr et al., 2007).

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Contrastingly, access and use are not always directly related. Researchers argue that parks also have reputations reflecting their use, repute, upkeep, and design quality (Byrne, Wolch, & Zhang, 2009). Furthermore, within cities, green space is not always equitably distributed and access is often highly stratified based on income, ethno-racial characteristics, age, gender, (dis)ability, and other axes of difference (Byrne, Wolch, & Zhang, 2009; McConnachie & Shackleton, 2010). While parks differ in terms of size, quality, range of facilities, availability of organized recreation, or perceptions of safety among actual or potential users, they are designed to serve diverse communities and wide-ranging recreational needs.

Thinking Outside the Box

In promotion of healthy parks, healthy communities, education, and urban planning, public health experts will need to think outside the box for solutions. The best solutions for leading to healthy communities will emerge from the learning cities framework that designates areas a continuing education structures. Many of the concerns about residential or commercial zonings have been the result of limited policies not viewing those same areas as larger zones for learning and continuing education, which contribute to the health of communities. It still remains challenging to develop specific policies and guidelines to (re) design these areas to support such learning and physical activity (Koohsari et al., 2015). This is mainly because there is a lack of prescriptive evidence for urban designers and policy makers for optimal amounts (also known as thresholds) of specific public open space attributes (such as attractiveness or proximity) needed to influence physical activity (Koohsari et al., 2013; Sugiyama et al., 2012).

Advancing health in environments is a challenge for learning cities. Those that are able to leverage the synergy between professions will fare better than those with limited cohesion. Institutional theory as an explanatory factor for why we see certain interventions lends itself to this discussion. In this chapter, the argument has been complementing an ecological modeling of behavioral health with a rationalization of how organizations within learning cities decide on the best infrastructure. Furthermore, when addressing complex issues such as violence and obesity, health care organizations are a reasonable example to elucidate environmental obstacles facing communities and individuals. Here, the benefits of preventing violence are multiplied because violence prevention generates a ripple effect and a slew of positive health outcomes (Davies, 2012). The downstream impact on health status and economic savings has the potential to be monumental.

The imperative to address such environmental injustices and related public health disparities, as well as enhance urban ecologies, has led planners to focus on both traditional parkland acquisition programs and innovative strategies for expanding green space resources (Wolch et al., 2014). In addition, community-based organizations, often aided by environmental groups, are refocusing urban brownfield remediation projects on urban green space to address public health and environmental justice concerns (Barnett, 2001). The public health community has reached across sectors to establish relationships with other professionals who are directly involved in decisions about the design of the built environment, and major national conferences in public health, planning, transportation, smart growth, parks and recreation, and related fields now routinely have included sessions on health and built environment issues (Jackson et al., 2013).

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CONTINUING EDUCATION: COMMUNITIES OF LIFELONG LEARNING

What makes discussions about advancing healthy communities so inviting is that it reintroduces individuals to considering how their environment can be conducive to their own well-being. This requires a level of learning and engagement where the structures of education can support communities, but never dominate them. Current traditional higher education has dominated the opportunities of learning that exists beyond the structures of education. The underlying connection of the built environment contributing to the health, well-being, and overall quality of life for all people cannot be overstated. This discussion promotes parks in their broadest sense, serving communities with societal benefits and opportunities. It is also important to emphasize that there are different views and experiences among all people in society related to the essential conditions for positive and sustainable health outcomes.

Parks, again as an example, set in isolation from the context of family, community, even a city of individuals, may send a blind message: Simply that parks, and the discussion of park visits, activities, or innovations toward healthcare, are one-size-fits-all. The more insightful message embraces the diversities and complexities that parks must address in servicing healthy communities. But before the health impact of parks can reach its full potential, there must be some consideration given to the continual education and learning of citizens in the community: Those diverse individuals, who the parks are intended to serve. Given the matters of diversity related to gender, age, race, religion, sexual orientation, and other considered identities, such as social class, educational level, even health disparity, parks must consider how communities learn together and share diverse experiences of living. This section will focus on the concept of lifelong learning as a mechanism for communities to integrate leisure activities, the built environment, and educational practices to advance healthy communities. First, community education is outlined to provide a basis for discussion. And second, the impact of education on lifelong learning are highlighted to bridge the notion of increasing community drivers in the face of community burdens.

Community Education

The support of lifelong learning as a way to advance environments in healthy communities would bring about a *community education* that advances a multifaceted agenda, ranging from educational development and health quality to collective action and social justice (Jarvis, 2004). Community education is multifaceted partly due to the multiple definitions of community. Most scholars mention the work of Tönnies in comparing *community* versus *society* (Jarvis, 2004). In essence, *community* is an intimate and closer form of human relation than *society* (Hunt, 2005). The sense of community is further highlighted through the term commerce, which features the process of communication and exchange among individuals.

Moreover, when community modifies the term education, the meanings vary worldwide. In the U.S., community education is usually reserved to public schools. Others mention community-based learning occurring in libraries, churches, and community centers. However, the importance of community education in the context of our parks' discussion is in its collective focus to bring about solidarity and collective action. As Clark (1987) adds, "The primary aim of community education is to enable the members of any collective to become increasingly ecumenical and autonomous…a total process enabling individual and society to become more fully human (p. 62)."

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It is the notion of becoming fully human, which drives the importance of considering community education and lifelong learning for our overall quality of life. Placing education and learning in a broader context of society, has led to a consideration of another concept we have reflected as "learning cities." Here, learning cities are rebuilt based on supporting lifelong learning and community education for all its citizens (Scott, 2015). Such a reconstruction will require the role of leisure in humanizing learning cities, socializing common experiences (Hibbler & Scott, 2015), and constructing the health and educational frameworks for infrastructure and organizational policies (Howard et al., 2015). Ultimately, learning cities would provide us the humanity, community, and policy for developing supportive structures, such as parks and recreation areas in nurturing our overall quality of life, health, and community education.

The potential for parks to play a role in community education and lifelong learning brings to life the newer idea of learning cities. Arguably, learning cities could be the 21st century version that traces back to the century-old land-grant idea and its institutions dedicated to provide land and resources for their citizens. The institution of land-grant colleges was an experiment in higher education in the U.S., but the individual states decided upon their respective establishments. As a result, various official establishment years of land-grant colleges existed according to the First Morrill Land-Grant Act of 1862. These land-grant colleges were presumably open to the public, becoming less prestigious than their older counterpart colleges that offered education for a privileged few (McDowell, 2001; Williams, 1991). The faculty of traditional education taught liberal arts and classics, while the land-grant colleges required an industrial new education acting as the national schools of science in agriculture, mechanics, and polytechnics. The key point has been that the original establishment of land-grant colleges has remained an experiment in transition, reinforced by the Hatch Act of 1887; the Second Morrill Act of 1890, and Equity in Educational Land-Grant Status Act of 1994 (McDowell, 2001).

The importance of land-grant institutions in this chapter is that they serve as a forerunner for the future of learning cities that expands education and learning to the public community. What is also important to note is that the land-grant idea and its institutions have been instrumental in promoting engaged scholarship through the trifold mission of teaching, research, and service: Now a hallmark of American higher education.

The practice of transforming urban space into urban greenspace, within the context of learning cities, takes on diverse concerns of communities. Still there remains a need to consider the social, political, even educational concerns for serving the good of humanity and community. For example, a significant organization that signaled an important movement in community education is the Highlander Folk School (1932-1961), which Myles Horton founded that served people struggling for social and economic justice (Stubblefield & Keane, 1994). Horton and Highlander represented a nontraditional view of education and social analysis to understand societal power in order to change it (Peters & Bell, 2001). The Highlander School and its social-educational activities developed into a radical institution and environment attracting a wide variety of visitors, writers, ministers, musicians, labor and political leaders, students, educators, government officials, and social reformers (Horton, 1989). The work of Horton and Highlander, as highlighted by the civil rights movement, was "toward a 'complete' democracy in all sectors of society; economic, political, industrial, and family" (Peters & Bell, 2001). Addressing the build environment as a way to increase the health and well-being for individuals will undoubtedly have to address the power that confronts these ambitions. Using environments to advance healthy communities must empower individuals, through community education and lifelong learning, to collectively act to bring about sustainable social justice and change.

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Literacy Impact of Lifelong Education

The major lessons from such nontraditional sources of education and learning feature the expansive opportunity of the build environment to supporting collective and cooperative action. Educational organizations, must not only develop individuals, but also change communities to address the literacy power and problems that lie within them. Also, such organizations must collaborate with every sector of society to support a diversity of concerns such as health disparities. Developing initiatives in these ways would advance the notion of learning cities that allow people to work together toward a comprehensive democracy, where all voices are welcomed, heard, and appreciated.

In adopting a broader view of community education, it seems vital to remember the seminal writings of early 20th century thinker, Basil Yeaxlee and his thoughts about lifelong education and learning. Yeaxlee introduced learning and education as a lifelong enterprise (from cradle to the grave), integrating learning across work, leisure, and community (Cross-Durrant, 2001). Now almost every OECD country, from South Korea to Canada, makes reference to lifelong learning and the knowledge society in its education policies and its concepts now constitutes a meta-discourse in policy terms (Green, 2002). In wide agreement, lifelong learning promotes a transformation of education that fully develops individuals for perpetual growth, harmony, and the "wholeness" of humanity (Cross-Durrant, 2001).

More recently, lifelong learning has been further advanced referring to both individual and institutional forms of learning (Jarvis, 2004). Individual in that lifelong learning occurs throughout a person's entire lifespan, while institutional where lifelong learning occurs in formal educational settings. This explains how it involves formal, non-formal, and informal learning situations (Jarvis, 2004; Livingston, 2002). Compared with the strands of lifelong education, resemblances occur where informal learning situations are connected to expressions of community education, and non-formal learning situations are connect to expressions of continuing education. However, formal learning, which usually refers to institutional schooling, does not resemble expressions of recurrent education. In fact, formal learning has often ignored the intent to provide education as a public good for all (Chapman & Aspin, 1997; Jarvis, 2004).

Many would agree that any phrase claiming "lifelong learning for all" involves an individual and private expression of learning coupled with an institutional and public application of education. In this way, learning and education are distinct properties that are combined to form a new meaning for lifelong learning: A meaning that engulfs past differences into future roles and responsibilities; aims and aspirations; performances and outcomes for a larger learning-knowledge society (Yorks & Scott, 2013). Because lifelong learning is both private and public, it must extend itself within the context of economic and social change (Chapman & Aspin, 1997). The most pressing issue in the current century involves work and employment in a knowledge economy (Chapman & Aspin, 1997; Livingston, 2002).

In current times, it would be a similar mistake to view education only for the sake of attaining employment or for the sake of acquiring social skills. These are equally essential, but still overlook the importance of developing ones' community and collective society. The significance of including health and health services into the discussion of worldwide systems, bring about new ways of viewing education. These new ways would view parks, as nontraditional systems of continuing education, for the sake of understanding health and healthy communities. One major distinction about parks, although it may not offer accredited courses or guaranteed paying jobs, is that parks do offer the spaces for reinventing and prioritizing important needs. For what good is it to acquire a degree, if the knowledge obtained have not improved real lives; how long can we really work effectively, if our health undermines that work, jobs,

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and employment? The overall health that we are considering is not only individual, but also social; and the ultimate life we are promoting continues at every stage, lasting across generations.

Community education, lifelong education, or lifelong learning are different terms, but with similar meaning in its role for improving individuals' health, life, and well-being. However, it is important to note that lifelong learning is interpreted and practiced differently across areas of the United States, North America, and Europe in addition to South American, African, Australian, and Asian countries. These different interpretations will influence how lifelong learning policies are introduced and how learning cities will be advanced in respective communities. Yet, an overall common theme could describe lifelong learning that occurs throughout an entire lifetime, "from the cradle to the grave." It could address the distinctions regarding where this learning-for-a-lifetime may take place, which would bring about the meaning of learning in its relation to education, and other associated expressions such as community, continuing, and lifelong education. For the purposes here, we express lifelong learning in its broadest view that aligns with many nontraditional systems of continuing education, namely parks, or fundamental policies, specifically revisiting legislation of the Lifelong Learning Act, which further describes the societal impact and practice of learning cities in America (Scott, 2015).

DISCUSSION OF LIFELONG LEARNING, LEARNING CITIES, AND HEALTHY COMMUNITIES

Adopting a more comprehensive view of education and learning, from the start, resolves ongoing philosophical debates that span several decades (Jarvis, 2004). For instance, learning has been often attached to its immediate and practical activities, the acts of doing and achieving a list of goals and objectives. Likewise, education has been associated with its formal systems and structures insofar as producing and rewarding credentials and degrees, not for the purpose of improving the health and quality of life of human beings. In other words, education and learning have often been overlooked in considering the overall health of our society. The role of parks as educational structures can change the way education is viewed, such that the phrase, learning cities could become a common expression shared by all. Key expressions to underscore this renewed language of education and learning relating to healthy parks and people include "the giving of self in service" and individuals being "in perpetual living relationship to the whole." Both expressions describe education and learning as a continual process of connecting individuals to helping the entire community. In this way, lifelong learning takes on a greater purpose for everyone without exception, in the overall health, life, and learning-for-all.

Thinking about lifelong learning, as an all-inclusive education, may mistakenly suggest a distinction among individuals in our community, between adults and children, or different persons and their reasons for knowledge and skills. For some, it may be lifelong learning to work for everyone in a health community. For others, it must remain an all-inclusive concept that respects individual differences, yet remain a concept that does not divide others by their differences. By promoting learning cities, social unity is being argued for through the practice of lifelong learning. Within nontraditional continuing education structures, learning occurs outside of schools, colleges, and universities; in healthy communities, interaction among individuals takes place for other reasons than work, especially for reasons of recreational leisure, public health, and lifelong learning.

Augmented by meanings of community education and lifelong education, lifelong learning serves as another point into describing learning cities and the diverse individuals within communities. Exploring

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the wonderfully inexhaustible realms of collective knowledge signals the continuing process of inquiry and discovery that defines lifelong learning. Learning cities would allow lifelong learning to be cultivated, where humans can learn, personally and collectively, to live healthy lives and share spaces for continual development.

Just as land-grant institutions advanced the trifold mission of teaching, research, and service, Chapman and Aspin (1997) describe lifelong learning for three central elements: 1) economic progress; 2) personal development and fulfillment; and 3) social inclusiveness and democratic understanding. Economic progress has been closely associated with jobs and employment. Simply, earning a living wage has been an issue that cuts across social concerns of poverty and lower-economic classes. Personal development underscores the role of individuals to pursue their happiness and to take care of their personal health through actions, such as exercise, recreation, and nutrition. Social inclusiveness takes on a collective purpose that seeks compromise among individuals and reaches self-governing, democratic solutions for honoring humanity. Lifelong learning, in respect to these central elements, involves the responsibility of everyone to continually change by learning from one another. We continually learn through telling our experiences, revealing our issues, and sharing our solutions to common problems.

The synergy required in developing healthy communities point towards the need for implementing the elements of lifelong learning. We believe that the most productive steps involve the further inclusion of social leisure, public health, and continuing education structures. Such inclusion are the components of healthy parks, healthy communities, and ultimately, learning cities. In short, learning cities brings about a culture of collaboration required for addressing the importance of healthy and healthful communities. The slight distinction between *healthy* and *healthful* is the difference between showing good signs *of health* versus having what is beneficial *to health*. Adding parks show good signs of health in a community, and also applying lifelong learning is beneficial to this health, which becomes apparent in the implementation of learning cities.

FUTURE ARRIVAL OF LEARNING CITIES FOR HEALTHY PARKS

In our view, the future arrival of learning cities describes the support of government, organizations, and institutions in the collective development of education and learning. Thus, the challenge for any definition and description of lifelong learning, especially in regards to others, is how individuals continue to develop their quality of health, life, and well-being. The answer to this question may lie in rethinking lifelong learning and the implementation of parks and recreation areas within a learning cities framework. Since many historical accounts of education have been associated with individuals' preferences, parks are challenged to shift individuals' mindsets to think of a larger collective purpose, such as a healthy society. We contend that lifelong learning can support such an assessment. Supporters of lifelong learning must begin to notice its universal and absolute properties for the collective development in our freedom of expressions, which are in accordance to our community and humanity.

As a result, it would be paramount to consider implementing concepts of lifelong learning and learning cities within parks and communities. In our view, advancing learning cities is the most viable option. In the context of learning cities, education is expanded and learning would continuously happen at every stage of life. Both children and adults, whether across classrooms, parks, or cities would educate, learn, and interact together. The most immediate opportunity that parks and recreation administrators can promote is the need for individuals to continue learning throughout their lives from sharing experiences

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of different social identities, diverse cultures, and distinct challenges. The role of parks, recreation, and leisure, in partnership with other continuing education structures, will help contribute to lifelong learning on a broader scale. Such potential community collaboration reveals what is essential about learning cities, that they bring populations together through the synergy, health and well-being of a fully-diverse society.

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KEY TERMS AND DEFINITIONS

Built Environment: Provides the setting for human action and activity, including parks, buildings, green spaces, communities, and cities; also a determinant of public health outcomes, health status, access to health care, or the provision of care.

Healthy Parks: Acts as nontraditional continuing education structures to support and benefit from the diverse attributes of public health, social leisure, and lifelong learning.

Learning Cities: Represents the geographical space for implementing lifelong learning among individuals, institutions, communities, state and municipal governments.

Leisure: Describes resulted actions relating to time, activity, state-of-mind; values expressing enjoyment, happiness, satisfaction; or engagements demonstrating physical, mental, social development, group interaction, and collective participation.

Lifelong Learning: Situates the continuance of education during every state of living; an action of social participation for the continued benefit of a society.

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Chapter 36
Hunting HIV-Positive Women in Greece as Parasites

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ABSTRACT

In this chapter, the authors discuss public policies of stigmatization and fascitization. In Greece, HIV-positive women have been imprisoned while their personal data have been published in newspapers and the social media aiming to inform citizens and to protect public health.

INTRODUCTION

The society of risk and the economic crisis induced significant changes in the Greek legal traditions. Particularly, there is an enormous and diffused threat emerging constantly from every dimension of social life. Having realized that social contradictions create more and more dangerous precincts, state authorities have been attempting to ensure a sense of security for the citizens. Thus, under exceptional conditions state authorities subsist enforcing the repressive state apparatus while trying to develop the legal framework of the crisis management. Simultaneously, the constitutional phenomenon is subject to the society of risk.

Following the 9/11 in the United States of America, a new situation has been born for the human rights community. The USA and Europe have introduced measures which restrict civil liberties, while applying policies to prevent and manage the crisis. The measures are justified in terms of the need to combat terrorism. Thus, after September 2001, a series of human rights violations have been noted, for example regarding the rights of detainees and asylum-seekers, or the right to privacy (Contiades, 2002, pp127). In Greece, the revision of the Constitution in 2001 has adjusted to changes with regard to the society of risk. In the postindustrial era, problems and conflicts have been aroused and shifted the focus to questions concerning the development of science and technology, the environmental degradation and bioethics. Hence, the new constitutional rights adapted in the Constitution amended in 2001 adopting the logic of "new terrorism", citizens seem to have been losing civil liberties (Alivisatos, 2011).

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Subsequent to the revision in 2001 and 2008, the Constitution responds to the financial crisis, while succumbing to the rhythm of the economic cycle and the demands of the markets. Specifically, the problem of the current crisis in Greece also reflects a constitutional crisis. A coordinated attack on the rights of first and second generation changes or inhibits the role of rights. The deregulation of the social structure has the possibility to jeopardize political and social achievements, as well as to weaken the rights, facilitating the action of molecular fascism and enforcing the fascistization of society. There are several examples of human rights violations documented in Greek society: violation of the right to freedom of expression, the right to a fair trial, the freedom of assembly and association, the rights and freedoms without discrimination and the rights of the individual. Either through the abnormal functioning of the system of checks and balances or through an unclear correlation between rights and their limitations, it is reasonable democracy tends to be relativized.

THE PERSECUTION OF HIV-POSITIVE WOMEN

In the framework of an intervention for epidemic surveillance in a prostitution house in Athens, the Hellenic Center of Disease Control and Prevention (HCDCP) has detected HIV-positive sex workers. Thus, the HCDCP announced the results of their investigation in order to inform and to protect people. Prior to the elections, state, physicians and police officers collected prostitutes and forced them to take an HIV test. Having arrested 32 HIV-positive women (28/4/2012), the attorney of the Athens First Instance Court ordered the disclosure of the prosecution as well as of their identities and photos. The HIV-positive women were imprisoned and the last five of them were released in March 2013.

On grounds pertaining to the protection of the community from contagious diseases, the personal data of HIV-positive women have been published in newspapers, the media, social media and the Internet, which is a major violation of the right to protect personal data. According to the Greek Constitution (Art 9(1)), "all persons have the right to be protected from the collection, processing and use, especially by electronic means, of their personal data, as specified by law" (Center for European Constitutional Law,2001, pp.22. The protection of personal data is ensured by an independent authority, which is established and operates as the law provides (Center for European Constitutional Law,2001, pp.22). Personal data concerns specific information on an individual such as their name, residence, bank accounts, salary and employment, while sensitive personal data refer to the "*sensu stricto*" of private life. This does not mean that the protection of personal data coincides with the protection of privacy (Mitrou, 2001, pp143). Particularly, sensitive personal data refer to religious and political beliefs, health and social welfare, sexual orientation, genetic data or past criminal convictions.

The processing of sensitive data is lawful and is permitted on grounds pertaining to public interest. Thus, the attorney ordered to publish the sensitive personal data and the photographs of HIV-positive women in order to safeguard public health. However, sensitive data can only be processed when the individual provides a written and detailed consent and upon approval of the Independent Authority for the Protection of Personal Data (DPA). A disclosure is allowed only through the official website of the Greek police, while any reproduction of these data is illegal according to the European Court of Justice. The European Court of Justice in the Satamedia case (C-73/07, 16.12.2008) ruled allowing the free flow of personal data from public documents. This means that any publication other than on the official police website is considered the processing of personal data. In order to reach a balance between the

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right to the protection of personal data and the freedom of expression, the ECtHR emphasizes that any derogations must be referred to as a journalist end, or an artistic and literary expression.

According to the principle of legality of the purpose and process mode, the processing of sensitive data should fulfill the conditions guaranteeing the individual's vital interests and should have a legal, tangible aim (Alexandropoulou-Aigyptiadou, 2007, pp 47). In addition, this disclosure violates the principle of proportionality. When applying the principle of proportionality, it is necessary that the processing be suitable for the desired end, be the least restricting to human rights among the others and coincide with the cost and the benefits caused (Chrysogonos, 2002,pp. 92,94). Thus, an unfavorable measure should be the mildest to the aggrieved individual. For example, instead of publishing the names and photographs of HIV-positive women, public authorities should have given information about the prostitution houses or the areas of Athens where these women worked. Furthermore, if HIV prevention is to succeed, it is important to create a social and legal environment that encourages people to get tested for HIV and use HIV services. By reducing stigmatization, discrimination, marginalization and violence, it is crucial to ensure the rights of HIV-positive individuals and their access to justice.

Besides, according to the 2001 revision of the Greek Constitution, all individuals are entitled to the protection of their health and their genetic identity (Art. 5(5) GC) (Center for European Constitutional Law,2001, p.19). Namely, HIV-positive women should be protected from the authorities and informed regarding their health condition. Patient confidentiality guarantees and enforces patients' privacy and prevents from accidental or intentional disclosure. By ministerial regulation (A1/6122 of 16.7/19.9.1986) doctors must report suspected AIDS patients to the head of the Department of the Ministry, in compliance with patient confidentiality. According to Arts. 19 and 3, the use of evidence acquired through the violation of the present article and of Articles 9 and 9(1) is prohibited (Center for European Constitutional Law,2001, p.30). The protection of patients' information is correlated with the inviolability of private life, including the data disclosed between a doctor and a patient. Essentially, patient confidentiality serves the private interest of patients while operating on grounds pertaining to public interest and public health. Confidentiality is fundamental for the healing procedure (Papaenvagelou, 2006, p. 63).

THE VIOLATION OF THE RIGHT TO PRIVACY OF HIV-POSITIVE WOMEN

The protection of personal data is associated with the inviolability of private life and the right to be let alone, as well as the right to the free development of personality (Iglezakis, 2003, p. 49). According to the Greek Constitution (Arts. 9 and 1), the private and family life of the individual is inviolable (Center for European Constitutional Law,2001, pp.21). In a post-panoptic society with the proliferation of "dataveillance", the value of privacy gives the opportunity to individuals to express their diversity and individuality without any fear. All individuals shall have the right to develop their personality freely and to participate in the social, economic and political life of the country (Art. 5 and 1)(Center for European Constitutional Law,2001, pp.22). Even under database or Internet/video surveillance, individuals can decide on their actions and abilities, while protecting their privacy. The violation of the right to private life often leads to insecurity, financial loss, social depreciation and marginalization. For example, HIV-positive face stigmatization and discrimination that has a devastating impact on their self-esteem.

The violation of the privacy and dignity of the individual constitute a loss of control over specified personal data, which essentially is equivalent to a total loss of autonomy. It is crucial that the individual decide which personal data may be published. The right to informational self-determination enforces

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privacy protection. Technical development and the rapid expansion of the Internet provoke terror, categorizing individuals into personal profiles of social media sites. Encountering this danger, the Greek Constitution adopted the right to informational self-determination to ensure that each individual is able to participate in and determine the collection, circulation and use of her/his own personal data.

According to Art. 2 and 1 of the Greek Constitution, the respect and protection of the human being is the primary obligation of the State (Center for European Constitutional Law, 2001, pp.17). The value of a human being combined with the right to informational self- determination succeeds in preventing individuals from becoming an object of data processing. The processing of personal data is dangerous both for the individual and general interest. On the one hand, the right to the free development of personality and the human being are protected, guarantying simultaneously the opportunity to participate in and act as a member of society (Iglezakis, 2003, pp.53). As a consequence, the protection of privacy does neither require the undesirable disclosure and processing of personal data, nor is intended to determine anew our own life and self in terms of freedom.

The right to private life is defined by the content of the right to protect personal data, enhancing the value of privacy. There should be a balance between a sense of security and the autonomy of each individual, which was ruined in the case of these HIV-positive women. Violating the rights and stigmatizing vulnerable groups cannot ensure public health and public interest. Reviving regulation, which allows police authorities to hunt, detain and force suspects to HIV or other contagious disease testing raised international awareness on the infringement of human rights and the fascistization of society.

Moreover, although the right of oblivion (the right to be forgotten) is not explicitly mentioned, it plays an important role in the society of digital memory. The right of oblivion was generated from the free development of personality, the right to protect the human being, the right to the protection of private life, of personal data and the right to informational self-determination (Panagopoulou- Koutnatzi, 2012, pp265). These rights provide that each individual might refuse to be confronted with their unfortunate past events, whether they have forgotten or are trying to forget it (Xanthoulis, 2012, pp8). The DPA ruled (8/2010) that the disclosure and the re-publication of sensitive data is illegal. Thus, according to the right of oblivion, it is permitted to destroy or anonymize personal data in any format: paper or electronic. In the human's rights community there is a tendency to enforce the core of human privacy due to the rapid evolution of ICT technologies.

HIV-POSITIVE PEOPLE AND DISCRIMINATION

What are the underlying dimensions in the case of HIV- positive women? Public shaming of HIV-positive women in Greece reproduces the logic of exclusion and ossifies racial prejudice. It is not a coincidence that several institutional reports link increased incidences of AIDS with groups of people living on the fringe of society, as immigrants. Essentially, authorities cannot fight the AIDS epidemic without banning racial discrimination. Unfortunately, in Greece the phenomenon of racial discrimination is highly widespread and self-perpetuating. The ruling of the European Court of Human Rights (ECtHR) in the case of I.B. v Greece, no. 552/10, 03 October 2013, is extremely crucial and quasi characteristic of Greek society.

This case concerns the dismissal of an HIV-positive employee, who lives in Athens. In response to a letter from his colleagues, the employer decided to call a doctor and have the precautions the staff should take to protect their health explained. Eventually, under pressure and the terror of the contagious

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nature of the illness, the company accepted the demand of the employees to "preserve their health and observe their right to work" and dismissed the HIV-positive employee. The

HIV-positive addressed the Greeks court, however in its ruling of 17 March, 2009 the Court of Cassation claimed that the company tried to defend its interest in order to gain restitution of peace of mind of the workers, who expressed fear regarding their health. Subsequently, the ECtHR ruled against Greece, because Greek justice deemed legal the permanent dismissal of this employee for being HIV-positive. The ECtHR held that a violation of the right to respect for private and family life along with the article on the prohibition of discrimination.

According to the ruling of the European Court, "discrimination meant treating differently, without an objective and reasonable justification, individuals in relatively similar or comparable situations. The Court considered that if the applicant's situation was compared to that of other employees, it was clear that the applicant had been treated less favorably than another colleague would have been, on account of the fact that he was HIV positive. The company's very existence was not threatened by the pressure exerted by the employees. The employees' prejudice could not be used as a pretext for ending the contract of an HIV-positive employee. Thus, I.B. has been a victim of discrimination on account of his health status, in breach of Art. 8 taken together with Art.14 (Case of BI v Greece, 2013)".

These two cases provide evidence to a dimension of structural and institutional racism in Greece, which expands the stereotypes. These situations underline existing oppositions between the legal frameworks of human's right and domestic strategies managing racial phenomena. Institutions often invoke general or public interest resulting in the violation of individual rights. People with "an undesirable difference" are associated with the concept of stigma, which elaborates discrimination and the basic sense of hierarchical behavior (Goffman,1963). The process of stigmatization depends on factors such as gender, sexual orientation, race, national or ethnic origin and class. It is important to read over and to comprehend the relation between domination and the way stigma functions. Adhering to the rules and obligations that status law defines, the body may be punished and the HIV-positive may be expelled, because s/he seems not to be able to participate in the social sphere (Foucault, 2011). UNAIDS defines the "HIV-related stigma and discrimination as a process of devaluation of people … Discrimination follows stigma with devastating results for people and unfair treatment (UNAIDS, 2007, pp.9)".

THE PROTECTION OF PERSONAL DATA IN AN EU'S FRAMEWORK

The digitalization of information combined with ongoing technological developments has increased the flow of data and a tremendous amount of reference to personal information. In the 90's the European Union was mostly a market-creating organization and for this reason the legal framework of data protection was limited to the violation of rights by market actors (Iglezakis, 2003, pp.146, 196). Later, the European Court of Justice clarified that the protection of personal data protracts beyond economic activities in other domains. Thus, in 1997 the Amsterdam Treaty extended the application of data protection and established the European Data Protection Supervisor, a supervisory authority. Simultaneously, the exchange of information among law enforcement authorities required the safeguarding of the harmonization of data protection rules, namely to prevent and prosecute criminal acts (Opinion of Advocate General Leger, 2006). This growing demand of collaboration is a result of the intensification of police cooperation within the European Union as a result of the terrorist attacks in New York.

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Regarding the protection of personal data, the Lisbon Treaty affirms that "Everyone has the right to the protection of personal data concerning her/him and that compliance with data protection rules shall be subject to the control of independent authorities" (Treaty of Lisbon,1997). "The European Parliament and the Council will jointly define the data protection rules relating to the processing of personal data both by Union Institutions (and bodies) and by Member States, when carrying out activities which fall within the scope of Union Law". Naturally, according to treaty and case law, the European Union accedes to the European Convention of Human Rights (ECHR) (Treaty on EU, 1992), without being part of it. Furthermore, the Charter of Fundamental Rights declares that fundamental rights as guaranteed by the ECHR and resulting from constitutional tradition common to the Member States are to be integrated into the Unions Law (The Chapter of Fundamental Rights, 2009).

There is a series of cases constituting the source of the configuration principles of law pertaining to the collection and processing of data and mainly of personal data. Especially, in the case of Z. v Finland (no. 22009/93, 25/02/1997), the ECtHR emphasized the protection of sensitive personal data. Thoroughly, in Finland during an investigation of an attempted manslaughter, the police demanded that the suspect undergo HIV testing. The suspect agreed to testing and learned that he was

HIV-positive. In the framework of the investigation police officers attempted to find his spouse and informed her that X was an HIV carrier. Z. refused to provide information on his husband or her health condition. On May, 27 1992 the prosecutor ordered that the police officers address physicians from the hospitals X has been treated in. Having interviewed the physicians in order to find evidence, the prosecutor ordered that the couple stands as witnesses at court, where they affirmed their health condition. The court's ruling has been published in a newspaper in Finland, bringing to light the name of X's wife and her medical situation.

According to the judgment of the ECtHR, "the protection of personal data, not least medical data, is of fundamental importance to an individual's enjoyment of her/his right to respect for private and family life, as guaranteed by Art. 8 of the Convention. Respecting confidentiality of health data is a vital principle in the legal systems of all the Contracting Parties to the Convention. It is crucial not only to respect the sense of privacy of a patient but also to preserve her/ his confidence in the medical profession and in the health services in general. Without such protection, those in need of medical assistance may be deterred from revealing such information of a personal and intimate nature as may be necessary in order to receive appropriate treatment and, even, from seeking such assistance, thereby endangering their own health and, in case of transmissible diseases that of the community (The Case of Z v Finland,1997,pp16)". Moreover, the ECtHR affirms that a Member State's legislation should safeguard personal health data and prevent them frok any publicity.

Respectively, the same principles pertaining to the protection of personal data were confirmed by the ECtHR in the case I. v Finland, (no. 20511/03 17/7/2008), . Underlying these cases, sensitive personal data must be secured from proceeding, collection or disclosure. Domestic legislation should ensure the freedom of information, providing at the same time the protection of the right to respect private life. However, under exceptional circumstances, the derogation of this general rule is allowed. This means that limitations and restrictions are crucial when state security and public interest are put in jeopardy (Sicilianos, 2001, pp134). Following this tendency, is it bizarre to think that growing exceptions constitute an unspecified source of risk for individual rights?

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GENDER, DOMINATION, AND MARGINALIZATION

Reproducing gender contracts and industry present the female body and "sells" women as objects through pornography and advertising. The image of women as objects of pleasure associated with the most fetishized part of the male body reproduces social relations within the patriarchal society. Thus, men and women follow the requirements of society governed by sexism while playing the active and passive role, respectively (Foucault, 1989, pp58, 59). This means that behaviors, attitudes and institutions based on the supposition of male dominancy and superiority. It is crucial to mention that at the beginning of the second half of the 20th century, the erotic desire of men needed to be satisfied directly, because it was recognized as a biological instinct (Kinsey, 1957, pp. 27). Therefore, women must discipline and shape a "docile body" in response to femininity, as expressed by the era (Foucault, Supervision and Punishment, 1989, pp20).

Apart from the role of increasing commercialization, HIV-positive individuals have been persecuted as witches once have been, as the symbols of non-reproductive sexuality. This logic confirms the prevailing view in the middle ages and connects the femininity of prostitutes with a filthy body, polluted and dangerous for public health. Naturally, this is opposed to the view of femininity in terms of chastity, serving the stereotypes of the "good wife". Protecting the marriage bond ensures a way of life which is socially acceptable (Foucault, 1993, pp179). It guarantees the sacred role of the family, of the good patriarchs working hard for their family's needs, of the active and moral citizens. With the convulsion of the power of Hitler, the Nazi continued proclaiming the conservative sexual morality (Roos, 2002). Essentially, by protecting the social institution of family, authorities did not negotiate the existing policy for the production of labor power (Federici, 2012, pp.193). The body in each case submits to a dominant discipline system and is converted into a field of violent, social relations.

Since late 1996 and early 1997, streetwalking has been a trivial form of prostitution (Lazos, 2002, pp.271). Police officers have been seeking to expel or control street prostitution, enforcing blitzes in prostitution houses/hotels and bars/pubs. Namely, their efforts focused on stopping prostitution by moving it away from the moral glances of passing citizens. A similar logic was applied in Germany at the time of Hitler: prostitutes were registered, controlled and had to work only in homes in order to satisfy the religious ethics of citizens (Roos, 2002). Nowadays, under the new conditions of development reprinted in the pulse and spatial planning of towns, clients are used to finding and meeting the "product", choosing a prostitute. Thus, it is necessary to combat the voluntary and forced prostitution of a renewed international network trafficking, otherwise we discover anew with surprise the existence of second-class citizens and their manipulation.

Prostitutes as potential disease-carriers are represented as a threat to social order. Since the 80's and the 90's, authorities have attempted to deal with HIV/AIDS and deducted that the source of social contagion are prostitution, homosexuality, immigration and drugs. Thus, addressing this new phenomenon, they try to inform citizens about their sexual choices and the danger of frequently changing sexual partners. In police operations aiming to safeguard public health combating HIV/AIDS, prostitutes (mainly women) are arrested and tested. Even though patriarchs actively participating in the act of prostitution are an integral part of commercial sex, no one claims these men responsible for potentially spreading venereal diseases both to their wives and other prostitutes. Based on a reconceptualization of prostitution, it is

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high time we discussed women's sexual subordination to men and the condemnation of gender-stereotype behaviors, while respecting diversity. It is crucial that the issue of an epidemic of terror and discrimination be triggered, while acknowledging that women are more likely to be affected, for socio-economic and cultural reasons.

CONCLUSION

Nevertheless, the triggering event resulting in the violation of rights could be fear or market, thus the European Union attempts to shield the protection of individuals rights and generally provides humans right and the principles of Human Law in a parliamentary democracy. The protection of rights pertaining to sensitive personal data, medical confidentiality as well as private and family life permits each individual to participate in the social, economic and political life. Concerning the "combating of certain types of discrimination regarding employment and occupation", in the case of Chacon Navas (C-13/05) the ECJ clarified that "by using the concept of disability, the legislature deliberately chose a term which differs from 'sicknesses`. The two concepts cannot therefore simply be treated as being the same" (The Case C-13/05,2006). Thus, the Court of Justice of the European Union has not ruled whether the concept of "disability" includes seropositivity.

According to the Human Rights Commission of the Council of Europe, "the challenges presented by HIV/AIDS require renewed efforts to ensure universal respect for and observance of human rights and fundamental freedoms for all. Emphasizing the responsibility of governments, in a spirit of human solidarity and tolerance, to counter social stigmatization and discrimination against those affected by HIV/AIDS, their families and those with whom they live, and people considered to be at risk of infection (Commission on Human Rights, 1996)". The International Labor Convention urges that seropositivity should not constitute a ground for discrimination regarding employment and occupation.

However, Canada and the USA have managed to essentially criminalize HIV, aiming to limit the transmission of HIV. Especially, the Supreme Court of Canada held that an HIV-positive individual must disclose her/his health condition to their partner before deciding any consensual sexual conduct, which poses a "significant risk" to the partner's health (Canadian HIV/AIDS Legal Network, 2012). These countries integrate criminalization as a policy to reduce ongoing evidences of HIV. This policy includes - among others – criminal prosecution for spitting as an illegal act hazardous for public health. Obviously, this has created a widespread confusion about the meaning of "significant risk". The prevention of HIV transmission should mean neither the violation of the rights of each individual, nor the pillory and criminalization of HIV exposure in the name of public health and terror. These state guidelines may punish behaviors, reproducing stigmatization, marginalization and the logic of racism.

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KEY TERMS AND DEFINITIONS

Docile Body: According to Foucault, individuals within their bodies are subjected to institutional regulation.

Gender: The term gender refers to the socially constructed roles, behaviours, attitudes and activities and sex concerns to a person's biological status.

HIV-Positive People: Means that individuals have been exposed to the Human Immunodeficiency Virus and there is the possibility to pass the virus along to others. Being HIV- positive does not mean that someone have AIDS.

Institutional Racism: Institutional racism is the phenomenon of involving procedures, practises and policies that intentionally or unintentionally reproduces the logic of racism.

Protection of Personal Data: The term protection of personal data constitutes an essential right, which protects and ensures data subjects and their privacy.

Right to Privacy: The right to privacy is the right to be left alone.

Structural Racism: Structural racism is the intersection of several fields of institutional racism as a result of the logic of racism being normalized and prevalent naturally.

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Chapter 37
Health Impact of Water-Related Diseases in Developing Countries on Account of Climate Change:
A Systematic Review – A Study in Regard to South Asian Countries

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ABSTRACT

Human health is heavily dependent on clean water resources and adequate sanitation. According to the WHO, diarrhoea is the disease most attributable to quality of the local environment. It has been estimated that 88% of diarrhoea cases result from the combination of unsafe drinking water, inadequate sanitation, and improper hygiene. A meta-analysis has been conducted over the existing literature specifically targeting water-borne and water-related diseases in developing countries. The results are synthesized through the simplest meta-analysis strategy: vote-counting. Given the range of impacts on account of climate change there is an urgent need of proper intervention to counterbalance the expected increase of occurence of water-related illness But given the limited progress in reducing incidences over the past decade consorted actions effective implementation and integration of existing policies is urgently demanded.

INTRODUCTION

Impacts of Water Related Illness on Health

The Third Assessment Report of the IPCC (IPCC 2001) estimates that globally the average land and sea surface temperature has increased by 0.60±0.2°C since the mid-19th century, with much of the change occurring since 1976. Of the many impacts of climate change, those on human health are often placed

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amongst the most worrying. The impacts of climate change on human health are many and complex. GHG emissions can in principle be considered as risk factor that could potentially be altered by human intervention, with associated effects on the burden of disease.

The increase in the frequency and intensity of extreme temperatures have direct and indirect effects on health. Direct effects include thermal stresses (cardio-vascular and respiratory diseases, heat exhaustion, heat cramps and dehydration), while indirect effects are related to the impact of heat extremes on urban air pollution and humidity (which can aggravate pre-existing morbidity).

Extreme temperatures tends to aggravate pre-existing respiratory and cardio-vascular diseases. In the recent years, extreme weather events, such as floods and landslides, storms, cyclones and droughts, have caused considerable damage and loss of life in China, Venezuela, Bangladesh and Mozambique. Direct impacts of extreme weather events include increased incidence of deaths, physical injuries and psychological stresses, while indirect impacts are related to increased risk of exposure to water-borne diseases due to water contamination, and impacts on malnutrition due to loss in agricultural production. Unsafe water and sanitation conditions and decrease water accessibility would further increase the transmission of infectious diseases (Markandya and Chiabai.,2009).

Climate change also leads to outbreak of water-borne diseases, with cholera and diarrhoea being potentially most problematic(McMichael *et al.*, 2006) The Intergovernmental Panel on Climate Change (IPCC) has declared with "very high confidence" that climate change already contributes to the global burden of disease (Confalonieri et al., 2007).

Human health is heavily dependent on clean water resources and adequate sanitation. According to the WHO, diarrhoea is the disease most attributable to quality of the local environment. It is estimated that 88% of diarrhoea cases result from the combination of unsafe drinking water, inadequate sanitation, and improper hygiene (WHO 2006, Pruss-Ustun 2006). Environmental factors account for an estimated 94% of the global disease burden for diarrhoea (WHO 2006), which is a leading cause of death among children. One of the main sources of diarrheal disease is contamination by faecal-oral pathogens that are largely caused by a lack of safe drinking water and sanitation facilities. Additionally, inadequate sanitation poses threats to the environment from improper disposal and treatment of human waste. It is important for populations to have access to drinking water and adequate sanitation because these factors play large roles in human health.

The IPCC summarized the main health impacts as follows:

- Increases in malnutrition and consequent disorders, with implications for child growth and development
- Increased death, disease and injury due to heat waves, floods, storms, fires and droughts
- Increased burden of diarrhoeal diseases
- Increased frequency of cardio-respiratory diseases due to higher concentrations of ground level ozone related to climate change
- Altered spatial distribution of some infectious disease vectors.

According to Haines et al(2006) research studies on the health impacts of climate change addresses three main topics- current associations between climate and disease; the effect of recent changes in climate; and the evidence base for projecting the future impacts of climate change on health.

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The impact of climate change on human health vary greatly depending on many variables including the behaviour, age, gender, race, and economic status of individuals. Moreover, such variables can also be expanded to include region, the sensitivity of populations, the extent and length of exposure to climate change, and society's ability to adapt to change. People living in small islands and coastal regions, megacities, and mountainous and polar regions are particularly prone to such degrading environmental conditions. McMichael et al (2000) inferred that the effects of global climate change are predicted to be heavily concentrated in poorer populations at low latitudes, where the most important climate-sensitive health outcomes (malnutrition, diarrhoea and malaria) are already common, and where vulnerability to climate effects is greatest affecting mostly the younger age groups.

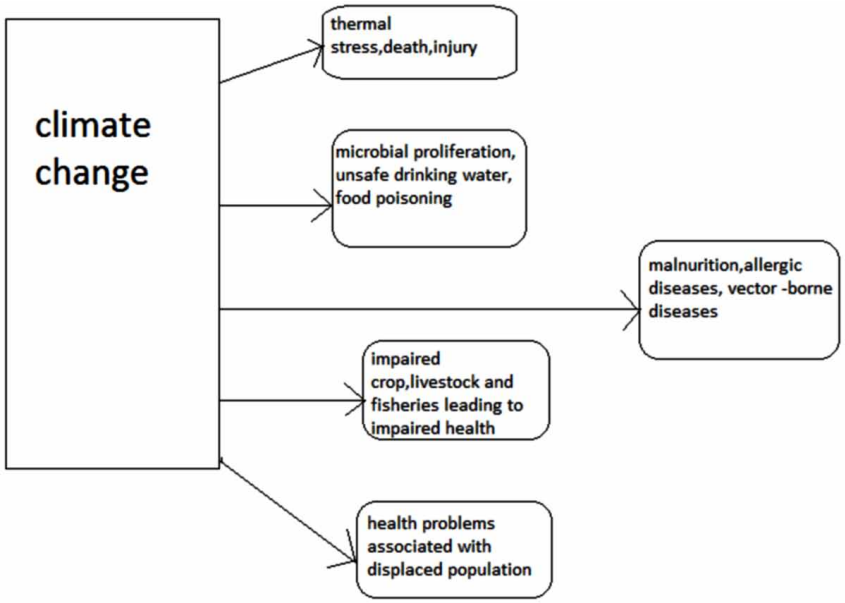
Likewise, children living in poor countries, the elderly, and those with infirmities or pre-existing medical conditions will be affected most sensitively by these alterations.

Figure 1 gives us an overview of the impacts of climate change on human health and what sort of mitigation and adaptive measures are required to resolve the problem.

Though different studies have tried to address the impacts of climate change on human health but as per IPCC(2014) there lies important research gaps regarding the health consequences of climate change and co-benefits actions, particularly in low-income countries.

Human health therefore figures prominently in assessments of the impacts of climate change. The welfare costs (or benefits) of health impacts contribute substantially to the total costs of climate change (Cline, 1992; Fankhauser, 1995; Tol, 2002). The majority of estimates of the economic damages of global warming rely on the methodology of direct costs, that is, damage equals price times quantity. In case of human health, the price is typically equal to the value of a statistical life, which is based on estimates of the willingness to pay to reduce the risk of death or diseases, or the willingness to accept compensation for increased risk (Viscusi and Aldy, 2003).

Figure 1. Impacts of climate change on human health



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Benefits of Quantification of Health Impacts of Water Pollution and Valuation

Climate change in regard to water pollution is also posing risks to human population health and well-being and thus is emerging as a serious concern worldwide (Kovats and Haines, 2005,Tol 2008., Stern.,2007) . In 2000 climate change was estimated to be responsible for approximately 2.4% of worldwide diarrhoea and 6% of malaria. According to the IPCC third assessment report the world temperature is expected to further rise during the century, implying increased health threats for human populations, especially in low-income countries.

According to Markandya and Chiabai (2009) Asia, Africa, Small island developing states and North America are mostly affected by water-borne diseases on account of climate change.

Reviewing the US literature addressing health impacts of climate variability and change Ebi et al.(2006), conclude that climate change is expected to increase morbidity and mortality risks from climate-sensitive health outcomes such as extreme heat events, floods, droughts and fires. A spread in vector–borne diseases, like malaria, is also expected (Remoundou and Koundouri, 2009).It follows from WHO(2004) that Diarrhoeal diseases account for 1.81 deaths in millions. Checkley et al. (2000) observed that daily hospital admissions for diarrhoea exhibited a twofold increase per 5 °C increase in the mean ambient temperature. Diarrhoea outbreaks are related to periods of heavy rainfall and runoff when subsequent turbidity compromises the efficiency of the drinking water treatment plants.

According to WHO(2004), diarrhoea is responsible for the loss of 73 million DALYs, acute respiratory tract infection for 95 million DALYs, malnutrition for 39 million DALYs and neglected tropical diseases for 19 million DALYs; all of which are directly or indirectly related to sanitation. Worldwide, diarrhoea, acute respiratory infections, malaria and immunizable diseases account for 70% of the deaths among children aged 0–4 years. It also suggests diarrhoeal diseases caused by inadequate access to safe water, lack of sanitation and poor hygiene may contribute up to 10% to the total burden of disease.In the context of South Asian countries there lies a significant relation between impact of climate change and incidence of water-related illnesses.

Climate change is by and large a relatively distal risk factor for ill-health, often acting through complex causal pathways which result in heterogeneous effects across populations.

Valuation Techniques for Measuring Health Impacts

Quantifying the range of human health impacts on account of climate change have been undertaken in the recent past.

Table 1. Health determinants and health outcomes existing in South Asian Countries

Events of Climate change	Bangladesh	Bhutan	Nepal	India	Sri Lanka
Malaria	Yes(NM)	Yes(NM)	Yes(T)	Yes(NM)	Yes(NM)
Dengue	Yes(NM)	Yes(NM)	No	Yes(NM)	Yes(NM)
Water-borne diseases	Yes(NM)	Yes(T)	Yes(T)	Yes(T)	Yes(T)
Water scarcity, quality	Yes(NM)	Yes(NM)	Yes(M)	Yes(M)	Yes(M)

Source: WHO(2005)
M=Mountainous, NM= Non-mountainous

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Various methods have been in the literature for the estimation of health outcomes of climatic change (Martens and McMichael 2002; McMichael and Kovats 2000). Gap still prevails regarding future projections on observed long-term climate trends due to lack of standardized long-term monitoring of climate-sensitive diseases in many regions, methodological difficulties in measuring and controlling for non-climatic influences on long-term health trends. The changes that have occurred so far are an inadequate proxy for the larger changes that are to forecast for coming decades.

Several studies has tried to address the issue of health impact on account of water pollution but a handful had tried to focus on specifically addressing the issue of water related and water borne illnesses on account of climate change(Markandya and Chiabai.,2009,Kim et al.,2014, McMichael et al.,2004,McMichael et al.,2006,Molla et al., 2006)

There are two alternative strategies generally undertaken for valuing environmental change affecting human health. The first strategy is to develop a comprehensive model of individual behaviour and choice in which environmental quality is one of the determining variables where such models will help in estimating willingness to pay as a functional of change in environmental quality. The second strategy is to deal with the two links separately. Economic values of changes in health risks would be derived and then that will be combined with independently derived predictions of health changes or risk changes as a function of environmental change.

Cost-effectiveness analysis (CEA) which is a technique for least cost intervention, which enables us to define priorities among different alternative interventions by identifying the least cost option to reach the underlying objectives. CEA is sometimes used as a second-best option when a full-blown Cost-Benefit Analysis (CBA) would be desirable, but many benefits cannot easily be monetized (Ortiz., 2005).

The cost-effectiveness ratio of a program is computed by dividing the annualized costs of the program by the physical benefits, measured in terms of lives saved (or life years saved), and cases of illness avoided. Results are expressed as unit costs, in terms of costs to be supported to save one life (or one year life) and to avoid one episode of illness. If all else is the same, the program deemed more cost-effective would be the one with the lowest cost per life saved or avoided case

In the context of climate change CEA is a useful tool to provide a measure of the costs of a program in terms that are comparable across programs. Studies on the costs of adaptation programs are indeed difficult to compare in a way that provides some guidance on whether they are justifiable or not (Markandya and Chiabai, 2009).

Remoundou and Koundouri (2009) in their study addresses on the main approaches for health impact valuations which can be broadly classified into revealed and stated preference techniques. Revealed preferences include cost of illness, human capital surveys, hedonic pricing and the Quality Adjusted Life Year studies or stated preference studies preferably the Contingent Valuation Method (CVM) and the Choice Experiments (CE).

As a researcher it becomes difficult in making a choice between various valuation techniques that exist in the literature as different estimation techniques have their own strengths and weaknesses. Given that limitation as well as time and budget constraints different studies had tried to capture the impacts on human health on account of water pollution.

Diener et al(1998) conclude that studies undertaking contingent valuation should distinguish between compensating variation and equivalent variation, and recognize that respondents can be gainers or losers in utility and therefore should be asked willingness-to-pay (or accept) questions as appropriate. Current critical-appraisal guidance in the health care literature for CBA is poor and unlikely to offer useful de-

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marcation between good and bad CBA studies. More work is needed exploring whether recently issued guidelines for contingent valuation in environmental damage assessment are applicable to health care studies.

Since primary data collection to establish the dose response functions or proceed with the valuations can be expensive and time-demanding, there is substantial policy interest in using benefit transfer techniques in the recent days. In this context, original values from existing studies are transferred to policy sites after correcting for certain parameters. Given the number of valuation studies, several meta-analyses studies have been popular in the recent past. Following this approach valuation estimates from existing studies are collected and the determinants of these estimates are examined. Meta-analyses can feedback the establishment of value transfer functions to estimate values for policy sites of interest based on properly adjusted information from existing studies on similar sites, study sites.

Diener et al., (1998) implemented meta-analysis in the context of CVM for valuing health care. 48 CVM studies were retrieved. It has been observed that the number of health care CVM studies is growing rapidly and the majority are done in the context of CBA. Moreover there is a wide variation among health care CVM studies in terms of the types of questions being posed and the elicitation formats being used. The classification and appraisal of the literature is difficult because reporting of methods and their relationship with the conceptual framework of CBA is poor.

There has been, however, been no formal systematic review specifically targeting the impact of climate change and health impacts in the context of water pollution except Fewtrell and Colford(2004) and Fewtrell et al., (2005).

We present a systematic review of all published studies where the occurrence of diarrhoeal disease has been considered as an impact of climate change. Other than that the review also incorporates studies which had adopted several interventions/ adaptive measures to minimise the occurrence of water-related illnesses in less developed countries and developing countries.

Diarrhoeal diseases are highly sensitive to climate, showing seasonal variations in numerous sites (Drasar et al. 1978). Diarrhoeal disease is one of the leading causes of morbidity and mortality in developing countries, especially among children under the age of five (Kosak *et al*., 2003; Prüss *et al*., 2002)

Climate-sensitivity of diarrhoeal disease is consistent with observations of the direct effects of climate variables on the causative agents. It has been observed that temperature and relative humidity have a direct influence on the rate of replication of pathogens, and on the survival of entero viruses in the environment. Studies like Eberhead et al., 1999, Purohit et al., 1998 describe climate effects on particular diarrhoea pathogens.

LITERATURE REVIEW

A literature review search has been conducted to survey studies on the area of health impacts due to climate change over the years. Very few papers had targeted to address the health impacts on account of water pollution as a result of climate change. Some of the key papers have been discussed as follows.

Purohit et al (1998) was one of initial studies in India tried to conceptualize relation between seasonal variation and occurrence of diarrhoea. Box-Jenkins methodology was employed for the analysis. The model suggested a strong influence of climatic changes on the incidence of the disease. Further study of weather parameters not only confirms that daily minimum temperature is the principal factor but also

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revealed that easterly wave is useful in predicting the peak of hospital admissions and the geographical sequence of outbreaks of the disease in tropical India.

Singh et al (2001) carried out two related studies in Pacific Islands to explore the potential relationship between climate variability and the incidence of diarrhoea. In the first study, they examined the average annual rates of diarrhoea in adults, as well as temperature and water availability from 1986 to 1994 for 18 Pacific Island countries. There was a positive association between annual average temperature and the rate of diarrhoea reports, and a negative association between water availability and diarrhoea rates. In the second study, they examined diarrhoea notifications in Fiji in relation to estimates of temperature and rainfall, using Poisson regression analysis of monthly data for 1978-1998. There were positive associations between diarrhoea reports and temperature and between diarrhoea reports and extremes of rainfall.

Bosello et al (2004) tried to quantify economy-wide impacts on human health due to climate change. Here they estimated the economic effects of human health impacts, and compare these to the direct welfare costs. In order to assess the systemic, general equilibrium effects of health impacts, induced by the global warming, they made an unconventional use of a standard multi-country world CGE model: the GTAP model. For diarrhoea, they report the estimated relationship between mortality and morbidity on the one hand and temperature and per capita income on the other hand, using the WHO Global Burden of Disease data. GDP, welfare and investment fall (rise) in regions with net negative (positive) health impacts.

Fewtrell and Cohord (2004) conducted a systematic review on intervention through improvements in drinking water, sanitation and hygiene facilities and diarrhoea. All interventions reduced diarrhoea morbidity, with pooled risk ratios ranging from 0.98 to 0.51 (where a risk ratio of 1.0 indicates no effect and lower risk ratios indicate stronger effects). The removal of poor quality studies from the analyses improved the strength of the intervention impact in most cases. The 95% confidence intervals (CIs) for the pooled risk ratios of various interventions overlapped, indicating their effects were not statistically significantly different from each other. In developing countries, water quality interventions, specifically point-of-use treatment, reduced diarrhoeal illness levels. Water supply interventions reduced diarrhoea, but this effect was mainly seen with the provision of household connections and use of water without household storage. Hygiene interventions, especially those promoting hand-washing, were effective. Only limited data were available for sanitation interventions, but these suggested effectiveness in reducing diarrhoea. Multi-factorial interventions consisting of water supply, sanitation and hygiene education acted to reduce diarrhoea but were not more effective than individual interventions. Relatively few studies examined interventions in established market economies. Those that did supported the effectiveness of hygiene interventions, sanitation, and water supply.

McMichael et al (2004) analyses suggested that climate change will bring some health benefits, such as lower cold-related mortality and greater crop yields in temperate zones, but these will be greatly outweighed by increased rates of other diseases, particularly infectious diseases and malnutrition in developing regions. Climate change was estimated to increase the relative risk of diarrhoea in regions made up mainly of developing countries to approximately 1.01–1.02 in 2000, and 1.08–1.09 in 2030. Richer countries (GDP >US$6000/year), either now or in the future, were assumed to suffer little or no additional risk of diarrhoea. Overall, the effects of global climate change are predicted to be heavily concentrated in poorer populations at low latitudes, where the most important climate-sensitive health outcomes (malnutrition, diarrhoea and malaria) are already common, and where vulnerability to climate effects is greatest. The children are found to be the worst sufferers.

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Fewtrell et al (2005) conducted meta-analysis on only those articles with specific measurement of diarrhoea morbidity as a health outcome in non-outbreak conditions 46 studies were extracted to provide summary estimates of the effectiveness of each type of intervention. All risk estimates from the overall meta-analyses ranging between 0·63 and 0·75. Water quality interventions (point-of-use water treatment) were found to be more effective than previously thought, and multiple interventions (consisting of combined water, sanitation, and hygiene measures).

Hashizume et al (2008) identifies groups vulnerable to the effect of flooding on hospital visits due to diarrhoea during and after a flood event in 1998 in Dhaka, Bangladesh. The number of observed cases of cholera and non-cholera diarrhoea per week was compared to expected normal numbers during the flood and post-flood periods, obtained as the season-specific average over the two preceding and subsequent years using Poisson generalised linear models. During the flood, the number of cholera and non-cholera diarrhoea cases was almost six and two times higher than expected, respectively. In the post-flood period, the risk of non-cholera diarrhoea was significantly higher for those with lower educational level, living in a household with a non-concrete roof, drinking tube-well water (vs. tap water), using a distant water source and unsanitary toilets.. The low socio-economic groups were most vulnerable to flood-related diarrhoea.

Tseng et al (2009) estimated economic impacts of climate change for dengue fever in Taiwan. Results indicate that people are willing to pay € 15.78, € 70.35 and € 111.62 per year in order to reduce the probabilities of dengue fever inflection by 12%, 43%, and 87%, respectively.

Chou et al (2010) investigated and quantified the relationship between climate variations and diarrhoea-associated morbidity in subtropical Taiwan. It addresses the local climatic variables and the number of diarrhoea-associated infection cases from 1996 to 2007. The study applied a climate variation-guided Poisson regression model to predict the dynamics of diarrhoea-associated morbidity. The variables incorporated in the model includes relative humidity, maximum temperature and the numbers of extreme rainfall, auto-regression, long-term trends and seasonality, and a lag-time effect. Results indicated that the maximum temperature and extreme rainfall days were strongly related to diarrhoea-associated morbidity. The impact of maximum temperature on diarrhoea-associated morbidity appeared primarily among children (0–14 years) and older adults (40–64 years), and had less of an effect on adults (15–39 years). Thus the children and older adults were the most susceptible to diarrhoea-associated morbidity caused by climatic variation. Policy measures as suggested in the study is to develop an early warning system based on the climatic variation information for disease control management.

Fadel et al (2012) attempts to quantify climate-induced increases in morbidity rates associated with food- and water-borne illnesses in Beirut-Lebanon. A Poisson generalized linear model was used to assess the impacts of temperature on the morbidity rate. The model was used with four climatic scenarios to simulate a broad spectrum of driving forces and potential social, economic and technologic evolutions. The correlation established in this study exhibits a decrease in the number of illnesses with increasing temperature until reaching a threshold of 19.2°C, beyond which the number of morbidity cases increases with temperature. By 2050, the results show a substantial increase in food- and water-borne related morbidity of 16 to 28% that can reach up to 42% by the end of the century.

Another study Moors et al (2013) in regard to the impact of future climate change on diarrhoea incidences in India. The study has been conducted in the Ganges basin of northern India. A conceptual framework was used for climate exposure response relationships based on studies from different countries, as empirical studies and appropriate epidemiological data sets for India were lacking. The climate variables for the study were- temperature, increased/extreme precipitation, decreased precipita-

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tion/droughts and relative humidity. Applying the conceptual framework to the latest regional climate projections for northern India shows increases between present and future (2040s), varying spatially from no change to an increase of 21% in diarrhoea incidences, with 13.1% increase on average for the Ganges basin. They suggested three types of interventions against diarrhoeal disease: reactive actions, preventive actions and national policy options.

Veronesi et al (2014) applied discrete choice experiment technique to predict for climate change scenarios which will lead to extreme rainfall and wastewater overflow and associated health risks study elicits the willingness to pay to reduce ecological and health risks from combined sewer overflows in rivers and lakes, and wastewater flooding of residential and commercial zones under the uncertainty of climate change. We implement a discrete choice experiment on a large representative sample in Switzerland. 71% of the respondents are willing to pay a higher annual local tax to reduce the risk of sewage overflows in rivers and lakes. Swiss households had also strongly valued the protection of water bodies, and mostly, the avoidance of high ecological risks and health risks for children in rivers and lakes. The findings also show that climate change perception has a significant effect on the willingness to pay to reduce these risks.

METHODOLOGY

The meta-analytical approaches provide a series of techniques that allow the cumulative results of a set of individual studies to be pulled together. It permits a quantitative aggregation of results across studies. Hunter et al(1982) argue that 'what is needed are methods that will integrate results from existing studies to reveal patterns of relatively invariant underlying relations and causalities, the establishment of which will constitute general principles and cumulative knowledge.

Meta-analysis was first proposed by Glass (1976) as a method for the systematic quantitative summary of evidence across empirical studies. It currently enjoys widespread use in several areas, including the health sciences, psychology, education, marketing, and the social sciences. Application of meta-analysis in economics began in 1989-1990 with studies by Stanley and Jarrell (1989), Jarrell and Stanley (1990), Smith and Kaoru (1990), Walsh et al. (1989, 1990), and Weitzman and Kruse (1990). Several hundred analyses have been prepared in economics, with at least one-third in the area of environmental and resource economics. Smith and Pattanayak., 2002 in their study compiled a list of non- market valuation studies in environmental economics for meta- analyses. Lewis and Pattanayak (2012) conducted a systematic review of the literature on the adoption of improved cook stoves or a movement up the energy ladder from dirty to clean fuel for households in developing countries through vote-counting.

An important criticism of the use of meta-analysis in the field of environmental valuation is that it compares findings from studies which are not the same. Including studies employing different standards of design or measurement will undermine the inferences made from a cross-analysis. There has to be a variation somewhere, besides statistical errors, in order to be able to explain differences in outcomes. The core question becomes therefore whether the analysis is appropriate for testing different findings derived by intrinsically different measures.

The simplest of the meta-analytical methods is vote-counting, in which the investigator categorizes findings as significantly positive, significantly negative or not significant for each variable (e.g. pollutants). The category with the most entries is then considered the best representation of the relationship between the dependent variable and each of the explanatory variables of interest.

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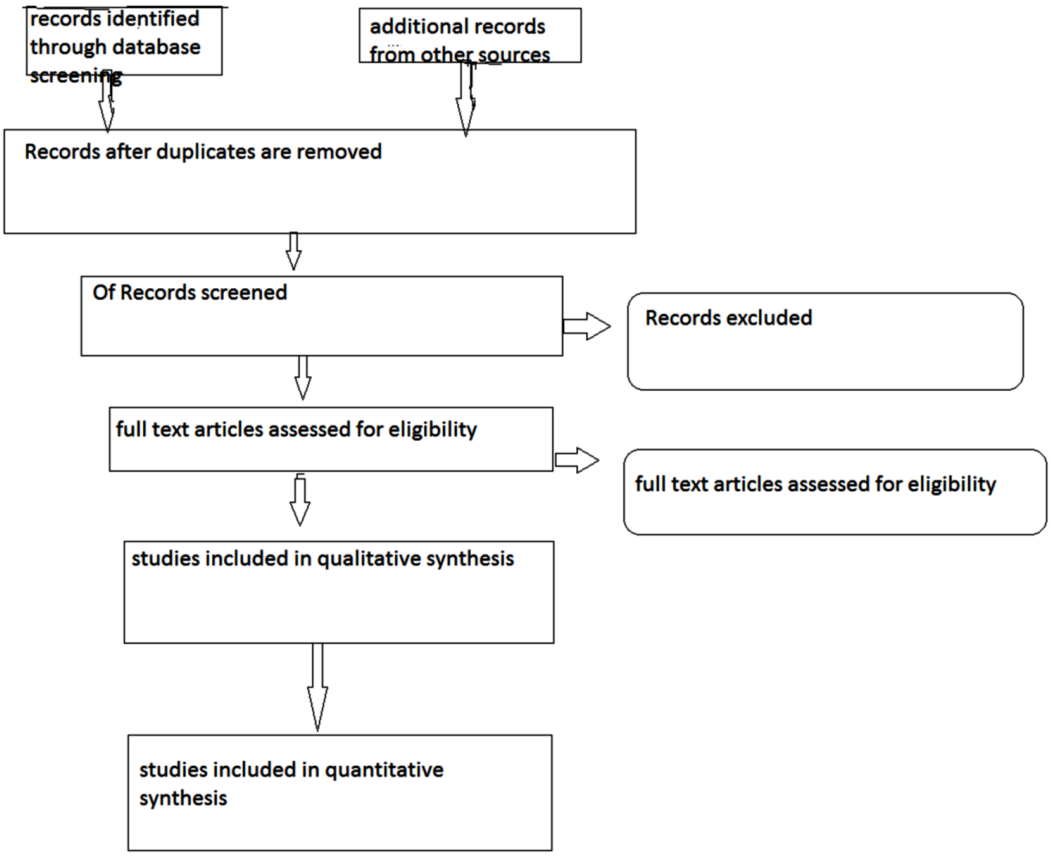
In this method, the investigator gathers all the relevant studies and then constructs one or more indicators of the relationships under investigation from each study.

Hedges and Olkin(1985) pointed out that the traditional vote-counting or box-score methodology uses the outcome of the test of significance in a series of replicated studies to draw conclusions about the magnitude of the treatment effect

In 1996, to address the suboptimal reporting of meta-analyses, an international group developed a guidance called the QUOROM Statement (Quality Of Reporting Of Meta-analyses), which focused on the reporting of meta-analyses of randomized, controlled trials. PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses), which have been updated to address several conceptual and practical advances in the science of systematic reviews. Moher (2009) reports different stages for a systematic review.

Before including studies and providing reasons for excluding others, the review team must first search the literature. This search results in records. Once these records have been screened and eligibility criteria applied, a smaller number of articles will remain. The number of included articles might be smaller (or larger) than the number of studies, because articles may report on multiple studies and results from a particular study may be published in several articles.

Figure 2. Flow of information through different stages of systematic review



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By counting up the number of votes across the studies, we can identify a general relationship for that specific variable. As such, vote counting provides a useful starting point for a systematic assessment of studies within a given research area, and has been popular in medicine and natural resource management. The number of studies falling to each of the categories is then tallied. In this method, the investigator gathers all the relevant studies and then constructs one or more indicators of the relationships under investigation from each study.

While refining our search criteria specifically targeting impacts of health impacts of climate change resulting in water borne diseases, it is very difficult to refine our search as very few papers related to health impacts as a result of water-borne diseases has specifically mentioned the issue of climate change. We tried to consider found in more recent literature searches. However the field of research is relatively new and expanding rapidly.

We initially tried to incorporate the studies in PubMed database with key word searches " economic valuation" "water quality", "access to proper sanitation and hygiene" against 'diarrhoea' and "climate change" .An additional series of searches paired 'sanitation', 'safe drinking water', and 'hygiene' against 'intervention'. The search was further refined by using "developing countries" and "South Asian countries"

The criteria "regression analysis" "economic valuation" were excluded as the number of studies turned out to be negligible in regard to climate change and water-related illnesses.

The following selection criteria were used to identify articles:

1. Description of reporting water related and water-borne illness on account of climate change
2. Studies done in the developing and underdeveloped countries specifically the South Asian countries
3. Diarrhoea/ Cholera morbidity reported as the health outcome, measured under endemic (non-outbreak) conditions.
4. The studies are conducted within 10-15 years.

Both peer-reviewed journal and grey literature was also included to avoid publication bias. Our search criteria ended in having 25 studies.

Data were extracted, wherever available from the selected studies. It include-

Study location (country and urban/rural population);

- Study type;
- Year of study
- Sample size
- Data collection method

For the studies related to intervention further we took into consideration the aspect of

- Type of intervention-
    - Hygiene interventions
    - Sanitation interventions
    - Water quality interventions
    - Multiple interventions

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The data from the studies are pooled together and vote- counting has been used for each of the variables selected –whether they happen to be positively, negatively significant or insignificant.

Table 2 gives an overview of the studies selected by systematic review.

The data are also extracted separately from the studies which account for some interventions to minimise water-related illnesses (see Table 3).

Table 2. Number of studies selected by search-criteria

Author	Year of Publication	Country/Location	Survey Technique	Year of Data
Dhara et al	2013	India	Preview	-
Diener et al	1998	-	Meta-Analysis	-
Tseng et al	2009	Taiwan	Preview	
Bosello et al	2004	Different regions of the world	CGE using GTAP	2050
Adamowicz et al	2004	Canada	Choice experiment	2004
Benova et al	2014	-	Meta-Analysis	-
Amr and Yasin	2008	Gaza strip	Historical data and interview questionnaire	2000-06
Azizullah et al	2011	Pakistan	Meta-Analysis	
Chou et al	2010	Taiwan	climate variation-guided Poisson regression model	1996-2007
Fadel et al	2012	Beirut-Lebanon	Poisson generalized linear model	2001-10
Hashizume	2007	Bangladesh	Poisson generalized linear model	-
Hashizume	2008	Bangladesh	Poisson generalized linear model	1998-2008
Singh	2001	Pacific Islands	Poisson generalized linear model	1986-1994
Checkley et al	2000	Peru	Time series model	1993-98
Checkley	2003	Peru	Birth cohort	1995-98
Fewtrell	2005	-	Meta-Analysis	
Halvorson et al	2008	Mali		2008
Luby et al	2011	Bangladesh	500 intervention and 500 control intervention	2007
Moors et al	2013	India	Regional climate model simulations	2013-2040
Cama et al	1999	Peru	Odds ratio	1995-97
Pinfold et al	1991	Thailand	Charts/Simple calculations	1982-87
Saidi et al	1997	Kenya	Hi square, t test	1991-93
Purohit et al	1998	India	Box-Jenkins	1992-96
Fewtrell and Colford	2000	-	Meta analysis	-
McMichael et al	2004	-	Meta Analysis	-
Bhandari	2013	Nepal	Time-series analysis	1998-2001

Source: Authors' own compilation

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Table 3. Number of studies selected on types of intervention

Author	Year of Publication	Country/Location	Survey Technique	Type of Intervention
Lee et al	1991	Thailand	RR	Hygiene
Pinfold et al	1996	Thailand	RR	Hygiene
Shahid et al	1996	Bangladesh	IDR	Hygiene
Daniels et al	1990	Lesotho	OR	Sanitation
Sathe et al	1996	India	RR	Water quality
Xiao et al	1997	China	RR	Water quality
Cama et al	1999	Peru	OR	Water quality
Sobsey et al	2003	Bangladesh	IDR	Water quality
Aziz et al	1990	Bangladesh	IDR	multi intervention
Mertens et al	1990	Sri lanka	IDR	Multi intervention
Hoque et al	1997	Bangladesh	RR	Multi intervention
Nanan et al	2003	Pakistan	OR	Multi intervention

Source: Fewtrell et al(2005),Fewtrell and Colford, own compilation

LIST OF VARIABLES

Increase in Temperature

A warmer climate could cause water-borne diseases to become more frequent, including cholera and diarrhoeal diseases such as giardiasis, salmonellosis, and cryptosporidiosis. Diarrhoeal diseases are already a major cause of morbidity and mortality in South Asia, particularly among children. It is estimated that one-quarter of childhood deaths in South Asia are due to diarrhoeal diseases. As rising ambient temperatures increase, bacterial survival time and proliferation and thus the incidence of diarrhoeal diseases might further increase.

Diarrhoeal diseases are largely attributable to unsafe drinking water and lack of basic sanitation; thus, reductions in the availability of freshwater are likely to increase the incidence of such diseases. Rapid urbanization and industrialization, population growth, and inefficient water use are already causing water shortages in India, Pakistan, Nepal, and Bangladesh. Climate change will exacerbate the lack of available fresh water as annual mean rainfall decreases in many areas.

Extreme Rainfall

Floods are low-probability, high-impact events that overwhelm physical infrastructure, human resilience, and social organisation. Floods result from the interaction of rainfall, surface run-off, evaporation, wind, sea level, and local topography. In inland areas, flood regimens vary substantially depending on catchment size, topography, and climate.

Relative humidity have a significant effect on the occurrence of diarrhoea(Hazizume.,2008). Other variables include the socio-economic factors like income, age, and children.

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Figure 3 compiles the results obtained from vote-counting of the selected studies. Out of the selected studies only 2 studies had applied stated preference technique where the consumers are willing to pay for water related illness on account of climate change.

Almost all the studies are positively significant for maximum temperature and extreme rainfall.3 studies are negatively significant for the variable GDP/level of income with health impact. The number of sick days lost adversely affects the level of income at household level and in an aggregate level has a negative impact on the country's GDP. 12 studies had stated of the negative impact of level of humidity on health. Lastly the variable age is positively significant. The age group (0-5) and the old age people are more vulnerable to climate change impacts and water related illnesses. The children are more affected as a result of occurrence of water-related illnesses on an account of climate change.

Intervention Related Variables

Hygiene intervention includes handwashing with soap and hygiene education. Sanitation intervention includes provision of latrines, water quality intervention includes treatment of water and multiple interventions include all taken together. For all the studies in South Asian countries hygiene, improvement in water quality as well as combinations of multiple interventions significantly minimises the occurrence of diarrhoea.

Policy Implications and Conclusions

Quantification of health impacts from specific risk factors, derived from a systematic review of cross-country studies provide a powerful mechanism for comparing the impacts of various risk factors and diseases. It allows us to begin to answer questions like -on aggregate impact, how important is climate

Figure 3. Vote counting of the selected studies over occurrence of illness

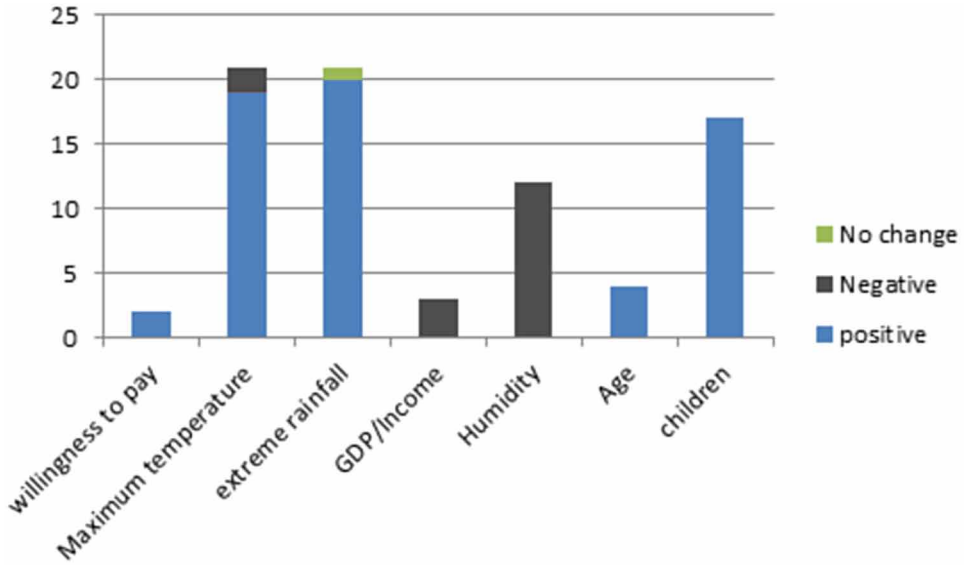

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Table 4. Economic benefits from improved sanitation

Beneficiary	Direct Economic Benefits of Avoiding Diarrhoeal Disease	Indirect Economic Benefit on Account of Health Improvement	Non-Health Benefits Due to Improved Sanitation
Health sector	Less expenditure on diarrhoeal disease	Value of less health workers falling sick with diarrhoea	More carefully managed on water environment and effect on vectors
Patients	Less expenditure on diarrhoeal diseases and related cost Less expenditure on transport in seeking treatment Less time loss due to treatment seeking	Value of avoided days lost at work Value of loss of death	More carefully managed water environment and effect on vectors
Consumers			Time-saving for better access to water and sanitation Switch away from more expensive water sources Rise in property value Leisure activities and non-user value

change more vulnerable to health risk compared other risk factors for global health? How much of the disease burden could be avoided by mitigating climate change? Which specific impacts are likely to be most important and the affected regions?

Gaps may still persist in quantifying such impacts by such a systematic review as each valuation tool has its own limitations and the actual situation may vary from inference we derive from studies in that area.

On the other hand,in order to cope with the adverse health effects of climate change, adaptation measures, plans and programs are needed. Adaptation is defined in terms of "policies, practices, and projects with the effect of moderating damages and/or realizing opportunities associated with climate change".

Though there lies significant benefits from possible interventions like better sanitation there involve significant costs for interventions (See Table 4). Ebi(2008) tried to estimate the costs of specific interventions for treatment of additional cases of malaria, diarrhoea and malnutrition expected between 2000-2030, due to climate change. It concludes that additional annual costs will be around US$ 3-8 billion for malaria and US$ 3-9 billion for diarrhoea worldwide. For diarrhoea, Markandya and Chiabai(2009) suggested structural intervention can be implemented which provide also considerable non-health benefits. The costs of improved water and sanitation, require huge investments to meet the MDGs, result in costs per case avoided that are fairly low.

In order to give a rational basis for prioritizing policies, at the least it is necessary to obtain an approximate measurement of the likely magnitude of the health impacts of climate change. Integrating environmental, public health, and meteorological observations to real-time public health issues, along with efforts to downscale long-term climate models should be effectively and efficiently put together to accurately estimate human exposure risks and burden of disease.

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Chapter 38
A Study on Adoption of Employee Welfare Schemes in Industrial and Service Organisations:
In Contrast with Public and Private Sectors

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ABSTRACT

During the past few years practicing employee welfare schemes has become a key factor for the overall growth and development of any organisation. Organizations provide welfare facilities to their employees to keep their motivation levels high. Employees' welfare is essential for any organisation, as they shed the blood for achieving the objectives and goals of the organisation. The welfare schemes improve the organisational relations and also enhance the productivity of the employees. The main aim of implementing the welfare measures in any organisation is to secure the labour force by providing proper working conditions and minimizing its hazardous effect on the life of the employees and their family members. A study was undertaken to know the various welfare schemes adopted by the industrial and service organisations and its influence on the employee's productivity in both public and private sectors.

INTRODUCTION

The term welfare suggests the state of well being and implies wholesomeness of the human being. It is a comprehensive term and refers to the physical, mental, moral and emotional well-being of an individual (Aswathappa, 2005). All these four elements together constitute the structure of welfare on which its totality is based. According to Hopkins (1955), Welfare is fundamentally an attitude of mind on the part of management, influencing the method in which management activities are undertaken. Employers concerned with introducing or extending welfare programmes now or in the future must be

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concerned, not only with the past and current experience, but with developing trends. The term welfare is a relative concept; therefore it varies from time to time, region to region and from country to country. Welfare helps in keeping the morale and motivation of the employees high so as to retain the employees for longer duration. The welfare measures need not be in monetary terms only but in any kind or forms.

Labour is any physical or intellectual activity applied in industrial production and one who performs it is a worker. According to the traditional economic theory labour can be defined as, a factor of production which consists of manual and mental exertion and receives some return by way of wages, salaries or professional fees (Railkar, 1990). The term labour, labourer, workers, workman or employee are all used to refer to the wage earning human agents in various industries and organisations. The concept of Employee welfare is flexible and elastic and differs widely with times, regions, industry, country, social values and customs, the degree of industrialisation, the general social economic development of people and political ideologies prevailing at particular moments. Employee welfare is an extension of the term welfare and its application to the employees. Employee welfare means anything done for the comfort and improvement, intellectual or social, of the employees over and above the wages paid which is not a necessity of the industry. In a Resolution in 1947, the ILO defined labour welfare as "such services, facilities and amenities as adequate canteens, rest and recreation facilities, arrangements for travel to and from work, and for the accommodation of workers employed at a distance from their houses and such other services, amenities and facilities as contribute to improve the conditions under which workers are employed".

The employee welfare schemes includes monitoring of working conditions, creation of organizational harmony through infrastructure for health, general insurance, retirement benefits, housing facilities, and education benefits for employees and their children, and so on. Labour welfare implies the setting up of minimum desirable standards and the provision of facilities like health, food, clothing, housing, medical assistance, education, insurance, job security, recreation etc. Such facilities enable a worker and his family to lead a good work life, family life and social life (Sarma, 1996). Employee welfare entails all those activities of employer which are directed towards providing the employees with certain facilities and services in addition to wages or salaries.

Welfare schemes should be implemented by all the organisations, whether public sector or private sector and industrial or service sector, as it raises the morale of employees, reduce the risk and insecurity, eliminates absenteeism, and improves the quality of living, which would go a long way in achieving the goals of an organisation. Employee welfare is the key to maintain smooth employer-employee relationships. In order to increase employee welfare facilities, employers need to offer extra incentives in the form of employee welfare schemes, and to make it possible to pursued employees. The very logic behind providing welfare schemes is to create efficient, healthy, loyal and satisfied labour force for the organization. The study presents a comparison of the various welfare schemes implemented in both the industrial and service sector in contrast with public and private sector organisations.

EMPLOYEE WELFARE SCHEMES

In the recent years implementing necessary employee welfare schemes have become a key factor for the overall growth and development of any organization. The organisations provide welfare measures to their employees to increase their efficiency and reduce the absenteeism. Voluntary efforts for the welfare of the employees by the management may reduce the thought of government and others parties interven-

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tion in future. The employee welfare schemes can be classified into two categories viz., statutory and non-statutory welfare measures.

The statutory schemes are those schemes that are compulsory to provide by an organization as compliance to the laws governing employee health and safety. These include provisions provided in industrial acts like Factories Act 1948, Dock Workers Act (safety, health and welfare) 1986, and Mines Act 1962. The statutory welfare measures include the provisions such as, drinking water, facilities for sitting, first aid appliances, latrines and urinals, canteen facilities, spittoons, lighting, washing places, changing rooms, rest rooms, etc. The non-statutory welfare measures differ from organization to organization and from industry to industry. The non-statutory welfare schemes may includes personal health care, flexi-time, employee assistance programs, grievances policy, maternity & adoption leaves, medi-claim insurance scheme, employee referral schemes, etc.

The Factories Act 1948, as amended by the latest amendment in 1987 makes elaborate provisions in relation to health, safety, and welfare of employees, provisions regarding working hours including weekly hours, daily hours, weekly holidays, regarding employment of young persons, annual leaves with wages and provision regarding employment of women and young persons. In this act the provisions are also made in connection with first aid appliances along with a room are to be maintained in every organization. The Governments have been empowered to make rules requiring that in any organisation wherein more than two hundred fifty workers are ordinarily employed, canteens, shelters, and restrooms shall be provided and maintained for the use of employees. Finally the Act makes provision for the employment of Welfare Officer in manufacturing organisations and service sector also. Thus, it is clear that the Act makes very elaborate and unambiguous provisions regarding the minimum welfare standards to be followed by the management. But laying down the standards alone is not enough; it must also to be ensured that these provisions are implemented successfully. The non-implementation leads to dis-satisfaction of the employees working in the organizations.

OBJECTIVES OF THE STUDY

The purpose of the study is to investigate the literature related to the employee welfare schemes from various research findings and studies. The main objective is:

1. To identify the various welfare schemes practiced in the industrial and service sectors of both public and private sector organisations.
2. To compare the satisfaction level of employees' on the welfare schemes and also analyzes its influence on their productivity.
3. To suggest measures for improving the overall welfare amenities in both the industrial and service sector organizations.

RESEARCH METHODOLOGY

The present research is an enquiry into the various employee welfare schemes practiced by different industrial and service sector organisations with reference to public and private sector in Visakhapatnam city, and the satisfaction experienced by the employees working in these organisations. It aims to draw

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a comparison on level of satisfaction experienced by employees and its influence on their productivity. The data presented in the study are collected from both primary and secondary sources. The primary data was collected from the respondents i.e. employees by distributing questionnaires, through personal interviews, and direct personal observation. The information was collected from the employees who are working in different public and private sector organisations such as industrial organisations (manufacturing, automobile, and others) and service organisations (educational institutions, health centres, software companies, administrative, and financial institutions), individually and taken their views and suggestions. The purpose of the study was explained to them and they were asked to fill up the scales. They were assured of confidentiality of their responses.

The questionnaire was distributed to 400 employees' personally to know their views regarding the satisfaction level on the implementation of various welfare schemes from different organizations. These questionnaires were selected on random basis. The number of valid filled in questionnaires selected for the study from various organizations is 160; out of which 80 respondents are from Industrial organisations and 80 respondents from Service organisations (both include 40 employees each from Private sector and Public sector). The collected data is used to compare the opinion regarding the satisfaction of the employees on the provision of welfare measures.

The secondary data was collected from various published sources such as, books, news paper publications, journals, company magazines, official websites of various industrial and service sector organisations, and some other sites are also searched to collect the relevant data. The information collected from various sources are carefully computed, classified, tabulated, analyzed and interpreted. The statistical technique used for analyzing the data collected from the tabulated data are analyzed with tables & charts wherever necessary, so as to draw inferences based on findings, suggestions and conclusions on employee welfare schemes. The main objective is to know the various employee welfare schemes and to spotlight on the areas that the management of both the industrial and service sector in contrast with public and private sector organizations needs to pay attention.

LITERATURE REVIEW

The study provides an extensive review of available literature in the area of employee welfare to develop a thorough understanding of the conceptual constructs and empirical research. Previous research has identified several factors relating to employee welfare schemes, situated on both organizational and employee levels. A study conducted by Zacharaiah (1954) in his study based on a sample survey of manufacturing undertakings in Bombay, covered welfare services and working conditions while surveying the factors affecting industrial relations. It was observed that better working conditions and adequate provision of welfare services would contribute to harmonious industrial relations. Saiyaddin (1983) examined the purpose and cost of non-statutory welfare activities for the organizations. Five public and six private sector organizations were selected for the study and brought out an important conclusion that the most predominant theme in the minds of organizations when they think of the voluntary welfare measures was not only the output and efficiency but also increasing loyalty and morale. In respect of cost, the study revealed, that the public sector organizations spend more on welfare activities, as compared to private sector. While public sector spends more on transportation and recreation, private sector was found to be spending more on housing according to the study.

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Burchardt (1997) examines the balance between public and private sector welfare activity in five areas: Education; Health; Housing; Personal Social Services; and Income Maintenance and Social Security. In the Report of National Commission on Labour (2002), Government of India, made recommendations in the area of labour welfare measures which include social security, extending the application of the Provident Fund, gratuity and unemployment insurance, etc. A study by Kumar and Yadav (2002) titled Satisfaction Level from Labour Welfare Schemes in Sugar Factories in Gorakhpur Division, revealed the overall satisfaction level of workers from labour welfare schemes was low in both the private and State sugar factories. Further, the workers in both sectors ranked the four labour welfare schemes according to their importance, which fell in the following order housing scheme, medical scheme, followed by education and recreation schemes. Karl (2005) in his Labour market reforms and economic growth, the European experience in the 1990s', has specified the purpose of this paper is to reassess the relative impact of labour market regulation on economic performance. Inflexible labour markets combined with high welfare costs are often thought to be the main cause of low growth in Europe .The main result is that regulation impacts on growth, the impact of regulatory change is, however, less easy to demonstrate.

Robinson, Sparrow, Clegg, & Birdi (2006) in a study identified the key behaviours, which were found to be associated with employee engagement. The behaviours included belief in the organisation, desire to work to make things better, understanding of the business context and the 'bigger picture', being respectful of and helpful to colleagues, willingness to 'go the extra mile' and keeping up to date with developments in the field. Manju and Mishra (2007) in a study found that the police service provides essential service to the public in Kenya and thus their labour welfare activities need to address the same. Welfare services may be provided for matters concerning employees in terms of supplementing the income of the workers by providing services such as housing, medical assistance, canteens and recreation facilities. Binoy, Joseph, & Raju (2009) in their 'Labour welfare in India' studied in the article points out that the structure of a welfare state rests on its social security fabric. Government, employers and trade unions have done a lot to promote the betterment of workers' conditions.

According to Priti (2009) the role of welfare activities is to promote economic development by increasing efficiency and productivity with the underlying principle being making workers give their loyal services ungrudgingly in genuine spirit of co-operation and the general well-being of the employee. Shobha & Manju (2010) in their stated that labour absenteeism in Indian industries can be reduced to a great extent by provision of good housing, health and family care, canteen, educational and training facilities and provision of welfare activities. Manzini & Gwandure (2011) studied that the concept of employee welfare has been used by many organisations as a strategy of improving productivity of employees especially in the mobile industry since work related problems can lead to poor quality of life for employees and a decline in performance. It is argued that, welfare services can be used to secure the labour force by providing proper human conditions of work and living through minimizing the hazardous effect on the life of the workers and their family members. Patro (2012), in a study found that the employees are the assets of every organisation. The needs of the employee must be satisfied in order to meet the goals of the organisation. Any organisation would be effective only when there is high degree of co-operation between the employees and their management. Some measures are also suggested that help to increase the quality of work life of employees.

Satyanarayna & Reddi (2012) stated that the overall satisfaction levels of employees about welfare measures in the organization cover are satisfactory. However, a few are not satisfied with welfare measures provided by the organization. It is suggested that existing welfare measures may be improved further. Such welfare measures enrich the employee standard of living and their satisfaction levels. A research

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study in different organisations by Parul & Ashokkumar (2013) concluded in terms of proving that the different welfare provisions provided to the employees working in an organisation under Factories Act, 1948 are having positive relation with the employee satisfaction, after analyzing the correlation between these two factors. The reason behind this result is that these are the factors that lead to satisfaction and if these facilities are not present, it sometimes leads to dissatisfaction. Nanda & Panda (2013) stated the Rourkela Steel Plant has adopted a better kind of welfare activities which create an effective working environment and thus better productivity. There are different kinds of welfare schemes like medical allowance, death relief fund, insurance, housing, transportation, and recreation club facilities, etc., are provided by the company to the employees to maintain better industrial relations. Patro (2015) in a comparative analysis of welfare measures in public and private sector found that an employees' welfare facility is the key dimension to smooth employer-employee relationship. These welfare facilities improve the employees' morale and loyalty towards the management thereby increasing their happiness, satisfaction and performance.

COMPARATIVE ANALYSIS AND FINDINGS

The employees of different industrial organisations and service organizations related to both public and private sector are asked whether they are satisfied with the various welfare schemes implemented in their organizations. A questionnaire with both open-end and close-end questions was designed to get the required information from the respondents i.e. the employees. To analyze the responses of the employees on implementation of the welfare schemes, a 5-point rating scale technique is used. The scale ranges from Excellent (1), Good (2), Satisfactory (3), Poor (4), and Not In-force (5). The questionnaire was framed in simple and clear manner such that it enables the respondents to understand and answer the question easily. Based on the questionnaire survey a comparative analysis and interpretation is made on various welfare schemes implemented in these organisations.

In the study both, statutory and non-statutory welfare schemes are considered for the comparative analysis. Six important statutory welfare schemes are identified such as canteen and store facilities, medical and health benefits, drinking water and sanitary facilities, restroom and locker facility, workmen compensation, and safety measures. And eight non-statutory welfare schemes such as housing and quarter facilities, educational benefits, transport allowances or facilities, retirement benefits, recreational facilities, grievance settlement forums, retention polities, and other allowances and facilities are identified for collecting the opinion of the employees along with their comments and suggestions. The results and findings regarding the employee welfare schemes that influence the employee's productivity are discussed in the paper.

The comparison of statutory and non-statutory employee welfare schemes implemented in industrial organisations with reference to both public and private sector organisations are shown in Table 1.

It is observed that almost all the statutory welfare schemes are implemented in both the public and private sector. Regarding the non-statutory welfare schemes in public sector almost all employees' responded positive, where as in private sector many of them responded that these facilities are not properly implemented in their organisations. The overall comparison of employee welfare schemes are shown in Table 2 and Figure 1.

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Table 1. Comparison of employee welfare schemes in industrial organisations

Sl. No.	Factor Perception		Public Sector						Private Sector					
			Excellent	Good	Satisfactory	Poor	Not In-force	Total	Excellent	Good	Satisfactory	Poor	Not In-force	Total
Statutory Welfare Schemes														
1	Canteen & Store Facilities	#	4	19	11	6	0	40	5	21	9	5	0	40
		%	10%	48%	28%	15%	0%	100%	13%	53%	23%	13%	0%	100%
2	Medical and Health Benefits	#	6	24	9	1	0	40	2	15	12	8	3	40
		%	15%	60%	23%	3%	0%	100%	5%	38%	30%	20%	8%	100%
3	Drinking Water & Sanitary Facilities	#	6	22	10	2	0	40	7	20	10	3	0	40
		%	15%	55%	25%	5%	0%	100%	18%	50%	25%	8%	0%	100%
4	Rest Room & Locker Facility	#	5	23	8	2	2	40	1	13	19	4	3	40
		%	13%	58%	20%	5%	5%	100%	3%	33%	48%	10%	8%	100%
5	Workmen Compensation	#	3	25	9	3	0	40	3	9	13	7	8	40
		%	8%	63%	23%	8%	0%	100%	8%	23%	33%	18%	20%	100%
6	Safety Measures	#	4	23	8	5	0	40	4	14	16	5	1	40
		%	10%	58%	20%	13%	0%	100%	10%	35%	40%	13%	3%	100%
Non-Statutory Welfare Schemes														
7	Housing/Quarter Facilities	#	7	20	11	2	0	40	0	3	7	11	19	40
		%	18%	50%	28%	5%	0%	100%	0%	8%	18%	28%	48%	100%
8	Educational Benefits	#	4	22	10	2	2	40	2	6	9	16	7	40
		%	10%	55%	25%	5%	5%	100%	5%	15%	23%	40%	18%	100%
9	Transport Allowances/ Facilities	#	8	17	12	2	1	40	5	17	12	4	2	40
		%	20%	43%	30%	5%	3%	100%	13%	43%	30%	10%	5%	100%
10	Retirement Benefits	#	11	22	7	0	0	40	0	2	3	10	25	40
		%	28%	55%	18%	0%	0%	100%	0%	5%	8%	25%	63%	100%
11	Recreational Facilities	#	2	11	9	5	13	40	2	4	8	14	12	40
		%	5%	28%	23%	13%	33%	100%	5%	10%	20%	35%	30%	100%
12	Grievance Settlement Forums	#	3	12	14	8	3	40	3	5	14	12	6	40
		%	8%	30%	35%	20%	8%	100%	8%	13%	35%	30%	15%	100%
13	Retention Policies	#	7	19	10	3	1	40	2	6	15	12	5	40
		%	18%	48%	25%	8%	3%	100%	5%	15%	38%	30%	13%	100%
14	Other Allowances/ Facilities	#	6	12	17	3	2	40	1	3	13	15	8	40
		%	15%	30%	43%	8%	5%	100%	3%	8%	33%	38%	20%	100%

The overall comparison of welfare schemes in industrial organisation with regard to statutory schemes shows that, in public sector 12% and in private sector only 9% responded excellent. 57% in public sector and 38% in private sector responded that these facilities are good. In public sector 23% are satisfactory and in private sector 33% are satisfied. 8% responded poor in public and 13% said poor in case of pri-

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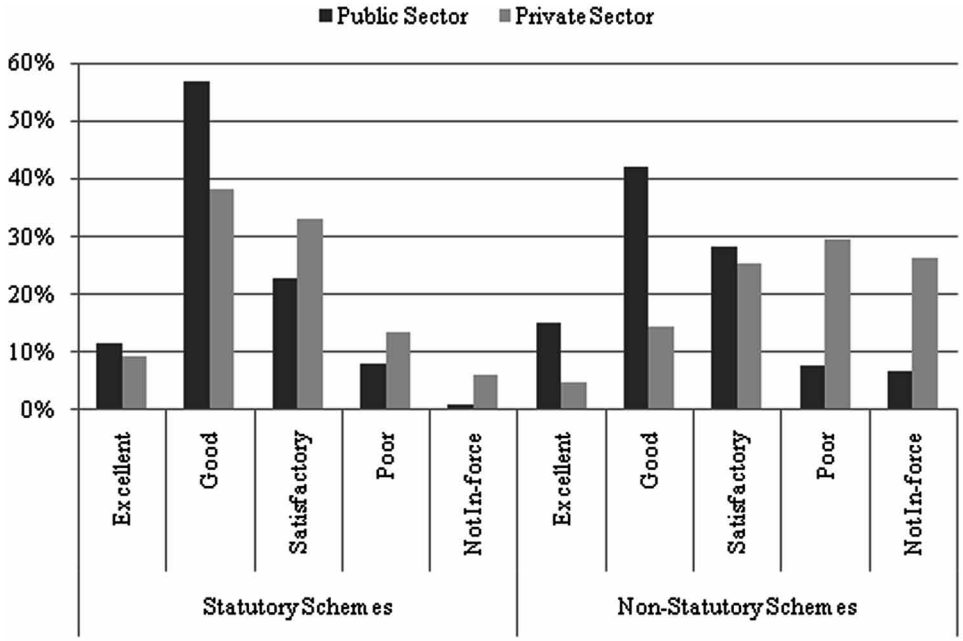
Table 2. Overall comparison of welfare schemes in industrial organisations

Perception/ Sector		Statutory Schemes					Non-Statutory Schemes				
		Excellent	Good	Satisfactory	Poor	Not In-force	Excellent	Good	Satisfactory	Poor	Not In-force
Public Sector	#	28	136	55	19	2	48	135	90	25	22
	%	12%	57%	23%	8%	0%	15%	42%	28%	8%	7%
Private Sector	#	22	92	79	32	15	15	46	81	94	84
	%	9%	38%	33%	14%	6%	5%	14%	25%	29%	27%

Figure 1. Overall comparison of welfare schemes in industrial organisations



vate sector. Finally, only 1% of public sector and 6% of private sector employees responded that welfare schemes are not in-force in their organisations.

With reference to the adoption of non-statutory welfare schemes in public sector 15% responded excellent and 5% responded excellent in private sector. In public sector 42% responded well and 28% are satisfied. In private sector 14% responded well and 28% are satisfied. 8% responded poor in public and 29% said poor in private sector. And only 7% of public sector and 6% of private sector employees responded that these welfare schemes are not in-force in their organisations. It is found that the public sector employees are more influenced when compared to the private sector employees. The management's of private sector need to put much effort to implement better welfare schemes to their employees as it influences the work productivity. The public sector can also focus on the better implementation of the non-statutory welfare schemes in their organisations.

The comparison of statutory and non-statutory employee welfare schemes implemented in service organisations with reference to both public and private sector organisations are shown in Table 3.

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Table 3. Comparison of employee welfare schemes in service organisations

Sl. No.	Factor Perception		Public Sector						Private Sector					
			Excellent	Good	Satisfactory	Poor	Not In-force	Total	Excellent	Good	Satisfactory	Poor	Not In-force	Total
Statutory Welfare Schemes														
1	Canteen & Store Facilities	#	3	21	10	4	2	40	6	20	10	4	0	40
		%	8%	53%	25%	10%	5%	100%	15%	50%	25%	10%	0%	100%
2	Medical and Health Benefits	#	9	23	6	2	0	40	1	13	15	5	6	40
		%	23%	58%	15%	5%	0%	100%	3%	33%	38%	13%	15%	100%
3	Drinking Water & Sanitary Facilities	#	10	23	7	0		40	9	23	7	1	0	40
		%	25%	58%	18%	0%	0%	100%	23%	58%	18%	3%	0%	100%
4	Rest Room & Locker Facility	#	6	21	10	2	1	40	2	15	17	5	1	40
		%	15%	53%	25%	5%	3%	100%	5%	38%	43%	13%	3%	100%
5	Workmen Compensation	#	5	22	8	3	2	40	2	7	13	12	6	40
		%	13%	55%	20%	8%	5%	100%	5%	18%	33%	30%	15%	100%
6	Safety Measures	#	5	25	6	3	1	40	4	15	17	3	1	40
		%	13%	63%	15%	8%	3%	100%	10%	38%	43%	8%	3%	100%
Non-Statutory Welfare Schemes														
7	Housing/Quarter Facilities	#	8	21	7	3	1	40	0	1	10	9	20	40
		%	20%	53%	18%	8%	3%	100%	0%	3%	25%	23%	50%	100%
8	Educational Benefits	#	6	25	8	0	1	40	3	7	8	13	9	40
		%	15%	63%	20%	0%	3%	100%	8%	18%	20%	33%	23%	100%
9	Transport Allowances/ Facilities	#	4	19	13	1	3	40	4	15	14	6	1	40
		%	10%	48%	33%	3%	8%	100%	10%	38%	35%	15%	3%	100%
10	Retirement Benefits	#	12	23	5	0	0	40	0	3	7	8	22	40
		%	30%	58%	13%	0%	0%	100%	0%	8%	18%	20%	55%	100%
11	Recreational Facilities	#	3	9	13	8	7	40	1	2	8	15	14	40
		%	8%	23%	33%	20%	18%	100%	3%	5%	20%	38%	35%	100%
12	Grievance Settlement Forums	#	2	9	16	9	4	40	2	6	15	14	3	40
		%	5%	23%	40%	23%	10%	100%	5%	15%	38%	35%	8%	100%
13	Retention Policies	#	9	18	11	2	0	40	3	9	12	13	3	40
		%	23%	45%	28%	5%	0%	100%	8%	23%	30%	33%	8%	100%
14	Other Allowances/ Facilities	#	8	11	18	2	1	40	2	3	11	18	6	40
		%	20%	28%	45%	5%	3%	100%	5%	8%	28%	45%	15%	100%

In service organisations, it is observed that almost all the statutory welfare schemes are implemented in both public and private sectors and the employees are also satisfied with these facilities. The non-statutory welfare schemes are fully implemented in the public sector and in case of private sector these schemes are not fully operational. The overall comparison of the employee welfare schemes in service organisations is shown in Table 4 and Figure 2.

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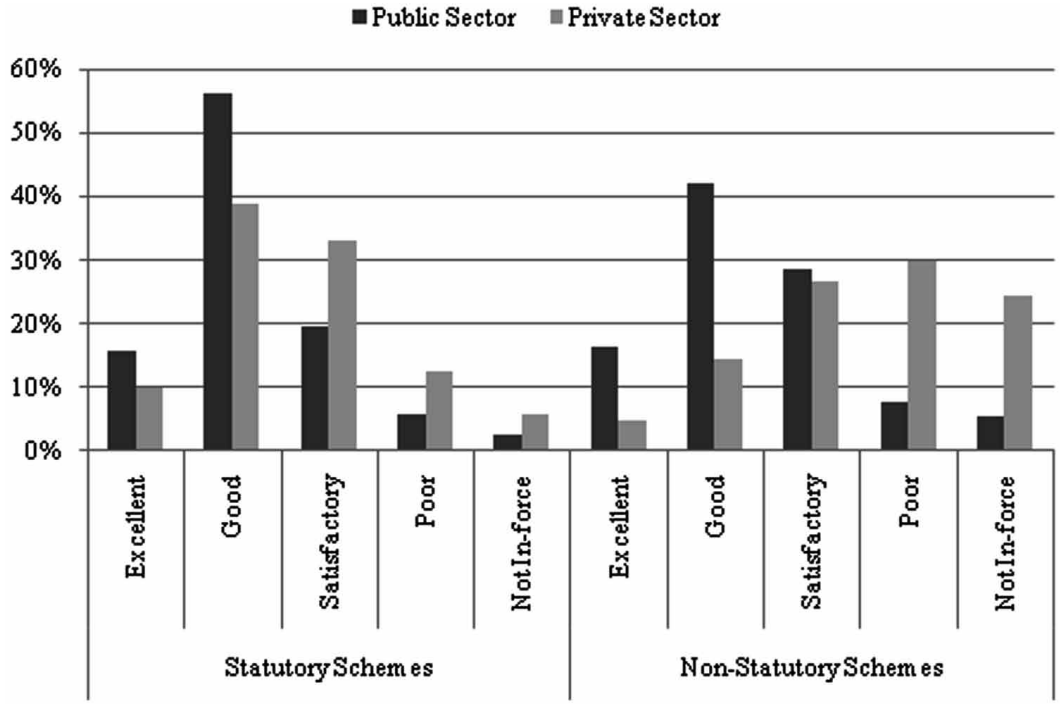
Table 4. Overall comparison of welfare schemes in service organisations

Perception/ Sector		Statutory Schemes					Non-Statutory Schemes				
		Excellent	Good	Satisfactory	Poor	Not In-force	Excellent	Good	Satisfactory	Poor	Not In-force
Public Sector	#	38	135	47	14	6	52	135	91	25	17
	%	16%	56%	20%	6%	2%	16%	42%	29%	8%	5%
Private Sector	#	24	93	79	30	14	15	46	85	96	78
	%	9%	39%	33%	13%	6%	5%	14%	27%	30%	24%

Figure 2. Overall comparison of welfare schemes in service organisations



From the overall comparison of welfare schemes in service organisations, with reference to statutory welfare schemes, it is found that 16% responded excellent in public sector and only 9% responded excellent in private sector. 56% in public sector and 39% in private sector responded that these facilities are good. In public sector 20% are satisfied and in private sector 33% are satisfied. 14% said poor in private sector and only 30% responded poor in public sector. Finally, 2% responded that these welfare schemes are not in-force in public sector, where as in private sector 6% said that the welfare schemes are not in-force.

The adoption of non-statutory welfare schemes in service organisations shows 16% responded excellent in public sector and only 5% responded excellent in private sector. 42% in public sector and 14% in private sector responded that these facilities are good. In private sector 27% and in public sector 29% are satisfied. 8% in public sector and 30% in private sector reported poor. And only 5% of public sector and 24% of private sector employees responded that these welfare schemes are not in-force in service

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organisations. From the comparative analysis it is observed that the private sector employees are not much influenced when compared with the public sector. The management's need to improve these schemes, as it helps in increasing the productivity of the employees.

A comparison on the implementation of the statutory and non-statutory welfare schemes in industrial and service organisations with reference to both public and private sector employees is shown in Table 5.

Table 5. Comparison of welfare schemes in industrial and service organisations

Sl. No.	Factor Perception		Industrial Organisations						Service Organisations					
			Excellent	Good	Satisfactory	Poor	Not In-force	Total	Excellent	Good	Satisfactory	Poor	Not In-force	Total
Statutory Welfare Schemes														
1	Canteen & Store Facilities	#	9	40	20	11	0	80	9	41	20	8	2	80
		%	11%	50%	25%	14%	0%	100%	11%	51%	25%	10%	3%	100%
2	Medical and Health Benefits	#	8	39	21	9	3	80	10	36	21	7	6	80
		%	10%	49%	26%	11%	4%	100%	13%	45%	26%	9%	8%	100%
3	Drinking Water & Sanitary Facilities	#	13	42	20	5	0	80	19	46	14	1	0	80
		%	16%	53%	25%	6%	0%	100%	24%	58%	18%	1%	0%	100%
4	Rest Room & Locker Facility	#	6	36	27	6	5	80	8	36	27	7	2	80
		%	8%	45%	34%	8%	6%	100%	10%	45%	34%	9%	3%	100%
5	Workmen Compensation	#	6	34	22	10	8	80	7	29	21	15	8	80
		%	8%	43%	28%	13%	10%	100%	9%	36%	26%	19%	10%	100%
6	Safety Measures	#	8	37	24	10	1	80	9	40	23	6	2	80
		%	10%	46%	30%	13%	1%	100%	11%	50%	29%	8%	3%	100%
Non-Statutory Welfare Schemes														
7	Housing/Quarter Facilities	#	7	23	18	13	19	80	8	22	17	12	21	80
		%	9%	29%	23%	16%	24%	100%	10%	28%	21%	15%	26%	100%
8	Educational Benefits	#	6	28	19	18	9	80	9	32	16	13	10	80
		%	8%	35%	24%	23%	11%	100%	11%	40%	20%	16%	13%	100%
9	Transport Allowances/ Facilities	#	13	34	24	6	3	80	8	34	27	7	4	80
		%	16%	43%	30%	8%	4%	100%	10%	43%	34%	9%	5%	100%
10	Retirement Benefits	#	11	24	10	10	25	80	12	26	12	8	22	80
		%	14%	30%	13%	13%	31%	100%	15%	33%	15%	10%	28%	100%
11	Recreational Facilities	#	4	15	17	19	25	80	4	11	21	23	21	80
		%	5%	19%	21%	24%	31%	100%	5%	14%	26%	29%	26%	100%
12	Grievance Settlement Forums	#	6	17	28	20	9	80	4	15	31	23	7	80
		%	8%	21%	35%	25%	11%	100%	5%	19%	39%	29%	9%	100%
13	Retention Policies	#	9	25	25	15	6	80	12	27	23	15	3	80
		%	11%	31%	31%	19%	8%	100%	15%	34%	29%	19%	4%	100%
14	Other Allowances/ Facilities	#	7	15	30	18	10	80	10	14	29	20	7	80
		%	9%	19%	38%	23%	13%	100%	13%	18%	36%	25%	9%	100%

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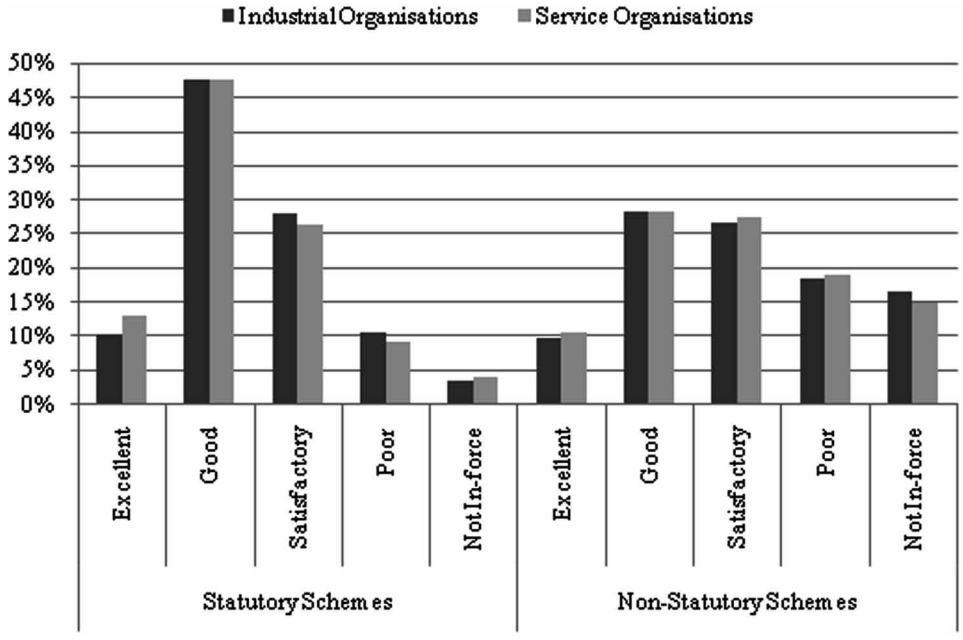
The employees of both industrial and service organisations are almost satisfied with the statutory welfare schemes implemented in their organisations. Regarding the implementation of non-statutory welfare schemes, both the industrial and service sector employees are not much satisfied. Many employees responded that these schemes are not implemented in their organisations. The overall comparison of the responses on the employee welfare schemes in industrial and service organisations with regard to public and private sector are shown in Table 6 and Figure 3.

The overall comparison of the statutory employee welfare schemes shows that in industrial organisations 10% responded excellent and in service sector 13% responded excellent. In both the industrial and service organisations 48% reported that these facilities are good. 28% in industrial and 26% in service organisations are satisfied. 11% in industrial and 9% in service organisations responded poor. 4% of the employees of both industrial and service organisations reported that these schemes are not in-force. The non-statutory welfare schemes are also implemented equally in both the industrial and service organisa-

Table 6. Overall comparison of welfare schemes in industrial and service organisations

Perception/ Organisation		Statutory Schemes					Non-Statutory Schemes				
		Excellent	Good	Satisfactory	Poor	Not In-force	Excellent	Good	Satisfactory	Poor	Not In-force
Industrial Organisations	#	50	228	134	51	17	63	181	171	119	106
	%	10%	48%	28%	11%	4%	10%	28%	27%	19%	17%
Service Organisations	#	62	228	126	44	20	67	181	176	121	95
	%	13%	48%	26%	9%	4%	10%	28%	28%	19%	15%

Figure 3. Overall Comparison of Welfare Schemes in Industrial and Service Organisations



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tions. The perception of the employees on these schemes is 10% responded excellent, 28% good, and 19% poor in both the industrial and service organisations. 27% in industrial and 28% in service organisations are satisfied. Whereas, 17% in industrial and 15% in service organisations reported that these schemes are not in-force in their organisations.

The study clearly states that in case of industrial organisations or service organisations, both the public sector and private sector employees are equally satisfied with implementation of the welfare schemes in their organisations. The organisations need to put much effort to improve the welfare schemes implemented in their organisations as it enhances the employees' productivity and the organisations effectiveness.

RECOMMENDATIONS

The organisations should make pragmatic efforts to enhance the employees' work life and job satisfaction to increase their productivity and performance. Based on the comparative study, comments and suggestions given by various employees of industrial and service sector certain recommendations are made for further improvement in implementation of welfare schemes in the organisations that could be extremely useful for the management of both the public and private sector organisations to increase the organisational efficiency.

1. The management should update the employees about the different welfare schemes adopted in their organisations and suggest them how to make use of these facilities.
2. The employers need to concentrate on the facilities provided to the employee's outside the work place like quarters, medical benefits, etc., which helps in having better quality of work life.
3. The private sector whether industrial or service organisations need to improve the welfare schemes implemented in their organisations.
4. Proper incentives, allowances, promotions, etc., should be worked out that will fulfill the ambitions and aspirations, which will go a long way in elevating their level of job satisfaction.
5. The management should conduct stress reducing events like yoga and meditation for the employees.
6. The employers of private sector organisations need to identify the needs of their employees and provide necessary welfare schemes that will influence them in getting job satisfaction.
7. Improvements should be initiated in the field of grievance handling, rest room facilities, service awards, and other motivating facilities in both the sectors.
8. Necessary steps must be initiated to conduct job training programmes, seminars and workshops to update and enhance the knowledge of the employees.
9. A welfare officer can be appointed to solve all the problems of the employees and maintain good relation between the employees and employer.
10. The private sector organizations must take initiative to provide retirement benefits for their employees.
11. The private sector organisations must try to initiate necessary steps to provide subsidized canteen and store facilities to their employees.
12. The public and private sector organisations have to provide separate restrooms for both male and female employees.
13. Both the public and private sector organisations must set up a reading room or library for employees to make use of their leisure time and enhance their knowledge.

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14. The management can think of formulation of a problem solving committee including the employees and administration, for the better solution of the welfare problems of the employees.
15. The organisations can appoint a welfare officer to solve all the problems of the employees and maintain good relationship between the employee, employer and other departments.

The welfare schemes should be properly implemented in the organisations, as it may increase job satisfaction and employees' productivity. The researcher hopes that the industrial and service organizations of both private and public will consider the recommendations stated above. If they do, then the present study would have made an immense contribution towards increasing the welfare, well-being and job satisfaction of employees working in these organisations.

CONCLUSION

Every organization whether private or public sector and industrial or service organisations have to adopt the welfare schemes for better employee productivity and organisational development. A satisfied employee is the key factor, who acts as the organization's ladder for success. Welfare helps in keeping the morale and motivation of the employees high so as to retain the employees for longer duration. The thought of employee welfare has been used by many organizations as a strategy of improving the employee's productivity, especially in the private sector since work related problems can lead to poor quality of life for employees and a decline in performance. The welfare schemes improve the employees' morale and loyalty towards the management thereby increasing their happiness, satisfaction and also their productivity.

After the comparative analysis of the whole data it can be stated that the overall satisfaction of employees on both statutory and non-statutory welfare schemes in the industrial organisations with regard to public sector is good and private sector is satisfactory. However, in service organisations, the private sector employees are not satisfied with implementation of welfare schemes in their organizations when compared with the public sector employees who are more than satisfied with these welfare schemes. Therefore, it is suggested that the existing welfare schemes may be improved further as they enrich the employee's standard of living and their satisfaction levels. The private sector organisations has to take necessary efforts to find out what the employees want and implement those welfare facilities for the successful development of the organization. New schemes and facilities should be added to existing ones to improve the efficiency and quality of work life of the employees by the management of all organisations.

An employee welfare facility is the key dimension to smooth employer-employee relationship. The organisations should take necessary steps to solve the problems in those measures; so that the employee can do his job more effectively. New schemes and facilities should be added to existing ones to improve the efficiency and quality of work life of the employees by the management of all organisations. This study is expected to help other researchers to concern deeper about the various welfare schemes that influence the employee's performance and organisational productivity. A further research with regard to other industrial and service sector organisations can be considered as provision of welfare schemes has become important in every type of organisation.

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Section 4

Organizational and Social Implications

This section includes a wide range of research pertaining to the social and behavioral impact of Public Health and Welfare and contemporary coverage related to the corporate and managerial utilization of information sharing technologies and applications. Chapters in this section critically analyze and discuss trends in Public Health and Welfare. Also investigating a concern within the field of Public Health and Welfare is research which discusses the effect of user behavior. With 11 chapters, the discussions presented in this section offer research into the integration of global Public Health and Welfare as well as implementation of ethical and workflow considerations for all organizations.

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Chapter 39
Fostering Global Citizenship in Higher Education:
Development of an International Course in Global Health

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ABSTRACT

Despite growing public awareness, health systems are struggling under the escalating burden of non-communicable diseases. Arguably, one must place themselves within the broader/global context to begin to truly understand the health implications of personal choices. Fostering a 'global citizen' perspective among graduates has become an integral part of the Higher Education (HE) discourse; this discourse can and should be extended to include global health. A global citizen is someone who is aware of global issues, socially responsible, and civically engaged. From this perspective, personal health is not solely an individual, self-serving act. Rather, the consequences of lifestyle choices and behaviours have far-reaching implications. This chapter details: (a) the development of an international global health course designed to foster global citizenship; (b) the research-led pedagogy; (c) the methods of student evaluation; and (d) the importance of such a course within the broader context of HE.

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INTRODUCTION

Global citizenship development has become an integral part of the HE discourse; this discourse can and should be extended to include global health. Global health, alongside climate change, is one of the greatest contemporary challenges facing humanity. Considering this, universities have an opportunity to address contemporary societal issues that presumably their graduates will be grappling with after graduation. While there are many ways of engaging students with extant issues, study abroad and other internationally focused pedagogies can serve as a powerful approach. However, it has been argued, with specific reference to global health, that there is a '...need for a radical reform to curricula to foster engaged global citizenship; yet little is written depicting how individual courses and their instructors may support such reform' (Hanson, 2010). This chapter will argue that HE and the process of study abroad can play a key role in the fight against non-communicable diseases (NCDs), a major global health issue. Specifically, a critical understanding of global health can aid in fostering global citizenship, which in turn may empower students to become civically engaged and potentially drive social change.

BACKGROUND TO NON-COMMUNICABLE DISEASES

From Personal to Global

Health systems are struggling under the escalating burden of NCDs. This is currently recognised as a global issue; worldwide there were 57 million deaths in 2008, 63% of which can be attributed to NCDs, with over 80% of these deaths occurring in low- and middle-income countries (Hunter & Reddy, 2013; WHO, 2015). Clearly, lives can be saved and the global economy would be much stronger if people did more to avoid poor lifestyle choices such as physical inactivity and unhealthy eating habits (WHO, 2013). Yet despite growing public awareness about NCDs and the consequences of such lifestyle choices, NCDs continue to rise. Based on this observation, perhaps 'personal'-responsibility is not the answer, and conceivably the answer is 'global'-responsibility, manifested as an awareness of and commitment to global citizenship.

Obesity, a prominent NCD (Stoner & Cornwall, 2014), makes an excellent *exemplar* for the 'globalization' of health. Globally, the prevalence of obesity (defined as a BMI $\geq$30) doubled between 1980-2008, from 6.4% to 12.0% (Stevens et al., 2012). Notably, as with the general trend for NCDs, obesity is now increasing at a faster rate in low-and middle-income countries than high-income countries (Kelly, Yang, Chen, Reynolds, & He, 2008; Popkin, Adair, & Ng, 2012), thereby particularly afflicting nations with limited public health resources and ensuring this phenomenon is a true global health concern. Since changes to our genetic makeup cannot fully explain this relatively recent obesity pandemic, lifestyle factors have been cited, including declining physical activity levels and less healthy food choices. These lifestyle choices are *modifiable*, implying that we have the power to change this crisis through personal responsibility. Yet despite growing public awareness, the trend has not been encumbered (i.e., perhaps 'individual' responsibility is not the answer). In fact, the global prevalence of obesity is accelerating and obesity is occurring at an increasingly younger age (Olshansky et al., 2005), leading to personal, community, national and global consequences.

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Personal

Obesity is associated with a clustering of cardio-metabolic complications, including hypertension, hypercholesterolemia, Type-2 diabetes, and subsequent cardiovascular diseases (Dietz, 2004). This clustering of complications not only contributes to a decreased lifespan, but also to a decreased quality of life (Brettschneider et al., 2013). Notably, the higher populations in low- and middle-income countries, mean that NCDs, including obesity, will be responsible for three times as many disability adjusted life years as communicable diseases (maternal, perinatal and nutritional conditions) combined by 2030 (WHO, 2008).

Community

NCDs, including obesity, can exact enormous social costs (Hammond & Levine, 2010). Obesity and associated co-morbid complications may impair an individual both physiologically and psychologically, limiting the capacity of said individual to contribute to family and community. Moreover, if the complications of obesity become severe, the individual may require homecare, which may place a financial burden on the family and a psychological burden on the caregiver and family (Hammond & Levine, 2010).

National

The obesity epidemic is placing an increasing economic burden on greater society, including productivity costs, transportation costs, and human capital costs (Hammond & Levine, 2010). Limiting these costs to (lost) productivity, in the United States (US) alone it is has been estimated that total productivity costs are as high as USD $66 billion annually (Hammond & Levine, 2010). Considering obesity is occurring at an increasingly younger age (Stevens et al., 2012), this figure is likely to grow.

Global

The financial consequences world wide of the escalating burden of NCDs are considerable, with the World Economic Forum predicting that by 2030 NCDs will result in a cumulative loss in global economic output of USD $47 trillion or 5% of GDP (Alliance, 2014). However, arguably the most significant costs of this burden are more far-reaching; poor lifestyle choices, including those choices that contribute to obesity, have been linked to climate change and subsequent loss of biodiversity (Diaz, Fargione, Chapin, & Tilman, 2006). For example, the use of personal vehicles to commute to school or work, instead of walking or cycling, results in environmental pollution. Poor food choices, including high meat consumption results in inefficient land, soil and water resources use (Tukker et al., 2011). Environmental pollution and inefficient use of natural resources are contributing to the loss of biodiversity, implicating the production of food, fibre, potable water, shelter, and medicines (Diaz et al., 2006). These biodiversity-related consequences impact especially negatively on individuals and indigenous groups from low Gross Domestic Product (GDP) countries, who are more directly dependent on ecosystem services (Diaz et al., 2006).

Perspective

Above we have indicated some consequences of obesity from personal, community, national and global perspectives. These examples are by no means exhaustive, and similar lists can be constructed for

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other NCDs. However, these examples are sufficient to highlight that personal health is not solely an individual, self-serving act; rather, the consequences of our lifestyle behaviours can be wide-ranging and widely impacting. The remainder of this chapter will argue that HE can play a role in tackling the NCD pandemic by fostering 'global' responsibility, manifested as global citizenship. More specifically, we will argue that short-term international education programs, when appropriately designed, provide a delivery mechanism that can elicit a shift in perspective and engage students with beliefs and values different to those that individuals may have previously held. Using such a delivery mechanism, HE can enable global citizens who are civically engaged and capable of driving social change. The remainder of this chapter will detail specific steps required to foster global citizenship, provide a case study of an international global health program, and outline a working model for measuring global citizenship higher learning processes.

WHAT IS GLOBAL CITIZENSHIP?

Global citizenship, like other complex psychosocial concepts, being framed by a single definition does not typically capture the complexity of the phenomenon. Nonetheless, there have been three key dimensions identified by Schattle (2009), which serve as commonly accepted denominators of global citizenship:

1. **Global Awareness:** Understanding and appreciation of one's self in the world and of world issues;
2. **Social Responsibility:** Concern for others, for society at large, and for the environment; and
3. **Civic Engagement:** Active engagement with local, regional, national and global community issues.

In one of the most thorough reviews of the global citizenship concept in the study abroad literature, Schattle (2009) proposed that it 'entails being aware of responsibilities beyond one's immediate communities and making decisions to change habits and behaviour patterns accordingly' (p. 12). This clear delineation across seeking awareness or information, heeding and understanding responsibilities, and changing habits and behaviours on a scale, a scale which includes but goes beyond the border of one's own community, is essential to the practice of global citizenship.

When it comes to understanding global citizenship in connection with the previously identified dimensions, the context in which global citizenship is framed is imperative to our understanding. There is consensus that both the natural and built environments are the context in which global citizenship can be best understood (Attfield, 2002; Bryant, 2006; Dobson, 2003; Winn, 2006), because concern for the environment benefits the individual and all others, invoking a sense of obligation beyond that of simply the individual. According to Dobson (2003), the environment constitutes a *community of obligation* in which social responsibilities and behaviours extend in the form of an ecological footprint. In distinguishing between a Good Samaritan (i.e., based on charity) and a Good (*Earth*) Citizen (i.e., based on obligations), Dobson (2003) argued that 'the idea of the ecological footprint converts relationships we had thought to be Samaritan into relationships of citizenship' (p. 105). Citizens, then, are not merely global by reason of their experience (e.g., exposure to new culture, international travel etc.), but as a result of their pro-environmental (positive or negative) behaviours that make an impact (again, positive or negative) across populations. Central to this perspective is that experience can shape behaviour, but typically through a reflective process.

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With the ever increasing role of HE institutions (HEIs) in the development of global citizens, global citizenship should be considered more of a frame of mind or worldview and approach, than it is a simplified learning outcome. It is inherently complex in comprehension and practice. With this, global citizenship should not be framed as simply an outcome of HEIs, but rather, it should be perceived and addressed as a process in and of itself.

WHY IS GLOBAL CITIZENSHIP IMPORTANT TO GLOBAL HEALTH?

There have been increasing calls (e.g., Lewin, 2009; Stearns, 2009) from both the political and academic arenas, to ensure the capacity of HE students to think and act globally in order to effectively address political, social, economic, and environmental problems on a global scale (for a more extensive review see Stoner, Perry, Wadsworth, Stoner, & Tarrant, 2014). A seminal publication from the National Leadership Council for Liberal Education and America's Promise (LEAP) - *College Learning for the New Global Century* (AACU, 2007), identified the tenets of global citizenship as an essential learning outcome of university students for the following reasons:

- To provide students with the skills to manage real-world demands of work and civic responsibility;
- To do so with an understanding of the broader context of life in a complex and globally connected society; and
- To be competitive for employment opportunities by being able to operate within an ever increasing and expanding global economy.

With regard to global health literacy, Hanson (2010) suggested a need for 'radical reform to curricula to foster engaged global citizenship' (p. 70). Hearing a call is the first step to pursuing a call like this one from Hanson (2010). This reform to the curriculum focuses on the process of practices for delivering the content and providing the experience necessary for learning to occur. Moreover, increased attention with the issue of global health education illuminates a demand for pedagogies that promote culturally sensitive practices, personal transformation (reflection), extended understanding of social change (Hanson, 2010), a renewed emphasis on social determinants of health (Baum, 2007; Hanson, 2010) and social accountability (Boele & Heck; Hanson, 2010). To these ends, Hanson (2010) unequivocally stated that there is a 'need for educators to integrate global health and global citizenship in ways that foment action on the social determinants of health inequities' (p. 75). This clearly extends and intensifies the clarion call associated with the connection between global citizenship and global health as an important joint venture to be considered.

Additionally, the intensification of and access to technology has established links between institutions, communities, cultures and individuals, and today's university graduates live, work, and learn in a world that is more accessible than ever before (O'Steen & Perry, 2012). While the availability of modern travel and technology is not accessible to all of Earth's seven billion 'citizens', those who have access and acceptance into HEIs also have greater opportunities for globalized experiences and, concomitantly, global literacy than previous generations. The opportunity for a student to contextualize their existence within a global context has the potential to promote deeper understanding of cultural differences and provide a personally relevant counterpoint for juxtaposing their own beliefs with those of others (Perry

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et al., 2013) (see section: Digital Media: Integrating Technology and Reflection). In HE today, internationalization and globalization are fundamental components of the learning process.

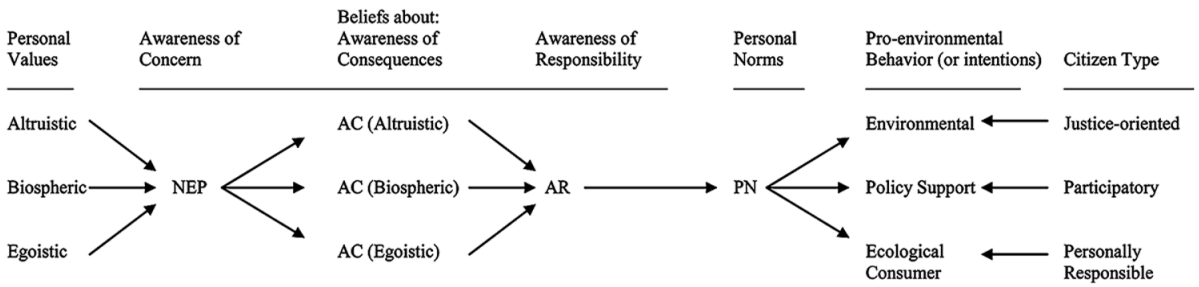
HOW DO WE MEASURE GLOBAL CITIZENSHIP?

When it comes to measuring global citizenship in the form of learning outcomes, particularly operationalized within a study abroad framework, there are an array of proposed models (McKeown, 2009; McLeod & Wainwright, 2009; Sobania & Braskamp, 2009; Streitwiser & Light, 2010; Sutton & Rubin, 2004; Tarrant, 2010). When considering the reasons or justifications for how global citizenship, operationalized within a study abroad framework, may be correlated with predetermined learning outcomes, the modified Value-Belief-Norm (VBN) model is valuable (Stern, 2000).

As noted previously (see section: *What is Global Citizenship?*), there is a consensus that the natural and also the built environment is the context in which global citizenship can be best understood. Drawing on this context, Tarrant (2010) developed a VBN model to assess global citizenship and the 'added value' attributable to study abroad. Reasonably, issues such as health inequities among populations based on social-economic status, ethnicity, and gender, and the role of social determinants in these discrepancies are indeed global in design (and effect) and concomitantly transcend national and international boundaries. Adapting Stern's (2000) VBN model, Tarrant identifies two components based on: (1) an awareness/belief that specific environmental conditions (e.g., poverty, health, climate change etc.) threaten or have adverse consequences for the things the learner values; and (2) an awareness/belief that the individual/learner can act to reduce the specific threat(s) (Stern, 2000; Tarrant, 2010). These components and the extent to which an individual learner aligns with these two beliefs are critical to the conceptual framework. Moreover, these components clearly demonstrate the imperative of awareness. In connection with this supposition, the first step to addressing global health—whether focused on disparities, causes, preventions, or treatments—is to start by raising awareness (Stoner et al., 2015). Currently, the world population's access to information, treatments, opportunities, and resources are not equally available, an issue that relates back to global citizenship. This is a clear point of alignment with the explicit goals associated with the education of global citizenship and the discrepancies associated with public health on a global scale.

Figure 1 provides a schematic of the VBN model that has been used to examine the effect of study abroad on the development of global citizenship. The two components Tarrant (2010) identified (the

Figure 1. A modified value-belief-norm theory of global citizenship
Source: Tarrant (2010)



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connection between environmental conditions and the threats on a learner's values and the belief that the learner can reduce the threats), which underpin Figure 1, have a common denominator. That denominator is a learner's values and what the learner is willing to do about those values. Put simply, awareness is a critical predisposition or catalyst for informed action, but the learner's understanding of their personal values is the filter whereby awareness can either permeate or stymie.

Based on the framing within pro-environmental behaviours (modified from Stern, Dietz, Abel, Guagnan, & Kalof, 1999) the following three measures are relevant to the VBN model and are demonstrated in Figure 1: (1) environmental citizenship; (2) willingness to support environmental policies; and (3) ecologically conscious consumer behaviour. This measure is then extended to align with the learner's 'citizen-type' according to Westheimer and Kahne (2004). These particular citizen-types formulate a primacy from less intensive to more intensive actions and commitments associated with the learner's awareness of responsibility and personal norms. In this, the citizen-types classifications are described as: 1—*personally responsible citizen* (someone who acts responsibly in their community, recycles, gives blood, volunteers in times of crisis); 2—*participatory citizen* (someone who is an active member of a citizen sector, community, or civic organization); and 3—*justice-oriented citizen* (someone who critically assesses social, political, and economic structures to see beyond surface level justifications and challenges injustices within their community).

HOW DO WE FOSTER GLOBAL CITIZENSHIP (AND GLOBAL HEALTH)?

Nurturing a globally-minded citizen has typically been associated with a transformative learning experience and subsequently, Mezirow's (1991) Transformative Learning Theory (H. L. Bell, Gibson, Tarrant, Perry, & Stoner, 2014). This includes those pedagogies that engage the student with alternative lenses, orientations, or points of view related to a complex issue (such as global health), and ultimately leading to a change in perspective (Mezirow, 1991). Arguably, a key to transformation is educative experiences coupled with critical reflection (Dewey, 1938; Kolb, 1984). An experience without critical reflection is solely an experience, which does not necessarily provide an individual with the opportunity to shape perspective; it actually has the possibility of being *mis-educativ*e (Dewey, 1938; Wojcikiewicz, 2010).

In addition to critical reflection, Hanson (2010) argued for the following curricular modifications; interdisciplinarity and engaged learning practices. The factors of reflection, interdiscplinarity, and engaged learning will be reviewed here as key components for addressing the 'how to' of fostering global citizenship and global health as allied concepts.

Reflection

An integral component of any effective experientially-based learning process is critical reflection (Kolb, 1984). Critical reflection, as a process, seeks to engage an individual in 'scratching below the surface' to be deep and accurate when determining the value of a decision, experience, or theory (Alwehaibi, 2012). An educative experience should serve as a departure point for learning, not an end-result and subsequently should present an opportunity for response or an investigation of an experientially-based question or line of inquiry (*'why'*). An investigation of 'why' begins with thought-provoking, informed questions and focuses on inspiring learners to pursue their own learning and meaning-making. Whether an experience and subsequent reflection leads to a transformed self/perspective or an affirmed self/

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perspective is not relevant; what is relevant is that the process of reflection is imperative for learning (Dewey 1938).

This demonstrates the iterative nature of knowledge, which is typically bound by time and context, and shapes educator's goal of engaging students in obtaining an ever-growing understanding of their world. By engaging students in critical reflection and discussion, it becomes possible to foster a shift in perspective where students become 'critically aware of how and why their assumptions have come to constrain the way they perceive, understand, and feel about their world' (Mezirow, 1991, p. 167). From this process, it is plausible that a learner's reinvestment in informed application can lead to greater sensitivity, stronger acumen, and a more informed approach to the issues that are affecting the wellbeing of our communities both local and global.

The method or practice applied by learners to navigate the reflective process is important and should, as a consequence, shape the way teachers facilitate learning environments. This is supported by Peterson's (2002) argument that while experience is one of the best teachers, it is never as valuable as when it is combined with critical analysis, reflection, and the interpretation and filtration of learners. An established and widely accepted approach to critical reflection within experientially-based pedagogies is the *DEAL* model (Ash & Clayton, 2004). This model offers three-steps following a student's engagement with an experience:

1. Description of experiences objectively;
2. Examination of experiences through reflection prompts related to learning goals; and
3. Articulation of Learning goals for future action for improved practice and further refinement of learning.

The Description, Examination, and Articulation of Learning (DEAL) occur in sequence after an experience has been completed. DEAL can be used throughout a semester and assigned iteratively. For example, if a group of short-term study abroad students are studying local indigenous health disparities, the model could be repeated after each interaction/experience associated with their time abroad. DEAL, being used to its fullest potential, is applicable to experientially-based pedagogies.

Interdisciplinary Approach

Jacobs (2015) compared HE discipline centric approaches to focusing 'on a set of trees within a great forest' and extends this metaphor further by suggesting that interdisciplinary approaches tend to take a more inclusive view of the landscape by surveying the forest, generally, and 'drawing upon various tree experts depending on the needs, contexts, and circumstances' (p. 2). Through an examination of the literature associated with many HE disciplines, Jacob (2015) highlighted a trend 'away from disciplinary hypothesis-based research to problem-based, interdisciplinary studies' (p. 52). Specifically, an interdisciplinary approach seeks to involve two or more subject areas or ways of knowing, which is particularly relevant when studying complex global health models - or even a seemingly simple tenet of health!

While there are many accepted definitions associated with interdisciplinary approaches, Newell (2007) offered a definition that frames the approach as a two-part process associated with integration, 'it draws critically on disciplinary perspectives, and it integrates their insights into a more comprehensive understanding…[which] can also be adapted to the creation of a new complex phenomenon' (p. 248). From

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this, it may be postulated that a concerted effort may be formulated to address the broader, perhaps more complex issues being faced in our world and communities. Global public health, in alignment with the framework of global citizenship, is undoubtedly a complex phenomenon influencing our communities on both a local and global scale (Stoner et al., 2014).

It appears that, as social issues become increasingly complex (or are realized as being more complex) the connections between/among disciplines become more difficult to determine. For example, issues of public health and environmentalism can become issues of social justice and inequality that, in order to fully comprehend, must be addressed through a range of paradigms of inquiry and discourses rooted in political science, sociology, human geography or criminal justice. Addressing these complexities does not need to occur in isolation, but through integration across respective disciplines. This integration is what interdisciplinary approaches seek to achieve.

Engaged Learning

Student engagement as a theory, model, practice, and instrument of measurement and/or analysis has become one of the most recognized concepts in HE globally. Student engagement focuses on relationships between students' involvement and empirically-based university conditions that positively impact and influence students' commitment to participate (Kuh, 2008). Moreover, this conceptualization and measurement of engagement is based on two critical features of collegiate quality:

The first is the amount of time and effort students put into their studies and other educationally purposeful activities. The second is how the institution deploys its resources and organizes the curriculum, other learning opportunities, and support services to induce students to participate in activities that lead to the experiences and desired outcomes such as persistence, satisfaction, learning, and graduations. (Kuh et al., 2005, p. 44)

To capture a student's involvement in conditions that lead to higher engagement, personal growth, retention, and learning, a survey has been developed i.e., the National Survey of Student Engagement (NSSE) (Kuh, 20013). Since 2000, this survey has been completed by nearly 2,000 institutes of HE education, accumulated an aggregate sample size of nearly five million students, and been modified to fit the tertiary education contexts, cultures, and countries of Australia, New Zealand, South Africa, Canada, and Japan (AUSSE, 2015; NSSE, 2015; Strydom & Mentz, 2010). This survey has had a substantial impact on both the student affairs (co-curricular) and academic affairs (curricular) educational approach.

The teaching practices we adopt in order to bring about engagement within our classrooms and across our university are influential. According to 15 years of student engagement research using the NSSE survey to inform pedagogical practices, the following ten practices have been identified as 'high-impact':

- First-Year Seminars & Experiences
- Common Intellectual Experiences
- Learning Communities
- Writing Intensive Courses
- Collaborative Assignments & Projects
- Undergraduate Research
- Diversity/Global Learning

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- Service-Learning/Community-Based Learning
- Internships
- Capstone Courses & Projects (Kuh, 2008).

Most salient to this chapter and the 'how' of pedagogically creating conditions that can positively impact engagement, are Diversity/Global Learning and Service-Learning/Community-Based Learning. Diversity/Global Learning will be described in the section *Case Study: Short-Term Global Health Course*. Service-Learning/Community-Based Learning will be described as service oriented initiatives focused on analysing, addressing, and reflecting on issues with the community as an educative experience that prepares students for citizenship, work, and life (Kuh, 20013). These high impact practices have been applied in classrooms around the world and are currently some of the most adoptable and applicable methods for engagement and good teaching and learning practices.

GLOBAL CITIZENSHIP AND SHORT-TERM STUDY ABROAD

In order to nurture global citizenship, there is a requirement for a delivery mechanism that can compel a shift in perspective and engage students with a set of beliefs and values that may differ from their own current views. This shift can occur as a result of a transformative educative experience, where students not only reframe their own identity but also begin to negotiate a sense of belonging that 'reimagines' the global community, encounters and engages diversity, and constructs citizenship as a site of struggle (Pashby, 2008).

While short-term study abroad programs have been criticized for being academically 'light' (McKeown, 2009), those programs can, nevertheless, present a unique opportunity for providing action-oriented experiences that encourage reflection, critical analysis, and synthesis (Perry, Stoner, & Tarrant, 2012). A growing literature demonstrates that short-term study abroad programs are capable of fostering global citizenship when aligned with traditional (see section below for further discussion, *Digital Media: Integrating Technology and Reflection*) methods of critical reflection (Tarrant & Lyons, 2012; Tarrant et al., 2014; Tarrant, Rubin, & Stoner, 2014; Tarrant et al., 2011; Wynveen, Kyle, & Tarrant, 2012). We assert that experientially based, short-term educational travel programs provide a relevant learning site for students to experience, grapple with, reframe, and reflect on issues global in nature—ultimately fostering the conditions necessary for transformative experiences that have been shown to lead to a shift in perspective, awareness, and worldview. Such programs may provide an experience of cultural immersion and exposure to values and beliefs that differ to students' own beliefs, and can highlight common challenges faced by all societies. This can be achieved by exposing students to new cultures, places, and learning environments (Perry et al., 2012), and can serve as the disorientating dilemma necessary to initiative perspective transformation (Mezirow, 1978).

It is important to note that, while the *experience* is indeed a key component to the transformative learning, the catalyst for this transformation is the juncture between experiences and a sound pedagogy underpinned by critical reflection (Clark, 1991). As discussed above, critical reflection is the mechanism by which students begin to make meaning out of their experiences and adjust their frames of reference (Moore, 2005). Simply stated, the attributes of an engaged global citizen do not just happen, they accumulate through an educative experience, conscious engagement, critical reflection, and informed application.

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CASE STUDY: SHORT-TERM GLOBAL HEALTH COURSE

Discover Abroad and Massey on the Move

The Discover Abroad office (www.discoverabroad.uga.edu) at the University of Georgia (UGA) in the US has provided international outbound study tours for over 3,000 US students throughout the South Pacific since 2000, and is among the leading efforts for short-term programmes in the US. In 2012, Discover Abroad was recognised by the Institute of International Education as runner-up for the prestigious Heiskell Award (the highest accolade in the field of HE) for Best Practices in Study Abroad. The courses offered by Discover Abroad are research-led, utilizing the *Conceptual Framework for Exploring the Role of Studies Abroad in Nurturing Global Citizenship* (Tarrant, 2010). A framework which couples sound pedagogical content with concrete experiences (*engaged learning*) and critical reflection. Using this framework, Discover Abroad has developed a number of *interdisciplinary* short-term courses (8-24 days) that have proven effective in fostering global citizenship (H. L. Bell et al., 2014; Tarrant & Lyons, 2012; Tarrant et al., 2014; Tarrant et al., 2014; Tarrant et al., 2011; Wynveen et al., 2012). This research paradigm is now being extended to investigate the value of these courses in fostering other HE outcomes i.e., in documenting the 'value added' of studying beyond the campus environment (Tarrant et al., 2014).

Massey on the Move (www.masseyonthemove.org) was developed at Massey University in New Zealand (NZ), to establish a partnership with Discover Abroad and to co-develop an international Global Health course (see below) designed to foster global citizenship. The Global Health course is open to students in both NZ and the US and serves as an experiment in 'peer-peer' learning.

Global Health: The Importance of Sustainable Environments

Despite growing public awareness, health systems are struggling under the escalating burden of non-communicable diseases. While personal responsibility is a crucial step in maintaining health, alone it is insufficient (Stoner et al., 2014). All decision-making is highly socially, culturally, and structurally contextualized (R. Bell, Lutz, Webb, & Small, 2013). Through examining the way these decision-making dimensions interact in other places, students can begin to understand the impact of their own decisions, and the extent to which those, too, are circumscribed socially, culturally, and structurally. From this perspective, we argue that one must place themselves within the broader/global context to begin to truly understand the health implications of personal choices (Stoner et al., 2014). For example, personal health is not solely an individual, self-serving act. Rather, the consequences of one's lifestyle behaviours have deep and wide consequences extending to the community, national, and global contexts. Being a true global citizen means one is: (a) cognizant of these interconnections and the role personal decisions play in each context; and (b) civically engaged and capable of driving social change. Therefore, the overarching aim of this course is to promote global health by fostering global citizenship, where global citizenship is defined using three criteria: (1) aware of global issues; (2) socially responsible; and (3) civically engaged.

This 24 day interdisciplinary course represents a unique collaboration between Discover Abroad and Massey on the Move. At UGA the 6-credit *interdisciplinary* upper division course is cross listed in Anthropology, Ecology, Forestry and Natural Resources, Geography, and International Affairs. At Massey University the course is worth 30-credits (equivalent of 6 semester credits in the US) in the Health Sciences, and students can split the credits to cover Science and Social Science requisites. The

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course examines the relationship between global health and sustainable natural and human environments, integrating diverse natural, biological, and social science perspectives. The stated learning outcomes are:

1. To evaluate relationships between human societies and their environments from multiple disciplinary perspectives, and to demonstrate how human-environment interactions influence lifestyle choices and health;
2. To describe the importance of biodiverse natural environments to global health, and address impacts of human actions on natural systems, and human responses to those changes;
3. To explain how health disparities that adversely affect indigenous cultures result from colonial, historical, environmental, global, and economic factors;
4. To distinguish and evaluate the challenges of maintaining health that may be particular to indigenous cultures;
5. To recognize 'health', 'disease', 'prevention', 'risk reduction' and 'medical treatment' as social constructs contingent on culture, environment, and global influences; and
6. To identify and describe sustainable approaches that help shape a community's ability to maintain and promote health.

Itinerary

Australia's Sydney and far Northeast Queensland offer ideal laboratories for comparing and contrasting cultures (notably Aboriginal Torres Strait Islanders, and Western) and environments (cities, Great Barrier Reef, rainforest, and outback) to understand the complex relationships between environmental sustainability and public health. One of the greatest benefits of these locations is that Australian approaches to both natural resource management and health care are different from what most of the students are accustomed to. Further, recent changes in the region allow for greater Aboriginal control over the planning and deployment of health care measures, providing students a unique insight into Indigenous health and community-led decision-making processes. This is vital as students need to learn how to differentiate between 'constructive and destructive traditions' in order to make and support decisions that enhance life in general (Bowers, 2003). Since Aboriginal (indigenous) traditions view the natural environment as a key part of any social, cultural, or structural dimensions of decision-making, this is an excellent way to introduce students to different ways of defining health, and measuring health outcomes, which may collectively enable them to question their own definitions of health and wellbeing.

The course is delivered in a modular format according to four subthemes, which are location dependent. The course begins in Sydney, where module one examines the interactions between 'Urbanization and Public Health'. The effects of urbanization on public health are of particular concern to Australia, with approximately 75% of the population living in urban areas and 65% living in the eight capital cities. Of note is the fact that the majority of Aboriginal people live in these urban areas and suffer disproportionately from the effects of 'lifestyle' diseases. Key questions addressed include:

1. *What factors contribute to or impede healthier lifestyles in urban environments?* and
2. *Why may Aboriginal people be disproportionately affected?*

In Module 2 students travel to far Northeast Queensland and the Great Barrier Reef, where students spend several days examining 'the importance of natural resources to health and wellbeing'. Coral reefs

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are among the world's most biologically diverse and productive ecosystems and supply a vast array of goods and services. Those reefs are of particular importance to many indigenous coastal communities, who not only depend on these ecosystems for most of their protein needs, but also as a primary economic driver. The Great Barrier Reef World Heritage Area, extending 2,300 kilometers along Australia's Northeast coastline, is the largest natural feature on Earth created entirely by living organisms, and provides an excellent context to examine direct and indirect importance of natural resources to human wellbeing. It is here that the emphasis is on the different ways that 'environment' is incorporated into indigenous and Western worldviews and the ways in which those worldviews motivate behaviour with regards to managing ecosystems.

For Module 3, students travel to the Daintree Rainforest, where they spend a number of days investigating the relationships between 'climate change, biodiversity and indigenous health'. The cultural dimension of health decision-making is woven throughout the program with visits to health care facilities and decision-making bodies specifically related to Aboriginal health in Northeastern Queensland. The goal is to introduce students to different ways of defining health, some of which include maintaining a close relationship to the local natural environment, but also to show them that they too, 'have culture' meaning they too, make decisions based on their own cultural understanding of the world, of what is right and normal. Just as Aboriginal health and wellbeing may come through maintenance of their cultural practices, so may Western health and wellbeing be determined by factors beyond biology. At the same time, structural impediments, such as a lack of basic infrastructure, lower socio-economic status, and chronic health problems contribute to the lower adaptive capacity of many communities.

For the final module, students are taken to Tyrconnell (*Outback*) and Atherton Tablelands (*Outbush*), where they critically examine strategies for 'improving indigenous health'. Here they explore Western approaches to health from cultural, economic, and environmental perspectives and make comparison to Aboriginal perspectives to sustaining healthy communities and environments. These remote locations are beneficial, too, in that they provide space and time necessary to process information (critical reflection). During that time it is envisaged that students are able to 'unpack' what they are learning, both through group discussions and personal reflection time.

Academic Model

As mentioned above, the course is delivered in a modular format according to four sub-themes, which are location dependent i.e., experimental (see itinerary above). Each sub-theme addresses relatively complex ecological, social, and cultural issues related to sustainability and global health, and is comprised of a short narrative/introduction, a series of readings, field activities, service-learning, seminars, and a collection of classroom lectures from travelling faculty and local experts (i.e., from local universities, government agencies, NGOs, organizations etc.). Modules consist of a series of essays, group debates, science projects, and critical reflection. There is also an iterative thematic essay, focused on 'understanding the meaning of progress' (sustainability, values, and the triple-bottom line), and a final two hour, open-book exam which addresses inter-connections between key concepts explored throughout the course. Finally, one week after the end of the course, students deliver a three-minute critical reflection video (see below *Digital Media: Integrating Technology and Reflection*) that addresses the same topic as the thematic essay.

The module approach outlined above provides students with a myriad of learning opportunities that are pieced together over the course, requiring active engagement, both physical and intellectual. While this

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approach may seem disparate, the course content and the style of teaching is iterative. More specifically, building upon the theoretical framework offered by Dewey (1938) and Kolb (1984), the course employs a simple pedagogical primacy, known as the three Ds: *Directing*, *Discussing*, *Delegating*, with each 'D' representing a unique style of facilitating learning (Thornton, 2013). Initially, the educator adopts the Directive Style, telling the students what to do, how to do it, and when it needs to be done. For example, through this style the educator will raise awareness about the global rise in NCDs, including obesity, providing a knowledge base to build upon (Global Citizenship Criteria 1: Aware of Global Issues).

Subsequently, using the Discussant Style the educator, in a Socratic manner, frames the concept with challenging questions to guide discussion and illuminate the students' biases, worldview, perspective, and attempts to challenge these preconceived notions and how they came to be. For example, through this style the educator will raise awareness about the consequences of lifestyle-driven obesity, and ask the students to begin to question how their health actions and lifestyle choices impact the global community (Global Citizenship Criteria 2: Social Responsibility). Finally, as a facilitator adopts the Delegation Style the challenging questions begin to come from the students themselves. As the task experience increases and the students become more empowered and *civically engaged* (Global Citizenship Criteria 3), this is where critical reflection (see below: *Digital Media: Integrating Technology and Reflection*) becomes imperative for student learning. At this point the facilitator assumes the role of learning facilitator and the students become the arbiters of their own learning and, just as importantly, become lifelong learners. While the content is always changing and adapting, the process whereby students make sense of the content is enduring.

Given the complexity of the latent construct of global citizenship, there is unlikely to be a 'one-size-fits-all' pedagogical approach. However, in order for a HEI to identify the most appropriate model, there must first be a philosophical platform to place the building blocks. Utilizing the pedagogical model described above, the context of environmental sustainability (including climate change) has been successfully applied to foster global citizenship (H. L. Bell et al., 2014; Tarrant & Lyons, 2012; Tarrant et al., 2014; Tarrant et al., 2014; Tarrant et al., 2011; Wynveen et al., 2012). This previous work has used *international* (study abroad) transformative learning experiences; it may be argued that engaged learning coupled with critical reflection on global issues is most powerful when there is 'direct' contact with said issues. In support, there is mounting evidence suggesting that international experiences provide powerful *dis*-orientating experiences, leading to deep reflection, critical analysis, and synthesis (McKeown, 2009; Sutton & Rubin, 2004; Tarrant et al., 2014; Tarrant et al., 2011).

Critical Reflection: Digital Storytelling's Unique Value

For their final assignment students' deliver a three-minute digital story focusing on the notion of progress, as a novel means of critical reflection. Traditional forms of critical reflection can and do work in the context of short-term study abroad (H. L. Bell et al., 2014; Tarrant & Lyons, 2012; Tarrant et al., 2014; Tarrant et al., 2014; Tarrant et al., 2011; Wynveen et al., 2012). Nonetheless, we argue that reflective experiences can be further enhanced by using technologies and services many students are intimately familiar with and use on a daily basis (Figure 2). In this regard, digital storytelling can provide students with a louder, clearer voice, utilizing a presentational form (Taylor & Ladkin, 2009) to reflectively articulate themselves and develop the foundation of a civically engaged citizen.

Pathway 1 presents the 'just do it' approach, where it is expected that experiential education (A) is sufficient to foster global citizenship (C). Pathway 2 couples experiential education (A) with a traditional

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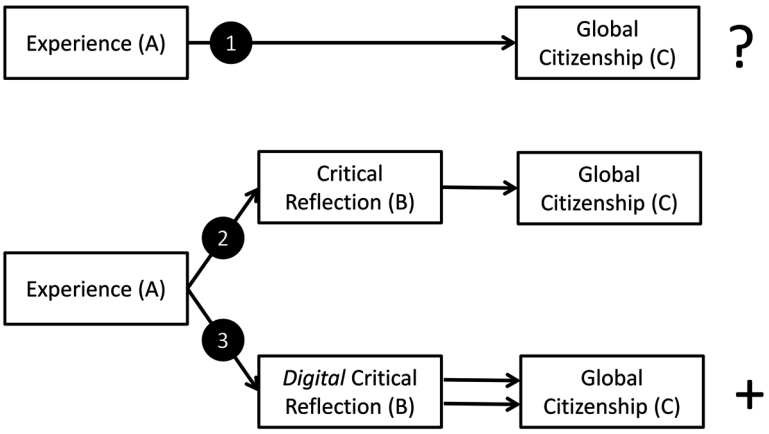
Figure 2. Pathway from experience to global citizenship



critical reflection (e.g., paper-based) (B) approach, an approach demonstrated to lead to global citizenship (C) within the context of international education (H. L. Bell et al., 2014; Tarrant & Lyons, 2012; Tarrant et al., 2014; Tarrant et al., 2014; Tarrant et al., 2011; Wynveen et al., 2012). Pathway 3 replaces traditional critical reflection with digital critical reflection (C), an opportunity to meet learners on the platforms and forums where they live, communicate, and already engage, and subsequently enhance reflective process.

Reflective digital stories, when compared to traditional reflective journals, have been demonstrated to be more indicative of the impact experiences had on students' learning and competency (Walters, Green, Liangyan, & Walters, 2011). Walters et al. (2011) stated that '[w]hile journals recorded a catalogue of events, the digital stories, even at the lowest-level of reflection, were more indicative of the impact of the experience… than journals' (p. 49). While it has been clearly presented that critical reflection methods are imperative for students to make sense of experiences, the use of digital stories could be a medium that provides students with familiar space for the presentational form to be developed in an authentic, true-to-self, presentation-based format. Moreover, this forum has greater potential to take the learning experience beyond the classroom, helping students to connect with the global-community, and to potentially become truly engaged global citizens empowered with voices to evoke change (for further review see Perry et al., 2015).

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

While the Value-Belief-Norm model for assessing global citizenship (Tarrant, 2010) provides a basis for understanding a transformational shift in 'citizen-type', it does not provide an avenue to explore the ways in which students may (or may not) reach the desired outcome of becoming a justice-oriented (global) citizen. If the goal of short-term study abroad is to foster global citizenship, and if global citizenship is the result of a shift in perspective and worldview, then we need to uncover the critical moments at which students form deeper meanings about who they are in relationship to the 'bigger picture' of the globe. Moving forward, a new conceptual model that includes the theoretical construction of critical reflection and subsequent transformative learning will be key in providing a deeper understanding of the juncture

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at which students' realities are reframed and new meanings are made. Furthermore, longitudinal research is required to understand the long-lasting effects of experiential study abroad programs; research in this arena may uncover information that will aid in the development of study abroad programs, ensuring that not only are the desired learning outcomes achieved, but that appropriate experiences truly provide opportunities for lifelong perspective shifts.

Lastly, while support should be given to international experiences, specifically those focused on global health issues, the research is limited with regards to the 'value added' of study abroad (i.e., direct comparisons to campus-based initiatives) (Tarrant et al., 2014). For example, it is more than likely that a student will not need to travel beyond the local community to experience the NCD pandemic. In particular, service-learning is a powerful medium which could be exploited to enable and critically reflect on engaging learning experiences (Kuh, 2008; O'Steen & Perry, 2012). Campus-based educational models could be particularly powerful if coupled with international education; by utilizing *local* contexts to engage students with *global* issues, there is potential for sustained student engagement following disorientating international experiences. Further research is warranted to investigate the interplay between/among on-campus, off-campus and study abroad experiences.

CONCLUSION

There have been increasing calls, from both the political and academic arenas, to ensure the capacity of HE students to think and act globally in order to effectively address political, social, economic, and environmental problems. This call can and should be extended to include global health, which together with climate change are, arguably, the *two* biggest concerns facing humanity. However, responding to these realities requires a considerable increase in the global literacy of the typical college graduate. A global citizenship competency, within the context of global health, should become an integral component of a university's core curriculum, alongside fundamental disciplines such as history or science. Simply put, there are practical pedagogical decisions that can be made to refocus the core curricula on learning outcomes directly related to the issues being encountered by today's communities.

One such pedagogical model includes short-term, faculty-led, experiential programs. Such programs are capable of not only playing an important role in not only fostering some of the outcomes considered critical to national security, globalization, global competitiveness, and social norms, but also to tackle the 'wicked' global health concerns. For example, such programs can help students to understand that personal health is not solely an individual, self-serving act; rather, the consequences of our lifestyle behaviours have deep and wide consequences extending to the community, national, and global contexts. Being a true global citizen means one is: (a) cognizant of these interconnections and the role personal decisions play in each context; and (b) civically engaged and capable of driving social change.

A word of caution must be clearly stated at this juncture. To date, the academic response to calls for greater global learning have focused on a 'just do it' approach. The number of students participating in education abroad is often the primary indicator of a HEI's success in achieving globalization aims. An experience without critical reflection, however, is just an experience, which does not necessarily provide an individual with the opportunity to shape perspective, and actually has the possibility of being *mis-educative*. Accordingly, we encourage faculty to incorporate field-based learning experiences into study abroad curricula and to consider their role as facilitators of citizen activism (Hanson, 2010), promoting

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opportunities for civic engagement, responsibility, and global awareness. The challenge, evidently, is to develop programs in a measured and effective way. Such programs must be attractive to students, yet *not* turn the travel experience into a token service program of consumerism with little value beyond the tourism dollars it generates.

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KEY TERMS AND DEFINITIONS

Critical Reflection: A process, seeks to engage an individual in 'scratching below the surface' to be deep and accurate when determining the value of a decision, experience, or theory. An essential step in transformative learning.

DEAL Model: A sequence of steps which occur after an experience has been completed: (1) Description of experiences objectively, (2) Examination of experiences through reflection, (3) Articulation of Learning. This model may be iterative e.g., if a group of short-term study abroad students are studying local indigenous health disparities, the model could be repeated after each interaction/experience associated with their time abroad.

Digital Storytelling (Critical Reflection): An alternative to paper-based reflection. An opportunity for critical reflection method to be intensified by meeting learners on platforms where they already live, communicate, and engage.

Engaged Learning: Focuses on relationships between students' involvement and empirically-based university conditions that positively impact and influence students' commitment to participate.

Global Citizenship: A multi-faceted term which is general accepted to include three key criteria: global citizenship is defined using three criteria: (1) aware of global issues; (2) socially responsible; and (3) civically engaged.

Global Health: The health of populations in a global context. Places a priority on improving health and achieving equity in health for all people worldwide.

Interdisciplinary Approach/Interdisciplinarity: An approach which seeks to involve two or more different subject areas or ways of knowing.

Mis-Educative: An educative experience without critical reflection i.e., does not shape perspective.

Non-Communicable Diseases (NCDs): Also known as chronic diseases i.e., not passed from person to person. The four main types of NCDs are cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes. NCDs are of long duration, generally slow progression, and are highly modifiable by lifestyle behavioural e.g., physical activity, nutrition, smoking.

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Pro-Environmental Behaviour: Behaviour that consciously seeks to minimize the negative impact of one's actions on the natural and built world.

Tarrant's Adapted Value-Belief-Norm (VBN) Model: Two components based on: (1) an awareness/belief that specific environmental conditions (e.g., poverty, health, climate change etc.) threaten or have adverse consequences for the things the learner values; and (2) an awareness/belief that the individual/learner can act to reduce the specific threat(s). In this, the learner's values and what they are willing to do about those values are significant. Simply put, awareness is a critical predisposition or catalyst for informed action, but the learner's understanding of their personal values is the filter whereby awareness permeates or is stymied.

Three D's: *Directing*, *Discussing*, and *Delegating*, with each 'D' representing a unique style of facilitating learning. An iterative approach to education, which ultimately contests students to derive the challenging questions themselves, and become arbiters of their own learning.

Transformative Learning Experience/Theory: Pedagogies that engage the student with alternative lenses, orientations, or points of view related to a complex issue (such as global health), ultimately leading to a change in perspective.

Value-Belief-Norm (VBN) Model: VBN focuses on values and moral norms. Individual choice about pro-environmental actions can be driven by personal norms; an internalized sense of obligation to act in a certain way. Norms are activated when an individual believes that violating them would have adverse effects on things they value. Personal values (e.g., altruistic values, egoistic values) are antecedents of environmental beliefs.

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Chapter 40
Community Development and Faith-Based Organizations: Lessons for Global Health

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ABSTRACT

This chapter is a reflection of analyses, experiences and research on the opportunities and challenges of working with faith-based organisations (FBO's) in the context of global health. The purpose of this chapter is to demonstrate the important role that FBO's have with state and non-state actors in the development of communities in complex contexts. The role of FBO's in development are demonstrated in reference to the Author's work experience with FBO's, which form case studies in East Africa, and Timor Leste. Further analyses through literature build on these experiences to demonstrate the leading role FBO's can have with state and non-state actors, and the effects on public health. In the case study of Timor Leste, suggestions are proposed to overcome challenges and build on the opportunities of state and non-state actors incorporating the Catholic Church into health programs.

INTRODUCTION

In Timor Leste, as in other regions of the globe there is economic, political and social turmoil that impedes education, health care, and cultural and religious identities, and exacerbates poverty. There is definitely a need for a well functioning democratic state particularly in fragile states in need of peace from war. Other factors are the social and cultural norms in communities. Wolfgang (2005) argues that an actor that can guide a constructive debate between groups with different opinions can influence social change and transform a violent state with peace. Actors such as FBO's have a significant role in peace transformation and teach values, that can help individuals and communities examine the social changes in their context. FBO's influence can reshape ethics and moral actions that are essential for peace transformation and impact on health.

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In the past, the role of faith in development has been largely disregarded in International organisations programs that are mainly focused on the development of a well functioning state. This chapter will demonstrate that faith and development are not separate, and faith can be a significant component to develop a well functioning state in fragile or failed states. FBO's can be agents for social development, improved economic and political development and freedom of poverty and improved public health of fragile and failed states. This chapter examines this perspective further with the following questions in an analysis of the health system in Timor Leste:

1. What role does faith have in the development of communities?
2. Are FBO's effective for improving health outcomes and development of communities? What opportunities and challenges are there for states and non-state actors to partner with FBO's for improved public health?
3. How can we incorporate FBO's into health programs within the context of Timor Leste?

These questions were formed on the basis of my experience working with CMA and MAA at a national level and associated field work. Research was explored further with these questions in mind, and literature in this chapter will be used to demonstrate the important role of FBO's in development, the associated challenges and potential opportunities for the partnership of FBO's with state and non-state actors to improve public health.

The objectives of this chapter are:

1. To highlight the influential role of FBO's with citizens in the context of fragile and failed states.
2. To stimulate the awareness of FBO's as an important determinant of global health for all relevant international health stakeholders.
3. Finally, to present the opportunities there are for state and non-state actors to work with FBO's in the case study of Timor Leste, and suggest possible solutions for further research to be explored.

This chapter will discuss the role of faith in development as a basis for the relationship of FBO's relationship with citizens and state and non-state actors. The research and analyses applied in the context of Timor Leste is a model for further research in global health. This topic is an important contribution to this book, as it represents an emerging field of global health and development that has not been researched in depth.

ANALYSIS

The following analyses are formed on the basis of a combination of my work experience and observations in the field whilst working with different FBO's and literature sought from journal articles, published books, state documents, reputable and organisations websites.

Whilst working with MAA, in August, 2011 at the height of the emergency phase in North East Kenya, I visited the region for 2 weeks to work alongside the implementing partner, Waso Resource and Development Agency (WARDA). Together we assisted with providing emergency relief items, and assessment of further needs for development activities in water, nutrition, sanitation and health for the local and refugee communities for management and sustainability. This field experience stimulated my

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interest in aid and development assistance from Non-Government Organisations (NGO's) and International Non-Government Organisations (INGO's) role in Public Health, and the role of states and FBO's in public health of communities.

In 2013, during my work with CMA, I visited members of the Timor Leste National office, known as Timor Leste Pontifical Mission Societies (PMS) to further develop the partnership between the offices for mutual interest of CMA funded Timor Leste projects. During the seven day trip in country, I met with Church members including, Bishops, the National Director of PMS, missionaries implementing the projects, and many beneficiaries. I heard many stories of the traumatic history of Timor Leste and the influential role of the primary FBO, the Catholic Church in the communities I visited throughout the dioceses of Baucau, Dili and Maliana. This interested my research into the role of FBO's in spiritual and social development in the recovery of local Timorese people. The post conflict era is recent, and there is much opportunity for development of Timor Leste in various areas.

I have also worked with partner organisations of CMA in Papua New Guinea (PNG) and the Philippines, which have helped me understand the role of spiritual development and FBO's. This was insightful, especially in recovery and development of humanitarian emergencies and ongoing poverty. These crises are directly linked to public health. However, for limitations of space and focus on the most relevant experiences and research this chapter will not refer to these field experiences.

Together, my field experiences were the basis of the literature review using the above key words, and related articles. Further research, lead me to identify the significance of failed and fragile state contexts, and explore the role of state and non-state actors and FBO's in health in these particular contexts.

WHY FAITH-BASED ORGANISATIONS?

FBO's are important actors in development and play a vital role in shaping the economic, social and political contexts of communities and states. They have been in the development area since the colonial period when they "partnered the colonial state in providing vocational training centres, hospitals and health clinics in the colonies". So why are FBO's not officially recognised as an important component in the development of communities? Towards the end of the Second World War the need to re-build communities was essential, which lead to the growth of state and nation run development programs. More recently there is acknowledgement of FBO's by development practitioners and policy makers in analysis of the social and cultural dynamics of communities in developing nations and the need to incorporate the influential role of FBO's into development policy, which has lead to the re-evaluation of the role of faith in development (Clarke, 2005). International Organisations such as The World Bank, and the United Nations have acknowledged the role of FBO's in social development and health in recent years. For example, the World Bank acknowledges the importance of spiritual development within individuals and its different expressions in FBO's (Toole, 2006). The recognition of spirituality, which is at the centre of the lives of millions of people, has lead to a shift from separateness of faith and development to an engagement of the partnership and practice.

This chapter takes into account the route of faith, which is spiritually derived. Therefore it is necessary to define the meaning of faith as 'internalized beliefs and experiences, as opposed to the social and institutional aspects of organized religion' (Plante & Sherman, 2001).

Faith is the foundation of FBO's teachings and in fragile states or failed states faith is often the common reason for individuals and communities unity. FBO's teachings of faith can transform conflict into peace

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(Wolfgang, 2005). In contrast, FBO's can also use faith as an instrument for conflict lead social change. The literature review indicated that determining a definition of a FBO is challenging. Some definitions imply that FBO's could be religious congregations and others imply that FBO's are organisations with faith-based initiatives. In this chapter FBO's are defined as "Places of worship or congregations, that represent not only physical safe spaces but also extensive reach into neighbourhoods through complex social networks" (Asomugha, Derose, & Lurie, 2011). For example, FBO's may be churches or non-state actors such as NGO's that have faith driven values.

The examples I refer to will be focused on Christian or Islamic FBO's since the chapter draws on experience with these organisations and literature that supports my analyses. I hope to stimulate further reading and exploration on the opportunities there are for state and non-state actors to work with FBO's in the implementation of health programs and the empowerment of communities' and nations.

WHAT IS DEVELOPMENT?

The word 'development' is used frequently in literature and conversation in the humanitarian and International Relations field. Development is the second component of the relationship between faith and development. Such terms include economic development, developed and developing countries, sustainable development, social development, human development and organisational development. Thus, development is complex to define, and is necessary for me to define for you to understand the references to development throughout this chapter. Development is essentially the improvement in human welfare, quality of life, and social well being for individuals to meet the population's needs and wants. To further demonstrate what development is in country context, it is the combined answer to questions; "What has been happening to poverty? What has been happening to employment? What has been happening to inequality?" (Lehmann, 2011).

Spiritual development is a driver of faith in an individual and in communities, and the literature review indicated that it is difficult to define. Love and Talbot (1999) analysed various definitions of spiritual development and define it to, "involve an internal process of seeking personal authenticity, genuineness, and wholeness as an aspect of identity development". Individuals express their level of spiritual development through physical, psychological and social experience which is a measure of their level of inner peace (Greenstreet, 2006). Beliefs and values branch from the spiritual dimension of the individual, and their physical, psychological and social expression, for spirituality that is sought through religion. Hence, religion can have a profound influence on individuals to find faith in a God and live in line with the requirements of that faith (Greenstreet, 2006). This is particularly relevant to individuals that have experienced intense suffering, which commonly occurs in violent states.

Another area of development is social development. The United Nations Institute for Social Developments (UNRISD's) (2011) paper defines social development as; "Processes of change that lead to improvements in human well-being, social relations and social institutions, and that are equitable, sustainable, and compatible with the principles of democratic governance and social justice". Thus, social development incorporates factors of spiritual development of individual's outward social interactions and human well-being in a holistic perspective for communities or states' social development. This relationship between social development and spiritual development should be explored in further research.

Sustainable development is an area of development that has been used in the recent 50 years passed, which evolved from giving 'aid'. The literature review highly debated the meaning of sustainable devel-

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opment in various contexts and applications. The International Institute for Sustainable Development (2013) defines sustainable development as:

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is measured using indicators of environmental quality. At the community level sustainable development is the measure of how effectively a community can help themselves in the present, and sustaining these levels into their future generations.

These different areas of development are interrelated with faith, which is the sustenance for the work of FBO's at the community and state level. Although, development incorporates spiritual development and faith, these specific words are not commonly used in development or public health programs due to their implications of religion that is not thoroughly researched.

This chapter will refer to development in case studies at a grass-roots community level, through to a district, national and an international level focusing on the improvement of global health which is related to various areas of development.

HEALTHY STATES VS. FRAGILE AND FAILED STATES

Over the last 20 years there has been an increase in the number of countries that are unable to ensure their nations security, and emergency and development needs, that are compounded by the citizens inadequacies (such as education), war and humanitarian emergencies. A healthy state is characterised by the states capacity, legitimacy and local embedding for sustainable development. Worthington (2011) indicates that state capacity is the capability of a national government to provide social services to civilians independent of the assistance of third party organisations. The process of international aid and contracts develops the state capacity as an end goal. The author reiterates that legitimacy is the "The generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions". Whereas, local embeddedness is "the geographic, ideological, and normative close proximity of an institution to the people it interacts with, serves, or represents" (Worthington, 2011). These same principles can be applied to FBO's which have shown to demonstrate these determinants. Newbrander (2007) also indicates that for the state to be effective, it requires the 'willingness' to govern. Zivetz (2006) outlines that fragile states are characterized by public management weaknesses with underdeveloped or broken relationships across Government Institutions, the private sector and the states citizens. Often the state has economic instability, centralized decision-making, corruption, and may have ethnic or political tension. This compromises the states priorities to its citizens and leads to a vicious cycle of poverty, insecurity and conflict. Fragile states also show greater risk for the public's health (Collier & Anke, 2004). Thereby the state is incapable of sustainable development.

The classification of a failed state is debatable. Many of the globes newer states share many of the above characteristics and it has become more difficult to classify whether they are fragile or failed. Rotberg (2003) details that failed states are exacerbated by deeper conflict, danger, and war. Commonly, war in failed states stems from ethnic, religious, language or community tensions, and violence is either directed to the existing Government or institution in power. In majority of failed states the Government or institution in power repress the citizens, and subjects them to restricted political goods and insecurity.

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Failed states often refer to non-state actors as the preferred supplier of political goods to serve the basic needs of the citizens. Many failed states may not be able to control parts of their territory; therefore they lose authority and control. In failed states the destruction of infrastructure is severe, and the health system and education is often privatized. In economic development declining levels of national and per capita annual GDP can be an indicator of a failed state.

Newbrander (2007) highlights a framework for health systems in fragile and failed states to identify the priority areas to address, including:

1. Address the urgent health needs;
2. Gather information;
3. Create a package of basic health services;
4. Develop policies, strategies, and plans;
5. Develop human resources for health;
6. Ensure a regular supply of essential drugs;
7. Finance services adequately;
8. Redevelop and reform the health sector;
9. Rehabilitate or reconstruct health facilities;
10. Coordinate donors.

In this chapter, I will refer to the role of FBO's with state and non-state actors predominantly in fragile or failed states. Newbrander's (2007) frameworks for health care areas in fragile and failed states offer beneficial considerations in designing effective healthcare services and delivery in consideration of all stakeholders. The determination of the characteristics of failed and fragile states is important for future public health researchers and policy makers to further define these priority areas to restore fragile states in early stages and for sustainable development of the states.

THE ROLE OF NON-STATE ACTORS

More recently, non-state actors have demonstrated an important role in the security, recovery and provision of services of citizens in fragile and failed states. Non-state actors involvement in fragile and failed states have occurred in the cases of Afghanistan, Sudan, Pakistan and Timor Leste. In this chapter I will refer to non-state actors including local NGO's and INGO's. FBO's are also non-state actors, which will be discussed in depth later in this chapter. NGO's can be classified according to the social services they deliver including relief and welfare, sustainable systems development particularly for the environment, people's movements in activism, and community-based voluntarism (Korten, 1990).

Leader and Colenso (2005) describe the type of frameworks at the country level for non-state actor (mainly INGO) partnerships, including; Consolidated Action Plans (CAP) and Transitional CAP's which are usually produced by OCHA in post-conflict situations, and The Transition Result Matrix (TRM), that was used by the World Bank in Timor Leste. Furthermore, peace agreements, which often have an important reconstruction program as an incentive for agreement from parties. Also, Joint assessments by multiple donors, which is commonly a component of the peace agreement. And, some frameworks are part of the National Budget as a whole.

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NGO's play an important role with Governments, and donors that often serve a large portion of funding for contracting services for health care delivery in fragile and failed states. Many contracts are funded primarily with donors in response to serving the immediate needs of the citizens rapidly. Contracting with NGO's occurs particularly when there is a lack of Government infrastructure and available skilled workers. NGO's are usually more flexible than Governments with readily available skilled workers to adopt the contract (Palmer, Strong, Wali, & Sondorp, 2006). Furthermore, contracting with NGO's often builds on the voluntary resources of the not-for-profit private sector, and enables more flexibility and creativity in health service delivery and credibility (Loevinsohn & Harding, 2005). The Authors emphasize that, contracting with NGO's can be highly effective in increasing services quickly to reach the poorest and most vulnerable communities in fragile and failed states. NGO's also have the resourcing and skills to implement, evaluate and monitor activities to determine measurable results that are preferred by donors and Governments. Moreover, the nature of competitiveness motivates NGO's to implement effectively and efficiently and enables Governments to focus on planning, financing and regulation.

Contracting with NGO's easily identifies the advantages in the short-term relief of citizens in fragile and failed states. However, further research is required to determine if health systems need to be restructured in the long-term development of the country. Moreover, many low-income countries do not have a large demand of NGO's competing for contracts. Thus, there are limited alternative providers, and programs may be difficult to monitor for effectiveness, programs may be contracted with low management costs, existing Governments with low capacity for health service delivery are more likely to have a fragile stewardship role, and the health system may be fragmented. Further research is recommended to specify the capacity of NGO's to reach the most vulnerable groups in fragile states, and measure the effects of competition on health service delivery for effectiveness against the efforts to win the contract (Strong, Wali, & Sondorp, 2014). Also, it is debatable whether NGO's, particularly INGO's remain in the country in the long-term and whether contracting with INGO's in the long-term dis-encourages sustainable development.

RELIGION AND HEALTH

The relationship of faith and health is an emerging topic of research in the last 20 years, focused on the correlation of religion, social and health sciences. It has baffled scientists since it is difficult to compare faith and beliefs to human physical and mental conditions. As such, research is limited as a means of evidence. The role of health is related to our system of beliefs, community interaction, and our practices.

Our psychological health represents our mental health whereby our religious beliefs are influential in the expression of our thoughts and practices. Research has demonstrated this correlation with religious beliefs that can be a self-coping mechanism, for better mental health (Koenig et al., 2001; Marks, 2005).

Our biological health represents our physical health that can be mitigated by our religious practices and abstinences. For example, Elifson, Klein and Stark (2003) demonstrated that being religious was a strong predictor of women's sexual practices related to HIV risk, and women that were least religious were reported to have the greatest risk, whereas faith and community correlates with our social interactions and support system. In a study of faith communities of African-American churches in the United States it was determined that the social and spiritual support of the African-American people was consistent with the reduction of cases of drug and alcohol substance abuse (Watson et al., 2003). All of these relationships between religion and health are necessary to reflect on in the involvement of FBO's in the

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beliefs and health practices, and availability of community support systems. Since this topic requires further research and is dependent on external factors, I suggest you refer to additional readings for a deeper understanding of the relationship between religion and health.

FBO'S AND PUBLIC HEALTH

In the following topic, the discussion focuses on the positive influence of religion and FBO's in fragile or failed states since it is more closely related to the influence of the Catholic Church as the primary FBO in the case study of Timor Leste. However, further research is recommended to determine the characteristics of an FBO that can positively develop the state and improved public health compared to an FBO that poses risk of destruction to the state.

The relationship between religion and health is an important determinant of the association of FBO's and public health. This association can be classified as committees or health groups within the church, and the collaboration of FBO's with state and non-state actors (Campbell et al., 2007).

For the committees or health groups within the church, health would be part of their mission or ministry and they would be involved in health outreach activities in communities. For example, feeding the poor and hungry with soup kitchens or providing basic health care in medical camps etc. In this example, the church already has pre-existing capacity within the local communities.

For non-state actors collaborating with FBO's, this includes NGO's partnering with churches for better health service delivery and health promotion. This is advantageous for NGO health programs and health education to reach remote communities that have limited access to health care. Campbell et al. (2007) indicates that this relationship builds on sensitivity and culture within communities, and the community support system of the church. Such activities include NGO staff liaising with the church leaders to involve them in delivery of health activities, and educating and training church leaders and other religious clergy in health education. NGO staff may attend church gatherings and promote health practices, or work alongside the church's own health outreach activities to build the relationship of trust with the religious clergy and local communities. Lasater, Becker, Hill, & Gans (1997) highlights that the integration of important health messages with church scriptures is beneficial to build the importance of healthy practices to influence health-seeking behaviours and healthy behaviours. This strategy for NGO's implementation of health programs is built on the legitimacy of the church within the local communities, and the church's local embeddedness through its social network that are the same characteristics of a healthy state.

Whereas, the collaboration of FBO's with state actors are developed in line with the National Health Plans through to the district health care services in partnership with churches and FBO's. Church leaders may be members of the National Health Committees, or work alongside district health staff in hospital and local clinics (DeHaven, Hunter, Wilder, Walton, & Berry, 2004). This partnership has mutual benefits, as it is important for the state to build the capacity and legitimacy among the local communities. In turn, the FBO's have the support of the state in their health outreach activities that benefits the local communities with increased access to available healthcare.

The collaboration of FBO's and state and non-state actors presents many opportunities for public health researchers, however it also raises important challenges. Such challenges include mistrust of FBO's partnering with the state and INGO's and in some cases the many years it takes to build these relationships of trust which may not be realistic for the timeline of donor funded health programs. Also, the separation

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of the church and state, as the church may see this as an opportunity to engage new members, which is not the states purpose. Moreover, increased process driven evaluation and auditing requirements from the church would increase their workload and not meet their own calendar of activities. This may discern church members from participating. Furthermore, there may be a conflict of values between NGO's and state health programs and the church (Campbell et al. 2007). For example the church does not promote the use of contraceptives in the prevention of HIV, as this conflicts with the Catholic Church's values. Also, the nature of numerous INGO's and NGO's competing for the implementation of their programs in the same communities can be an impediment to effective healthcare programs (Birdsall, Rodrick, & Subramanian, 2005). Finally, the respect and sensitivity of religious differences and practices by state and non-state staff in outreach activities and health promotion activities.

In failed or fragile states, FBO's can be the primary support system for communities, and have a large influence on their health seeking practices and behaviours. FBO's also have a role in mental health of traumatised communities enabling better coping and peace transformation from their support systems of trust with the people. In some cases FBO's also demonstrate the characteristics of a healthy state that enables NGO's better access to the local communities for health service delivery.

Further research is needed on the collaboration of FBO's with state and non-state actors to determine the actual contexts this partnership can be applied to benefit the nation's public health in consideration of the challenges and external factors.

CONCLUSION OF BACKGROUND

This chapter will explore the role of FBO's in health and states, particularly fragile or failed states. The opportunities for state and non-state actors to partner with FBO's will be highlighted amongst others, as well as the challenges associated with this relationship. The discussion will incorporate the theme of development and faith, and the role of FBO's in shaping a well functioning state in an analysis of the context of Timor Leste. With further reference to case studies in the role of Christianity in PNG, and the role of Islam on health in East Africa this chapter will discuss the opportunities and challenges FBO's have to develop well-functioning states. Possible solutions and further research will be discussed in the case study of Timor Leste as a model to improve public health in other fragile of failed states.

Timor Leste Country Context

Timor Leste is a small country in the Asia-Pacific that lies between Indonesia and Australia. The country has a mountainous terrain with highlands in the centre where majority of the population are and a sparsely populated coastline that is more fertile. The climate has two monsoon seasons that brings a heavy downpour and two dry seasons that at times lead to droughts (USAID Timor Leste, n.d.). With a current population of 1.2 million, more than eighty percent of Timorese live in remote areas. Timor Leste represents one of the newest democratic states in the world, and is also one of the poorest nations in the world whereby approximately thirty seven percent of the population live below the basic needs poverty line of US$1.25/day (Department of Foreign Affairs and Trade [DFAT], 2013), and almost forty percent of the population have no access to a sustainable water source (Asante & Hall, 2011). The average life expectancy is sixty two years of age (DFAT, 2013).

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The country is diverse in language, people and culture. The current national languages are Tetum and Portuguese, although Indonesian, English, and 15 other indigenous languages are widely spoken (USAID Timor Leste, n.d.). The Timorese main form of income is subsistence rain-fed agriculture, of which ninety percent of the rural poor depend on with almost no income. Staple foods include cassava and maize. More recently imported foods include oil, rice and noodles (World Food Program [WFP] Timor Leste, n.d.), Timor-Leste imports half of its cereal consumption as a result of major food shortages when new harvest is not yet grown (WFP Timor Leste, n.d.).

The country faces various challenges including infrastructure of a damaged road system, high levels of crop failure (WFP Timor Leste, n.d.), and inadequate spending of resources for service delivery particularly to remote areas (DFAT, 2013). There is widespread poverty, high unemployment levels (of which nineteen percent of youth 15-29 years are employed) and only sixty four percent of men and fifty three percent of women are literate. Timor Leste is not likely to meet the millennium development target for primary school enrolment by 2015 (DFAT, 2013). Furthermore, the quality of education provided in schools in Timor Leste needs to be further assessed. Timor Leste's economic state is improving in terms of non-oil economy, however is still highly dependent on the income of oil and gas which may not be sustainable in the long-term (World Health Organisation [WHO], 2014b).

In terms of health, poor access to potable water and sufficient sanitation leads to outbreaks of diarrhoea, which contributes to death of children. In remote areas only twenty five percent of family units have access to a sanitation facility and have access to a supply of potable water (DFAT, 2013). Timor Leste has one of the highest rates of maternal mortality (450-557 deaths per 100,000 live births) with women dying at childbirth in Asia (Burnett Institute Timor Leste, n.d.). Poor utilisation of ante-natal care and poor reproductive health is a common cause of child mortality (97 per 1,000 live births in children under five) (Asante, Hall & Roberts, 2011). Common diseases in children that contribute to child mortality in the country include respiratory infections, malaria, and diarrhoeal illnesses. Other health problems are under nutrition in forty five percent of children that are particularly from remote areas, tuberculosis with 8,000 active cases reported nationally, and sexually transmitted infections frequent in sexually active groups commonly found in Dili and Baucau districts (Burnett Institute Timor Leste, n.d.). Timor Leste is not likely to reach the millennium development targets to eradicate extreme poverty and hunger and improve maternal health (DFAT, 2013).

The History of Timor Leste and the Catholic Church

The history with the Catholic Church began when the Portuguese arrived on the coast of Timor in Oecusse, at approximately 1515 for trading of sandalwood (Suter, 1993). By 1702 the state was a Portuguese colony and remained in Portuguese rule until Independence in 1974 (Lyon, 2011). During this period the Dutch controlled West Timor and there began a series of territorial disputes between the Dutch and the Portuguese, which lead to the implementation of the border that remains today (Horta, 2013). By 1780 there were fifty churches and the first formal schools and monasteries were built. Dominican and Jesuit Missionaries were advisory's between the state and the church. The church played a significant role in Portuguese rule as both priests and military commanders. The church's presence was recognised by the state and the partnership was mutual, as clergy were in charge of implementing government policies. The church's influence began merging the Indigenous Timorese with Portuguese norms, and became more involved with education and political institutions of Timor Leste, and defence of human rights of the Indigenous Timorese (The Catholic University of America, 2003; Hill, 1978). Many Catholic

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missionaries were seen as community leaders and highly respected over the state authorities (Dunn, 2003). The local embeddedness of the church within Timorese communities stimulated the foundation for legitimacy and capacity at the political level.

At the beginning of World War II, the Australians and Dutch landed in Dili using Timor Leste as a strategic location for defence and a diversion of attack from the Japanese. Catholic missionaries fled at the onset of the Japanese invasion in Timor Leste, and the Japanese conquered the Australian's and the Dutch on the Island, and occupied the island for the next three years (Dunn, 1994; Horta, 2013). At the end of the war 60,000 Timorese were killed in attempts to protect Australians. When the Japanese finally departed Timor Leste, the country was left in ruins, and Catholic missionaries returned to govern Timor-Leste (Dunn, 1983). During this time for the next fifty years, the church focused on conversion of Indigenous Timorese and simultaneous preservation of the Timorese culture and Animist traditions. The church's legitimacy amongst communities was profound, and the church grew with exponential numbers of nuns, priests, churches and evangelised followers, and administered sixty percent of schools in the country. By 1973, twenty nine percent of the population was Catholic (Taylor, 1991).

In 1974, political tensions arose between FRETLIN (the Revolutionary Front for an Independent Timor Leste) and the rival, the Timorese Democratic Union (UDT). The Indonesians from West Timor took advantage of the conflict and began a series of invasions into Timor Leste from the western side of the Island displacing Timorese civilians (Dunn, 2003). FRETLIN took control of Portuguese Timor, and granted independence of the country as the Democratic Republic of East Timor (RDTL) in 1975. However, Timor Leste was yet to become independent for another twenty five years. Nine days after the announcement of the independence of the Timor Leste freedom was short-lived and the withdrawal of the Indonesian forces and their militias inflicted extreme violence and destruction (Dunn, 2003). More than 100,000 Timorese were killed in the invasion and another forty percent of the population were displaced which resulted in a famine (Taylor, 1999). The commitment of the many Timorese priests that accompanied their communities to protect them strengthened the relationship with the Timorese and the church. Three years later the number of conversions increased to sixty percent of the Timorese population (Lyon, 2011).

The Indonesian rule enforced laws in population control, Bahasa Indonesian as the national language overriding Portuguese, and religious conversion to Islam. The church protested against these Indonesian laws by gaining support of its international Catholic network. The church sought permission from the Vatican to empower the local Timorese communities to speak Tetum instead of Indonesian, which further instilled trust from the local Timorese with the church. The church and the Vatican also opposed the Indonesian family planning program and population control laws as violations of the Timorese human rights. The church was offended by the conversion laws against Catholicism (Lyon, 2011). The church's support and empowerment of the Timorese strengthened their relationship and trust with the local Timorese, in opposition with the Timorese's distrust for the Indonesian state. The church became politically mobilised as the only defender from the Indonesian state on behalf of the Timorese people. This placed the church in an autonomous power to challenge the Islamic-based Indonesian state, and eventually lead to the independence of Timor Leste (Bishop Belo, 1989).

The conflict and violence under the Indonesian occupation was hidden from international media, until the release of a video from a British cinematographer that filmed the massacre of 300 students at a funeral in Santa Cruz, Dili. The students were marching in the memory of the death of a fellow student at the hands of the Indonesian Militia. Remarkably the video initiated the defence of Timor Leste by individuals and International Organisations pressuring their Governments to assist the Timorese people

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(Horta, 2013). Church members were conflicted with the church's position in the political scene of Timor Leste, with some members advising that the church should avoid any political involvement and others remaining in a political position (Lyon, 2011).

In 1992 two Catholic leaders, President Jose Ramos Horta and Bishop Ximenes Belo appealed to the Vatican and International Organisations for assistance to resist the Indonesian forces on behalf of the Timorese. In recognition of their humanitarianism they were awarded the Nobel Peace Prize in 1996 (Toole, 2006). The Catholic Church member's act of advocacy demonstrates the church's influence that extends greater than the Timor Leste state to the Vatican through the church's international network.

During 1997-1998 Indonesia suffered an economic crisis. As an outcome of international recognition of the complex state of Timor Leste, the UN negotiated an agreement with the Indonesian government to allow the Timorese the freedom to choose independence (Dunn, 2003). On the 30 August, 1999 the Timorese voted more than eighty percent in favour of independence. Unfortunately, the Indonesia proxy militia and Indonesian armed forces attacked the Timorese, targeting church members. This resulted in many deaths and further displacement of Timorese into the mountains of Timor Leste and refugee camps in West Timor and neighbouring islands (Horta, 2013).

In 2001, parliamentary elections resulted in the success of FRETLIN, and the new Timorese constitution was based on Portugal with included a Prime Minister and President. After two years of UN intervention, Timor-Leste became independent on May 20, 2002 and became the world's newest country and democratic state with is first President, Xanana Gusmao (Dunn, 2003; Horta, 2013).

Since the new elections, the church became conflicted in a power struggle between the Prime Minister and the President. The church supported the President as a result of the independence, while FRETLIN supported the Prime Minister. This saga sparked clashes between the church and FRETLIN. This resulted in FRETLIN protesting to remove compulsory Catholic education from the national curriculum, and the dissolution of Indonesian militia war crimes. Eventually, protestors supporting the church lead to the forced resignation of the Prime Minister in 2006, and assignment of the new Prime Minister Jose Ramos-Horta who supported the church profusely. The church's state capacity and legitimacy politically mobilised the GOTL to ensure continuous compulsory Catholic education and the revision of laws to outlawed abortion (Lyon, 2011).

During the 2007 Presidential elections church members had a high influence over the election process, and President Jose Ramos-Horta won the election over FRETLIN, while Xanana Gusmao was appointed Prime Minister (Constitution of the Democratic Republic of Timor Leste, 2005).This placed two church supporters in leading power of the government of Timor Leste. In 2008, further violence targeted political officials and President Jose Ramos-Horta managed to survive an attempted assassination (Horta, 2013). In 2008 the President signed an agreement declaring the GOTL adopts the laws in line with the Vatican including anti-abortion and anti-prostitution (Lyon, 2011). With President Jose-Ramos-Horta representing the church, the church remains the leading political power in Timor Leste. The church's influence is unlikely to falter due to the strong relationship they have built with the Timorese people in the last 300 hundred years.

There have been shootings in Dili in August, 2011. The UN withdrew their local assistance to Timor Leste after twelve years, leaving the current independent Timorese state in power (Horta, 2013).

Despite, the country's independence, almost fifty percent of the Timorese are still in refugee camps in West Timor and fighting still occurs on the East West border between Indonesia and Timor Leste (Horta, 2013). Moreover the country's economy is fragile with roads and infrastructure and communication channels destroyed and slowly being restored (Asante et al., 2011).

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Since the repeated foreign invasions and destruction of the Timorese culture, the Timorese are hesitant to trust foreign assistance, and have great legitimacy for the church, thus the church remains highly politicised and highly influential. In the traumatic history of the Timorese in the last few centuries, the Catholic Church is demonstrated as a growing leader at the local, national and international levels. The church's pre-existing community support network placed them in an ideal position to provide services to conflicted and insecure Timorese. At the national level church members became political leaders with the support of the Timorese citizens, then successfully advocated for the rights of Timorese citizens with the support of the Vatican and the international community. The Catholic Church demonstrated the characteristics of a healthy state that the failed state was originally weak in. The church had a leading role in the recovery and development of the Timorese nation, which is still ongoing.

Timor Leste's Emerging Healthcare System

Prior to 1999, state healthcare comprised of community health centres that provided primary care to remote villages, and mobile clinics, and sub-centres for outreach services. Tertiary care included the main Dili Hospital and 8 small hospitals amongst the districts, with a Central Health Laboratory in Dili and 11 specialist Doctors (World Bank East Asia and Pacific Region, 2000). After the 1999 vote for Independence in the country, the mass conflict left more than thirty five percent of health facilities destroyed and greater than forty percent badly damaged. Many health staff from central and district levels fled the country and remaining medical equipment and supplies were stolen or destroyed (International Monetary Fund, 2000).

In 1999, in response to the turmoil and displacement of the Timorese people, the International Organisations launched a peacekeeping operation and introduced the United Nation Transitional Administration for East Timor (UNTAET). The UNTAET was set up to enforce laws in legislation to regain power, and coordinate humanitarian assistance of organisations and aid to build capacity of the state. This set the path for the formation of a transitional cabinet, with a UN Representative and Timorese groups which was the first Constituent Assembly of Timor Leste. Simultaneously an independent Ministry of Health was established that still exists today (Rohland & Cliffe, 2002).

Alonso & Brugha (2006) indicated that in April 1999 a Strategic Development Plan for Timor Leste was initiated which included a new health system on the basis of equality, cultural diversity, acceptance, and accountability to the Timorese people. An East Timor Health Professionals Working Group was formed and hosted a workshop that brought together national and international NGO's, UN members and the National Council of Timorese Resistance. In March 2000 the outcome of this workshop was the constitution of the Joint Working Group on Health Services which lead to the declaration of the end of the emergency phase and beginning of the development phase in Timor Leste. The Interim Health Authority was also formed, composed of members of local and international UNTAET staff (Alonso & Brugha, 2006).

The authors highlighted that this change affected the private health sector, resulting in the departure of many NGO's that were providing emergency assistance to Timorese communities. Remaining active NGO's in each district were asked to manage the health service provision in partnership with the IHA that was decided at the central level. These decisions did not incorporate substantial Timorese communities' participation, or the highly influential role of the church among Timorese communities. The decisions further reduced health staff and facilities to provide only basic services to the whole country.

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Furthermore, the strategy focused on the rehabilitation of health services at the district level. The changes lead to the withdrawal of NGO's due to opposition of local health staff.

From 2000 – 2001 Timor Leste's health system had less doctors from one hundred and thirty five during Indonesian occupation to twenty. Moreover, international medical staffs were hired to replace local health staffs that were being trained internationally (Joint Assessment Mission, 1999).

The re-assessment of the hospital services lead to a plan which resulted in four small hospital units, one regional hospital and one national hospital that catered to referrals with 220 beds. During this time, the main sources of funding for Timor Leste was from the Humanitarian Consolidated Appeal, UN Agencies, NGO's, UNTAET and two Timorese trust funds (Alonso & Brugha, 2006). The general strategy was to strengthen the state of Timor Leste with public fund relations, then engage private partnerships once the state was able to provide a basic package of health care to civilians.

Some literature indicated the role of the UN and the international actors played an effective role in peace transformation and the rehabilitation of Timor Leste. The strategy encouraged a sector wide approach (SWAp) to coordinate and increase legitimacy of the state through trust of the Timorese people. The involvement of the Timorese in the decision-making process contributed to the establishment of the Ministry of Health. Although, the UN's decision-making at the central level often delayed implementation and was compounded by their weak logistical processes. (Macrae, 1997) The UN and International efforts certainly enforced security and the set up of the Ministry of Health. However, this assistance was not effective in reaching majority of grass-root communities. Furthermore, the lack of trust the Timorese had for the state proved to be a challenge in implementation of health services. Despite the limited literature to assess the role of the church in the public health of Timor Leste, the church played a large role in peace transformation of Timorese. The church has also demonstrated capability to influence Timorese behaviour changes that has lead to increased trust and legitimacy of the state. The role of the church in healthcare services and health care seeking behaviours of Timorese communities should be researched further.

The Health Sector Rehabilitation and Development Programme was formed in April 2000 led by the World Bank and the IHA. Two parts were developed to improve basic access of health care, and implement future policies and systems. Literature indicated that this strategy reduced duplication of health care and prioritised funding for public health area activities, as well as monitoring of activities (Tulloch, Saadah, Araujo, de Jesus & Lobo, 2003). However, monitoring of private healthcare including the assistance by the church is not evident in this assessment.

The Ministry of Health central office coordinates and manages all government health care and health policy and activities within the country. There are plans for policies for decentralisation through the district levels; however decisions at the central level seem to be the focus (Ministry of Health Timor Leste, 2005). Hence, the effectiveness of changes in state health polices to the grass root level requires further evaluation.

Between 2000 – 2007 there were twenty two nurses and mid-wives, and four doctors for every 10,000 people. These numbers of nurses, mid-wives and doctors are not nearly enough to assist ill people in the population of Timor Leste (Asante et al., 2011). There were approximately fifty senior managers and about one hundred and thirty middle managers across the country's health care system. The middle managers lead health service delivery in teams of six people at the district level called the district health management team. A designated manager is assigned for each team in each of the thirteen districts. Management competency of the district level seems low, and only five of the thirteen districts have a referral hospital according to the literature until 2007 (Asante et al.,2011).

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The health system of Timor Leste faces numerous challenges including, poor capacity for the co-ordination and monitoring of donor programs, poor management and leadership, insufficient funding, inability to provide equal services to rural areas as the urban areas, and poor coordination of logistics that impedes the delivery of drugs and supplies within the country (Asante et al., 2011; Ministry of Health Timor Leste, 2007). There is a need for strong and effective management and leadership capacity and performance to accelerate service delivery.

Access to health services, including maternal and child services remains limited especially in the rural areas that contributes to high maternal and child mortality (Richards, n.d.). An implication of this may be distrust by Timorese women to foreign and modern health care after a history of being subjected to population control methods in the Indonesian power of the State. Timorese women who had sought family planning services were being forced into sterilisation, and many women have avoided the state-run health services (Lyon, 2011). Furthermore, the health workforce in Timor Leste is dominated by men, by 2:1. Providing health services while being sensitive to tradition and culture poses management challenges, as tradition or recent history such as population control are sometimes found to be constraining factors.

A recent study by the World Bank discovered that malnutrition and poor health are a huge impediment to the education and labour productivity in Timor Leste. The study determined that it is essential to address these health issues in the country in order to build capacity at the institutional level and increase skills of the Timorese for labour productivity (USAID Timor Leste, n.d.).

The new Government of Timor Leste (GOTL) Strategic Development Plan 2011-2030 framework has been designed to improve the country's development through decentralisation with a focus on social capital, economic development and infrastructure development. The decisions for the objectives of this Strategic Development Plan were made at the central level with the assistance of the USAID and US Government agencies with the GOTL to align the objectives of the Strategic Development Plan with the Ministry of Health objectives (USAID Timor Leste, n.d.).

Within these objectives, the Timorese Ministry of Health has introduced a new health program called Servisu Integrado Saude Communitaire (SISCa), meaning Integrated Health Services at the Community level in Tetum. The SISCa program is intended to bridge the relationship of the state with remote communities to improve their access to healthcare, encourage health information sharing and improve health education. The program consists of six core areas including; population registration, nutrition assistance, maternal and child health, personal hygiene and sanitation, health care services, and health education (Health Alliance International, n.d.). The initiative is for the SISCa program to be incorporated in all village councils, called sucos in the 13 districts of Timor Leste. Suco councils are comprised of elected community members that coordinate public services, maintain social infrastructure, mediate dispute resolutions and represent communities at the district level (USAID Timor Leste, n.d.). The program requires community mobilisation of community leaders and suco council members, NGO's and the church members to work together to provide relevant health care within each of the six core areas. The location of each SISCa post is decided by a community consensus to encourage community participation and may be a church, school, home, community centre or open area. With the assistance of community health workers and registered volunteers, each SISCa post is to hold health activities once a month for a minimum of four hours in duration (Ministry of Health Timor Leste, n.d) For the social capital area, the SISCa program is a recognised effort by the GOTL and INGO's to incorporate community participation and the private sector including the community influence of the church. However, the affectivity of the program is yet to be determined in future assessments.

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Papua New Guinea: A Case Study of the Church and Health

The Context of Papua New Guinea

PNG is situated in close proximity to Timor Leste, between Australia, Indonesia and the Solomon Islands. The main island also shares a border with Indonesia. The population of PNG is approximately seven million (World Health Organisation [WHO], 2014a) of which majority are under the age of fifteen and about eighty five percent live in remote areas (Asante & Hall, 2011). There are more than 800 language groups with diverse cultures and beliefs (United Nations Development Program [UNDP], 2013). Despite the country's rapid economic growth this is not reflected in PNG's public health, and development challenges remain (Uniting World, n.d.). Various statistics are similar to that of Timor Leste, and PNG experiences many of the same challenges to healthcare and development. Just less than fifty percent of PNG's population live under the poverty line of $1.25 a day. PNG has the highest growth rates across Asia and the Pacific at 2.5%, and the lowest life expectancy in Asia and the Pacific countries at 61 years of age (UNDP, 2013). More recently the life expectancy of women has overtaken men in PNG 61:65 M:F (WHO, 2014a). Less than half the population have access to an improved water source.

Maternal health is an increasing problem in PNG, while approximately thirty nine percent of births are delivered by skilled health workers (Asante & Hall, 2011). HIV/AIDs is a critical health problem for PNG as rates remain high, with approximately 34,100 cases reported in 2009 of the majority between the ages of fifteen to forty eight (Asante & Hall, 2011; Uniting World, n.d.). Other health issues for PNG, include communicable diseases such as malaria, tuberculosis, diarrhoeal diseases, and acute respiratory disease as the major causes of mortality (UNDP, 2013). The GDP expenditure on health in PNG has declined in recent years, and the country is heavily reliant on external donor funding for public health expenses (Asante & Hall, 2011).

The first Christian missionaries arrived in PNG in 1848, and Missionary nurses did not arrive until the late 19th and early 20th centuries (Ascroft, Sweeney, Samei, Semos, & Morgan, 2011). PNG became Independent of Australia in 1975. The country has had a history of invasions and the support of different FBO's similar to the context of Timor Leste. However, the historical conflicts and the fragile economy of Timor Leste are more recent, and has mainly been supported by the autonomous FBO, the Catholic Church.

PNG also has a mix of different cultures and social dynamics that impact on other issues including tribal fighting, the wantok system (which is a typical payback system), and extreme gender issues that cause violence against women and reflect on health issues including HIV/AIDs, and child health and maternal health (Gibbs & Young, 2007; Manjoo, 2013).

Health challenges in PNG include poor competence and managerial skills of district health workers. This is exacerbated by the weak decentralisation structure of the health system and the wantok behaviours. The country also experiences challenges to the access of healthcare to the majority of remote people. Other factors that contribute to the lack of access are the mountainous terrain, finance, human resources, and poor quality of care (Asante & Hall, 2011).

The Church and Health System in Papua New Guinea

With ninety six percent of the population of PNG members of a Christian church, FBO's have played a large role in PNG's economic, social and political context. (Uniting World, n.d.) Due to PNG's history,

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in some rural and remote areas, (in particular the mainstream churches i.e. Catholic, Anglican, Lutheran, and United Churches) have a greater presence than the government (Ascroft et al., 2011).

Christian FBO's run forty six percent of health facilities in PNG including sixty percent in rural areas, and five out of eight nursing schools, and all the community health worker schools. The FBO's also contribute to education in the country, including forty seven percent of elementary schools, fifty three percent of primary schools, thirty percent of secondary schools, and sixty seven percent of teacher education tertiary institutions (Uniting World, n.d.). FBO's also run aid posts in health care facilities predominantly in remote areas where majority of the population resides. The posts are staffed with a community health worker nurse and provide frontline primary care often replacing doctors in areas that largely do not receive government funding. Out of the total 4,400 community health workers across PNG, FBO health services employ a large proportion of them, to manage their health services (IRIN Asia: Humanitarian News and Analysis, 2014). Ascroft et al. (2011) highlights that church workers demonstrate strong motivation to serve in the communities, are flexible, have close relationships with the communities, and are innovative to produce high work ethics in low cost health service provisions.

Furthermore, in PNG, the FBO's play a large role in gender equality that has had a positive effect on behaviour changes in men and women on gender-based violence which is common in HIV cases. The churches influence on behaviour changes to gender-based violence has been via political and social means. Eves (2012) refers to the Catholic Bishops Conference of PNG in 1987 in a statement "Marriage must be a free contact between equals and that there was no place for violence between marriage partners" and that "the payment of bride price does not give the husband the right to beat his wife." At the social level pastors preparing couples for marriage were inclined to educate the couples on these terms. The Catholic Church National Pastoral Plan (2006-10) also incorporates objectives whereby all parishes have to include protective action strategies in situations of domestic violence in the name of Christianity. Moreover, the National Plan indicates that training programs for counselling on domestic violence and HIV/AIDs should take place in each parish every three years (Eves, 2012).

The unity of the churches national network across the country to influence social and political changes is evident in PNG. The local embeddedness of the churches in PNG and their capacity to politically mobilise changes has a profound effect on healthcare in the country. Ascroft et al. (2011) details that PNG has established a Churches Medical Council (CMC) comprised of members from registered church agencies to represent church health service providers. The CMC is a national council that works in partnership with the central government of PNG. The National Department of Health also supports grants for FBO health facilities, and a Health Sector Improvement Program Trust Account provides funding to both government and FBO health care facilities. The national agreements between the churches and government are informal without signatures. There is a legal framework in place in an attempt to formalize agreements, which are important to improve financial transparency.

PNG's partnership of the state with FBO services for funding is critical to the health care provision in PNG. However, whether it is sustainable to improve healthcare is ambiguous, since majority of the funds are dependent on external donors and the GDP for healthcare has not increased recently (Ascroft et al., 2011).

Further research is needed on the partnership of the FBO's and the government of PNG in provision of healthcare, as the role of FBO's has often been isolated from national policy and planning. More evaluations on the church's role in primary health care is beneficial to determine the extent to which the churches are effective since the government funding to churches has blurred the classification of the church's assistance in either the private or public sector (Ascroft et al., 2011).

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The case study of the church's role in healthcare in PNG, demonstrates similarities and possible solutions to integrate partnerships between the government and FBO's that may be applied to the context of Timor Leste. Some of these strategies face challenges, and the effectiveness of the church's role in health care in PNG requires further research.

East Africa: A Case Study of the Complex Emergency in 2011

The East African region, also known as the Horn of Africa, has been in a drought for the past 2 decades. In 2011, the drought was declared an emergency level within parts of Ethiopia, Kenya, Sudan, Uganda, and in July 2011 famine was declared in Somalia by the United Nations. (Maxwell & Fitzpatrick, 2013; Relief Web, 2011b). The famine and emergency affected up to 13 million people with limited access to basic needs, such as food, water, shelter, good sanitation and medicines (Relief Web, 2011a). Thousands of nomadic people were internally displaced, and some fled to neighbouring countries in search of food and water to refugee camps or local communities. The region was affected beyond the international community's capacity for international response in the provision of aid. This was a complex emergency compounded by insecurity from rebel group attacks across the Somalia and Kenya border, the control of the Al-Shabaab government in Somalia, and counter terrorism laws in Somalia in the midst of a drought (Maxwell & Fitzpatrick, 2013). Furthermore, extreme poverty and malnutrition was prevalent.

In August 2011, I visited the north eastern region of Kenya, close to the Kenyan and Somalia border whilst working with MAA in partnership with the community-based organisation (CBO) WARDA. MAA had sent containers of food and clothing by shipment to Mombasa in Kenya for overland travel to displaced local and refugee communities in Dadaab, and surrounding areas including Garissa, and Wajir districts. MAA also funded food for this region as part of their Ramadan program in August 2011.

In 2011, the Dadaab refugee camp held over 300,000 refugees, about 160,000 of which had come from neighbouring countries. Of the total, thousands were awaiting registration and living in areas around the camp whereby local communities had offered their land and already limited resources to assist the refugees (Pizzi, 2013). Together with WARDA staff I assisted handing out emergency food items from MAA's Ramadan program to local internally displaced people, in the Dadaab refugee camp and surrounding local areas. I witnessed other INGO's assisting refugees in Dadaab, although none within the internally displaced areas that WARDA was able to reach during my visit.

MAA's existing relationship with WARDA in prior years enabled a fast response to provide emergency items to affected communities within Kenya along the Somalian border. WARDA staffs are comprised of members that are predominantly local Islamic faith volunteers and speak the local Somali language that is spoken throughout this region. Majority of the volunteers are familiar with the existing context, and the physical, social and cultural challenges in the region. For MAA to work with a CBO such as WARDA within its existing partnership network represents the advantage of a FBO to work within their network and access affected communities through a CBO that is already present and familiar with the context. Moreover, WARDA is comprised of mainly Islamic faith members local to the region, and had valuable knowledge effective to reach remote communities of internally displaced and refugees that other INGO's may not have reached.

There is opportunity for INGO's and donor countries to work with FBO's such as MAA at the national or international level to access their extensive network and reach affected communities. Of course there are many factors that represent challenges to this type of partnership, such as INGO's working with their existing national offices in disaster response that may hamper flexibility to other partnerships. Also, they

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commonly have tight polices and regulations by their governments of which CBO's like WARDA may not be trained or resourced to comply with completely. Also, national governments which some INGO's work with have their own national policies and disaster response programs that may not align with the standards of FBO's. Or the national governments may be subject to corruption, or clash of state to FBO differences which can be barriers in emergency contexts.

In Kenya's neighbouring country Somalia, access for INGO's to provide emergency items to affected internally displaced people was extremely challenging as the Al-Shabaab governing group had restricted access of international organisations to provide aid to starving Somalians. Somalia was classified as a failed state by the United Nations. As a result of the conflict and famine many communities of Somalian internally displaced people were not assisted with food, water, health care and shelter and experienced abuse, and thousands of people died (Maxwell & Fitzpatrick, 2013).

Muslim Aid Somalia was already present in Mogadishu and partnered with Muslim Aid UK to provide emergency assistance to internally displaced people in a refugee camp in Mogadishu. Many aid organisations were banned by the by the Al-Shabaab government to provide aid to affected Somali communities. These organisations included the World Food Programme, and some United Nations organisations. Fortunately, the Islamic FBO's Islamic Relief and Muslim Aid, and the International Committee of the Red Cross (ICRC), were permitted to continue some aid activities in famine areas. The Al-Shabaab government was willing to work with particularly Islamic FBO's as they shared the same values of faith, and represented no issues of conversion to Christianity which the Al-Shabaab were opposed to (Zimmerman, 2011). This case study represents the advantage FBO's can have in a failed state controlled by a strong faith-based group that can access affected communities of a disaster throughout their own network. It also represents an opportunity for INGO's to work with FBO's, as many INGO's have rigorous emergency response programs in humanitarian disasters ready and prepared to act. The legitimacy of the Islamic FBO's in a country that is predominantly Islamic represented an advantage for the Somalian state to be flexible to receive aid from Islamic FBO's.

In the cases of Timor Leste and Papua New Guinea the role of FBO's is demonstrated to have a generally positive effect on the public health of civilians. However, in Somalia the presence of Islam's legitimacy, and capacity, held the Al-Shabaab with control over the Somalian state and Somalian people that had extremely negative implications that affected the lives of millions of people in the midst of a famine. For this reason, further research is required to determine the roles of FBO's in fragile states, and identify factors that may categorize an FBO as necessary for state partnership. Research and considerations are also necessary to determine the characteristics of FBO's that have state capacity and control with negative implications.

A Way Forward for Timor Leste?

The literature on the history of Timor Leste indicates that the Catholic Church has a locally embedded network that has been effective to reach civilians from urban to remote communities. The church's locally embedded network provided the foundation for strong trust and higher capacity with the citizens than the state. The church demonstrated effectiveness in building post-conflict state capacity via political influence, and provided positive contributions to the Timorese through provision of services including healthcare and sustaining the Timorese local dialects.

During my trip to Timor Leste in April, 2013, I had discussions with various church members and Timorese people about their needs, and the challenges they experience in their daily responsibilities. I

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also had discussions with them about their achievements and thoughts about solutions to some of the challenges, and activities they were already doing that were effective within their respective communities. Their faith and the work of the church were heavily involved in their daily lives. In my observations the Timorese are a forgiving nation, and the church's political position within the state is a good foundation now to build further partnerships with the church for improved public health. The enhancement of the current health system is fundamental to the development of Timor Leste. I was only in Timor Leste for 7 days, visiting beneficiaries of projects and project people responsible and church staff of PMS, and did not meet health officials. Therefore, I refer to the literature and analyses on the health system in Timor Leste to generate my analyses.

To illustrate some of my considerations and recommendations I refer to Newbrander's (2007) framework for health systems in fragile and failed states to identify the priority areas that the Catholic Church as the primary FBO in Timor Leste can assist with. Since, Timor Leste is in recovery stages with the previous and current assistance with state and non-state actors, several priority areas that Newbrander indicates to improve the health system are already in place. The following considerations and recommendations focus on specific priority areas that can be enhanced with state and non-state actors partnering with the Catholic Church at the national, district and local levels. These include; gather information, develop policies, strategies and plans, develop human resources, create a package of basic health services, redevelop and reform the health sector, finance services adequately, and coordinate donors.

Gather Information

There is a need for further evaluations of Church-based health promotion (CBHP) suggested by Campbell et al. (2007). The design of the CBHP activities are beneficial to consider the cultural and sensitivity of Timorese citizens that are predominantly Catholic.

The University of North Carolina (n.d.) highlights important areas that need to be considered and achieved for the CBHP program to be successful. These include; partnership development and building trust, transparency between all stakeholders, formative and qualitative research through communications with key church leaders, health staff and other advisors, implementation of activities sensitive to the socio-cultural environment of which the community contributes to implementation, and keeping in mind planning for sustainability.

It is also necessary to assess the health care provision in Timor Leste to include both the private and non-private healthcare including church health services (Alonso & Brugha, 2006). This data is important to provide a realistic mapping of health care services in each sector. Particularly church health services that often have better access to remote areas compared to many district health services.

In order to further assess the state health care providers, it is suggested to monitor and evaluate activities and objectives of Timor Leste's Ministry of Health within the National Health Sector Strategic Plan 2011-2030, and other areas of the Strategic Plan as the development of each area contributes to the social development, sustainable development and economic development of Timor Leste. The timeframe for these evaluations may be considered in the current National Health Sector Strategic Plan which ends in 2030. These CBHP and assessments of activities could take place during this time, beginning prior to 2020, and monitored for 5 years initially. Targets will need to be planned in determining state and non-state providers information including the churches for evidence based research. Moreover, improved health care assessments of both the state and non-state actors will identify barriers in each group in which the church can have a large influence. Furthermore, this is important to determine the involvement of state

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and non-state actors and existing health care services in the country. Also, as a means to measure the association with the Catholic Church's network involved in health service and their potential involvement in health service delivery. Politicians that are church members could be used for political mobilisation of the evaluation of CBHP and mapping of state and non-state health services in Timor Leste.

Develop Policies, Strategies, and Plans

Should the CBHP evaluations be favourable to church health service delivery the state should consider incorporating the church health services as part of a health program within the Ministry of Health's objectives in Timor Leste, similar to that of PNG. The CBHP can be evaluated based on the criteria suggested by the University of North Carolina (n.d.). Should targets be achieved, the Ministry of Health can be lobbied to review the research and rethink a restructure of the remaining 10 years of Timor Leste's National Health Sector Strategic Plan 2011-2030. This advocacy for restructure would need support from political Catholic leaders and health planning experts, and the consideration for existing funding and donors input.

Further interventions and recommendations of activities into the future will depend on the results of the evaluations and mapping of the state and non-state actors and assessment of church involvement against targets in health care delivery. Ultimately, strategies will be most successful if they build on existing strengths and know-how within the church, whilst developing the church's capacity to be empowered to deliver health care and health promotion and sustain the implementation over time.

Another alternative that should be explored further is the identification of existing NGO's and specific FBO's in each district working with church health services. The mapping of FBO's partnerships with church health services is necessary to determine their involvement with church health services, as there is opportunity for these FBO's programs to be incorporated with the suco council and district health teams through the church network. There is also potential to build on the FBO's international network for the international community's support and partnership with INGO's as demonstrated in the case study of Somalia in 2011. These activities may be more likely to reach more than three quarters of the population in remote areas of which the church is likely to be the centre of their community interactions.

It is recommended to consider formal contracting for these partnerships with the church and state and NGO's for transparency of funds and data to be provided to the state and donors. These partnerships should be sealed by formal signed contracts with the state and FBO or NGO via the Timor Leste Ministry of Health where possible. The contractual agreement should include the roles and responsibilities of each actor, and details of the length of the program, the limitations and flexibilities, and numbers of personnel and expectations, data collections, confidentiality and relevant payment and incentives (Campbell et al., 2007).

Martins, Kelly, Grace, and Zwi (2006) identify similar Memorandum of Understandings (MOU's) that were formalised between Caritas Timor Leste and implementing partners during the roll out of the National Tuberculosis Control Program in Timor Leste that was developed from 1999. The program incorporated local expertise, cultural sensitivity of the citizens experiencing distrust of the state, lessons learned from the previous tuberculosis program in Timor Leste, and strong collaboration with Caritas Timor Leste, local NGO's and INGO's and donor representatives. Caritas Timor Leste became the leading agency of the National Tuberculosis Control Program appointed by the Interim Health Authority with credibility. The roll out of the National Tuberculosis Control Program by the leading FBO, Caritas Timor Leste is

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a potential model that should be considered in the development of the health framework with CBHP to build on the strengths of trained staff and the association through the Catholic network in Timor Leste.

FBO's such as Caritas Timor Leste may be potential implementing partners for CBHP and health service delivery in collaboration with church members. Consideration of some INGO's that have restriction to work with political agencies are necessary. Also, a learning lesson from that of Caritas Timor Leste as the leading agency is the need to empower the state to have legitimacy and capacity which may be lead by the state through the Ministry of Health of Timor Leste with FBO's as implementing partners.

Furthermore, it is beneficial to monitor the effectiveness of health service interventions to ensure funds are being used for the health care services and provision. Feedback of the monitoring data to all stakeholders is necessary to further demonstrate the role of church health services in the private sector. Care would need to be taken to ensure church health services are separated as either private or public funding as a lesson learned from that of healthcare in PNG.

Develop Human Resources for Health

In Timor Leste, there is a need for improvement in human resourcing at the district level, and for better management of district health teams and training for their roles. (Asante et al., 2011). Literature indicated that Timor Leste must focus on building the competence of individual managers, while also looking more broadly at the systemic issues that affect their performance and effectiveness (DFAT, 2013). Evaluations of the health system at this level will be helpful to identify causes, to aid solutions for improvements.

Church health staff are known to be motivated and willing to serve the Timorese citizens (Worthington, 2011). Thus, if evaluations are favourable to CHBP it is recommended to incorporate church health services in the Ministry of Health of Timor's objectives as part of the district health teams and at the local level. It is beneficial to build on the strengths of church's to improve the human resources for better health in the country. Church health members may be part of FBO's including the Catholic Church and other Christian religions. They should have a definite presence in the suco councils which represent direct links with the local communities and the districts, as a valuable source of measurable information. Church health members should be involved in the states district health teams, recruitment and training of local Timorese health staff to be sensitive to the cultural and religious values of its citizens. Care should be taken here to ensure the ethical equality of health staff selected and trained.

Also, measures need to be in place to ensure district health teams are coordinating regularly with suco councils to encourage community participation, and any communication issues between the district health teams and the suco councils need to be addressed at the community, district and national level. This requires regular monitoring and feedback to the district and state levels.

The incorporation of church members at the national, district and local levels are important in developing the partnership between the state and the church within the health system framework which the church is embedded in since they 'are there to stay'. This is vital as there is no certainty for INGO's to be involved in health service delivery in the long-term. Sustainability is developed from the community's implementation, which in Timor Leste, heavily involves the Catholic Church's network and Timorese citizens. The involvement of church members at all levels also promotes cohesive feedback from the top down, and bottom up. This is necessary to fulfil reporting requirements for funding, and measurable learning's from activities for improvements to future activities. Lastly, it enables the state's health care services to reach grass-root communities, and is likely to encourage better health seeking behaviours in locals.

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Create a Package of Basic Health Services

The SISCa program implemented nationally through the Ministry of Health of Timor Leste already provides a framework for the provision of basic health services and development of the health system. The interventions in the SISCa program significantly incorporate feedback from local communities via suco councils, and focuses on bridging the gaps in human resources, health care access and referral systems. The SISCa activities targets vulnerable groups including; children under 5 years of age, pregnant mothers, the reproductive age group, and the elderly and disabled. Some basic services include; immunisation for BCG, DPT, hepatitis B, polio, measles, and tetanus toxoid, antenatal care and neonatal care, and diagnosis and treatment of infectious diseases.

Church members often run their own health programs delivered through mobile health clinics or medical camps. More than basic services, church members should be incorporated into the SISCa program more significantly to assist with health promotion, health education and referral systems. In the long-term, post 2020, the incorporation of church health services into Timor Leste's National Health Sector Strategic Plan may make it possible for the church's assistance to health promotion activities through the Catholic Church's national network. The support of missionaries for health promotion of prevention and treatment of infectious diseases can be held through church masses, community meetings, Catholic schools, and respected church leaders such as parish priests. This would involve communication and coordination with the Catholic education teams in each district, including principals and teachers. It would need to incorporate public health training for teachers, and the design of a program for workshops and classes for teachers to teach students. Such issues should include; the importance of hygiene and hand washing, early diagnosis of malaria, dengue and respiratory infections and signs and symptoms, and the prevention and control of infectious diseases. Other topics for health training may include the importance of nutrition, sexual education for prevention of HIV/Aid's and sexually transmitted diseases.

Redevelop and Reform of the Health Sector

The Ministry of Health in Timor Leste could be set up to support grants for FBO health facilities through a Health Sector Improvement Program Trust Account as occurs in PNG's National Department of Health. This would provide grants for the needs of staff and availability of medicines and equipment in district health centres, local clinics and mobile clinics. It is important that these national contractual agreements between the government of Timor Leste and churches are formalised with signatures, as detailed previously. Church health services and district health services have often run their own health services, due to the divide of church and state over recent years. However, the church's local embeddedness and the states resources and funding may benefit a mutual partnership with the church and the state in the future.

Similarly, to the CMC in PNG a CMC could be introduced to partner with the state to better coordinate external funding for healthcare, and as an intermediate between the state and grass-root Timorese communities through the district health staff. The CMC in Timor may be comprised of members of registered church agencies including the Catholic Church to represent church health providers. Furthermore, in an effort to address conflict and promote security, the State could be privy to the nationalisation of a Catholic Church Pastoral Plan (CCPP) in Timor to address violence to promote peace and reconciliation. The CCPP could be responsible for addressing ethical conflict of interest in public health issues including maternal and child health issues associated with the high fertility rate in Timor Leste (Ruether, 1991.), and the use of contraception and abortion. This is a challenging area for the church as it questions their

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values and beliefs. However, a Catholic Church Council and state partnership might be a means to begin discussions and positive interactions between the state and the church to compromise ways to address the rapidly increasing population and reproductive health that impact on maternal and child health.

A focus on human rights may be an option, which has shown to be the driving force for transformation of state policies in South Africa (Sandal, 2011). These kinds of partnerships between the government of Timor Leste and the churches and Catholic Church would promote the state with increased legitimacy from its citizens. It is necessary to develop trust between the state and citizens, and in turn influence CBHP activities and health seeking behaviours on the path to improving public health in Timor Leste.

In considering these opportunities of partnering with churches and the Catholic Church in Timor Leste, it is important to assess the capacity of the church network across all levels, national, diocesan, and parishes in effective coordination of health service interventions. During my visit to Timor Leste, I observed some division between Catholic Church members, and the hierarchical structure of Dioceses. These factors that pose a risk should be further researched as a consideration in the way forward for the formation of a CMC and a CCPP.

Finance Services Adequately

Another area for improvement concerns budgeting of the state for healthcare. There are issues in reporting of budgets for the district health plans to the Ministry of Health for consideration in the health budget. At times, this causes a lack of funds at the district health level with no budget to implement district health level activities (Asante et al., 2011). Improved reporting of funds and budgeting between the district health teams and the Ministry of Health of Timor Leste is important to incorporate consideration of the suco healthcare needs for their inclusion in the health budget. It is particularly important to consider the costs of resources for CBHP activities in line with the reformed Ministry of Health objectives with church, state and non-state actor partnerships. Improved reporting of funds in accordance with CBHP activities will enable better evaluation of church resources and funding needs. Ideally, it is beneficial for the state to consider funding for CBHP and other church health services in accordance with the revised partnership and Ministry of Health objectives to ensure sustainability of the health system framework.

Coordinate Donors

The total spending for healthcare in Timor Leste has been rising slowly since 2000, and donor funding has been declining (Asante et al., 2011). Donor funding represents a significant proportion of funds for the health sector (Alonso & Brugha, 2006). In contrast, there are interested donors to support programs in Timor Leste with CM, which is another form of donor funding. However, it is not clear that funding through CM is measured in Timor Leste's health sector. This poses the question 'Are there other FBO's in Timor Leste that are unaccounted for in the states health sector donor funding?' Thus, further assessments of the funding for healthcare in the private sector, for churches, FBO's and NGO's need to be considered for specific funding allocations in the country.

Alonso & Brugha (2006) discussed a potential intervention to setup a multi-donor trust fund to channel donor funds into the state. Depending on the outcome of the evaluations, donor funds could be channelled into a National Health Sector Improvement Program Trust Account like that in PNG as a component of Timor Leste's Ministry of Health's objectives. This is beneficial to provide funding to

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government and FBO and NGO facilities and better coordinate donor funds. The National Health Sector Improvement Program Trust Account could be accompanied with a National Department of Health to support grants for FBO health facilities and NGO facilities. These interventions require collaboration of church members at the political and diocesan level. Including collaboration with members of other FBO's to ensure cohesion in implementation of health sector activities and feedback of information. This collaboration may be challenging initially due to the current need for improved collaboration of Diocesan activities. Hence, discussions between political church members, health planners and NGO's and FBO's are necessary in the early stages. These interventions can also better evaluate financial mobilisation of incoming donor funds and the performance of state and non-state actors in implementation of activities. Also, it is important to develop the budget lead by the Government in a suitable timeframe for the budget cycle and resource priorities.

Partnerships between the state and FBO's and NGO's are necessary to make positive changes for public health, and for the development of the economy and lifestyle of Timorese people. Economic, social and sustainable development require a mix of improvements in areas such as; education, skills training, labour productivity, poverty, infrastructure of roads, sustainable commodities, human resourcing of the health sector, better access to health care, health promotion, and preservation of culture and traditions. A formalised partnership between churches, particularly the Catholic Church, other non-state actors and the state, can set the path to re-build the economy of Timor Leste as a whole. An educated, skilled and hardworking nation enhances labour productivity, and health seeking behaviours, and can break the poverty cycle for improved public health for the Timorese.

FUTURE RESEARCH DIRECTIONS FOR TIMOR LESTE

An emerging trend is the awareness of faith in development, as a contributor to public health and the capacity building of a whole nation. This chapter represents the potential opportunities for working with FBO's for development and associated challenges. It is an important emerging area in the field of global health.

The literature review demonstrated the concept of faith in development from various perspectives, concept frameworks and contexts. Faith as a factor in development has only been considered significantly in the past 20 years. It is an emerging concept amongst an international community of development practitioners, anthropologists, scientists, and religious peoples. The future of development incorporating the concept of faith opens up a door to a new direction for the study of global health and development.

This chapter is an important contribution to this book, as it provides insight into fragile and failed states which represents a focus on one third of the world's poor, 15% of the developing world's population, and only a quarter of international aid that is provided to fragile and failed states. These states have a detrimental impact to public health. In fragile and failed states; greater than one third of maternal deaths occur worldwide, fifty per cent of children die before the age of five, and one third of people living with AIDs are citizens in fragile states (Newbrander, 2007). Moreover, in Timor Leste more than 96% of the population are Catholic, and the Catholic Church as the primary FBO has shown to be in an influential position locally, nationally and internationally. The church had a profound influence on the trust of Timorese, peace building and public health particularly in the relief stages. Several other case studies demonstrate health frameworks, which incorporate FBO's in activities, as they have proven to be

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beneficial to the recovery and development of failed and fragile states. Thus, this chapter is beneficial to public health practitioners working or conducting research in fragile or failed states, which have critical public health issues.

I have highlighted the role of faith and FBO's in the outcomes of public health in Timorese communities, and state decisions. Timor Leste was used as a model to demonstrate the role of FBO's in the transformation of the state particularly in violent or fragile states. Furthermore, to provide a model using FBO's strengths, including the Catholic Church and other churches within a revised health system framework according to Newbranders (2007) priority areas in failed or fragile states. The case study of Timor Leste demonstrated issues such as health systems strengthening, health care service research, and social and cultural issues that represent contemporary public health challenges in health care systems in developing countries, which is the objective of this book. Suggestions and recommendations were proposed to stimulate further research and considerations for state and non-state actors involved in designing or improving health programs in Timor Leste and other failed or fragile state contexts. It is an exciting future for global health and FBO's that have wide networks to some of the most remote places on earth.

In determining a way forward for health systems to benefit the vulnerable target groups in a failed or fragile state, it is important to consider other factors that may affect the success of interventions. For Timor Leste the need to strengthen collaboration across the Catholic Church network is imperative to achieving success of the interventions in the suggested health system framework. This needs to begin in the early stages of redesigning the health system, and may be assisted by political church members and collaboration of state and non-state actor members.

Many of the interventions require FBO's to have significant mutual authority in terms of finance and budget, policies and reformation of the health system in Timor Leste. Thus, it is important to maintain ethical boundaries for all parties, to avoid unnecessary biases. Moreover, the state needs to pursue a leading role in partnering with FBO's and other non-state actors to encourage higher legitimacy and capacity of the state with the citizens. This is fundamental to implement an effective health system for any state, and should be considered for public health practitioners' considering partnerships with FBO's in fragile or failed states in future. It is also important to define the characteristics of failed and fragile states for future public health practitioners and policy makers to address the priority health areas to restore fragile states in early stages and sustain the health framework into the future.

In some cases FBO's in a leading position within a state have shown to be an impediment in states leading to state failure. This was demonstrated in the case study of the 2011 famine in Somalia. In East Africa, this lead to widespread internal displacement and migration of thousands of citizens to neighbouring countries in search of security with limited access to basic needs. This resulted in mass starvation and exacerbated infectious disease outbreaks, nutrient deficiencies and the death of many people. Thus, it is important for public health practitioners to consider the social and religious contexts of failed or fragile states in developing health frameworks. Future research is required to determine the characteristics of a FBO that can positively develop the state compared to a FBO that poses the risk of destruction to the state. Refer to additional readings for further insight into the case study of Somalia and East Africa during the famine and emergency in 2011.

Future research is also necessary to map the health activities of the private sector in failed or fragile states, particularly FBO's and NGO's effectiveness. This is necessary to assess their potential against the interventions proposed in the model of Timor Leste. Moreover, contracting with NGO's seems to be effective in providing short term health needs to citizens, however, their effectiveness in sustaining health activities in health systems in the long-term needs future research.

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The relationship between spirituality, religion, and health is also an important area for further research as it is intertwined with social relationships between the state, FBO's, and civil society. Further research that is measurable will increase the credibility of the relationship between spirituality, religion and health in science, which is important in shaping future health frameworks in the early stages of fragile states. It is also meaningful in future social and psychological science research. For further reading on religion and the impacts on health refer to additional readings.

CONCLUSION

In reference to the questions and objectives detailed in the introduction, this chapter has demonstrated analyses of the relationship of faith and development, the nature of fragile and failed states, and the role of FBO's in global health and development in the context of Timor Leste. Other case studies in PNG, and East Africa with various literature have assisted with the analyses. Various opportunities and challenges of the relationship of the state and FBO's have been discussed with a focus on Christianity and Islam that stems from experience. FBO's can be highly influential in states, particularly in fragile states, and effective in peace transformation and advocacy for the human rights of civilians as demonstrated in Timor Leste with the Catholic Church. FBO's high level of influence can also be detrimental to the health and safety of civilians in a state as shown briefly in the literature review.

This chapter analysed various elements of the health system in the context of Timor Leste and PNG to provide recommendations and solutions for the incorporation of church involvement in a revised health framework for Timor Leste. However, most of these analyses are based on literature and brief experience during my visit to Timor Leste in April 2013. Thus, further research on the private sector and FBO activities in health service delivery is recommended.

FBO's have national and international networks that represent an opportunity for partnerships with states and non-state actors in fragile and failed states. These wide and accessible networks for FBO's were demonstrated in the case study of the East Africa Somalia 2011 famine, Timor Leste's history and the literature review. The opportunity of partnering with FBO's for improved access to communities is fundamental to explore for the future of global health.

FBO's networks are commonly locally embedded in nations, which builds their strong relationships with communities as demonstrated in Timor Leste. The participatory nature of the church with communities in Timor Leste was a determinant of the church's legitimacy and state capacity in the country. These three concepts that usually classify a well-functioning state can be applied to FBO's such as the Catholic Church in Timor Leste which, demonstrated these qualities and success in eventual political mobilisation and lead to the independence of the Timorese nation.

It is envisaged that the insights into this chapter will stimulate further research for interested readers to explore some of the elements to continue this emerging topic for potential partnerships with FBO's for state and non-state actors to shape the future of global health. Particularly, further research to advocate for considerations of some of these recommendations for church, state and non-state partnerships to improve public health in Timor Leste. I have certainly experienced the role of faith in global health and development throughout my work experience, and FBO's represent a large proportion of this assistance and are interconnected with communities that development programs often work with. The role of FBO's in health is an important contribution to this book to determine the future direction of global health of fragile and failed states.

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KEY TERMS AND DEFINITIONS

Black Theology: In the context of South Africa, is based on existing church theology to support human rights of groups of civilians that were previously excluded, in the name of equality and justice through the Gospel.

Democratic: In the context of state represents the laws, and policies based on the collective people of the states input and votes.

Political Communication: Is the means or tools by which an influential group uses to influence the participation of politicians, media and voting public in democracy.

Political Mobilisation: An active form of political influence by an influential group in the development of relationships with the political state via protests, campaigning for election parties or potential candidates, and social groups for change.

Political Socialisation: Refers to the norms of the political system and internal processes that are influenced by the social, cultural or religious norms of an influential group.

Reconciliation: Refers to the peaceful outcome after two or more groups have reconciled their differences.

Spirituality: Represents the centeredness of being which binds a relationship with oneself, or another higher power or religious God.

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Chapter 41
The Role of Average Health Status:
Health Inequalities Matrix for Assessing Impacts on Population Health in Health in All Policies

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ABSTRACT

Economic, social and environmental policies, programs and projects have impact on health. Health in All Policies (HiAP) aims to improve population health by taking into account these impacts. HiAP needs appropriate tools for assessing impacts on population health. When making choices between policy options, decision-makers rely on predictions from Health Impact Assessment. Currently there is no gold standard for establishing and assessing validity of predictions. This paper distinguishes between two levels of causal pathways regarding health impacts – specific and conditional, and proposes the Average Health Status – Health Inequalities Matrix as gold standard. The Matrix facilitates making the right choices at any level and local context, thus is useful for researchers, policy-makers and practitioners for designing, analysing and evaluating all kinds of policies. By allowing quick, reliable and inexpensive appraisal of different policy options the matrix makes feasible taking into account the impacts on population health and paves the way for institutionalizing of HiAP.

INTRODUCTION

Simplicity is the ultimate sophistication (Leonardo da Vinci)

There is increasing awareness that policies in all sectors have some impact on health. Health in All Policies approach aims to improve population health and health equity by taking into account these impacts when decisions are made (WHO, 2014). In order to be successful, apart from political will and

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resources, Health in All Policies needs appropriate tools for proper assessment of impacts on population health from different policy options. Such tools include: Social Impact Assessment which looks at social consequences from a policy and aims sustainable development (Becker, 1997); Health Impact Assessment (HIA) which explicitly looks for and examines impacts on population health (Lehto & Ritsatakis, 1999); Average Health Status – Health Inequalities Matrix (Panayotov 2006b; 2008a) which looks at the impacts on population health from different policy options in terms of changes in average health status and health inequalities; and Equity-Focussed Evaluation – an emerging concept with developing methodology, which is concerned with achieving equitable development (Bamberger & Segone, 2011).

Melkas (2013) suggests that "HIA is a key tool". However, Panayotov (2010) points out that there are problems with HIA methodology, and policies can create and/or widen health inequalities, even if nobody is worse-off (see Examples, Case I). How to determine which is the best tool for successful Health in All Policies approach?

Population health has two major variables: average health status (AHS) and health inequalities (HI). During the last six decades decision-makers around the world were focused on improving AHS. HI are discussed since 1990 and Douglas & Scott-Samuel (2001) suggest that HIA should address HI, recognising that there is tension arising from the trade-offs between improving AHS and improving health of the most disadvantaged. What should decision-makers strive for in relation to population health: *improving AHS*, or *reducing HI*? While analysing the correlation between these two variables, Panayotov (2006a) points out that although that these two goals may look similar, they have different paths which lead to different ends. For example, AHS will improve, when the health of those who are better-off improves faster than rest of the population, but as result HI will increase. He points out that from an economics point of view creating and/or widening of HI represents *inefficient* and *unsustainable* allocation of limited public resources (Panayotov, 2006b). Showing that in relation to population health achieving *equity* is a premise for *efficiency (maximizing population health with limited available resources)*, Panayotov (2006b) asserts that HI should be reduced not only on compassionate grounds. Therefore, he suggests that the goal for improving AHS should go hand-in-hand with the goal for reducing HI.

Since neglecting health will cost much more later, the negative, mainly direct impacts are usually addressed and mitigated, often required by the local legislation. Vanclay et al. (2015) note that the focus of Social Impact Assessment has shifted from primarily addressing the negative impacts to enhancing the benefits (i.e. positive impacts). However, it has been noted that while enhancing positive impacts is a *prima facie* improvement, it can create and/or widen HI (Panayotov 2008a; 2008b; 2010). This happens when people who benefit more from the new policy are those who already are better-off. Panayotov (2008a; 2008b; 2010) asserts that for policies distribution of the benefit among the population is an important factor influencing outcomes, whether improving health is the primary objective (health policies, see Examples, Case I and Case IV) or the primary objective is different than health (policies in other sectors: energy, transport, education, agriculture, urban planning, etc., see Examples, Case II and Case III). In other words, *the distribution of the benefit from different policy options determines population health and/or its determinants*. Panayotov (2008a; 2008b) concludes that achieving equitable development (what Social Impact Assessments and Equity-Focussed Evaluations are about) is a premise for reducing HI and improving population health (what Health in All Policies and HIA are about).

By definition HIA is concerned with the potential and/or unintended effects on population health and the distribution of those effects within the population (Lehto & Ritsatakis, 1999). However, Kemm (2006) notes that many HIAs often "fall short of a proper analysis of distribution of impacts detailing how the various impacts would fall on different groups within the population". Probably because of

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this, the Commission on Social Determinants of Health (Marmot et al., 2008) has recommended assessment of health equity effects of public policy decisions by conducting health equity impact assessment (Recommendations:10.3;12.1;16.7). Panayotov (2011) points out that there is no need to invent a new name in order to conduct proper analysis of impacts' distribution among the population and to make recommendations for improving health equity. First, putting out new names diminishes the value and credibility of HIA. Second, the use of "health *equity* impact assessment" or "*equity focused* health impact assessment" implies that there can be '*other'* types of HIA which do not specifically consider *equity*, and this undermines the whole idea for addressing and reducing HI, since these can be ignored in the '*other'* HIAs. If properly conducted all HIAs should provide recommendations to improve health equity.

When making choices, decision-makers rely on the predictions from HIA. However, currently HIA has no gold standard – a test which always identifies the true condition – for establishing and assessing validity of predictions. This paper proposes that the Average Health Status – Health Inequalities Matrix (AHS-HI Matrix) could be such standard. This is a model for assessment of policies, programs, projects and other interventions on populations (hereafter the term *policy* will be used for all of them) regarding their impact on population health in terms of changes in the two major variables: AHS and HI. This paper will regard the role of AHS-HI Matrix only with HIA, since HIAs, Social Impact Assessments and Equity-Focussed Evaluations have the same domain and objectives and overlap substantially.

THE ROLE OF HIA FOR IMPROVING POPULATION HEALTH

Any policy is a decision for resource allocation with winners – people who benefit from it, and losers – people who benefit less, not at all, or are worse-off compared to their previous situation. Panayotov (2008a) points out that when people benefit less from a policy, but they are not worse-off compared to their situation before the change, they are *relative losers*. People are *absolute losers*, if as a result from the change, they are worse-off compared to their previous situation. Further, he asserts that when people benefit less before the change and also less from the new policy, they are *double losers* and this can create and/or widen HI, even if nobody is an *absolute loser*.

It is important to note that HIA should not be confined to or confused with health risk assessment and/or risk management. Banken (1999) suggests that HIA should be more about *prediction of tendencies and types of impacts* rather than absolute measures. In agreement with Banken, this paper argues that decision-makers should be more concerned with answers regarding impacts on population health in terms of changes in AHS and HI. Therefore, in order to be useful for decision-makers HIA should:

1. Explain *what* will happen with AHS and HI for each of the identified options/alternatives with clear statements of the following type: "If you do option 1, 2, or 3, then you'll get (population health) outcome X, Y, or Z"; and
2. Explain *why* this will happen, i.e. on what basis the predictions are made.

Outcomes corresponding for each policy option should be clearly defined, just as alternative policy options are, taking into account changes in AHS and HI. This requires that the "*what*" part should be done not for the population on average, but for stratified population groups which should reflect specificities of the local context (Panayotov, 2009). HIA should explicitly state what stratification of the population is considered (this may vary from case to case) and what is the rationale behind it (why such

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differentiation and increments are chosen). When specific health outcomes might be uncertain, unclear or otherwise unknown (especially due to complexity), outcomes about the determinants of health should be used instead, pointing out their impact on AHS and HI.

Since populations have normal distribution with bell-shape, which is defined by two parameters: *mean* (*average*) μ and *standard deviation* σ, Panayotov (2009) points out that the goal for improving population health means that decision-makers should strive for such distribution of the benefit among the population, which leads to reducing the standard deviation (proxy for HI) while improving the mean (AHS). This means that the population bell should become narrower (reduced HI) while moving to the right (i.e. increased life expectancy, improved Quality-of-Life and well-being) or moving to the left (i.e. reduced exposure, morbidity, mortality). On the other hand, widening HI will flatten the population bell, even if AHS improves. If presented correctly, policy impacts are easy to see, compare and comprehend even by lay people (Panayotov, 2010).

Both decision-makers and HIA practitioners should be aware that since "In HIA prediction is based on a set of causal or logic models" (Kemm 2006), quality/validity of predictions depends on quality/validity of the model, which in turn depends on quality of the theoretical framework used. It should be noted that at present regarding policies there are problems with validity of both causal and logic models. For example, Kelly et al. (2006) note that in relation to HI it appears from the evidence that in many cases the causal pathways are not always so clear and the covering laws (by which authors obviously mean the generative mechanisms) are not known at all. These problems stem from the fact that those models do not consider distribution of the benefit from a policy/intervention among the population. Panayotov (2008b; 2010) points out that for any specific case, no matter what the concrete causal pathways are (whether known and clear, or not), *the effects in which HIA is interested in are always a consequence from distribution of the benefit from implemented policy/intervention among the population*. AHS-HI Matrix is a model which shows how distribution of the benefit from a policy/intervention impacts population health in terms of changes in both AHS and HI. In order to be valid a model should be based on proper theoretical framework.

THE ROLE OF THEORY

Theoretical frameworks play fundamental role in constructing a model, since any flaw in them will inevitably affect negatively validity of the model. Decisions based on recommendations generated by problematic models may not be successful in achieving predetermined goal (for example, improving population health) and can be even counterproductive by creating and/or widening HI. Heller et al. (2004) stress that "unless public health programs are based on sound theoretical bases, they will fail". I want to emphasise that this applies also to recommendations in HIA.

In a treatise on scientific methodology in social sciences, Popper (1957) investigates the role of theory in testing a hypothesis, explaining observations and predicting outcomes. He points out that initial conditions influenced by the force of universal laws described in a theoretical framework result in outcomes. It is suggested that, like in mathematics, when two variables are known, the third can be inferred. For example, when the theoretical framework is valid and outcomes are known, initial conditions can be inferred. Similarly, when the theoretical framework is valid and initial conditions are known (the status quo which decision-makers want to change and different policy options to do this), outcomes corresponding to each option can be inferred (i.e. prediction can be made). Popper asserts that, when initial

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conditions cannot be explained or when outcomes differ from the predictions, the theoretical framework is falsified or refuted. He concludes that theoretical frameworks which better "survive" the process of refutation are more applicable to problem situations in real life. For appraisal of theories Popper states that theoretical frameworks can be judged objectively by the amount of truth that they imply. Thus, theoretical frameworks based on universal laws would provide more truth, as these will be valid in all cases.

Connelly (2001; 2005; 2007) notes that only theoretical frameworks based on critical realism (*if**A**-then always**B***) can provide universal explanations and predictions. Theoretical frameworks inferred only from empirical observations of outcomes and initial conditions might not be able to provide universal explanations and valid predictions. Validity may be problematic, if the universal laws (generative mechanisms) are not known. Apparently, this is the case regarding HI, because in spite of the abundance of empirical observations of outcomes and initial conditions, the Commission on Social Determinants of Health could not identify the universal laws (generative mechanisms) which create, widen, or diminish HI, and consequently there are no universal explanations and predictions provided in its final Report (Marmot et al. 2008). Not surprisingly Venkatapuram (2010), although praising the CSDH's Final Report as a positive step for addressing health in human development, notes that "the commission's policy recommendations are quite general" and admits that there are multiple problems with implementing the Commission's recommendations at local level in different countries. By revealing the universal laws (generative mechanisms) about impacts on population health from different policy options AHS-HI Matrix provides universal explanations and predictions. Thus it can be used as a gold standard facilitating making the right choices for addressing social determinants of health in order to reduce HI and improve population health at any local context.

THE ROLE OF AVERAGE HEALTH STATUS - HEALTH INEQUALITIES MATRIX

Matrices are known as a useful tool for demonstrating correlation between variables. Thérivel et al. (1992) point out their usefulness for identifying different impacts. If properly constructed, with all considered alternatives on one axis and the corresponding impacts on the other axis, a matrix can be very useful for comparing different options (Becker 1997), because the impacts are presented in a clear and systematic way (Barrow 2000). Kauppinen et al. (2006) note that regarding health "the same matrix can simultaneously deal with impacts, determinants of health or objectives" and point out that one main purpose of a matrix is to show the positive and negative impacts of different options on HI. However, regarding health impacts from policies, it has been noted that there are many uncertainties about causal pathways (Kelly et al. 2006; Kemm 2006; Mindell et al. 2004). Consequently, these uncertainties present considerable challenges when constructing a matrix. However, as already mentioned, no matter what the concrete causal pathways are, impacts on population health are always a consequence from distribution of the benefit from a policy among the population. According to Panayotov (2008a) this distribution is an important factor influencing the outcomes which in turn determine the impacts on population health manifested as changes in AHS and HI.

From any policy/intervention people can be either better-off, worse-off, or without a change (i.e. impacts can be either positive, negative, or neutral). On the vertical axis are all (nine) theoretically possible combinations of previous and new *winners* and *losers* from any policy/intervention on populations. "*Yes*" indicates change, and any row can have maximum of two times "*Yes*", as it is not possible for one to be simultaneously better-off and worse-off. On the horizontal axis are the corresponding impacts on

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population health in terms of changes in AHS and HI, both of which can increase, decrease or remain the same. It is assumed that it is not possible for one to be better-off from an intervention and this to be bad for one's health, and respectively it is not possible for one to be worse-off from an intervention and this to be good for one's health. Thus, any specific combination of previous and new *winners* and *losers* can achieve nothing else, but the corresponding impact on AHS and HI. Therefore, being based on critical realism – *if**A*** (specific combination of previous and new *winners* and *losers*) *then always**B*** (corresponding for this combination impact on AHS and HI) the matrix provides universal explanations and predictions for impacts on population health from different policy options (see Table 1).

AHS-HI Matrix has several *benefits* when used as a tool for analysis of health impacts from policies, projects, programs or other interventions on populations:

- **Universal applicability:** Since all possible combinations of distribution of the benefit from a policy or intervention on populations are considered, the matrix is applicable for assessment of any policy or intervention anywhere in the world, since no matter how different the local context is, there always will be *winners* and *losers* from this policy;
- **Comprehensiveness:** All possible options (alternatives) of distribution of the benefit from a policy or intervention are considered in the matrix;
- **Simplicity:** The matrix provides simple descriptions, yet sufficient for purposes of informing decision-makers;

Table 1. Average Health Status - Health Inequalities Matrix. (Copyright © 2008 ICARE. All rights reserved. Reproduced by permission of Independent Centre for Analysis & Research of Economies from: Panayotov J., 2008, Public Health and Average Health Status: Do Health Inequalities Matter?, ICARE, 08 August 2008: Table 2)

Outcome from New Policy, Program or Intervention										
Better-Off		Worse-Off		A H S			H I			
Previous Winners	Previous Losers	Previous Winners	Previous Losers	↑	↓	—	↑	↓	—	Case (Scenario)
YES	NO	NO	NO	X			X			1
NO	YES	NO	NO	X				X		2
NO	NO	NO	YES		X		X			3
NO	NO	YES	NO					X		4
YES	NO	NO	YES	x*	x*	x*	X			1*, 3*, 5
NO	YES	YES	NO	x*	x*	x*		X		2*, 4*, 6
YES	YES	NO	NO	X			x^	x^	x^	1^, 2^, 7
NO	NO	YES	YES		X		x^	x^	x^	3^, 4^, 8
NO	NO	NO	NO			X			X	9

AHS – average health status

HI – health inequalities

***** Whether AHS increases, decreases or remains the same depends on the balance of the gain/loss between recipients (can be positive, negative, or neutral).

^ Whether HI increase, decrease or remain the same depends on the balance of the gain/loss between recipients (can be positive, negative, or neutral).

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- **Clarity:** All possible options together with their corresponding impacts are presented in an easy to see, comprehend and compare, clear and systematic way;
- **Uncompromised validity:** Since all possible combinations of distribution of the benefit are considered and each one of these comes with only one corresponding outcome, all predictions that are made based on the matrix have the highest possible validity;
- **Efficiency:** The matrix requires significantly less time and resources: (i) for proper analysis of various impacts from all options/alternatives and their distribution within the population; and (ii) for collating and appraisal of relevant evidence;
- **Versatility:** The matrix facilitates swift adaptation to possible changes in objectives, available options/alternatives and/or the local context;
- **Fairness:** The matrix always shows the right way to reduce HI;
- **Flexibility:** The matrix can be tailored to diverse local conditions;
- **Reproducibility:** The matrix shows precisely what distribution of the benefit at local level is needed in order to achieve the desired outcome regarding the impact on AHS and HI in any specific case.

When choosing between different policy options decision-makers need tools which have the ability to:

1. Be applied across sectors and disciplines;
2. Develop and assess different scenarios, often in changing conditions;
3. Deal with complexity and uncertainties;
4. Be feasible, i.e. simple and easy use, allowing timely and inexpensive appraisal of the available options.

By meeting all these requirements, AHS-HI Matrix can be a successful such tool.

ENHANCING VALIDITY FOR POLICIES AND INTERVENTIONS ON POPULATIONS

HIA makes sense for decision-makers only if the predictions that it makes are valid. Veerman et al. (2007) examine the relevance of different forms of validity to HIA, pointing out that at present "it is unclear how the validity of predictions should be defined in HIA, and how it can be assessed". They suggest that only "three types of validity are relevant for HIA: plausibility, formal validity and predictive validity" and HIA studies and methods should be assessed for plausibility and formal validity only, since there are no gold standards to establish the predictive validity. While in agreement with Veerman et al. regarding usefulness of Popper's work (1957) for establishing and assessing validity of predictions in HIA, we have disagreement on some of their conclusions regarding the relevance of different forms of validity to HIA. Below is shown the usefulness of AHS-HI Matrix for different forms of validity in HIA, including its usefulness as a gold standard for establishing and assessing validity of predictions, plus a new form of validity – *validity of evidence* – is introduced.

According to Popper (1957) identical interventions applied to identical conditions lead to identical outcomes. Then, validity of predictions about the outcomes can be:

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- Established by confirming that initial conditions which will be modified and the policy/intervention which will be applied do conform to the ones already held to be valid to a gold standard; and
- Assessed by confirming that the outcomes achieved are identical with the ones from the gold standard.

In order to establish validity of predictions in HIA the *internal validity* should be in order in first place – that is the degree to which conclusions about causal relationships are valid. HIA relies on other disciplines to establish the *specific* causal pathways between health outcomes and exposure, or risk factors, or determinants of health. Veerman et al. (2007) assume these causal pathways to be valid and note that "HIA itself is not primarily intended to investigate causal relationships". Therefore they conclude that "the concept of internal validity does not directly apply to HIA". However, their assumption is problematic, since it is noted by many (Kelly et al. 2006; Kemm 2006; Mindell et al. 2004) that regarding social determinants of health (which are shaped by policies and/or interventions on populations) the causal pathways are not always as clear as they are for biological interventions (which are interventions on individuals). Mindell et al. (2004) point out that HIA is concerned with how different determinants of health are affected by the changes resulting from the proposed policy/intervention, however, still no clarification on the causal pathways is offered.

This paper distinguishes between two different types (levels) of causal pathways which are often confused, although they should not be. These types (levels) are to be called *specific* (level one) and *conditional* (level two).The relationship between these two is that *specific* causal pathways (what epidemiology is interested in) are affected by the *conditional* causal pathways (the distribution of the benefit from a policy among the population) as result of implemented policies. *Conditional* causal pathways will determine the extent to which the *specific* causal pathways will manifest in specific local context. Therefore, a *specific* causal pathway can lead to different outcomes due to different distribution of the benefit (i.e. *conditional* causal pathways). For example, population's exposure to noise and air pollution (well-established *specific* causal pathways) is affected by: (i) location of the highway; and (ii) interventions to mitigate the noise and air pollution (for example, using noise barriers, high-volume low-speed fans and air vents/shafts, traffic regulations/restrictions, etc.); both of which are determined from the decisions made by decision-makers (*conditional* causal pathways). In other words, *conditional* causal pathways (level two) determine the internal validity for policies/interventions on populations. Therefore, HIA should be concerned with establishing the *conditional* causal pathways which will determine the changes in the determinants of health. Thus, regarding *conditional* causal pathways the concept of *internal validity* applies to HIA. For HIA it is of paramount importance to get the *internal validity* right in first place, in order to get any predictions right.

As mentioned above, AHS-HI Matrix always explains when conclusions about the *conditional* causal pathways regarding changes in both AHS and HI are valid. A specific combination of previous and new winners and losers (row in the matrix) leads to the precise and the only corresponding outcome regarding changes in AHS and HI. Different combinations of previous and new winners and losers will lead to different manifestations of the same *specific* causal pathways (whether these are known and well-established or not), thereby achieving different outcomes. If the outcome regarding changes in AHS and HI from specific combination of previous and new winners and losers is not satisfying (i.e. it deviates from the intended), AHS-HI Matrix shows what should be changed in order to achieve the desired outcome. In other words, the matrix identifies what change in the distribution of the benefit from the policy/intervention is needed (on matrix' left-hand side) in order to achieve the desired outcome for AHS and HI

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(on matrix' right-hand side). These nine combinations are the *conditional* causal pathways for policies/interventions on populations and in every specific case AHS-HI Matrix allows us to determine whether the conclusions about these causal relationships are valid, i.e. to establish the *internal validity* in HIA.

External validity represents the extent to which internally valid results can be held to be valid in other cases. However, it is important to point out that identical policies or interventions will achieve different outcomes regarding AHS and HI when there is a difference in the *conditional* causal pathways (i.e. in distribution of the benefit at local level). Replicating identical policy or intervention will achieve different outcomes regarding changes in AHS and HI in all cases where there is a different combination between previous and new winners and losers from this policy/intervention. On the other hand, the same outcomes regarding changes in AHS and HI can be achieved only by policy option with the corresponding for this outcome combination of previous and new winners and losers. This means that *conditional* causal pathways determine the *external validity*. AHS-HI Matrix helps to establish the *external validity* by showing whether identical policy/intervention will deliver the same outcome in other cases. This will happen only if the *conditional* causal pathways are externally valid, i.e. when the specific combination between previous and new winners and losers (row in the matrix) in other cases is the same as the one from the original case.

Representation validity represents the extent to which a theoretical framework can be operationalised (i.e. used in diverse real world). AHS-HI Matrix can be used in any local context and at any level of decision-making, since, no matter how different a specific case can be, there always will be winners and losers from a policy, which in turn will affect the outcome for both AHS and HI. Thus, AHS-HI Matrix has high representation validity.

Face validity indicates whether the theoretical framework used is appropriate and plausible to measure what it intends to measure. AHS-HI Matrix is appropriate and plausible to measure changes in AHS and HI, not only because it accounts for whether both of them are affected by a policy, but also because it considers all potential alternatives/options (i.e. possible combinations between previous and new winners and losers from this policy) which can affect the outcome for AHS and HI. Thus, AHS-HI Matrix has high face validity.

Criterion validity represents the extent to which the available information about a set of variables can predict the outcome for another variable. In relation to population health, the information about a set of variables consisting of previous and new winners and losers can predict changes in the other variables: AHS and HI. It is widely recognised that the best way to establish validity of predictions about the outcome is comparison to a gold standard – a test which always identifies the true condition. Veerman et al. (2007) note that at present for HIA "there are no such standards" and conclude that "we have to make do with less than the gold standard". AHS-HI Matrix can be used as a gold standard, since it always shows the true condition about the outcome (changes in AHS and HI) from a set of variables (previous and new winners and losers). Thus, AHS-HI Matrix has high criterion validity.

Predictive validity represents the extent to which predictions about future or independent past events become a reality. Since AHS-HI Matrix always shows the true condition about the outcome (changes in AHS and HI), any prediction regarding changes in these outcomes based on the matrix will be correct and will materialize. Thus, AHS-HI Matrix has high predictive validity.

Construct validity is about the appropriateness of the scale in order to operationalise a theoretical framework. AHS-HI Matrix has the appropriate scale to deliver predictions about "tendencies and types of impacts" regarding AHS and HI, rather than absolute measures about individuals, precisely what the decision-makers need. Thus, AHS-HI Matrix has high construct validity.

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Content validity is about the extent to which a measure represents all facets of a given social construct. AHS-HI Matrix represents simultaneously the set of variables (previous and new winners and losers) and the outcome (changes in AHS and HI) for a given social construct (policies). Thus, AHS-HI Matrix has high content validity.

Convergent validity represents the extent to which the assessment is related to what it should theoretically be related to. Assessments provided on the basis of AHS-HI Matrix are entirely related to what they theoretically should be related to – the changes in AHS and HI as result from different choices of winners and losers from a policy. Thus, AHS-HI Matrix has high convergent validity.

Discriminant validity represents the extent to which the scale used to operationalise a theoretical framework differs from other scales designed to measure different theoretical constructs. The scale of AHS-HI Matrix which is intended to measure changes in population health (i.e. changes in AHS and HI) is completely different from the scales designed to measure the health of individuals, for example. Thus, AHS-HI Matrix has high discriminant validity.

Logical validity (also known as *formal validity*) is about whether the conclusion logically follows from the premises which are considered to be true. Conclusions made on the basis of AHS-HI Matrix logically follow from the premise that different distributions of the benefit from a policy/intervention (i.e. different combinations between previous and new winners and losers) lead to different outcomes regarding AHS and HI. Thus, AHS-HI Matrix has high logical validity.

Based on Occam's razor and Chatton's anti-razor principles a new, dialectic type of validity for establishing *validity of evidence* is suggested here.

Occam's razor validity represents the extent to which the evidence is most likely to be correct. It is based on Occam's razor principle that the simplest comprehensive description (of the evidence) is most likely to be correct. Vitanyi & Li (2000) have proven a mathematical criterion for evaluation of evidence, which confirms the validity of Occam's razor principle. For policies AHS-HI Matrix allows the simplest, yet comprehensive description of the evidence regarding changes in AHS and HI. On this basis, any evidence and conclusions inferred by AHS-HI Matrix will have high likelihood to be correct.

Chatton's anti-razor validity represents the extent to which the evidence is likely to be incorrect, because a simple description of the things might not be sufficient to verify an affirmative proposition. Formally it states that "If three things are not enough to verify an affirmative proposition about things, a fourth must be added, and so on". In other words, the evidence is most likely to be correct if Chatton's anti-razor validity is low. AHS-HI Matrix does not need to add more things in order to verify an affirmative proposition regarding changes in AHS and HI from a policy. Therefore, any evidence and conclusions inferred by AHS-HI Matrix will have low likelihood to be incorrect.

AHS-HI Matrix provides high *validity of evidence* regarding changes in AHS and HI from policies, since any evidence and conclusions inferred by AHS-HI Matrix will have high likelihood to be correct (Occam's razor validity) and low likelihood to be incorrect (Chatton's anti-razor validity).

KEY POINTS

What is Already Known

- Health depends not only on healthcare system, since decisions made in other sectors impact population health;
- Addressing social determinants of health is important for reducing HI;

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- Health in All Policies approach aims to improve population health by taking into account impacts on health from different policies in all sectors;
- HIA can assist decision-makers for making the right choices by predicting the impacts on population health from different policy options;
- There is no gold standard for establishing and assessing validity of predictions in HIA.

What this Paper Adds

- This paper makes a distinction between two types of causal pathways regarding health: *specific* causal pathways and *conditional* causal pathways;
- It is suggested that HIA should be concerned with establishing and assessing the *conditional* causal pathways;
- The paper explains the usefulness of AHS-HI Matrix:
  - As a gold standard for establishing and assessing all kinds of validity, adding one more – *validity of evidence*;
  - For critical appraisal of the evidence;
  - For dealing with complexity and uncertainties;
  - For developing and assessing different scenarios of policy options and their impacts on population health;
  - For applicability in all sectors, at all levels, and for all kinds of policies.

Policy Implications

- Sustainable development and population health are intrinsically linked, which requires all policies to be assessed for their health impacts;
- Decision-makers should take into account these impacts and should make choices which improve health of whole populations (i.e. improve AHS while reducing HI);
- Policies in all sectors should be designed to avoid *double losers*, a process in which AHS-HI Matrix facilitates making the right choices.

EXAMPLES

Case I, Fruits and Vegetables (F&V)

In 2006 there was a costly advertising campaign, including TV, "*2 fruits & 3 vegies*", aiming to improve the daily diet of Australians, most of whom were not consuming enough F&V. Since January 2007 I give this intervention as example for Case 1 from AHS-HI Matrix (improving AHS and increasing HI). I argue that this campaign, although that might be effective in increasing the consumption of F&V, will result in widening of HI, since the intervention benefits more those individuals who already are better-off (previous winners). Having more disposable income facilitates making healthier choices, while less disposable income can limit these. For example, if one is from a poor family and one learns from this campaign that consuming more F&V is good for one's health, it will make little difference to one's choices when buying food, since 1 kg tomatoes cost as much as 1 kg minced meat[1] and one knows from

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one's personal experience that 1 kg meat will keep one's family fed for longer than 1 kg tomatoes. In spite of increased awareness about the benefits from consuming more F&V, due to budget constraints one will have to skip the tomatoes, unless there is some kind of incentive like vouchers or subsidy for F&V, for example. This way the new intervention will benefit more those individuals who are worse-off before the intervention (previous losers), the intervention will "*work*" AHS will improve and HI will diminish, which will be example for Case 2 from AHS-HI Matrix (improving AHS and decreasing HI).

This intervention, which intended to change personal behavior, has led to unintended positive results: (i) governmental businesses and some progressive managers of private businesses in good financial situation have started to provide fruits only to their employees at workplace; and (ii) some private businesses have started to provide new service – home delivery of F&V. Although representing an enhancement of the positive impacts from the initial intervention, this also leads to increasing of HI, since once again those who benefit from it are the previous winners (better-off before), i.e. Case 1 from AHS-HI Matrix (improving AHS and increasing HI). Employees in businesses which are cutting costs, part-time and casual workers, as well as sub-contractors do not benefit at all, unless F&V were tax-deductible, for example, which apparently they are not. Similarly, lower socio-economic groups opt-out home delivery, as they know from their own experience that the extra money for the service would be better spent for more food or something else, unless the service were subsidized for them, for example, which apparently is not.

Case II, Solar Panels (SP)

With a primary objective reducing greenhouse gas emissions and reducing future investments for production and transmission of electricity the Australian Government provided substantial subsidies of up to AUD 8,000 for households who install SP. The intervention has become so popular that at the end of April 2010 more than 100 000 systems were installed[2]. However, providers of electricity felt the impact, as uptake of SP effectively means decline in demand for electricity and respectively in their profits. This negative impact for the electricity providers was quickly compensated by substantial price increase (unintended negative impact on population). I am not aware if HIA was conducted in regards to this policy, producing recommendations based on analysis of potential impacts and their distribution among the population. Although that the concrete causal pathways regarding health impacts might not be clear or known, this policy is example for Case 5 from AHS-HI Matrix (improving AHS and increasing HI), even if the gain of the winners exceeds the loss of the losers (Kaldor-Hicks Criterion). Subsidising solar panels is a policy which takes from all tax-payers, including the renters (previous losers), and benefits home owners (previous winners). On top of this, previous winners – the home owners – benefit from the change twofold: (i) they get the subsidy for SP; and (ii) they are less exposed to the higher electricity price, as they produce some of the electricity for their home. Previous losers – the renters and people from lower socio-economic groups who opt-out SP – are *absolute losers* as they are worse-off compared to their previous situation. They are now twice losers from the new policy: (i) they get no subsidy; and (ii) they are fully exposed to the higher electricity price. The result is growing disparities in disposable income between renters and home-owners. Since the disposable income determines one's choices (see Case I – F&V), previous losers (the renters) have less ability for making healthy choices, which leads to growing HI. Enhancement of positive impacts from this policy will lead to further increase in HI, unless policy changes are made to benefit specifically the previous losers (the renters).

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Case III, Smart Meters (SM)

Victorian Government started to install free-of-charge new electricity meters – SM – with primary objective to upgrade existing infrastructure in order to keep infrastructure costs down in the future. SM will be installed to 2.5 million homes and businesses at the rate of about 4000 a week, with the promise that these "will actually help reduce the costs of delivering power" according to the website of Department of Primary Industries, Victoria[3]. Ironically (or due to Case II, SP), the price of electricity went up by approx 50% (Dec 2009 – Dec 2010) and will triple by 2020 according to Grant King, CEO of Origin Energy, who noted "We think that, by 2020, the cost of electricity will be threefold what it is today, given the current policy of large amounts of renewables being forced into the system".[4]

Apparently, there is absolutely no benefit from SM for any group in the population. In fact, all groups are worse-off compared to their previous situation as they pay much higher electricity price. Assuming that those who were better-off before the intervention – higher socio-economic groups – have higher electricity consumption than lower socio-economic groups, they would have greater exposure to the higher price, thus will lose more. Although that the concrete causal pathways regarding health impacts might not be clear or known, this intervention is example for Case 8 from AHS-HI Matrix (declining AHS and reducing HI) provided that the loss of the previous winners exceeds the loss of the previous losers. However, considering the above mentioned Case II – SP, previous winners are likely to install SP and reduce their exposure to higher electricity prices, thus compensate their loss, which leads to Case 3 from AHS-HI Matrix (declining AHS and increasing HI). Enhancement of positive impacts which do not target specifically previous losers will lead to further HI increase.

Case IV, Nurse-on-Call (NoC)

In response to long waiting time in emergency departments in public hospitals Victorian Government introduced new program – Nurse-on-Call – which is "a phone service that provides immediate, expert health advice from a registered nurse, 24 hours a day, 7 days a week",[5] with primary objective to reduce waiting time. This service benefits mainly people from lower socio-economic groups without private health insurance, who can get expert health advice for the cost of a local cal, i.e. previous losers are now winners from the new intervention. People from higher socio-economic groups with private health insurance (previous winners) visit private hospital, usually with zero waiting time. From this intervention no population group is worse-off compared to their previous situation. Although that the causal pathways regarding health impacts might not be very clear, this intervention is example for Case 2 from AHS-HI Matrix (improving AHS and decreasing HI). Any use of this intervention from people with private health insurance (previous winners), although unintended, represents an enhancement of positive impacts which does not lead to increasing HI.

CONCLUSION

Economic, social and environmental policies are linked, interact and have impact on population health. No matter how infinitely diverse populations and local contexts can be, there always will be winners and losers from different policy options, and their specific combinations will determine their impact on AHS and HI. By taking into account these impacts Health in All Policies can improve efficiency

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in relation to health, which is ethical, as it helps achieving the overarching goal for improving health of whole populations. In order to be successful Health in All Policies needs reliable predictions about impacts on population health from different policy options. However, without a gold standard predictions can be problematic. AHS-HI Matrix explains the generative mechanisms which shape population health. Since the matrix always identifies the true condition and provides universal explanations and predictions regarding impacts on population health from different policy options in terms of changes in AHS and HI, AHS-HI Matrix can be used as a gold standard for establishing and assessing validity of predictions. The matrix meets all forms of validity and is particularly useful for solving problems with the evidence. AHS-HI Matrix facilitates making the right choices at any level and in any local context, thus is a useful tool for researchers, policy-makers and practitioners for designing, analysing and/or evaluating all kinds of policies, projects, programs or interventions on populations. By allowing swift, reliable and inexpensive appraisal of different policy options the matrix makes taking into account impacts on population health feasible and paves the way for institutionalizing of Health in All Policies.

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Chapter 42
Spatial Aspects of Mortality Rates and Neighborhood Environmental Characteristics in Seoul Mega City Region, South Korea

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ABSTRACT

This study of the spatial patterns of standardized mortality rates (SMRs) in Seoul Mega City Region (SMCR) explores whether neighborhood characteristics affect mortality rates and identifies important determinants of spatial disparity in mortality rates in SMCR. Spatial patterns of mortality rates show a strong positive spatial autocorrelation, suggesting that mortality rates are spatially clustered. A spatial lag model and a GWR model were used to reflect the spatial aspect of mortality rates. The spatial lag model showed better model fitness by considering spatial dependence of mortality rates. It indicates that a higher level of residential deprivation, a less walkable environment, less economic affluence and less social participation are all associated with higher mortality rates with statistical significance. This study suggests that health and welfare policy could incorporate urban planning to consider the neighborhood factors which determine mortality rates in order to improve the health of neighborhood residents.

1. INTRODUCTION

Over the last decade, interest has increased in how neighborhood characteristics affect residents' obesity, life expectancy, morbidity, and mortality (Gorden-Larsen et al., 2006; Rutt & Coleman, 2005; Wilkins et al., 2008). The effects of neighborhoods' social and economic features on mortality rates, general health status, health behaviors, and other risk factors of chronic disease have been the subject of studies in public

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health, urban planning, and geography. Relationships between neighborhood conditions and residents' health have significant policy implications for improving public health and reducing health disparities.

Research on how neighborhoods affect health has paralleled studies on the social determinants of health. Emphasis on the social determinants of health has been spurred by the Commission on Social Determinants of Health (CSDH), a global network of policy makers and researchers established by the World Health Organization (WHO). The Commission has addressed social factors in areas of poor public health and has acknowledged the effects of social and political conditions on geographic health inequality. Social determinants of health may include income, occupation, and education. Furthermore, these determinants may ultimately affect individual health outcomes through intermediate determinants such as material circumstances, psychosocial circumstances, and behavioral and biological factors (Solar & Irwin, 2010). Material circumstances include factors such as neighborhood quality and material consumption potentials. Psychosocial circumstances include social support, relationships, or perception of social and physical aspect of the environment. Behavioral and biological factors include nutrition, physical activity, and genetics. A mechanism of various structural factors of both society and individuals operates as causes of health disparity, but the root cause of health disparities is a structural mechanism in a socioeconomic and political context. This theoretical framework explains disease distribution by using approaches that incorporate proximal and distal factors and emphasizes the combined role of society, economy, and biology (Yen & Syme, 1999).

On a macro scale, this macrostructural mechanism results in differences among neighborhoods by building different residential environments through economic policies and political decisions. Neighborhoods mediate the way in which the structural mechanism affects residents, thereby carrying weight in the geographic variation of health. Even though the concept of neighborhoods is ambiguous (Diez Roux, 2001), neighborhoods can be defined in terms of social relationships and individuals' interaction patterns, such as the place where one shops, attends religious services, or attends meetings of volunteer organizations (Chaskin, 1997; Guest and Lee, 1984; Tienda, 1991). Individual behavioral patterns can depend on the physical arrangements of and social processes in the neighborhood. The way the neighborhood is structured can affect a resident's health, and differentiations between neighborhoods can result in health disparities. The meaning of neighborhoods constitutes a spatial segment, embracing social relationships and physical resources (Jones & Moon, 1993; Macintyre et al. 1993). It therefore has composite and intricate implications.

Previous studies of neighborhood in relation to health outcomes have suggested that three dimensions need to be taken into account for health disparities: economic condition (especially deprivation), physical environment, and social capital. Based on the literature, mortality rates tend to be higher in economically poor neighborhoods. Physical and social neighborhood environments can also have a strong effect on the choices and consumption of resources available to residents. Aspects of neighborhood design such as walkable environments can promote health by encouraging exercise habits (or healthy behaviors). People are more likely to be physically active when their neighborhoods have sidewalks and parks (both of which are conducive to exercise) and accessible public transportation (Bedimo-Rung et al., 2005; Floyd et al., 2011; Handy et al., 2002; Maibach et al., 2009; Saelens et al., 2003; Sallis et al., 2004; Tsai, 2009). Strong ties and trust among people within such neighborhoods have also been associated with better health (Kawachi et al., 1997; Lochner et al., 2003).

However, few studies have reflected on the multidimensional aspects of neighborhoods in terms of residents' health. In addition, despite much research on health and places, empirical questions on what specific aspects of the neighborhood context matter in health outcomes remains unexplored (Carpiano,

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2006; Cummins et al., 2007). Moreover, few studies have focused on the spatial patterns of health outcomes (Shouls et al., 1996; Lorant et al., 2001), even though examination of spatial patterns is a substantive issue that can uncover the impact of neighborhoods being modified by surrounding neighborhoods (Cummins et al., 2007).

This study examines the spatial patterns of mortality rates as an indicator of health across the Seoul Mega City Region and analyzes whether spatial clustering occurs. It analyzes the composite factors of neighborhood characteristics affecting mortality rates and identifies the important determinants of spatial variation in mortality rates. It also explores more suitable models to reflect the spatial aspect of mortality rates.

Few studies have explored the neighborhood or regional context and mortality in Korea (Kim, 2003; Kim, 2004). Thus, this research can illuminate how spatial factors mediate the association between neighborhood environment and mortality rates and propose ways for regional policy to reduce mortality rates. This study's findings can suggest an empirical foundation for policy in regions that have a similar spatial structure to Seoul Mega City Region, marked by huge economic disparities between the capital city Seoul and peripheries of the region, and largely composed of newly formed middle class due to fast economic industrialization.

2. LITERATURE REVIEW

Conventionally, most studies attribute health variations to individual risk factors (Pickett & Pearl, 2001; Cummins et al., 2007). Many of the mortality or health-related studies have focused on individual's socioeconomic status, including factors such as education, occupation, and income (Bartley et al., 1999; Chandola, 1998; Lahelma et al., 2004; Phelan et al., 2004; Raphael, 2006; Sacker et al., 2000). These three indicators are regarded as important factors that may influence mortality. Torssander and Erikson (2009) analyzed mortality by introducing four stratification variables: education, social class, income, and status. Among these, economic resources have been found to be more strongly related to mortality risk than education or occupation (Duncan et al., 2002; Sundquist & Johansson, 1997). Sloggett and Joshi's (1994) research also demonstrated that an individual's level of deprivation can explains one's health status.

However, this renewed interest in the effects of place or neighborhood has highlighted the relative importance of place characteristics (Macintyre et al., 2002). Multilevel regression analysis has shown that neighborhoods' environmental conditions have interactive effects with individuals' characteristics. In line with the classic literature, poverty has been shown to exacerbate disease and mortality. Studies have found that an area's economic condition independently affects mortality (Anderson et al., 1997; Haan et al., 1987; Yen & Kaplan, 1999). Furthermore, research has revealed that area-specific poverty has a stronger effect on certain population groups due to their interaction with individual factors. For example, area-specific poverty significantly affects mortality rates among those under the age of 55 even after controlling for individual factors (Waizman & Smith, 1998).

LeClere et al. (1997) found that a neighborhood's socioeconomic status has a stronger influence on mortality for males under the age of 65 than for females. Another study reported that the level of associations between individual characteristics and health outcomes vary based on the neighborhood's economic conditions (Shoul, Congdon, & Curtis, 1996). Multilevel regression analyses have shown whether individual risk factors are equally significant in all settings or are more important in certain

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types of places or people than in others (Cummins et al., 2007). These studies have identified a "mutually reinforcing relationship between places and people" while reporting the deleterious effects of a neighborhood's economic vulnerability on health.

Although the social and economic conditions of neighborhoods are important, a growing body of research has recognized the role of the physical environment in shaping health (Ewing et al., 2003; Frank et al., 2004). Residents in highly dense or mixed-use neighborhoods walk more than those living in less pedestrian-friendly locations (Frank & Pivo, 1995; Handy et al., 2006). In addition, recent discussions of obesity epidemic have focused on the role of the physical environment (Papas et al., 2007). Physical activity-promoting features such as the presence of gyms, parks, street connectivity, mixed land use, and high residential density are associated with reduced risks of obesity (Nelson et al., 2006; Gordon-Larsen et al., 2006). Furthermore, spatial attributes of places such as proximity or accessibility to the activity-promoting features are often used as proxy measures for actual exposure to health-promoting built environments. The spatial distribution of food stores in a neighborhood is also a critical issue in understanding the physical environment and obesity. A higher density of supermarkets or a lower prevalence of fast-food restaurants is associated with a lower rate of obesity (Morland et al., 2006; Meddock, 2004). However, the spatial pattern of the availability of fresh foods has an interactive effect with individuals' risk factors. Economically vulnerable people often live in areas with limited access to the services and amenities that affect health conditions (Cummins & Macintyre, 2002, 2006; Schafft et al., 2009; MacDonald et al., 1991; Chung et al., 1999; Morland et al, 2002). They are usually regarded as more affected by their built environments because their activity spaces are smaller and they are more constrained by the lack of transportation and opportunities for mobility (Papas et al., 2007).

In analyzing health outcomes, the literature has extensively linked social networks with social capital in neighborhoods (Kennedy et al., 1998; Lochner et al., 2003). *Social capital* is defined as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition"(Bourdieu, 1986). Social capital is a network with shared norms, values and understandings that facilitate co-operation within or among groups (Brian, 2007). It is an umbrella concept for social cohesion, social support, and social participation. Recent studies have linked social capital with population health (Kawachi, et al., 1997; Kawachi & Berkman, 2000; Kawachi et al., 1999). Indeed, social trust, civic participation, and reciprocity are closely related with mortality (Wilkinson et al., 1998; Lochner et al., 2003; Milyo & Mellor, 2003; Veenstra, 2002; Kennedy et al., 1998; Skrabski et al., 2004). Kawachi and Berkman's (2000) work suggested that individuals' health can be improved by sharing health-related information through community networks. According to Cho et al. (2005), a neighborhood's social dimensions have a significant impact on self-rated health, even after controlling for individual socioeconomic characteristics. This study demonstrated that perceived neighborhood characteristics such as dissatisfaction with neighborhoods or unsatisfactory relationships with neighbors significantly affected respondents' self-rated health status. The negative perception of the surrounding environment can be a source of psychological stress to residents, thereby creating a risk factor for their health. In addition, subjective satisfaction with one's neighborhood affects one's health more significantly than objective neighborhood characteristics such as income and education (Weden et al., 2008). The association between social capital and health implies that the way that people feel about their neighborhood can determine their health.

However, this link between social capital and health can also be affected by the economic condition and built environment of neighborhoods. Neighborhoods with low socioeconomic status (SES) are usu-

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ally characterized by social disorder and a lack of social control (Aneshensel & Sucoff, 1996). This often results in psychological stress for residents and arouses negative perceptions about their neighborhood (Ross & Jang, 2000). Individuals in deprived areas who already struggle with a lack of resources and limited accessibility to health-promoting physical features are further exposed to additional health risk factors. These interrelating neighborhood factors suggest that how a neighborhood affects health and how it causes health inequality are a very complicated and intricate process.

Most investigators have concluded that health outcomes depend not only on a person's age, gender, and occupation, but also on the ecology and the surrounding environment where he or she lives and works (Andeson et al., 1997; Haan et al., 1987; Mohan et al., 2005; Yen & Kaplan, 1999). Most people are keenly aware of the many tangible and intangible benefits of living in a good neighborhood. However, which and how specific neighborhood features affect residents' health and promote their well-being have not been fully explored. Those investigations might lead to more adequate urban planning and public health strategies.

In order to address this issue, this study explores the multidimensional aspects of neighborhood characteristics that affect mortality rates. We examine the economic, physical, and social environment simultaneously and in association with mortality rates. In addition, we analyze the geographical distribution of mortality rates. Studying any type of mortality is inherently geographical (Borden & Cutter, 2008), and mapping mortality rates allows for the exploration of spatial patterns. This spatial analysis will indicate whether mortality rates of specific areas are associated with increases or decreases in the rates of adjacent neighborhoods, suggesting an interactive effect of mortality rates.

3. ANALYSIS AND DATA

3.1. Study Area and Data

Seoul Mega City Region consists of the capital city of Seoul, city of Inchon, and Gyeonggi province (Figure 1). The study includes 60 municipalities of the Seoul Mega City Region.[1] In this study, administratively defined areas (municipalities) were used as rough proxies for neighborhoods. The municipalities are the basic administrative autonomous districts which operate with their own elected councilmen. The median size of municipalities is 14 square kilometers. This study used this unit because it is the smallest unit for which government–published census data and area attribute data are available. This analysis was based on two data sources: the 2010 Korean census data and the 2009 municipal statistical yearbooks of Seoul, Incheon, and Gyeonggi province. The census data from the Korean Statistical Information Service contain complete, enumerated information about population and households and are collected every five years. The municipal statistical yearbooks provide information about the registered population, households, infrastructure, and other social spatial information, and are updated each year.

The result of studying Seoul Mega City Region would suggest appropriate policy implications for other newly industrialized countries that underwent rapid urbanization with dramatic economic growth and population concentration in the capital city. More than 60% of South Korea's population lives in a single mega-city region, and the periphery of the region is deteriorated contrast to the affluent center city. The urban environment in Seoul Mega City Region and the ways in which neighborhoods function in terms of health might not be similar to those of Western society. Likewise, newly industrialized coun-

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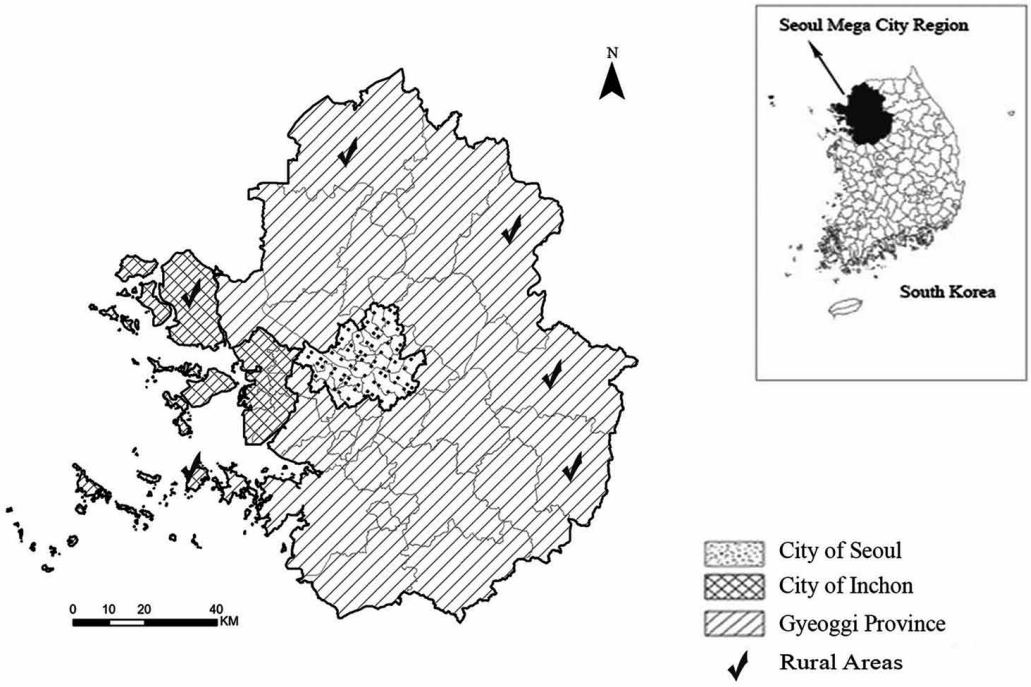
Figure 1. Seoul mega city region. Source: Lee & Joo, 2012. Note.The figure shows Seoul Mega City Region, located in northwestern South Korea



tries have different urban structures from Western countries. Seoul Mega City Region in South Korea is an appropriate example for the study of health issues in the urban environment for newly industrialized countries.

3.2. Statistical Methods

This study estimates the effects of neighborhood environmental characteristics on mortality rates. Several variables that have a strong correlation with standardized mortality rates (SMRs) were selected and categorized for economic conditions, physical environment, and social environment (see Table 1). However, the selected variables were correlated, causing multicollinearity in the multiple regression analyses (see Table 2 and 3). Most of the correlations among 13 variables are greater than 0.3. In case of average price of voter turnout, correlations with other six variables are over 0.3. In addition, one single variable cannot adequately represent a category of neighborhood context; for example, it is difficult to say that the park ratio solely reflects the physical environment of the neighborhood. To eliminate this problem, a factor analysis was used to extract new dimensional variables because it is more appropriate to use composite variables to realize each category of neighborhood characteristics. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to prove whether a factor analysis was appropriate for the sampled data set. Then, a multiple regression analysis (ordinary least squares [OLS]) was conducted with the factor scores obtained from the factor analysis.

This study also included a diagnosis of spatial patterns of mortality rates such as spatial dependency and spatial heterogeneity. Spatial dependency indicates that mortality rates are spatially associated. It

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Table 1. Independent variables

Category	Variable
Economic Environment	Local tax base
	Apartment housing price
	Per capita welfare spending
	Percentage of low-income subsidy grantees
	Number of fast food restaurants
Physical Environment	Ratio of park to total urbanized area
	Rate of vehicle ownership per 100 persons
	Residential density (household/km2)
	Ratio of old single detached house (built before 1979)
	Level of air pollution (PM: particulate matter, μg/m^3)
Social Environment	Number of volunteers per 10,000 persons
	Voter turnout
	Percent of population affiliated with social and religious organizations

Source: Korean Census Data 2010

Table 2. Correlation among variables

Variables	Local Tax Base	Average Price of Apartment Housing	Per Capita Welfare Spending	Percentage of Low Income Subsidy Grantees	Number of Fast Food Restaurants	Ratio of Park to Total Urbanized Area	Number of Vehicle Owners Per 100 Persons	Residential Density	Ratio of Old Single Detached House	Level of Air Pollution (PM Particulate: μG/M^3)	Volunteers Per 10,000 Persons	Voter Turnout	Percent of Population Affiliated with Social and Religious Organizations
Local tax base	1.000	0.646	-0.315	-0.406	0.746	0.051	0.340	-0.035	-0.273	-0.140	-0.057	0.213	0.418
Average price of apartment housing	0.646	1.000	-0.542	-0.375	0.785	0.071	-0.095	0.231	-0.496	-0.264	-0.100	0.317	0.351
Per capita welfare spending	-0.315	-0.542	1.000	0.617	-0.429	-0.252	0.348	-0.527	0.427	0.528	0.138	-0.423	-0.418
Percentage of low income subsidy grantees	-0.406	-0.375	0.617	1.000	-0.271	0.075	0.004	-0.017	0.515	0.135	-0.065	-0.375	-0.458
Number of fast food restaurants	0.746	0.785	-0.429	-0.271	1.000	0.145	0.082	0.122	-0.298	-0.182	-0.204	0.097	0.210
Ratio of park to total urbanized area	0.051	0.071	-0.252	0.075	0.145	1.000	-0.353	0.546	0.134	-0.466	0.095	0.367	0.303

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Table 3. Correlation among variables

Variables	Local Tax Base	Average Price of Apartment Housing	Per Capita Welfare Spending	Percentage of Low Income Subsidy Grantees	Number of Fast Food Restaurants	Ratio of Park to Total Urbanized Area	Number of Vehicle Owners Per 100 Persons	Residential Density	Ratio of Old Single Detached House	Level of Air Pollution (PM Particulate: µG/M^3)	Volunteers Per 10,000 Persons	Voter Turnout	Percent of Population Affiliated with Local Social and Religious Organizations
Number of vehicle owners per 100 persons	0.340	-0.095	0.348	0.004	0.082	-0.353	1.000	-0.715	0.096	0.531	0.114	-0.372	-0.068
Residential density	-0.035	0.231	-0.527	-0.017	0.122	0.546	-0.715	1.000	0.069	-0.600	-0.127	0.399	0.147
Ratio of old single detached house	-0.273	-0.496	0.427	0.515	-0.298	0.134	0.096	0.069	1.000	0.078	-0.038	-0.182	-0.246
Level of air pollution (PM particulate: µg/m^3)	-0.140	-0.264	0.528	0.135	-0.182	-0.466	0.531	-0.600	0.078	1.000	-0.004	-0.419	-0.384
Volunteers per 10,000 persons	-0.057	-0.100	0.138	-0.065	-0.204	0.095	0.114	-0.127	-0.038	-0.004	1.000	0.394	0.260
Voter turnout	0.213	0.317	-0.423	-0.375	0.097	0.367	-0.372	0.399	-0.182	-0.419	0.394	1.000	0.634
Percent of population affiliated with social and religious organizations	0.418	0.351	-0.418	-0.458	0.210	0.303	-0.068	0.147	-0.246	-0.384	0.260	0.634	1.000

reflects the Tobler's first law of geography "everything is related to everything else, but near things are more related than distant things" (Tobler, 1970). On the other hand, spatial heterogeneity means that the associations between mortality rates and neighborhood characteristics are spatially varied across locations due to the spatially heterogeneous characteristics of sample data. Spatial heterogeneity implies that every location has an intrinsic degree of uniqueness due to its situation with respect to the rest of study region (Miller, 1999).

Spatial dependency and spatial heterogeneity can be two sides of the same coin. The fact that mortality rates of neighboring areas are similar means that those areas are different from others farther away in the study region and the relationships among variables can be various depending on their geographic locations, which implies the possibility of spatial heterogeneity. In either case, the OLS is not an appropriate analysis since OLS assumes that the process operates identically all over the study area (Paez, 2004) and there are no local variations in the relationship between the dependent and independent variables (Gilbert & Chakraborty, 2011).

In order to analyze the spatial dependency of SMRs at the neighborhood level, the study applied a global Moran's I test using the GeoDa 1.01 software package. Neighborhoods were designated based on first-order rook contiguity. Furthermore, to analyze the observed patterns spatially, this study applied

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a local cluster analysis on a map of mortality rates. The G_i index, provided in ArcGIS10, was used to describe hot and cold spots of the mortality rates. The G_i index is an indicator that identifies spatial clustering by using a spatial weight matrix, w_{ij} and that generates a standardized value (Getis & Ord, 1992). Areas with values over 1.96 indicate hot spots of high mortality rates with statistical significance ($p < 0.05$), while areas with values below -1.96 indicate cold spots of low mortality rates with statistical significance ($p < 0.05$).

This study used global regression model to estimate the relationships between neighborhood characteristics and SMRs. Then, it employed spatial regression technique and GWR (Geographically weighted regression) in order to take into account the spatial nature of SMRs. The study compares the results based on each model and explores the most suitable model to explain mortality rates and neighborhood environmental characteristics in Seoul Mega City Region.

3.2.1. Spatial Regression

Two forms of spatial models, such as a spatial lag model and a spatial error model are generally used to improve regressions on spatially correlated data. Theoretically, these two forms of spatial interdependence have different interpretations (Anselin, 1988). In the case of the spatial dependency of the dependent variable, the spatial lag model is employed. To incorporate spatial effects, the spatial lag model includes a spatially lagged dependent variable (WY) as an additional predictor. The model is depicted as follows:

$$Y=\tilde{n}WY+ X\hat{a}+ \mathring{a}$$

$$Y=\tilde{n}WY+ X\hat{a}+ \mathring{a}$$

$$\left(1-\tilde{n}W\right)Y=X\hat{a}+\mathring{a}$$

$$Y=\left(1-\tilde{n}W\right)^{-1}\left(X\hat{a}+\mathring{a}\right)$$

In this model, ρ and β are coefficients and ε is an error term. W is a spatial weight matrix created based on rook contiguity. The model exhibits the spatial multiplier effect as $\left(1-\tilde{n}W\right)^{-1}$. This parameter explains the magnitude of the ripple effect over space. The direct effect of a factor on a dependent variable in a certain area can be magnified through spillovers (Mobley et al., 2009), finally affecting the dependent variables in neighboring areas. This implies that a phenomenon in a specific area is affected not only by the area's characteristics, but also by the characteristics of adjacent areas.

3.2.2. Geographically Weighted Regression (GWR)

GWR is a local regression technique used to explore spatially various relationships between dependent and explanatory variables (Fotheringham et al., 2002; Gebreab & Diez Roux, 2012; Chen & Truong, 2012). It generates local regression coefficients in each point in the study area. When the sample data are spatially varied, using the GWR model is appropriate since OLS and spatial regression models

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produce global regression coefficients, assuming that the relationships between variables are constant across locations. They might mask geographic differences in relationships and misrepresent nuanced local processes (Gilbert & Chakraborty, 2011).

GWR is an extended version of OLS in that it estimates the relationship between independent and dependent variables. The OLS regression model which produces one coefficient in a study area can be expressed as:

$$y = \hat{a}_0 + \hat{a}_1 x_1 + \hat{a}_2 x_2 + \ldots + \hat{a}_k x_k + \epsilon \quad (1)$$

Unlike OLS, GWR, which reflects spatially various relationships between dependent and independent variables can be written as:

$$y_i = \hat{a}_0 \left(u_i, v_i\right) + \hat{a}_1 \left(u_i, v_i\right) x_{i1} + \hat{a}_2 \left(u_1, v_1\right) x_{i2} + \ldots + \hat{a}_k \left(u_i, v_i\right) x_{ik} + \int_i \quad (2)$$

In Equation (2), (u_i, v_i) is the geographical location i, the coordinate of ith point in the study area. As the observed data is further from location i, it carries less weight than data closer to location i. By using the distant matrix, this model reduces spatial heteroskedasticity, non- constant variances of residuals which are generated by spatial variation of sample data. A weight matrix is created using a kernel function and represents that closer observation near to the regression point i have more weight. It is expressed as:

$$W_{ij} = \exp\left(-\frac{d_{ij}^2}{h^2}\right)$$

where d is the Euclidean distance between locations i, j, and h is known as kernel bandwidth. It shows distance decay effect; the closer observation carries more weight and over the bandwidth, weight becomes zero. This study employed an adaptive kernel, which allows variations in bandwidth based on data density. If sample data are densely located, bandwidths are smaller, while they are sparse over space, then bandwidths are larger. It used the Akaike Information Criterion (AIC) to diagnose model fitness and compare it with other models such OLS and spatial regression model.

3.3. Dependent Variable

The dependent variable in the regression model of this study is the standardized mortality rate (SMR) which is an age-adjusted death rate per 100,000 of the population.[2] By using the standardization method, we controlled unequal mortality rates across age cohorts. Since older cohorts tend to have higher mortality rates than younger cohorts, areas with higher proportions of old people have higher mortality rates than other areas, which causes biased estimations of neighborhood environmental impact on mortality rates.

3.4. Explanatory Variables

In the regression model, several variables were included at the neighborhood level as indicators of the economic, social, and physical environments. To represent the economic condition of the neighborhood,

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the median income level and unemployment rate are considered adequate variables. However, such data are not available at the neighborhood level in Korea. As income-related variables, five variables——local tax base, apartment housing price, per capita welfare spending, percentage of low-income subsidy grantees, and the number of fast food restaurants——were used. Local tax base and apartment housing price are indirect indicators of the neighborhood's income level. In addition, per capita welfare spending and the percentage of low-income subsidy grantees imply the area-based income level. Within the Seoul Mega City Region, fast food restaurants are more likely to be located in more affluent neighborhoods, in contrast to trends in the US, where fast food restaurants tend to be located in economically deprived areas (Block et al., 2004).

In terms of neighborhoods' physical environment, this study included variables such as residential density, ratio of park to total urbanized areas, amount of air pollution,[3] vehicle ownership, and number of single detached houses more than 30 years old. Residents of neighborhoods with a higher population density, higher park area ratios, lower rates of vehicle ownership, and lower levels of air pollution are more active than residents of less walkable neighborhood areas (Bedimo-Rung et al., 2005; Brownson et al., 2005; Ewing et al., 2003; Floyd et al., 2011; Maibach et al., 2009; Sallis et al., 2004). A lack of physical activity is closely linked to obesity, chronic disease, and mortality rates (Carlsson et al., 2007). In addition, a high prevalence of older housing usually reflects residentially vulnerable areas that are more likely to have residents with a low health status (Howden-Chapman, 2004).

Health and mortality can also be shaped by neighborhoods' social environments, including trust, connectedness, cooperation among residents, and community participation (Holtgrave & Crosby, 2004; Kawachi et al., 1997; Kennedy et al., 1998; Lochner et al., 2003; Veenstra et al., 2005). Regarding social environment, this study focused on social participation. It employed three variables: the number of volunteers per 100,000 of the population, the voting rate for the 19th National Assembly election, and percentage of population affiliated with social clubs and religious organizations. This information shows the degree to which people are involved with their neighborhoods.

4. RESULTS

4.1. Factor Analysis

With the independent variables discussed in the last section, multicollinearity is present. To correct this, this study employed a factor analysis using all 13 variables to categorize neighborhood characteristics. The suitability of factor analysis was determined by two criteria: the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity (Grace & Cass, 2004; Merkle et al., 1998). The KMO measure of sampling adequacy values for standardized mortality rates was approximately 0.67. The result of Bartlett's test of sphericity was 452.1, which is statistically significant. According to these results, the sampled data sets were suitable for a factor analysis.

Table 4 shows a varimax-rotated common factor matrix. Four factors appeared with eigenvalues greater than 1, explaining 77% of total variance. Factors may be interpreted as variables, being highly correlated with them. The higher factor loads represent better variables that were characterized by the factors.

Variables such as residential density, the ratio of parks to total urbanized areas, low vehicle ownership, and low levels of air pollution (PM) are highly correlated with factor 1. A factor loading of 1 could be labeled "walkable environment" because high-residential density, a high ratio of park areas, low

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Table 4. Varimax-Rotated Component Analysis of Factor Matrix

Variables	Factor			
	1	2	3	4
	Walkable Environment	Economic Affluence	Residential Deprivation	Social Participation
Residential density(person/km2) (built before 1979)	0.912			
Ratio of park to total urbanized area	0.649			
Level of air pollution (PM particulate: μg/m^3)	-0.762			
Number of vehicle owners per 100 persons	-0.84			
Local tax base		0.896		
Average price of apartment housing		0.759		
Number of fast food restaurants		0.912		
Ratio of old single detached house			0.815	
Per capita welfare spending	-0.56		0.592	
Percentage of low income subsidy grantees			0.779	
Volunteers per10,000 persons				0.799
Voter turnout				0.711
Percent of population affiliated with social and religious organizations				0.706
Eigenvalue	3.2	2.73	2.13	1.92
Percent of variance (%)	24.6	20.99	16.35	14.79
Total variance (%)	24.6	45.59	61.94	76.73

Note. Factor loadings less than 0.5 have not been printed and variables have been sorted by loadings on each factor.

levels of PM, and lower vehicle ownership are all related to pedestrian friendly environments. Factor 2 includes high-loading variables of local tax base, apartment housing price, and number of fast food restaurants. Factor 2 can be called "economic affluence" since people with high income usually pay more local tax and live in higher priced apartments. In Korea, the placement of fast food restaurants is affected by the influx of people into affluent areas. Factor 3 consists of high-loading variables such as ratio of older, single-detached houses, per capita welfare spending, and low-income subsidy grantees. Factor 3 is termed "residential deprivation" since deprived residential areas usually have a high ratio of older, single-detached houses, high levels of welfare spending per capita, and a higher rate of number of low-income subsidy grantees. Factor 4 has three high-loading variables: number of volunteers, voter turnout, and percentage of the population affiliated with social and religious organizations in the neighborhood. It is termed "social participation."

Factor score values for each neighborhood were calculated using factor score coefficients. Each factor has a different spatial distribution of factor scores (Figure 2), which shows that each factor is geographically evolved. For factor 1, higher scores are concentrated inside Seoul, meaning that its walkable environment is more developed. Factor 2 indicates there is a greater economic affluence in the southern

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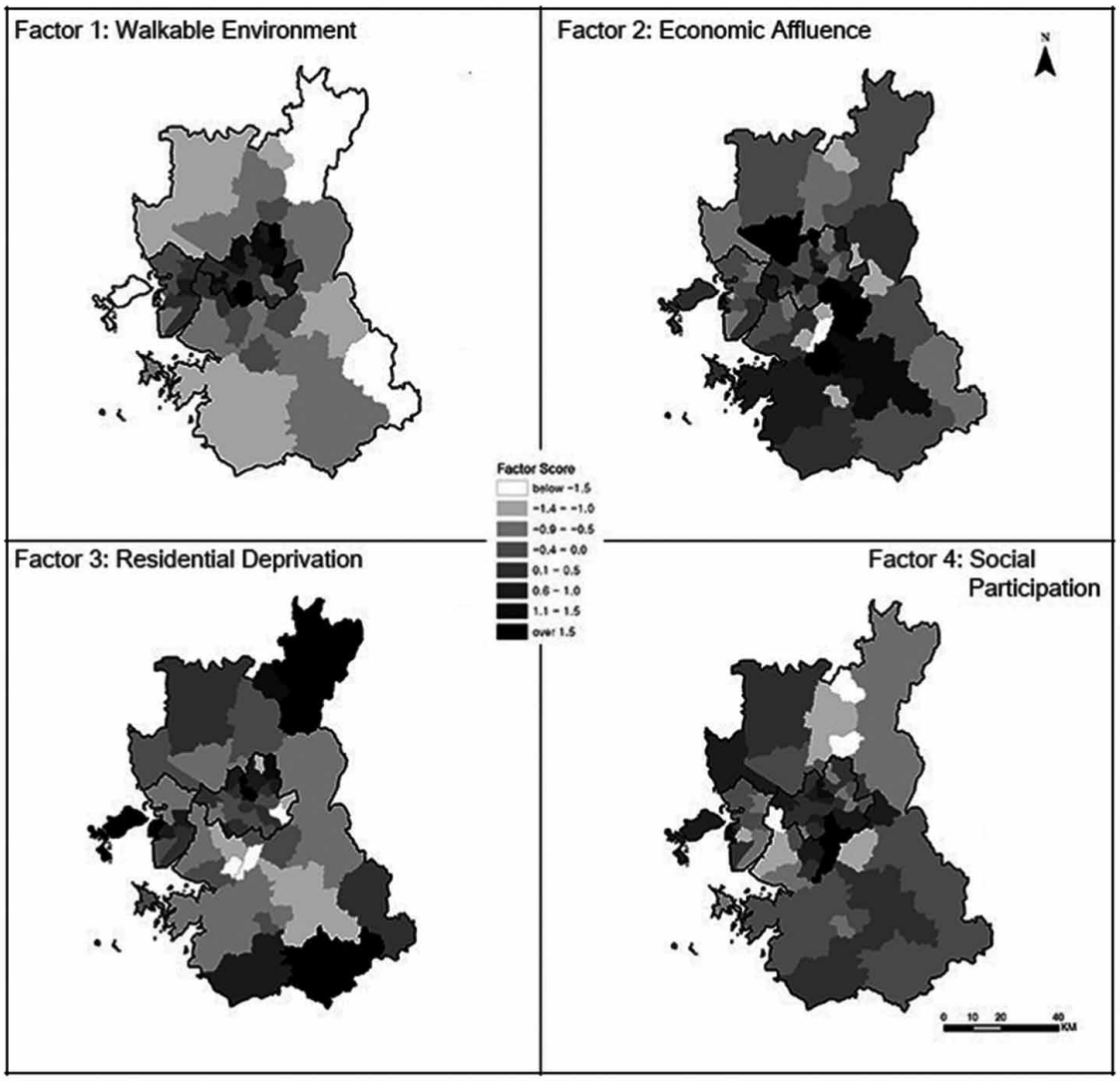
Figure 2. Spatial pattern of each factor score



part of the Seoul Mega city region. Economic affluence stretches from southern Seoul to the southern part of the region, and the low factor scores in the peripheries of the region imply that economic affluence is spatially confronting residential deprivation. Factor 3, residential deprivation, indicates high scores around the peripheries of the Seoul Mega city region implying that the outer sections of the region struggle more with the divested residential environment than the rest of the region. In terms of Factor 4, social participation has higher scores in the southern part adjacent to the city of Seoul. After factor score values were obtained for the four factors (Figure 2), the score values were used as independent variables in multiple linear regressions.

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4.2. Multiple Regression Analysis (OLS)

Regression analysis showed that walkable environment, economic affluence, residential deprivation, and social participation have strong relationships with SMRs, and each of these factors have statistically significant effects on SMRs ($p<0.0001$). They explain 81% of the total variation of SMRs in the Seoul mega city region. As neighborhoods become more walkable, and increase economic affluence with more social participation, and achieve lower levels of residential deprivation, their standardized mortality rates decrease. Social participation is most strongly related to SMRs, followed by walkable environment, economic affluence, and residential deprivation. This indicates that social participation and walkable environment can mitigate the impact of economic aspects on mortality rates:

$$Y = 389.46 - 20.48F1 - 16.34F2 + 16.22F3 - 26.56F4 R^2 = 0.806$$

(-0.452) (-0.361) (0.358) (-0.586)

F1: Walkable environment,
F2: Economic affluence
F3: Residential deprivation
F4: Social participation
() represent standardized coefficients (beta)

4.3. Spatial Pattern

In order to analyze the spatial patterns of SMRs, the study provides a map of SMRs exhibiting geographic clustering. While the neighborhoods in the southeastern part of Seoul have low SMRs, those in the northeastern outlying parts of Gyeonggi province show relatively high SMRs, indicating a spatial clustering pattern (Figure 3). The likelihood of positive spatial autocorrelation in the dataset was confirmed with a global Moran's I coefficient of 0.511 ($p < 0.001$). In the Seoul Mega City Region, mortality rates are spatially associated.

With the strong tendency for similar SMR values to cluster now established, the G_i values were used to identify the locations of the clusters. Cold spots with low SMR values spread particularly in the southern part of the city and neighborhoods adjacent to Seoul, which are marked as economically better off. At the same time, hot spots with high SMRs prevailed around the northeastern part of Gyeonggi province, which has the reputation of being an underprivileged area (Figure 3).

4.4. Estimation of Statistical Models

In order to estimate the relationship between mortality rates and neighborhood characteristics with considering spatial aspect, a spatial lag model and a GWR model were used; the estimation results and comparison with OLS model appear in Table 4. The GWR model reflects various relationships between mortality rates and neighborhood characteristics over space, but the range of each coefficient is not great. It also indicates that the degree to which neighborhood characteristics explain mortality rates varies

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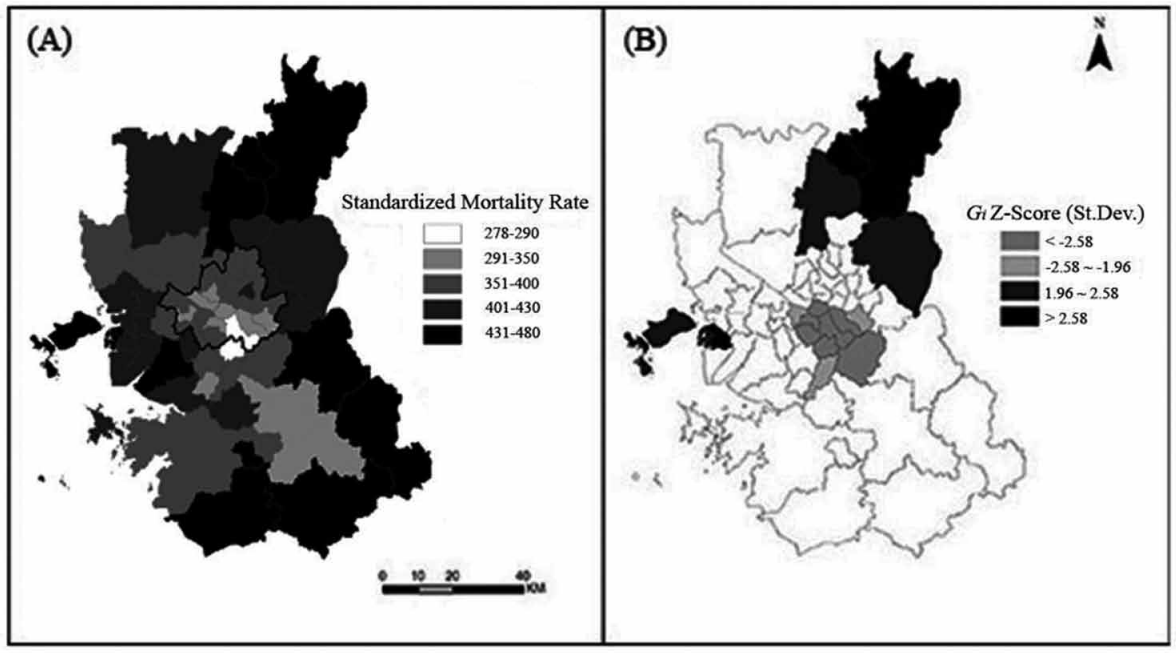
Figure 3. Map of SMRs (A) and Map of the G_i Values (B). Source: Lee & Joo, 2012. Note. Map (A) shows spatial pattern of Standardized Mortality Rates. Map (B) shows the G_i values, which explain local clusters of Standardized Mortality Rates



across locations as represented, but the differences of the values are not great depending on locations. The maximum R-square value is about 0.83, while the minimum value is 0.76.

The Akaike Information Criterion (AIC) can diagnose the model fitness (Chen & Truong, 2012; Fotheringham et al., 2002). Spatial lag model shows lower AIC, 535.29, which suggests an improvement of fit compared to OLS and GWR models, which are 538.28 and 544.21, respectively. By adding the spatially lagged dependent variable, the model can more adequately explain the relationship between mortality rates and neighborhood characteristics. The spatial autoregressive coefficient is estimated as 0.12 and is statistically significant ($p<0.1$). This means that mortality rate of one area increases by 0.12, while those of adjacent areas increase by 1. It suggests that if two neighborhoods are adjacent, the mortality rate of one can be influenced by the mortality rate of the other, indicating an interactive effect of mortality. The presence of a neighborhood with high mortality rates could raise the mortality rate in surrounding neighborhoods.

In terms of coefficients, the estimates of spatial lag model show decreases in absolute values compared to those of OLS. The addition of the spatially lagged dependent variables resulted in the coefficient values of the independent variables decreasing, but all of them are statically significant. Overall, the model estimate is quite powerful; it explains 82.1% of total variance (Table 5). In this spatial lag model, social participation has the strongest effect on SMRs, and walkable environment has the second highest impact, followed by economic affluence and residential deprivation, which is the same as in the OLS model.

It would be appropriate to say that in Seoul Mega City Region there is a spatial dependency of mortality rates, but the relationship between mortality rates and neighborhood characteristics is not spatially various with statistical significance.[4]

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Table 5. Estimated result of spatial regression model and GWR model

Factors	OLS	Spatial Lag	GWR		
	Coefficient		Mean	Maximum	Minimum
Rho		0.12**			
Constant	389.46***	287.11***	389.74	391.38	387.79
Walkable environment	-20.48***	-16.79***	-21.56	-19.6	-23.12
Economic affluence	-16.34***	-13.57***	-17.15	-16.32	-18.01
Residential deprivation	16.22***	14.52***	15.92	18.03	13.82
Social participation	-26.56***	-22.89***	-27.46	-25.49	-28.42
R^2	0.81	0.82	0.79	0.83	0.76
AIC	538.28	535.29	544.21		
Note. *p ≤ 0.1, **p ≤ 0.05,*** p ≤ 0.01					

5. DISCUSSION

This study reinforced the results of previous studies on health and neighborhoods, even in Seoul Mega City Region, whose mixed land use pattern and fast-growing urban middle class population distinguishes it from western societies and regions.

Our findings suggest that surrounding neighborhood environments affect mortality rates (Andeson et al., 1997; Gordon-Larsen et al., 2006; Haan et al., 1987; Kennedy et al., 1998; Lochner et al., 2003; Meddock, 2004; Morland et al., 2006; Nelson et al., 2006; Yen & Kaplan, 1999), but it focused on composite neighborhood factors and expanded the scope of the research by simultaneously analyzing the multidimensional characteristics of a neighborhood, including economic, physical, and social environment. It included specific features in the neighborhood context that are closely related to mortality rates. Instead of using a single variable, the research employed neighborhood factors using a factor analysis. The neighborhood characteristics cannot be represented by a single variable. Factor analysis sufficiently categorized the complicated neighborhood context and made it easier to clarify the effect of each neighborhood factor on mortality. The use of new composite factors solved the problem of multicollinearity in the multivariate regression analysis.

Positive spatial autocorrelation in the Seoul Mega City Region implied that the mortality rate of a given neighborhood is likely to be associated with those rates of adjacent neighborhoods. In order to estimate the effect of neighborhood characteristics on SMRS with reflecting spatial aspect of SMRs, a spatial lag model and a GWR model were employed and their estimation results were compared to that of OLS model. The spatial lag model is clearly preferred to the OLS and GWR models. The reason why the global model has better fitness might be due to the cultural and historical context of Seoul Mega City Region. The region has been the center of development since 1970, so it is very different from the rest of the country. If the scope of study area is extended to the entire nation, the result of model fitness might be different.

The spatial lag model empirically explained social miasma, indicating that living near a deprived place tends to undermine one's own health (Macintyre et al., 2002). It reflected the ripple effect of the neighborhood condition by modifying its negative or positive impact on health in other neighborhoods

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(Macintyre et al., 2002). The finding on spatial dependence of SMRs makes a significant contribution because many studies have focused on neighborhood impact without considering the spatial nature of SMRs. Previous studies on health and neighborhoods have assumed that neighborhoods operate independently of each other and do not often employ spatial lag model (Cummins et al., 2007). Neighborhood effects estimated by previous analyses should be interpreted with caution, as these estimated effects potentially suffer from omitted variable bias resulting from a spatial autocorrelated pattern.

A key limitation of this study is that administrative units were used as indirect proxies for neighborhood features. Since the municipal unit of analysis differs from people's perception of a neighborhood, the use of indirect proxies makes it difficult to explain association regarding neighborhood effects on SMRs. Moreover, due to data availability the study used a municipal unit as a neighborhood, but the scale is too large, which poses the risk of diluting the neighborhood effect. A smaller unit would reflect the concept of a neighborhood more appropriately and more accurately capture the relationship between health and neighborhoods than those using larger units. This study adopted a cross-sectional approach, which might not always be appropriate. Usually, the neighborhood context affects the mortality of residents with a certain time lag. People have been exposed to their surrounding environment over their lifespan. Thus, studying mortality rates of the present period should accompany an examination of the neighborhood characteristics that prevailed several decades earlier. It is not convincing to assume a zero time lag between exposure and outcome in studies of health and environment (Blakely & Woodward, 2000). Moreover, the study used aggregate measures regarding mortality rates and neighborhood factors. The use of aggregate variables makes it difficult to capture individual characteristics and behaviors that affect individual death. It interferes with plausible presumptions on causal pathways between neighborhood context and mortality.

Even though the study demonstrates a strong association between mortality rates and neighborhood factors, it does not prove through a causal mechanism how neighborhood factors affect mortality rates. Further studies should incorporate individual-level measures within the neighborhood context because a neighborhood affects health through individual processes (Macintyre et al., 2002). This would capture the mechanism by which the neighborhood context affects individual behavior and health outcomes.

6. CONCLUSION

Mortality disparity and health inequality at the neighborhood level are increasingly linked to the urban planning domain since urban planning creates health- promoting physical environments. The research result carrying weight regarding social participation and walkable environment implies that sound urban planning and community-based social policy can prevent or mitigate the impact of economic conditions on SMRs. Urban planning can design a walkable environment, which encourages residents to increase their participation in outdoor physical activities. Such an urban environment can contribute to decreasing the rates of obesity and mortality. Additionally, creating public space can promote social gatherings, enhancing the sense of community and social capital. An area-based health education program not only provides people with health information but also increases the chances of social encounters. This entire process could promote building a healthy lifestyle and ameliorate the social environment, improving the health status of people in neighborhoods.

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ENDNOTES

1 Six municipalities in Seoul Mega City Region are excluded since they are rural areas.

2 Standardized mortality rates=$\sum$(death rates per age-cohort * population per age-cohort)/population

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[3] The study used the level of PM, Particulate Matter, as an indicator of air pollution since based on EPA, particulate matter is emitted from urban sources such as automobiles, roads, and power plants and reported as causing health problems. http://www.epa.gov/airquality/particlepollution/index.html

[4] Koenker statistic about the sample data is not statistically significant ($p > 0.05$), which indicates that variances of residuals are not heterogeneous over space (Cardozo et al., 2012; Gao & Li, 2011).

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Chapter 43
Stakeholders Engagement and Agenda Setting in a Developing Context:
The Case of the Bangladesh Health Policy

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ABSTRACT

One area of focus in the study of policymaking in developing countries is the extent to which policymaking in the developing countries is similar to the interaction among stakeholder groups, including politicians, that occurs in developed countries. This paper explores this issue in the case of the development of the Bangladesh Health Policy 2011. It is found that the policymaking process has many well-organized actors with very clear and efficient roles in generating policy outputs. This study indicates that the distinctions between policymaking in western and eastern countries, at least in some countries, may be breaking down.

INTRODUCTION

Public policy making is not a simple function, but a process where different actors interact and try their best to influence the policy. The policy process and the dynamics of politics are interrelated. The main aim of this study is to uncover the dynamics of politics in the agenda setting of the health policy of Bangladesh, through investigation of the role of deferent actors.

In every policy process[1] politics plays an important role in idea generation, formulation and implementation (Peterson, 1993; Cited in Reich 1995). Policy reform in the health sector is not different from other policy reforms. In the process of health policy making of any country, different actors try to make the policy favorable to them by playing a significant role in its development. This interaction of different actors in a policy process is known as the politics of public policy. In the complex political process of health sector reform, viability of special agenda, type of changes in policy reform, and vision of national politics play important role (Oberlander, 2003; Roper, 2007). Generally, different actors have their own

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choices and preferences which are shaped by interest group politics[2] and national politics. Yet this does not necessarily mean that only group politics play the dominant role in the policy making. Rather, public opinion and the demands of donors have a significant impact on public policy (Oliver & Dowell, 1994). The case of health policy making of Bangladesh[3] is not an exception.

In Bangladesh, health is one of the most important sectors since good health ensures more social and economic production and good quality of life. Beyond debate, priority of the health sector is forefront in the development discourse, even though, 'health sector' itself is associated with multi-sectoral factors and actors (Perry, 2000). Thus, implementation of health sector policy requires interplay of actors and factors from different sectors and levels (local, national, regional and international) (Talukder, Rob & Mahabub, 2007). Public policy making in third world countries is not merely a simple function (Rahman, 1995 cited in Panday, 2001). When it comes to making of health policy in a developing country, it is more multi-sectoral than any other policy. This is because of the huge number of health issues and associated issues which require urgent attention (CSG, 2008). Numerous actors and factors play a crucial role in the health policy process of Bangladesh (Osman, 2004). In the total policy process, agenda setting is more important since actors (individual or groups) come forward with their (policy actors) ideas and issues at this stage. Thus, different dynamics occur at this stage. Actors' expertise, access (including network), information, authoritative and influential positions and strategies to highlight the specific issues are main determinant factors in drawing serious attention by government. The main focus of this study is on the dynamics of agenda setting in making health policy in Bangladesh. In order to find out the dynamics of agenda setting, the roles of the different actors have been investigated. To make the study more specific, community health related agenda setting in developing context the National Health Policy, 2011[4]' was chosen as a case.

Osman (2004) studied the process of formulation and implementation of health sectors plans in Bangladesh up to 2000. The study finding presented a comprehensive account of the dynamics of health policy process. Perry (2000) provided an in-depth assessment of numerous health and family planning activities having particular emphasis on some factors that influenced the health service delivery in Bangladesh. Mahmud (2007) described the chronology of health services delivery in Bangladesh having particular emphasis on identification of factors causing failure in the implementation of health services delivery. This writing was more focused on causes of implementation failure in health service delivery. Jahan (2003) illustrated how advocates for gender equity succeeded in influencing the restructuring of the health system in Bangladesh in the mid-1990s. The study explored the impact of advocacies for gender equity made in the design of the reforms. Shiffman (2003) drew political science and public administration theory to evaluate the Bangladeshi reform experience in the health sector. The study did so with reference to the norms of efficiency, effectiveness, sovereignty and democracy. Reich (1995) examined the political dynamics of health sector reform in poor countries, through a comparative study of pharmaceutical policy reform in Sri Lanka, Bangladesh, and the Philippines having a special focus on political will, political factions, and political survival models.

Existing findings substantiate existence of political dynamics in the health policy process in Bangladesh. Very few researchers have emphasised political interplay among the actors in health sector of Bangladesh. Thus, the issue of dynamics in agenda setting in Bangladesh deserves special attention for further exploration.

The 'health' sector, itself is very important sector for any nation, especially for developing nation. As in other developing nations, the health situation in Bangladesh is a developmental problem and without

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addressing this problem development initiatives in Bangladesh cannot be successful. In the context of Bangladesh, successful policy implementation is a rare event. So, the health sector of Bangladesh is not an exception in this regard (Walt & Gilson, 1994; Grieve, 1995; Nazneen, 2001). Inequality in health service delivery is an indication of the policy failure in health sector of Bangladesh (BDHS, 2007; Osman, 2004; Jahan & Salehin, 2006; Perry 1999).

Now a pertinent question can be raised: where lie the gaps in the policy process? Different researchers have tried to unearth the causes of implementation failure of different projects and policies, but very few attempts have been made to explore the dynamics in the policy process, especially in agenda setting, where inter-group politics play the main role. It can be argued that, without considering political dynamics, it would be very difficult to understand how health policy in Bangladesh is made. The National Health Policy, developed in 2007-2010, is a starling example of this. Thus, it can be claimed that an attempt to explore the political dynamics of agenda setting in health policy of Bangladesh is essential to understanding the process. How do policy shifts occur and what factors cause these shifts? In other words, why do policies change in the health sector of Bangladesh?

The study is qualitative and explanatory in nature. Mixed method approach (both quantitative and qualitative) has been used in this study. To analyze the politics of agenda setting case study is an ideal methodology since holistic and in-depth investigation is possible through this method (Feagin, Orum & Sjoberg, 1991). In the current study's context, the sample sizes were determined on the basis of the principles of Snowball Sampling. In this study, fifteen individuals were selected as respondent. In this technique, first subject was identified with serious attention and then the respondent was asked to identify the other potential subject.

THEORETICAL FRAMEWORK AND CONCEPTUAL CLARIFICATION

Agenda-setting is the most basic stage of the public policy cycle, which is concerned with identification of policy issues and placing these issues on the agenda of government. To promote an idea to a policy agenda requires participation of different actors in a competitive process. Participation in policymaking is a central question in the discipline of Public Policy. The role of interest groups and the public[5] in shaping administrative decisions was the main theme of early pluralists' work (notably Truman 1951, Cited in, Robinson and Eller 2010). The public participate directly as interest groups and indirectly, through the influence of elected officials. Later works, popularly known as "elite theory" (Lowi, 1979; Cited in, Robinson and Eller, 2010) focused on the dominance of political elites, bureaucratic elites and business elites in the policy-making process.

As a result of the pluralist/elitist debate over participation in administrative policymaking, a new model of policy decision making emerged. Cohen, March, and Olsen (1972) mentioned that organizations do not take decisions in a rational way (Cited in, Robinson and Eller, 2010). Moreover, rational self-interest is more dominant in organizational decision-making (interests of conflicting interest groups, from the pluralistic model or the interest of elites). In the competitive environment, organizations take decisions haphazardly based on a series of "streams" (the coming together) of organizational inputs. This is popularly known as the garbage can model (GCM) of organizational decision making. Kingdon (1995) applied this model of organizational decision-making to the policymaking processes. Kingdon described that policy processes are neither elite nor pluralist in their entireties. Instead, completion was

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found in separate "streams" of policymaking activity among pluralist forces and elite forces. According to Kingdon's view, an issue becomes an agenda item with the confluence of three "streams": the problem stream, the proposal stream and the politics stream (Laraway & Jennings, 2002)

The agenda-setting process happens in a specific policy environment which consists of different factors, like economic, political, social, geographical, demographical, cultural, institutional, international, etc (Cochran & Malone, 2005). In this complex interaction, both actors and institutions play their roles which are shaped by different factors. Some of these are involved in the process due to their formal authority to promote the agenda, to provide technical and financial support, while others are to advocate in favour of their own interests (Rhodes, 1997). In public policy, all actors are generally divided into two parts: state/governmental actors and societal actors/non-government actors. Elected officials (executive and legislative) and appointed officials reside within the state and interest groups. Research organisation and mass media reside within societal actors or non-state actors. (Howlett & Romesh, 1995). In every country, these two actors play vital roles, but both may not present equal influence. Role and influence of actors depend on nature of interest, capability, technical knowledge, power of actors as well as intensity of the importance of the factors. Especially, the role and influence of actors depends upon the dynamics of the role of these factors and actors (Verschuere,2009). In developing countries, public policy-making goes through a complex and ambiguous process. The process is ambiguous and complex because there is no formal, established and visible process and institutional arrangement in the public policy-making of Bangladesh (Aminuzzaman, 2002).

While there is no neat way to package the policy process (especially the agenda-setting process), due to its complexity and nonlinearity, Kingdon's theory can help to capture the facts and figures in health policy making in Bangladesh. The following will be an elaborative illustration of analytical framework of this research:

PROBLEM STREAM

Policy making presents several difficulties to the decision makers, apparently which do not get equal attention from them. To shape the agenda, the most important task is agreeing on how to weigh the competing difficulties. Most of the cases have shown that issues backed by major interest groups get more policy priority.

Demand for an updated health policy is not new in Bangladesh. Since its independence (1971), every Government has tried to come up with a comprehensive health policy for Bangladesh. After a long time, the Awami League[6] Government (1996-2001) formulated a national health policy, in 2000. In the meantime, due to different national and international factors, a lot of changes have been made to the health situation of the country. Therefore, stakeholders of this sector have long been calling for an updated health policy. In spite of several attempts made by different political Governments, no initiatives were successfully carried out. According to the respondents of the study, this policy formulation process goes back to the term of the interim caretaker Government[7] (2007-09). The then Health Advisor[8] of the Caretaker Government of Bangladesh, Dr. A M M Shawkat Ali, declared the formulation of new health policy within the following three months during a meeting on the World Health Day observation to provide better health services and ensure quality education in medical and dental colleges (The Daily Star, 07 April 2008). After this declaration, different interest groups tried to influence the policy makers to highlight their problems and prioritize their interests in the policy making process.

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According to the views presented by the study respondents, numerous problems were highlighted by different levels of organizations and individuals. More than 160 organizations and individuals submitted written demands to the Program Support Office (PSO), Health Nutrition and Population Sector Program (HNPSP), Ministry of Health and Family Welfare (MoHFW) prior to the preparation of the final draft. All of these demands reflected personal or professional interests. The written comments covered about 70 issues and a significant number of NGOs participated (Official documents of PSO, MoHFW and Interview, 2010). Weight of the problems and proper evidence and strategy to highlight the problems played important roles in catching the attention of the policy makers (Laraway and Jennings, 2002). Among the policy issues, some were more dominant compared to others, e g: Rural Community Health vs. Urban Community Health, Primary Health Care vs. Health Education, Female-Friendly Health Centres vs. Home Services, Preventive Care vs. Curative Care, Climate Change and Eco-Health, Communicable Diseases vs. Non-communicable Disease, Government as Regulator or Service Provider, Public Private Partnership or Privatisation, Medical Graduate vs. Health Assistant, Skill Development of Traditional Birth Attendant or Supply of New Skill Birth Attendant, Only Modern Medical Science or Modern Medical Science with Indigenous Treatment (Official documents of PSO, MoHFW,2010).

Study findings are one type of indicator that often focuses on a particular problem at a specific point in time. These studies are conducted by government agencies or nongovernment researchers or academics and may suggest that a problematic issue necessitates government attention. However, studies are not primarily used to establish whether problems exist. Instead, problems are determined through interpretation (Kingdon, 1995; Cited in Laraway & Jennings, 2002). Nevertheless, policy makers and those who work closely with them, rely on indicators to "assess the magnitude of a problem and become aware of changes in the problem" (Kingdon, 1995: 91; Cited in Laraway & Jennings, 2002). Considering this theoretical aspect as guidance for the study, the study was interested to know how community health issues were highlighted by the policy advocates. Most of the respondents considered that PSO, HNPSP, MoHFW did the ground work to prepare the draft health policy. Team Leader of PSO, HNPSP, MoHFW informed that the entire health sector of Bangladesh was visible to them and they knew which problem/s needed special attention to ensure health rights at all levels. To make the policy strategy justifiable and valid, PSO, HNPSP, MoHFW reviewed national level findings (Interview with respondents and team leader of PSO, HNPSP, MoHFW, 2010). Most of the respondents repeatedly mentioned the Bangladesh Demographic and Health Survey (BDHS, 2007)[9], Bangladesh Urban Health Survey[10] (BUHS) 2006, Multi Indicator Cluster Survey (MICS)[11] 2006 and Bangladesh State of Health[12], (BHW, 2007, 2008, 2009) as having influenced the highlighting of the community health issues (Interview and Policy Content Review, 2010).

Policy actors deal with lots of policy problems during the stage of agenda setting. A specific problem takes place as an agenda item in the process when that problem is accepted as a real problem. Diversity, extent and consequence of the problem in the life of common people were popular indicators to measure the weight of the policy problem (Dery, 2000). In every health system there are Community Health Status Indicators (CHSI), for providing an overview of community level health situation and to encourage dialogue about actions that can be taken to improve a community's health. In Bangladesh, health related Millennium Development Goal (MDG)s are taken as benchmarks to achieve the status of community health.

Most of the respondents viewed the situations of maternal health and child health, problems of health service providers, cost of health service, health services in remote area, women- friendly health service and HIV/AIDS issues to be the dominant factors for highlighting the community health issues

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as a problem in the agenda setting process of health service (Interview, 2010). Maternal health situation is one of the important indicators of achieving MDG-4. Presently the antenatal care[13] from a qualified contributor who has medical training has increased to 52 percent. There are disparities in urban – rural settings in antenatal care. 71 percent of mothers are getting antenatal care in urban region while it is only 46 percent in rural the areas (BDHS, 2007). Same study findings (BDHS, 2007) shows that women in urban areas are three times higher as likely as women in rural areas to give birth in a health facility. According to MICS (2009) report, Under 5 Mortality Rate in rural and urban areas are respectively 70 and 58 percent. The gap in awareness of HIV is much higher in rural area. Urban women (87% have basic knowledge) are more knowledgeable than their rural counterpart (BDHS, 2007).

Many international declarations (The International Conference on Population and Development, 1994; the Fourth World Conference on Women, 1995 and the Safe Motherhood Technical Consultation, 1997) highlighted that women's right to getting timely, affordable and good quality health care are parts of social justice and human rights (WHO/UNICEF/UNFPA, 1999). In this connection, it can be said that gender-friendly health services are the right of all classes of women in Bangladesh. BDHS (2007) illustrated that access to maternal health services is difficult because the service centers are located at places distant from client groups. On many occasions, women are not allowed to go such a long distance to avail the services. In the rural areas, social norms, values and beliefs pose major obstacles to going outside without the accompaniment of any close relatives.

Qualified health service providers, and their presence in the service-providing locations, are important indicators for providing quality health service in Bangladesh. In the rural areas of Bangladesh, absenteeism of doctors is 40% at the Upazila Health Centres (UPCs) and in the Union Health and Family Welfare Center (UHFWC) it is as high as 74% (Chowdhury and Hammer, 2004). Rural areas have a much higher density (170 per 10,000 population) than urban areas (81 per 10,000 population) when all types of providers are considered. There is also a huge urban-rural difference in the presence of different provider groups. In fact, the majority of qualified providers in addition to the physicians, such as nurses, dentists, technicians etc. practice in urban areas (BHW, 2008).

The percentage of women receiving antenatal care from a qualified provider, with medical training, has increased to 52 percent in Bangladesh. There are disparities in urban – rural settings in antenatal care. 71 percent of mothers are getting antenatal care in urban areas, while it is only 46 percent in rural areas (BDHS, 2007). National-level research findings (BDHS, 2007) show that women in urban areas are three times as likely as women in rural areas to give birth in a health facility. Women from the top wealth quintile are almost ten times more likely to deliver at a health facility than women in the bottom quintile.

Monitoring progress towards MDG 4: "reduce child mortality" is another important aspect for achieving ultimate target within 2015. The Infant Mortality Rate (IMR) is estimated at 45 per 1,000 live births, while the U5MR is around 67 per 1,000 live births (MICS, 2009). . If Bangladesh can maintain this trend, it will meet the final target well before 2015 in the term of national rate. Nevertheless, it is not high time to be satisfied, because there are, however, distinct regional variations that need to be addressed. Rural areas (according to MICS 2009 report, U5MR in rural and urban area are respectively 70 and 58), urban slums, the Chittagong Hill Tracts (CHTs), coastal belt regions and other ecologically vulnerable areas are falling far behind.

Findings of above mentioned revealed that health situation and care service scenario in Bangladesh is not good in rural areas. In evidence creation and dissemination, Bangladeshi State and non-government organisations or foreign donor agencies played vital roles. To ensure the quality of evidence, donors imposed a condition to involve international experts (organisational or individual), who played dominant

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roles in setting up study indicators and methodology finalisations. These decisions ultimately influenced the study findings. Donors played positive roles to involve the experts from the NGOs sector. Here, their argument is that GO-NGO collaboration or Public Private Partnership (PPP) can help to attain the desired goal by maximising both sectors' potentiality. In evidence creation, donors get feedback from stakeholders and policy-level actors from government (Interview, 2010).

In policy-level evidence creation, government bureaucrats, especially people with medical education background played important role. They have vast experience and expertise about the health sector in Bangladesh. Due to the procurement system of evidence creation and nature of health sector (sector wide approach and HNPSP pool fund invite public private partnership for donor support) government health experts are guided by a group of experts who are basically public health specialists (Interview, 2010). The study observed different BDHS reports and it was found that professionals from different INGOs, donor agencies and national NGOs are members of these study teams.

Different findings revealed that NGOs have been coming forward as vital policy actors in Bangladesh since the 1990s (Panday 2008; Rabbani, 2009). In this connection, they create evidence to promote community health issues as candidates for government action. To do this, they used some strategies to highlight their preferred issues.

NGOs ensured participation of top-level bureaucrats from National Institute of Population Research and Training (NIPORT), NIPSOM, BSMMU in evidence creation and ensured the participation of government counterparts who helped in the time of advocacy. NGOs offered key positions to the elite people in the health sector who have good access to the policy-level decision makers. NGOs collaborated with media people to disseminate the evidence to their policy community[14]. Respondents from both policy-makers and advocacy groups said that NGO advocates used personal relationships and work relationships to promote community health issues. For example, Team Leader, PSO, HNPSP, MoHFW said that senior professors and top management of NGOs talked with him over the telephone to highlight the community health issues (Interview, 2010). For the sake of in-depth probing, we investigated the reports of Bangladesh Health Watch[15] and found that they ensured the involvement of national professors, country directors of different INGOs, leading researchers and leaders from the media community to mobilise the policy community in the health sector.

Furthermore, among the professionals who are involved with party politics, DAB (Doctors' Association of Bangladesh, aligned with the BNP) and SCP (Shawdhinata Chikitshak Parishad, aligned with the Awami League) played influential roles in agenda-setting of community health issues. In this study, it is found that these members who are affiliated with SCP remained vocal from the very beginning of the policy process (Source: Interviews, 2010).

Also, actors from Civil Society Organizations (CSOs) were more vocal to highlight the community health issues. CSOs have arranged different seminars to demonstrate the stakeholders' views. For examples, Bangladesh Association of Pharmaceutical Industries (The Daily Star, 26 July 2008), Health Movement (The Daily Star, 23 September, 2008), Bangladesh Medical Associations (The Daily Star, 26 July 2008), Health Movement (The Daily Star, 13 September, 2008), Bangladesh Mohila Parisad, Health 21 (The Daily Star, 16 September, 2009)and the Health Rights Movement have raised their voices for proper allocation and utilisation of resources for ensuring the health rights of community people, especially the rural poor. Also, they repeatedly highlighted the importance of community clinics. At the time of investigation, we found that these civil society groups are not permanent organisations. After analyzing the members profile of these organisations, the study found that they had been formed with representatives from INGOs, Donor Community, BMA and NGOs.

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PROPOSAL STREAM

Consistent with Kingdon's model, more than one solution emerged for addressing a high visibility problem. Advocates of specific solutions and opponents of a specific solution describe both proponent and opponent sides of a specific problem. Considering the policy solutions, policy coherence and viability of these solutions in the specific context, decision- makers take decisions (Stout & Stevens, 2000). In agenda-setting of the health policy of Bangladesh, the community health situation is a highlighted problem. To solve this problem, different policy actors came forward with different solutions.

Since 2008, different types of actors, especially the stakeholders of health sectors, have been very active to promote their policy solutions. The study asked the respondents about different solutions which had been proposed by the different policy actors to solve the community health problem in Bangladesh. Respondents expressed the view that community clinics, health education, door-to-door service, creation of semi-skilled manpower, incentives for medical professionals, use of alternative indigenous treatment along with modern medical treatment, skill development of unskilled or semi-skilled practitioners and mobile medical services, etc. were the significant proposals for improving the community health situation in Bangladesh from both state and non-state actors (Interview, 2010).

Among the policy solutions, the community clinics got priority in ensuring the health rights of the rural people of Bangladesh. The study tried to explore the reasons why community clinic issues got priority as solution. To promote the community clinic issue on the policy agenda, international policy coherence, national policy coherence, viability of the proposal, positive attitude of donors, advocacy activities of the NGOs and interest of the ruling political party (opportunity to get a share of the large funds required and distribute jobs for renovating community clinics) were dominant factors. (Interview, 2010)

In agenda-setting, good examples, models and lessons learned, from both the national and the international contexts, are the dominant factors to vitalise a policy issue as an option for policy decision making. Success examples and lessons learned from non-government sectors, as well as success examples from GO and NGOs, played important roles in considering the community clinic as solution for the health problems of community people. In this regard, the Team Leaders of PSO, HNPSP and MoHFW mentioned that this policy document was very much influenced by lessons learned from different programs, like Past Experience of HPSP, Community based intervention of NSDP and BRAC's health programme (Interview, 2010).

POLITICS STREAM

According to the Garbage Can Model, a third stream of agenda-setting is the political stream. This stream considers the factors in the political environment that have a powerful influence on the agenda-setting. Kingdon identified three major components that make up the political stream: the national mood, organised political forces, and events within the Government (Laraway & Jennings 2002). In this section we would like to discuss how political parties play a role in agenda-setting for community health. A variety of beliefs and ideologies are found in political systems in general. It is important to understand how these beliefs and ideologies shape policy-making.

Since independence, all the ruling parties have taken Primary Health Care (PHC) as one of the priority sector for national development and carried on various programs for achieving Health for All (HFA). Although, broadly, the policy priority of each political party is the same, strategically they differ. Always,

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Awami League (AL)[16] gives preference to establishing community-level health facilities. In the first general election, held in 1973, Awami League pledged to accelerate family planning programmes and establish rural health centres. These commitments of AL have been reflected in the First Five Year Plan (1973-1978). Accordingly, the construction of health centres at the union level and health complexes (31- bed hospitals) at the *thana* (sub-district) level began (Osman, 2005 & Osman, 2008). At first, the BNP Government were more explicit about urban hospital-based care. Although, in the 1979 election, BNP gave priority to preventive care and rural health, in the 1996 election, they gave priority to curative care (Osman, 2005).

The Third Five Year Plan (1985–90) added a new dimension in health services, by focusing on Maternal and Child Health (MCH) as an effective means of population control, and community-based services were started. The Fourth Five Year Plan (1990–95) also emphasized MCH services, along with a focus on primary healthcare and EPI (Expanded Program on Immunization) clinics. The Fifth Five Year Plan (1997–2002) added certain new strategic issues under the influence of the Health and Population Sector Strategy (HPSS) adopted in 1997 (Osman, 2005 & Osman, 2008) to provide community-based health services.

The AL Government established health institutions at the village level for providing opportunities for more-inclusive forms of representation, to bolster community acceptance and to create real pressure on community-level staff. In 1998, as part of health sector reforms, the Bangladesh government attempted to enhance community participation in the public health system. Two experimental initiatives sought to bring about more 'people-centred' public health provisioning. In one initiative, the Ministry of Health and Family Welfare set up community-owned and -managed health clinics in every village or ward. In this connection, 11,159 community clinics were built during 1999-2001, to provide Essential Service Package (ESP) services to the rural poor but, by 2004, not one community clinic was functioning (The Daily Star, 29 April, 2004). One of the major causes was that the new BNP Government (2001-2007) did not find the community clinics so valuable. It was argued that "Community clinics were considered to be ineffective and an enormous financial burden, which was getting increasingly difficult for the government to maintain." (Cited in BHW 2009).

Also, the BNP Government thought that Family Planning (FP) staff were the core of Bangladesh's health service, as they remain in closest contact with the people through their door-to-door services. By offering one-stop service points, community clinics threatened to limit door-to-door service provision, thereby weakening field-level activities and reducing contact with the people. BNP Ministers said that the clinics were built on land donated by the communities, but that the sites were not always easily accessible. The Government de-emphasised the clinics and soon there was a chronic absence of staff, basic medical supplies, etc. (Cited in BHW 2009).

After the end of the BNP regime, in 2007, a new interim Caretaker Government (CG) sought to update health policy. While the CG were formulating the policy draft, AL arranged a press conference. At this conference, AL's Health and Population Secretary, Dr Mostafa Jalal Mohiuddin, stressed the AL's commitment to the community clinics in Bangladesh. (The Daily Star, 18 September 2008). According to the majority of survey respondents, the AL includes a number of health professionals and they are very much enthusiastic to promote the community clinic issues as a means of ensuring the health rights of the village people of Bangladesh (Interview,2010). Also, as a political party, AL has a commitment to the people to establish the community clinics for the betterment of the common people. The Election Manifesto of AL in 2008 highlighted the community clinic in the following way:

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In order to ensure health facilities to every citizen of the country, the health policy of the former Awami League Government will be reevaluated and adjusted according to the demands of the time. In the light of this policy, 18,000 community clinics, established during Awami League rule, will be re-commissioned. (Election Manifesto of AL in Election, 2008)

If top political leaders of the ruling Party take initiatives to promote a problem or proposal, then that problem or proposal gets priority promptly. According to the team leader of the PSO, HNPSP, MoHFW, the Party leaders of the new Awami League Government, elected in 2008, were very much interested in preparing a health policy and promoting the community clinic agenda, as well as giving direction about the strategic part of the policy content. Also, the Health Minister publicly promised that his Government would build one community clinic in each village (The Daily Star, 10 January, 2009).

In a parliamentary system, the Prime Minister is the top policy decision-maker in a country. So, the Prime Minister is the supreme policy decision maker in Bangladesh. Sheikh Hasina, the Prime Minister, back in office after an 8-year absence, took up the community clinic issue and often made promises to resuscitate the community clinics, even after the election (The Daily Star, 10 January, 2009; The Daily Star, 1 November, 2009; The Daily Star, 05 June 2010). The National Health Policy announced in 2011 was the result.

DISCUSSION AND CONCLUSION

Evidence is crucial to guide improvements in health systems and develop new initiatives. In this connection, state actors and non-state actors create evidence for highlighting the importance of a policy problem or issues. Also, in the study of agenda setting, it is important to understand how research and knowledge from various sources are produced and synthesised (Pang and et.al 2003). BDHS (2007), UHS (2006), BHW (2007, 2008, 2009), MICS (2006, 2009) etc. were main sources of evidence which highlighted the health problems of the rural community. This evidence revealed that the maternal and child health situation and services had not reached satisfactory levels due to human resource gaps at community level, absenteeism and unequal distribution of health service providers.

It was found that about 160 organizations and individuals took part in the agenda-setting process of the health policy. Among the participants, the NGOs' presence was significant considering their number. One may wonder why a significant number of NGOs took part in the agenda-setting process. The answer is a large number of NGOs are working in health sectors of Bangladesh, whose mission is to highlight the common peoples' rights and external support for doing policy advocacy (Rahman, 2006; Haque, 2002, WB 2005).

Donors provide financial support during evidence creation. While offering financial support, donors imposed some conditions, including methodology finalisation and indicators setting which, ultimately influenced the process of making evidence-based policy. In addition, donors suggested that government include NGOs in this process on the ground of GO-NGO collaboration or public-private partnerships. In the community health related evidence creation, USAID, UNICEF and WHO have played leading roles since 2000. This is not new in the health sector of Bangladesh. In case of evidence creation for a sector-wide approach, introduction of the donor community provided guidance and financial support for evidence creation. (Sundewall, Forsberg & Tomson, 2006). In other words, NGOs became power-

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ful and influential, especially because of their external sources of financial support, cooperation, and technical support from donors.

Civil society/NGOs are potential actors to highlight health rights and social welfare goals through mobilization of citizen demand. Also, the NGOs are playing the roles of academics and professionals by monitoring and analysing contextual factors (Schurmann & Mahmud, 2009). Bangladesh Health Watch (BHW) was in the leading position to provide evidence for policy-making. BWH, located in the BRAC School of Public Health, publishes a report every year, focusing on specific themes and key indicators. The first report, published in 2006, addressed the theme of health and equity. Bangladesh Health Watch is governed by an advisory board consisting of key persons in the field of development and health. A working group carries out different activities of the Watch. BHW ensured participation of top level bureaucrats, elite people in the health sectors who have good connection with the policy makers and leaders of media community. They assumed that media can help in disseminating information and mobilizing stakeholders. They are advocating involving people from government in order to build relationships and to make the government a part of this process (Haque, 2002).

To highlight the community health issues, people from bodies composed of medical professionals, top management of NGOs and people from donor community formulated different advocacy groups. By conducting in-depth investigations, it was found that medical professionals who are affiliated with national politics, (like SCP) were in leading positions to form different advocacy groups, with assistance from the people from NGOs and donor community. Overlapping in membership was found among the advocacy groups. The main causes of such overlap lies in the fact that the same people would like to push their preferred agenda to the policy arena. In addition, some instant advocacy groups were formed by the medical professionals to promote their policy agenda. Good connections or network among the medical professionals working in NGOs, INGOs and donor agencies played important roles to formulate the advocacy groups. Sometimes, they used personal relationships during advocacy, because informal relationships[17] in Bangladesh are very active in organisational communication.

The study findings recommend that successive Governments, of all ideologies, of Bangladesh have been committed to provide basic health services to all. Moreover, socially and economically, operation of community clinics is a reasonable strategy (in this country there are some successful community health programmes) in Bangladesh.

From the historical perspective, donors played an important role in the health sector of Bangladesh (Jahan 2003, Buse 1999). While identifying good practices, donors played a vital role by providing financial and non-financial resources. The donors helped the partners in capacity-building and in mapping of success examples. It is found in the study that members of the donor community were very much positive about community clinics in Bangladesh. Green signals from the donor communities was one of the major factors that highlighted the issue. Leading donor agencies and UN bodies and WHO showed their commitment to provide support in the improvement of community clinic services (The Daily Star, 10 March 2010).

Politicians were initially influenced by the bureaucrats to reverse the reform. In this study, it is found that, as a political party, AL made a commitment, in their election manifesto of 2008, that they would restart the community-level health clinics. Moreover, top-level policy- makers, including the Prime Minister and Health Minister, were enthusiastic to promote the community health issues that they had publicly addressed.

It can be concluded that, in the problem stream, evidence production and dissemination were highly-supportive in highlighting the problems of community health issues as policy agenda. These problems

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were highlighted in different documents of governments, NGOs and donors. Moreover, these problems were recognised by bureaucrats, politicians, media people, donors and NGOs. In the proposal stream, national and international policy coherences, international and national good practices and positive attitudes of donors were among other factors that supported the community clinics as a policy proposal. Also, political support of the ruling party (AL) was positive, to highlight the community clinic and community health issues.

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KEY TERMS AND DEFINITIONS

Agenda Setting: Policy actors deal with lots of policy problems during the stage of agenda setting. A specific problem takes place as an agenda item in the process when that problem is accepted as a real problem.

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Caretaker Government: The caretaker government of Bangladesh is a form of government system in which the country is ruled by a selected government for an interim period during transition from one government to another, after the completion of the tenure of the former.

Interest Group Politics: Interest group politics mean politics among the core stakeholders who have specific interest.

Policy Process: Policy process refers to inter-linkage among problem identification, problem recognition, policy formulation, implementation and evaluation in a specific policy.

ENDNOTES

1 Policy process refers to inter-linkage among problem identification, problem recognition, policy formulation, implementation and evaluation in a specific policy.

2 Interest group politics mean politics among the core stakeholders who have specific interest.

3 Bangladesh is a South Asian country.

4 Previous 'National health policies' of Bangladesh have covered a number of issues on health. Basically health policy is a package for providing the health services in Bangladesh.

5 Here "public" means people who are not part of any organization or elite group.

6 One of the major political parties of Bangladesh.

7 The caretaker government of Bangladesh is a form of government system in which the country is ruled by a selected government for an interim period during transition from one government to another, after the completion of the tenure of the former.

8 In the interim caretaker Government, advisors take the place of Ministers, but they are not Members of Parliament and are meant to be apolitical.

9 In this study National Institute of Population Research and Training (NIPORT) Dhaka, MoHFW, Bangladesh ; Mitra and Associates, Dhaka, Bangladesh and Macro International, Calverton, Maryland USA were the key actors.

10 In this study involved organizations were National Institute of Population Research and Training (NIPORT), MEASURE Evaluation, International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), and Associates for Community and Population Research (ACPR).

11 Bangladesh Bureau of Statistics, Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh, and UNICEF played dominate role in research agenda setting.

12 James P. Grant School of Public Health, Center for Health Systems Studies, BRAC University, Bangladesh has taken necessary initiatives to conduct the study.

13 Medical care before delivery.

14 A wide range of policy actors who are directly or indirectly involved in particular policy.

15 A professional body formatted by the BRAC University School of Public Health.

16 One of the leading political parties of Bangladesh.

17 Teacher-student relationship, working relationship and relationship from school or University.

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Chapter 44
Response to School Violence

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ABSTRACT

This chapter sets forth to examine the different forms of violence that are present within U.S. school systems along with the general response to these acts. Acts of institutional and personal violence will be discussed along with the potential harm that each act presents. While institutional violence often goes ignored, the impact of these acts can have a substantial negative influence on the life and future career of children. Alternatively, instances of personal violence frequently receive substantial media attention while also causing high levels of fear among the American public regarding the safety of our schools. The most publicized and heinous type of personal violence that has transpired within school settings is events involving an active shooter(s). In addition to identifying the various types of violence, suggestions for improvement and preparedness are offered to reduce the prevalence of violence within schools.

INTRODUCTION

School violence has become an ever increasing concern for members of society and educational leaders. While past topics of school-related issues have had a tendency to focus on school performance and the educational achievement of students, school systems are now presented with the challenge of developing policy initiatives to specifically address the broad threat of school violence. When discussing school violence, many people tend to automatically think of intruders on campus and school shootings. Although it is necessary for school systems to develop safety plans to address instances of intruders and school shootings, these events are relatively rare and are often the result of moral panics created from sensational reports of these infrequent acts by the news media. Other more common forms of violence are more frequently committed even though they are often overlooked in terms of news media accounts or concerns within the community.

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The recent media focus on school violence (Knezevich, 2013; Strauss, 2013; Taylor, 2015) has increased the discussion regarding the prevalence, causes and prevention of school violence. School violence is not a new phenomenon but in recent years it has spread to American suburbs and rural areas where it had previously not been a reason for concern (Watts & Erevelles, 2004). This spike in school violence has led to the development of local, state and federal initiatives to prevent and combat the issue as well as numerous studies examining the causes and consequences of school violence (Redding & Shalf, 2001). While violence in schools is viewed by the public as an imminent threat, research shows that middle and high school students are optimistic and feel relatively safe at school as they believe that violence is more likely to occur elsewhere (Chapin & Coleman, 2006). Optimistic bias involves the belief that "bad things happen to others, but not me" (Chapin & Coleman, 2006). From that standpoint, it is argued that in order to reduce school violence, we must reduce optimistic bias and recognize our own vulnerability to these acts (Chapin & Coleman, 2006).

This chapter will provide an exploration of the many ways that violence is present within educational institutions. The examination will cover common acts of violence that are routinely publicized as well as other, less common, forms of violence that are generally not perceived to be equated to violence. The purpose in identifying both forms is two-fold: one, to show how violent acts can be intentionally or unintentionally perpetrated in the pursuit of either personal or institutional goals. Secondly, to demonstrate that all forms of violence within educational institutions detract from the overarching purpose of ensuring that students have a safe place to develop into intellectual beings and that these acts can negatively impact the future life opportunities of these kids. As will be seen, some of these events will generate a response from law enforcement officials while others will remain outside the jurisdiction of the criminal justice system. The law enforcement and educational system response to these acts will be examined along with suggestions for potential improvement to reduce the perpetration of these events.

SCHOOL VIOLENCE

Kids spend a majority of their time during the day within a classroom setting (Meehan & Kerig, 2010). It is the expectation that kids should be subjected to a safe, secure environment that fosters their intellectual growth and achievement. Unfortunately, schools have become battlegrounds where students and teachers fear for their safety and academic achievement is reduced (Kingery et al, 1993; Sturge, 1982). Eitle and Eitle (2003) found that the presence or fear of violence within schools would create stressful places to work and learn which could plausibly lead to students being less attached and committed to school. As students become less attached and committed to scholastic achievement, increased instances of low educational performance and dropping out of school become realistic concerns.

School violence is a broad term that includes youth violence that occurs on school property, in transit to and from school on buses, or during school-sponsored events (Centers for Disease Control and Prevention, 2013). School violence has been defined as any behavior that violates a school's educational mission or climate of respect or jeopardizes the intent of the school to be free of aggression against persons or property, drugs, weapons, disruptions, or disorder (Center for the Prevention of School Violence, 2008). Violence is often viewed as behaviors that create harm, damage, or injury. A more accurate understanding of violence should include aggressive acts that place another in fear of harm or injury although the actual infliction of damage may not occur. The justification for this stance stems from the fact that aggression has tremendous physical, economic, social, and psychological consequences (Park-

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Higgerson et al., 2008) that can lead to a wide array of negative behaviors, including alcohol and drug use, suicide, depression, anxiety, and other psychological problems (Centers for Disease Control and Prevention, 2013). As a result of these destructive outcomes, the terms "violence" and "aggression" are frequently used interchangeably.

In order to foster a positive educational environment, school systems have a duty to reduce fear and the presence of aggression and violence within their institutions. Teachers serve a pivotal role in this challenge since they are the primary school representative who has daily personal contact with each student in their respective classes. As a result, teachers are placed in a difficult position to teach students while simultaneously managing various nonacademic barriers within the classroom environment (Osher et al., 2004) that they are often ill-prepared to recognize or mediate (Farmer et al., 1999; Osher et al, 2004; Reinke & Herman, 2002). The inability or reluctance to give teachers the necessary skills and tools needed to detect and remedy these type obstacles create an environment where various types of violence can become a common occurrence. In order to make any attempt at reducing violent behaviors within schools, one must first understand the different forms from which violence can originate.

Forms of School Violence

There are two basic categories of violence that are present within educational systems, interpersonal and institutional. Interpersonal violence is the more recognizable form of violence and is often the one to gain news media attention as well as societal interest. A lesser recognized form of violence that is equally present within schools is institutional or organizational violence. To understand both forms, greater examination of each is needed.

Interpersonal Violence

Interpersonal violence can be understood as acts of aggression orchestrated by an individual or group against another individual or group. These type acts are often popular topics for the news media, cause tremendous concern to the public (Elam & Rose, 1995), and are often perceived to be a major public health and educational problem (Weiler et al, 1999). Interpersonal violence does not specifically involve one particular act of violence but can manifest itself in numerous ways. For example, bullying, harassment, assaults (physical, sexual, and verbal), and murder are commonly recognized types of interpersonal violence. These acts do not represent a comprehensive list of all behaviors that fall within this category. Instead, bullying, harassment, and assaults represent some of the more prevalent forms of violence within schools that have a negative impact on students. Although rare, murderous events on school campuses cause tremendous fear, provide front-page stories for the news media and generate concern as to whether these attacks are becoming more frequent and destructive. Greater discussion of these particular forms of violence will be given over the next few pages.

Bullying

Bullying is a common form of violence found within many areas of the school system (Meehan & Kerig, 2010). In fact, bullying can be classified as one of the largest problems facing schools. In examining the pervasive nature of bullying, Booth et al., (2011) found that the percentage of students reporting to have been bullied at least once a week has steadily increasing since 1999. Olweus (1991; 1993) stated

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that a person is a victim of bullying whenever he or she is repeatedly subjected to hurtful actions, either physical or psychological, by one or more people. Bullying behavior can manifest itself either physically through pushing, shoving, kicking, etc., or it can be displayed in the form of verbal or psychological harassment. Verbal and psychological harassment would include instances of threats, taunts, teasing, name calling, inappropriate or vulgar facial or body gestures, and refusing to comply with an individual's wishes, such as not moving, etc. (Meehan & Kerig, 2010). Harassment can also take the form of excluding others from activities and threatening to end a friendship for the sole purpose of harming the individual (Crick & Grotpeter, 1995). Kaltiala-Heino et al. (1999) found that 15% of students have reportedly bullied others. Victims of bullying can replicate the cycle of violence by retaliating against the offender (DeBernardo & McGee, 1999) and can also have thoughts of suicide (Meehan & Kerig, 2010). While the experience of being bullied is traumatic and can impact school performance, there is reason to be concerned for the welfare of the children who are demonstrating the bullying behaviors as it has been found that roughly 50% of those engaged in bullying conduct come from abusive homes (Kaltiala-Heino et al., 1999). Additionally, those who bully often misbehave more at school, have a tendency to blame others for their behaviors, and frequently lie to escape negative consequences for their actions (Kaltiala-Heino et al., 1999).

With the increased use of technology within society, along with the popularity of social media sites, peer interaction no longer is dependent on verbal or face-to-face encounters. Many children, particularly teenagers, remain in virtually immediate contact with peers through the use of websites such as Facebook, Twitter, Snapchat, email, etc (Meena et al., 2012). While such sites have many positive benefits for individuals, they can also be used to victimize others through acts of cyberbullying. Like bullying, cyberbullying occurs when an individual repeatedly threatens or harasses others who are viewed as being different or powerless (Thornberg, 2010) through the use of a computer and in cyberspace (Bates & Swan, 2014). These acts can be an extension of traditional, face-to-face bullying behaviors or they can be stand-alone acts of aggression. Research has found that boys tend to be bullied more often in person than girls (Baldry, 2004: Beran & Tutty, 2002; Ma, 2002), while girls appear more often to be victims of cyberbullying (Li, 2006; Wade & Beran, 2011). Increased instances of cyberbullying have generated tremendous concern among educators, parents, and other adults in stopping the behaviors (Patchin & Hinduja, 2011). Due to the ever-connected world that technology and social networking sites have created through the use of mobile devices, such as cellphones, iPads, etc, it is more difficult for victims of cyberbullying to escape situations which lead to their victimization. The constant and pervasive nature of cyberbullying has received recent national attention due to the harm experience by victims, particular those who committed suicide (Khadaroo, 2013; Roth 2014). Although this is concerning enough, it has been found that victims and offenders of bullying are both more likely to have suicidal thoughts or are more likely to commit suicide than youth who have not been bullied (Hinduja & Patchin, 2010).

Assaults

Assaults are another common form of aggression faced by many children within the school environment which can encompass many different acts ranging from fights, sexual assault, and murder. The Model Penal Code Section 211.1 defines assault as an attempt to cause or purposely, knowingly, or recklessly causes bodily injury to another; or negligently causes bodily injury to another with a deadly weapon; or attempts by physical menace to put another in fear of imminent serious bodily injury. Fights are a frequent form of assault present within schools. Most of these confrontations are the direct result of interpersonal

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disputes between the individuals or groups that, without intervention, escalate into a physical altercation (Flaherty, 2001). Although some assaults are perpetrated with the use of a weapon, such as a knife, gun, or other instrument, research shows this is not common as approximately 8% of students indicated that they were either threatened or injured by a weapon on school property or at a school function (Centers for Disease Control and Prevent, 2005).

Schools have recently been subjected to criticism regarding their handling of sexual assaults on school property (Saunders, 2013; Marklein, 2014; Walton, 2015). As a result, much concern has been levied at understanding the exact scope and nature of these acts, along with sexual harassment, within educational institutions. While a vast majority of these news media reports have been focused on events that have transpired on college campuses (Saunders, 2013; Marklein, 2014; Walton, 2015), sexual assaults and harassment are also perpetrated within K-12 educational systems (Associated Press, 2001; Winton, 2012). Sexual harassment can be defined as "unwelcome conduct of a sexual nature. Sexual Harassment can include unwelcome sexual advances, requests for sexual favors, and other verbal, nonverbal, or physical conduct of a sexual nature" (U.S. Department of Education, 2001, p. 2), and would include such acts as making sexual comments, gestures or rumors; spying on others as they shower or undress at school; touching, grabbing, or pinching another individual in a sexual manner; and having clothes pulled up, off, or down in a sexual way (Gruber & Fineran, 2007). While the exact extent of sexual harassment may not truly be known, a study conducted by the American Association of University Women found that 19% of students reported exposure to systematic sexual harassment (Gruber & Fineran, 2007).

Sexual assaults involve "the compulsion of another to participate in a sexual act without consent, or through threat or coercion, or by placing the other person in fear of imminent bodily injury" (Lippman, 2013). The most commonly recognized form of sexual assault would be instances of rape. In comparison to other crimes, rape is the most under-reported crime (Alvarez & Bachman, 2014). Being the victim of these violent encounters is traumatic for anyone but the impact could be more dramatic for younger victims (Kendall-Tackett et al., 1993). These victims may experience more severe and chronic issues of depression, anxiety, betrayal, and anger that may lead to further self-destructive behaviors later in life, such as illicit substance use and inability to form lasting, emotionally supportive relationships (Kendall-Tackett et al., 1993). According to the Centers for Disease Control and Prevention (2012), 42.2% of female rape victims were first raped before age 18 and, more specifically, 29.9% of female rape victims were first raped between the ages of 11-17. A 2011 survey of high school students found that 11.8% of girls and 4.5% of boys from grades 9 – 12 reported that they were forced to have sexual intercourse at some time in their lives (Centers for Disease Control and Prevention, 2012). It is even more alarming that 12.3% of female rape victims and 27.8% of male rape victims were first raped when they were age 10 or younger (Centers for Disease Control and Prevention, 2012). These statistics provide context to the problem of children being raped. Although these figures do not necessarily differentiate whether the rapes occurred on school grounds or were originally initiated at school or at school functions, these figures do highlight the vulnerability of young people to be victims of sexual assault regardless of whether it happens on or off school property. These figures also signify the importance of school personnel to recognize any signs or indications that a child may be the victim of sexual assault.

Murder

Of the different forms of interpersonal violence present within school systems, murder, although rare, is perhaps the most feared act of aggression (Bates & Swan, 2014). Our perception of homicidal acts within

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educational institutions has been shaped by media coverage of these events and do not accurately reflect the reality of these events. Much of this attention is attributed to a series of high-profile school shootings that occurred during the 1990s (Borum et al., 2010). In fact, approximately 2% of youth homicides occurred at school during the years of 2009 – 2010 (Robers, Zhang, & Truman, 2012), and 99% of all violent deaths of children occur away from school (Centers for Disease Control and Prevention, 2001). Modzeleski et al. (2008) found that during the 10-year period of 1996-1997 to 2005-2006, there were 207 student homicides that took place in U.S. schools. This would result in an average of 21 deaths per year. They further analyzed the data by dividing the nation's approximately 125,000 elementary and secondary schools (U.S. Department of Education, 2008) by 21 to determine that any given school can expect to experience approximately one student homicide every 6,000 years. While the data suggests a different reality from that portrayed by the news media, many schools are tasked with the duty of developing safety precautions and plans to reduce the potential for homicides on school grounds and to implement procedures to mitigate casualties that may be caused by such acts.

Of school murders, mass murders have seemingly gained more media attention and have caused greater societal concern than other forms of violence (Savage, 2013; De Avila, 2013). This recent interest is often thought to have started with the Columbine High School (Colorado) massacre on April 20, 1999, that was perpetrated by 18 year old Eric Harris and 17 year old Dylan Klebold that resulted in 24 people injured and 13 killed. Since this incident, the nation has witnessed other high profile mass shooting in schools with the most recent being the attacks at Virginia Tech (2007) and Sand Hook Elementary School (2012) in Newtown, Connecticut. While many may believe these offenses present a relatively new problem for school systems, this is not the case. The massacre at the University of Texas at Austin on August 1, 1966, shocked American society as being one of the most horrific acts of school violence up until that time. On that date, Charles Whitman, a former marine, barricaded himself in the 27 story tower located on the University's campus and preceded to kill 14 people while wounding 30 others before law enforcement was able to intervene. The perpetration of mass shootings on school grounds has caused such concern and questions as to whether the events are becoming more frequent, many recent studies have been conducted on the nature and extent of these acts (Agnich, 2015; Barbieri & Connell, 2015). Between 2000 and 2013, there were 160 instances of mass shootings that occurred within the U.S. (Federal Bureau of Investigation, 2014). The most common (N=73; 45.6%) place for these acts to have transpired was places of commerce (i.e., businesses, malls, etc.). The second most common venue for these attacks was educational systems (N=39; 24.4%), including Pre-K to Grade 12 as well as institutions of higher education. While predictions of where the next shooting will occur and who may be the next perpetrator of these acts are inherently flawed and inaccurate, some general commonalities have been found. According to Kimmel and Mahler (2009) school shootings are more common in "red" states (states that voted Republican in the 2000 election), the shooter is more likely to be a White male who is more likely than not to have experienced bullying stemming from homophobic beliefs. In addition, insufficient sleep among students is linked to higher odds of involvement in school violence-related behaviors in comparison to students with sufficient sleep (Hildebrand et al., 2013).

Although firearms are the most common weapon used in the commission of these acts (Thornton et al., 2013), it must be realized that other instruments can also be used to carry out these heinous crimes. One of the earliest reported mass murders within a U.S. school was carried out without the use of a single firearm. On July 26, 1764, a small group of Native Americans invaded a schoolhouse for white settlers and proceeded to attack Enoch Brown and the school children with clubs and knives which resulted in

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the death of 9 individuals (Hutchinson, 2013). Although rare, schools and law enforcement officials must be cognizant of the probability of other weapons, besides firearms, being used to conduct assaults designed to cause mass casualties.

While shooting incidents within schools receive more media coverage, they are not the only incidents that have become a significant problem for school age children and adolescents. Bullying, bullying victimization and fighting in school have been linked to future violence and depression among school age children that may have effects well after they have reached adulthood (Perlus et al., 2014). Haynie et al. (2009) report that adolescents' indirect exposure to school violence results in an increased likelihood of school dropout and teenage pregnancy. These results are not simply risk factors for failing educationally but also increase the odds that the individual will not be able to obtain gainful employment as an adult as well as increasing the propensity to take part in criminal acts. From an optimistic viewpoint, acts of interpersonal violence are generally overt in nature and should be rather easily detected. Other forms of aggression, such as institutional violence, are normally covert and, at times, unintended which causes many to not recognize the harmful impact of these acts.

Institutional Violence

Institutional violence can be defined as acts of violence that:

emanate in the context of definitions and patterns of interactions and relationships within the social milieu of the fundamental institutions in society (such as the family and familial organizations, school and educational organizations, workplace and economic organizations, place of worship and religious organizations, and the state and the political/legal and public agencies or organizations. (Thornton et al., 2013, p. 7)

Institutional violence often goes unrecognized by society and the news media as it is often not perceived to be a form of aggression or violence (Thornton et al., 2013). In many cases, this viewpoint can be attributed to the fact that interpersonal violence is the result of deliberate acts perpetrated by an individual or group against another individual or group. Alternatively, institutional violence is frequently caused by the application of policies and directives or through the perceived authority manifest in positions of power (i.e., husband, principal, employer, etc.) (Thornton et al., 2013). As a result, institutional violence may not always arise from deliberate and intentional acts aimed to cause harm to another person but may be the inadvertent result of unequitable policy mandates and initiatives. While a broad category, institutional violence includes such activities as ignoring abusive treatment of students by school authorities, medicating students to keep them complacent and still, and failing to provide adequate education through discriminatory education practices (i.e., tracking some students to succeed and other to fail).

Educational Tracking

Tracking in schools refer to the assignment of students to specific groups and courses based on such things as standardized test results and past performance. By assigning students to these ability-groups, school systems are able to expose children to curricula based on models that attempt to predict what tracks would be best for the student regardless of student interest or ambition. These tactics developed in the early 20th Century in America as educational institutions began to place the large numbers of im-

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migrant children starting school into courses appropriate to their respective ability levels. Since then, tracking has been expanded to include the monitoring of all students and generally begins in primary school and continues throughout high school (Thornton et al., 2013). Instances of tracking are most commonly recognized during the high school years as students are placed in different curricula tracks, such as college preparatory, general education, vocational, etc.), that will ultimately determine the direction of the student in life after graduation (Futrell & Gomez, 2008). The practice of tracking appears to be logical and is most aptly associated with the achievement of specific funding measures related to national and state funding measures (such as Title I funds) but the tactic should create concern for the long-term intellectual, professional, and financial growth and stability of the student. Students assigned to higher-level tracks are given more challenging and enriched course skills and material than students in lower-level tracks who are often given assignments that focus on menial skills such as memorization (Ascher, 1992; Wheelock, 1992; Burns & Welner, 2005; Futrell & Gomez, 2008). While some may argue that the practice of tracking is not a form of violence as there are no injuries or harm encountered by the children, a counter-argument can be made that it is harmful and is more impactful than many assaults and other commonly agreed upon forms of aggression (Thornton et al., 2013). Specifically, the assigning of children to specific educational tracks has a direct impact on later life opportunities, such as careers and income potential (Thornton et al., 2013). While the "injuries" sustained as a result of tracking may not be immediate, harm is experienced by the child not being able to adequately fulfill their true potential as adults. If lost wages and career positions could be calculated, a strong case could be made that tracking could have a more detrimental impact on the child, in terms of losses, in comparison to assaults, robberies, etc.

Ignoring Abuse to Students

Many states have recently enacted legislation that designates government officials as being mandatory reporters of potential abuse. The enactment of these laws is rooted in the historical practice of educational authorities electing to not take allegations of abuse seriously (Beck et al., 1994). While most of this criticism has been levied against reported acts of bullying, they can also be extended to other abusive relationships including those between school officials and students. The practice of ignoring allegations of abuse has not always been deliberate as school officials have generally been allowed freedom to determine the legitimacy of the reports. In many cases, school officials do not have the necessary training or skills to determine the authenticity of these non-academic allegations (Farmer et al., 1999; Osher et al, 2004; Reinke & Herman, 2002). There have been other situations where educational representatives may have knowledge of the alleged abuse but have elected to not get involved as a result of the perception that the behavior has been blown out of proportion, is minor kid-type activity that will pass, or simply refusal to get involved – particularly in the event that the allegation of abuse involves another school official. From this perspective, one must question whether there is any need for concern over these type behaviors.

Medicating Students

A trend of medicating students has developed over the past twenty years within schools to help create an environment that facilitates learning by reducing distractions (Foltz, 2012). Each year, many students who exhibit issues of inattention and disobedience garner the label of being a problem student (Mazza, 2014) although no other circumstances may be present to justify this label. Furthermore, these students are

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routinely alleged to suffer from Attention Deficit Hyperactivity Disorder (ADHD) and are subsequently prescribed one of several psychostimulants or Ritalin (Mazza, 2014). To provide context to this issue, there were 950,000 children and adolescents in the United States in 1990 that had been diagnosed with ADHD. By 1995, this number had risen to 2.3 million and continued to double over the next five years. As a result of this increase, Ritalin production in the United States has increased 1700 percent over the last fifteen years of the twentieth century (Mazza, 2014).

The challenge of keeping students attentive and complacent has been a historical problem for educational institutions (Mazza, 2014). Various attempts have been made to determine the historical cause of these student issues in an effort to make them more submissive to school policies as well as to, theoretically, improve learning (Mazza, 2014). Most of these attempts have been levied at determining what is "wrong" with the child that may cause these unwanted behaviors. Current practices generally reveal that schools pressure parents of these children to have their children diagnosed and medicated for ADHD although the child may not actually suffer from this disorder (Foltz, 2012). Forced diagnosis and medication may remedy the problem of unwanted behaviors for schools but the question must be raised as to whether we are better off now than before. Foltz (2012) found that the answer to this question would depend on who is being asked. Since this discussion always leads to strong debates, some people would argue for the utility of this practice as it makes "out-of-control" kids more manageable while others would contend that these behaviors are attributed, more or less, to kids simply being kids – which should not warrant forced medication (Foltz, 2012).

Have kids become more uncontrollable in the past? Is medicating kids at an early age the solution to this if they have become more unmanageable? Diller (2006) contends that this disruptive behavior could be attributed to the higher standards that are placed on students to learn skills earlier than ever before. For instance, students face increased stress related to passing standardized exams and gaining acceptance into colleges and universities as adult economic achievement is often dependent on being successful in these endeavors. Diller (2006) further argues that these stressors contribute significantly to the increased reliance on medication to help students focus on school materials in addition to be more compliant within the classroom environment. Some may contend that as long as the desired outcomes are being met, specifically if forced medication helps the child to be successful in school, why should we be concerned over this? In addition, they may also question whether this is actually violent or harmful to the child. While the long-term use of these substances can have potentially damaging results on the developing brain of kids (Foltz, 2012), there are other reasons why we should be concerned about this and the other forms of violence present within schools.

Why Be Concerned?

Violence and aggression can present itself in many facets within schools. Some of these acts, such as interpersonal violence, garner national attention and concern while other, lesser-known, forms of aggression receive very little to no recognition. Does this suggest that we should only be concerned about a select group of aggressive acts such as rapes, bullying, and murders? School systems and society should be focused on creating a safe, secure educational environment where children are free from fear and other distractions (individual and systemic) that will impede their intellectual and academic growth and development. It is a known fact that violence within the school setting has devastating and long-lasting effects (Cirillo et al., 1998). Violence can lead to many negative health behaviors and outcomes, including alcohol and drug use, suicide, depression, anxiety, and many other psychological problems (Centers

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for Disease Control and Prevention, 2013). These resulting behaviors of violent victimization are not simply restricted to the adolescent years but may also extend well into the adult years where they can have a harmful impact on pro-social romantic, personal, and professional relationships.

Concern should also be given to the systemic response to certain behaviors as well. While certain educational initiatives (i.e., tracking, etc.) and certain forms of disciplinary measures within schools may appear to be developed to assist the student with academic success or to minimize the potential for wrongful behavior, they can also lead to increased student hostility, anger, aggression against school property, other students, and authority figures (Dornan, 1978; Lewin, 1997a, 1997b). If what is currently being done isn't achieving the desired results and may be leading to further acts of aggression, it is imperative that school systems and the legal system re-examine their response to develop alternative options that can actually reduce the likelihood of violence, both interpersonal and institutional, from being perpetrated in our educational system.

THE RESPONSE TO SCHOOL VIOLENCE

The concern surrounding educational achievement has always been a high priority for many school districts until recently. Within the past few years, the problem of violence in schools has become the highest priority for reform and intervention (Noguera, 1995). This reform has traditionally been focused on addressing the problems of interpersonal violence within the school system with very little focus or recognition being given to institutional forms of violence (Thornton et al., 2013). While many educators may understand the impact and occurrences of institutional violence, many are helpless in expressing their concern or unable to change these events due to political mandates and the fact that perpetration of institutional violence is often attached to funding initiatives either at the state or federal level. Since the various acts of institutional violence are very rarely criminal in nature, in that they do not violate any established criminal laws, law enforcement officials are unable to respond to these acts. The irony is that acts of institutional violence are equally devastating in comparison to events of interpersonal violence, yet we often elect to ignore the long-term consequences of institutional aggression.

In responding to acts of interpersonal violence, most schools are challenged because educational leaders do not have the experience or expertise to adequately prevent, identify, or respond to interpersonal violence (Farmer et al., 1999; Reinke & Herman, 2002; Osher et al, 2004). Some school personnel may also believe that it is not their responsibility to perform such duties as their role and desire is to teach. What is fundamental to the duty of all public servants is to create a safe, secure environment for citizens (and themselves), especially in the context of school children who are entrusted to our care. In an effort to respond to such threats, educational systems often do what most governmental agencies do well – they create additional policies to outline measures to prevent, reduce, and respond to acts of aggression. The reality is that policy creation does not necessarily equate to a reduction in violence nor does it guarantee that what is written in the policy is actually what occurs (Haynie et al, 1997). To be effective, policy must be communicated, executed, enforced, and evaluated so that every employee understand and knows how to respond, particularly when confronted with acts of violence (Weiler et al., 1999). This process will cause school personnel to transition away from their traditional, academic comfort zone while leading them to a more involved role in the process of detecting and mitigating risk factors that can lead to aggressive behavior.

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Zero-Tolerance Policies

During the late 1980s and early 1990s, some schools enacted harsh penalties through the passage of zero-tolerance policies to combat weapons and drugs on their campuses (Skiba, 2000). Although these policies were designed to prevent the possession of firearms on school grounds, common practice has extended the provisions of this policy to prohibit other weapons such as knives with blades longer than 3 inches, knives that open mechanically, daggers, and brass knuckles (Dunbar & Villaruel, 2002). In addition, some states have also applied these policies to more minor, "problematic" behaviors such as insubordination and disruption of the school environment (Schwartz & Rieser, 2001). The penalties under zero-tolerance policies generally range from suspension, expulsion, and up to criminal charges being filed against the offending juvenile(s). While educators and lawmakers may argue that such policies are necessary to control the behaviors of students, opponents frequently argue that these mandates are too rigid, and criminalize what can often be classified as childish behavior (Bates & Swan, 2014). These same opponents also contend that many acts punished through zero-tolerance policies could be mitigated and remedied through other more rehabilitative approaches that are less stigmatizing to the offending juvenile (Bates & Swan, 2014).

Gage et al. (2013) observed the effectiveness of a zero tolerance policy geared towards reducing the amount of unexcused absences in a rural high school. The results signified that the high school's zero tolerance unexcused absence policy was correlated with the loss of points among students who were previously failing and who ranked in the lowest academic level (Gage et al., 2013). Of numerous school safety measures, Blosnich and Bossarte (2011) found that having adults in hallways was the only factor significant in reducing likelihood of being physically bullied, having property vandalized, or having rumors spread. It may be that the presence of an adult serves as a "capable guardian" reducing the suitability of a target in a school setting.

While these types of policies were originally meant to control serious school violations more often than not they are being use to deal with minor violations and there is some evidence to suggest that they may be causing unintended consequences (Martinez, 2009). Similarly, Skiba (2000) conducted a review of the literature on zero tolerance policies and found that, although they have been around for decades, there is little data available to examine the assumptions made by zero tolerance school policies. The information that is available signifies that zero tolerance policies can negatively impact the relationship between education and juvenile justice and goes against what we know regarding juvenile development (Skiba, 2000).

Target Hardening

Most of the responses to school violence have focused on individual responsibility and blame; installing cameras throughout the facility, placing metal detectors at entrances, having resource officers on the premises to "patrol hallways", and the implementation of various policy initiatives, such as requiring the use of clear or mesh backpacks to prevent weapons from being easily hidden (Noguera, 1995). In fact, school districts comprise the largest purchaser of metal detectors in the United States (Garbarino, 1996). These types of strategies are meant to prevent school violence and to hold those individuals accountable for their actions. Nonetheless, some research has found that these forms of control can increase school violence (Wallace, 2001). These types of zero-tolerance school policies are often developed as a quick way to deal with students disciplinary problems and in order to make public the rules and regulations

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of the school and the associated punishment of violating such rules. Jennings et al. (2011) researched the efforts to reduce crime and violence in schools by pairing with local police departments in order to employ school resource officers, install video cameras, and utilizing metal detectors. The study examines the relationship between law enforcement and school security measures in relation to violence in schools (Jennings et al., 2001). The results are mixed on whether or not school resource officers reduce the risk of violence but there is evidence to suggest that the presence of school resource officers may serve as a deterrent for school violence (Jennings et al., 2011). In terms of the effects of metal detectors, Hankin et al. (2011) reviewed literature which indicated insufficient data to determine if the presence of metal detectors in schools reduced the risk of violent behavior but found that it did help students perception of whether their school was safe or not.

Implementation of protective measures within school facilities closely resembles the initiatives used to combat the threat of crime and violence within the larger American society. This approach is based on the perspective that aggression is best dealt with force (Noguera, 1995). While these deterrents are implemented with commendable intentions, there are also concerns that surround these practices. The use of these measures transforms the very perception of schools to appear more punitive and prison-like (Noguera, 1995). With this transformation, students could easily equate being in school to being in a detention center or a prison. The application of labeling theory would suggest that if this is the indirect label "prisoner" that placed on students, they will eventually accept and internalize the label. This will then create situations where the student will demonstrate behaviors, from minor forms of deviance to major forms of criminality, which will be in conformity with the label. In essence, we must question whether our response to violence actually acts as a deterrent or whether it inadvertently creates an environment that is more prone to aggression and delinquency.

Use of Law Enforcement

A popular and quick strategy to reduce school violence has been to hire police and security guards (Beger, 2002). During the 2009 – 2010 school year, approximately 29% of public schools had full-time police officers or other security personnel on campus (National Center for Education Statistics, 2013). Over the past 15 years, the fastest growing category of law enforcement officers placed within public schools has been School Resource Officers (SROs) (Beger, 2002). These officers take part in a range of duties that include patrolling school grounds, assisting with situations where students break school rules, and making arrests of students who commit crimes on school property (Beger, 2002). In addition, these officers perform other non-traditional law enforcement duties such as chaperoning school events, counseling students, mentoring students, and conducting substance abuse prevention seminars and other types of life skills training (Johnson, 1999; Burke, 2001).

Beger (2002) asserts that the "influx of police officers in public schools has shifted the responsibility for maintaining order and discipline in the classroom away from teachers and into the hands of law enforcement officials" (p. 122). This would enable teachers to focus more specifically on what they do best: educating students. While this would seem to be popular among the teaching population, the trend of moving school discipline in the direction of law enforcement has also gained the support of many state lawmakers (Beger, 2002). Though this transition seems logical, there are potential negative consequences associated with law enforcement officers being charged with the duty of enforcing order and compliance within schools. While the implementation of school resource officers provides the ability to increase interaction and build relationships between police personnel and students, the traditional crime fighter

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mindset that is often employed in the pursuit of hardened criminals on the streets will likely not produce favorable reactions within the confines of educational facilities. Reacting to instances of disorder within schools using the traditional crime fighter mentality will likely lead to increased instances of criminal charges being filed against kids although other alternatives may be more effective in remedying the issue. While temporarily rectifying the problem, criminal charges may have a longer lasting, more detrimental impact with many unintended consequences. More specifically, a strict enforcement of rules within schools can lead to what has been appropriately labeled as a School to Prison Pipeline which holds that "the overly harsh rules, security enhancements, and punishments mean that for many students, school becomes a preparation ground for prison" (Bates & Swan, 2014, p. 210). In this case, the question of whether we are positioning students for success upon graduation or if we are setting them up for failure must enter the conversation.

Alternatively, there are positive attributes associated with school resource officers. As noted, their presence on school grounds represents a tremendous opportunity to increase interaction and develop meaningful relationships with the student population. In order to capitalize on these potential rewards, school resource officers should not approach their duties from a crime fighter perspective but should be willing to accept a social service mindset in the performance of their duties. Fox and Levin (2015) suggest that "the real contribution of competent, community-minded school resource officers may be more educational than confrontational" (p. 219). In order to accomplish this, they further state that effective resource officers routinely patrol school hallways, make connections with students, and provide educational programs that help prepare students to effectively response to a wide range of threats, including natural disasters and armed intruders (Fox & Levin, 2015). Instead of focusing on crime fighting, these suggestions imply that school resource officers are more effectively able to assist the school in preventing violence by serving the needs of the school and student population. From a fundamental perspective, they are better able to perform their duties by focusing on people and the process of developing community amongst the entire school population.

Response to Active Shooters

With the sensationalized media coverage of active shooter situations within schools, many members of society, lawmakers, and educational leaders question what can be done to prevent these horrendous acts as well as what should be done to minimize the damage. As a result of the national attention to these acts, school systems are expected to have safety plans in place for these very rare, but significant, types of school violence (Vossekuil et al., 2002). Unfortunately, there are no simple, single solutions to this dilemma that can be implemented and executed in every school facility. While there are a multitude of reasons for this, it can best be summarized by identifying that every institution is different in design and structure. In addition, although safety plans can be developed and implemented, not every plan will effectively work for every situation that an organization may encounter. To develop and profess that a single "system" will work for any type of intruder or active shooter situation at every institution would be fraudulent and would, in effect, place school systems in situations where more people could be victimized if or when these type acts occur.

While a "one-size-fits-all" approach is impossible, it is possible to be better prepared for these rare acts by examining what is already known about past acts of active shooter events. Shootings within school environments account for some of the higher casualty counts due to the amount of individuals closely congregated together (Federal Bureau of Investigation, 2014). Many of the perpetrators have a

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connection, as current or former employees or students, to the school which enables them to be familiar with the physical design and potential safety measures of the institution. The most common place for these attacks to be conducted within buildings is in hallways or in classrooms, where there is generally a higher concentration of potential victims. It would be logical to believe that higher victim counts would indicate the presence of multiple offenders in the perpetration of these attacks but a vast majority of school shootings are conducted by a single instigator (Federal Bureau of Investigation, 2014). Besides the fact that most of these perpetrators are male, an accurate profile that best describes who may potentially be a school shooter has been problematic to develop (Vossekuil et al., 2002).

What can be done to prevent and respond to these attacks? School officials and students must be cognizant of others around them. It is easy to develop the mindset that these offenders are heinous monsters different from us but this is not the case. Although prior warning signs (i.e., comments, notes, behavioral changes, etc.) are often given, it must be recognized that many people, under the right circumstances and motivations, could develop into the next offender. Awareness of one's surroundings can also be extended to knowing the physical design of school campuses, including the layout of specific buildings that one frequents. School personnel and students should always have an "escape" plan to the nearest exit as well as having mentally prepared for a variety of situations that may occur (i.e., school shootings, fires, etc.). Mental preparation through the examination of hypothetical situations can greatly assist individuals in knowing how to respond in the event that they must take action. Many school systems have routine drills that prepare staff and students for fires, tornadoes, etc., but rarely do these same institutions have training to prepare their employees or students for other situations, like school shootings. For those institutions that do have school intruder/active shooter drills, many conduct the training at the worst times – when the potential victims (i.e., staff members or students) are not on campus. It is common knowledge that individuals operate in the manner in which they have been trained. This is the prevailing wisdom behind having practice for sports teams, other extra-curricular school activities, and fire/tornado drills, yet very little attention is given to preparing people for other scenarios. In essence, preparation for these situations can best be summarized as A-C-T[1]. To reduce injuries and casualties to violent encounters, school and law enforcement personnel must Assess, Communicate, and Take action. This would involve assessing what was observed or heard, communicating to others about what is transpiring, and taking necessary action to reduce injuries while seeking help.

In an effort to improve communications with students and employees in the event of emergency issues on school grounds, such as intruders, many schools have implemented developed emergency notification systems. These systems will send an automated phone call or text message to employees and students to alert them of the danger that is present. In order to receive these alert messages, individuals must agree or opt in to the system in order to receive these warnings. While this response has been viewed as a way to improve communications between institutions and those that frequent these facilities, the more important goal has been to prevent those who have yet to arrive at school from entering a hostile or dangerous environment.

For many institutions a common challenge that is often encountered is restricting access to buildings. This is usually easier to accomplish for lower level institutions such as elementary schools which normally have one point of entry for people into the building but this becomes challenging for higher level institutions (particularly colleges and universities) which frequently have multiple points of entry into buildings. Having only one entrance into a building or institution would be ideal although it is often

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impractical. As the number of entrances into a building increase, it is more difficult to regulate the flow of people in and out of the facility. While most people have no desire to take part in violent activity, such as school shootings, multiple entrances into buildings also provide motivated offenders easy access to and from buildings. The relative ease of moving in and out of buildings presents two challenges. One, it makes it more difficult for law enforcement to find and confront the offender. Secondly, it also provides the offender with increased chances of victimizing larger numbers of people. To assist with the monitoring process, many schools have installed security cameras throughout buildings (Noguera, 1995) that are primarily geared towards entrances and exits. Although security cameras have the appearance of being proactive measures to reduce violence, their application is actually reactive as video footage is often not viewed until after an event has transpired.

Concluding Thoughts on Our Response

Violence has always been present within the school environment, regardless of whether it has been demonstrated through acts of bullying or to various forms of institutional violence, such as the educational tracking or forced medication of students. As previously discussed, some forms of aggression are more easily recognized than others. Some, such as educational tracking and forced medication of students, are routinely dismissed as forms of violence and are instead viewed as legitimate methods to accomplish educational goals and means to ensure student success. While our general response to violence has been to place responsibility on the offender, perhaps it is time to also consider what may have precipitated the commission of these acts. Instead of taking a traditional legalistic approach to resolving every act of violence in schools, other less stringent alternatives may be more effective in reducing these events. By critically evaluating our current response to violence, we can better understand how we need to respond in the future.

WHERE DO WE GO FROM HERE?

Frustration often arises due to the perception of no actual solution to violence within schools. Human nature causes us to seek simple, direct remedies that will be a cure all for every problem encountered. Unfortunately violence within schools is a complex issue that has many underlying causes and can manifest itself in many different fashions. To properly respond, we must understand that all violence is connected in regards to the mentality of the offenders (Alvarez & Bachman, 2014). Specifically, all perpetrators of violence believe their actions to be justified as they are reacting to their own perceived victimization by others or society (Alvarez & Bachman, 2014). Similarly, individuals who commit acts of institutional violence feel their aggressive acts are necessary to remain loyal to higher authorities, such as conformity to impractical policy or performance mandates and the avoidance of situations that may bring negative publicity or attention to their particular institution.

Regardless of whether the acts can be classified as interpersonal or institutional forms of violence, there has to be a time when it will be recognized that violence is violence regardless of type or perceived justification. While much of the traditional approach has been on individual responsibility and blame (Noguera, 1995), it must be realized that society and school systems often take part in measures to create their own reality – a reality that does include violence. Farley (2002) highlighted this sentiment:

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We take monstrous pleasure in creating monsters. Our monsters, to the surprise of no one, behave monstrously. For this, their monstrous behavior, they are monstrously punished…We take a monstrous pleasure in punishing our monsters. Our punishments, our pleasures, create our monsters – and so it goes, we the people (the state) versus them. (p. 1494)

To find a potential resolution or solution to violence, each person (i.e., students, school authorities, and society at large, etc.) must examine our role in the perpetration of these acts. While no person ever deserves to be victimized, there are things that each of us either consciously or subconsciously do that increases or decreases our risk of victimization.

Many offenders felt bullied, persecuted, or were injured by others prior to their attacks (Vossekuil, 2002). This perception can be the result of either interpersonal conflict or institutional aggression. In either event, the perpetrator felt justified in their attacks as they perceived the act as restoring balance or justice for their prior victimization. As a result, the cycle of violence continues to replicate itself in many forms with no apparent end. Our historical practice of punishment, especially from a criminal justice perspective, has often been one of exclusion, specifically excluding the offender from the benefits and privilege of being a part of society (Thornton et al., 2013). From this stance, exclusion may only serve to provide further justification for the wrongful acts already committed by the offender as well as representing a motivational force to commit future acts of violence. Instead of alienation, perhaps we would be better served by refocusing on ways to repair the harm caused by wrongful acts and re-integrating the offender back into society and schools. If so, implementing restorative justice practices at the first signs of injustice within schools could perhaps minimize the potential of larger scale acts of violence from happening. Additionally, the practices of restorative justice seek to address wrongdoing, repairing harm, meeting needs, and re-building community (Braithwaite & Strang, 2001). Being that many offenders felt alienated prior to their perpetration of violence (Vossekuil, 2002), restorative justice and its function building cohesion and re-establishing a sense of community may prove beneficial in the pursuit of reducing school violence.

In an attempt to reduce school violence, law enforcement personnel and school officials must work together to develop safety plans and to conduct necessary training to more effectively respond to various acts of aggression. This training must involve all members of the school community, including students. The duties of school personnel must also expand outside of the traditional academic role in the detection and response process to aggression as they are the first line of protection for these institutions. While a strict law enforcement response to a variety of school disturbances has been implemented in many jurisdictions, this type response that often involves the filing of legal charges often does little to remedy the underlying problem. It must be realized that "fighting force with force" is not the solution and that zero-tolerance policies often cause the very acts they are intended to prevent. Common sense must be reincorporated into the safety and disciplinary operations within school facilities. Of higher importance is to evaluate our own interpersonal relationship with others (including the role that we occupy in achieving organizational goals) and how this interaction may cause others to feel victimized and, thus, perceive it justifiable to react violently within school facilities. Change, including the reduction in violent and aggressive acts, must begin with each person individually before institutional change (organizations, society, etc.) can become a reality.

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ENDNOTE

[1] A-C-T™ is a trademarked acronym developed by Lt. Colonel Chris Owens of First Line Security and Training as part of a training program to help organizations respond to acts of violence.

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Chapter 45
The Role of Online Health Education Communities in Wellness and Recovery

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ABSTRACT

This chapter discusses the powerful role of online health education communities in wellness, fitness, and recovery. From knee and hip replacement to student service worker burnout, there are many freely available professional online communities, which provide health education and support for a wide variety of needs. Using qualitative inquiry, this multiple case study includes site analysis. This study explores whether adult learning principles are embedded in the design and operation of these popular virtual health education communities. The analysis specifically examines the presence and function of four specific adult learning theories' characteristics: informal learning, self-directed learning, peer learning, and common adult learning principles. Additionally, the nature of benefits and support are documented. Finally, in addition to the analysis and discussion, the chapter provides examples to identify emergent guidelines for discerning trustworthy vs. unhelpful online health education communities. Several suggestions are provided for future research.

THE REAL BENEFITS OF VIRTUAL EXPERIENCES

One Friday morning, Isabelle Snead had fallen on the ice on her way to her car. The injury was more than the word "painful" could describe, and the doctor confirmed that the hip was broken. At 55 years old, she needed a complete hip replacement. The first thoughts were, "How am I going to handle all of this by myself?" and "What am I getting into?"

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The medical team at the orthopedic surgeon's office was fine-tuned to make arrangements for the surgery and home based physical therapy. The doctor and staff took plenty of time to explain the procedure, as well as the benefits and risks. Although her health care providers explained the specifics of her surgery and care, Isabelle needed so much more. She needed social support, understanding, and knowledge. Her friends and family were scattered across the USA, and were far from being the ones to provide the support she needed. She wondered where she might attain these intangibles in a healthcare system, which often seems to value income over patient care.

Isabelle did what 72% of Americans do when they have a healthcare question; she went online and began searching for answers (Fox & Duggan, 2013).

Two months after Isabelle's surgery, she is more active each day. The surgery proceeded as the doctor had described, but it was the virtual community at BoneSmart® that was her mainstay of support and information. From detailed medical articles about the surgery and what to expect in recovery, to online forums for asking questions, and the space to chronicle her own journey, she had used the resources day and night during those months. It was an interactive online community of education, healing, and, now, wellness. And unlike many others she had seen, it was not left to the participants to fend for themselves. Instead, BoneSmart.org is hosted (or facilitated) by experienced orthopedic nurses. This fact no doubt was responsible for boosting the credibility and tone of the discussions tremendously.

She remembered that before surgery she was so frightened, mostly of the unknown. Thankfully, she had stumbled upon the virtual community of BoneSmart®. She had navigated to the videos and other materials, which explained the hip surgery and recovery process. So much of her anxiety was reduced by reading articles, which provided important information and facts that she could read and review at her own pace.

Having gained confidence with the value of BoneSmart.org, she had created a free user account and shared that her surgery was days away. When she logged in the next morning, there were multiple well wishes from other BoneSmart.org users who had already been through the same surgery! Now she had a virtual cheering section.

The Need

When a patient receives a diagnosis which requires extensive medical intervention, or worse, the rest of the world and its concerns, fade in comparison. At such times, it may seem like the ominous tunnel of the Unknown includes only fear and confusion. These are some of the reasons that the medical field is called not only a *healing*, but also a *helping* profession.

Since the 1990s in the United States, the medical field has been experiencing tremendous change on several levels (Kooijman, 1999). Not only did technological innovation take on a new pace of advancement with microbiology and genetic research, but also biomedical ethics needed to chart new territory by addressing current issues and anticipating potential consequences. In addition, an equally powerful transformation was in motion -- the metamorphosis of health insurance.

During this time, entire new classifications of health coverage were developed with health maintenance organizations (HMOs), managed care, and more. Promoted through The Health Maintenance Organization Act of 1973 (Pub. L. 93-222 codified as 42 U.S.C. §300e), HMOs are health plans which provide

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financing and delivery of health care services for its subscribers among a specific set of providers. The customary freedom to select one's doctors, hospitals and other medical services, which had been the norm previous to 1973, was forever changed.

Advancing 40 years after this widespread introduction of managed healthcare, the extensive impact is obvious. Instead of personal choice in making our healthcare decisions, insurance companies determine them. Moreover, physicians, physical therapists, and other providers must adapt treatment to the limitations of coverage deemed appropriate by the insurance agency. These are just a few of the tremendous changes which have contributed to healthcare providers being able to spend less time with patients even though they are performing more complex treatments and surgeries (Schuster, McGlynn, & Brook, 2005). Where is health education provided in this model? Where does one seek information and answers to questions about treatments, medications, potential complications, and recovery?

The emphasis in our society has gradually shifted from a symptom focus to wellness, from a deficit model only, to health education and support. There are many issues and trends that have contributed to this societal change in health and wellness; innovation, medical advancement, managed care, and insurance agencies are among them. The general public has not always been quick to change behavior when it comes to expectations and habits. However, recent studies of the American public' technology use reveal that we use online resources heavily to meet our needs for health education.

Consider the following data which further describes how Americans use the internet for accessing healthcare related information. The Pew Research Internet Project reported the information in 2014.

- 87% of U.S. adults use the Internet.
- 90% of U.S. adults own a cell phone and 58% of U.S. adults own a smartphone.
- 72% of internet users looked online for health information within the past year. (Pew Research Internet Project, 2014)

As far as what these people were looking for, most frequently they were researching specific diseases or conditions; treatments or procedures; and doctors or other health professionals (Pew Research Internet Project, 2014). A very curious trend is that 50% of the online searches for health information were conducted on behalf of someone else. This information would seem to indicate that the person in need may not have had access to technology, did not know how to use it, or both.

Beyond researching health issues, Americans also *reported* their pursuit of fitness and their wellness. Regarding tracking habits, 60% of U.S. adults indicated they track their weight, diet, or exercise routine, 33% their health indicators or symptoms, like blood pressure, blood sugar, headaches, or sleep patterns, and 12% record health indicators of the person for which they provide care. The result of this data is that seven in ten U.S. adults reported they track at least one health indicator (Pew Research Internet Project, 2014).

Pertinent to the focus of our chapter, did people use technology to track wellness and fitness? As seen in Figure 1, the 2014 data revealed that 21% of those who reported health data used form of technology to do so.

The Pew Research data (2014) also reveal that people who have chronic health conditions (and their caregivers) were those most likely to be tracking health indicators. Furthermore, they were the group who were more likely to track this information in a formal manner. They also reported that tracking data contributed to a change in their health (46% of the trackers), led them to ask new questions of their doctors or pursue a second opinion from another doctor (40%), and/or affected decisions about treatments (34%).

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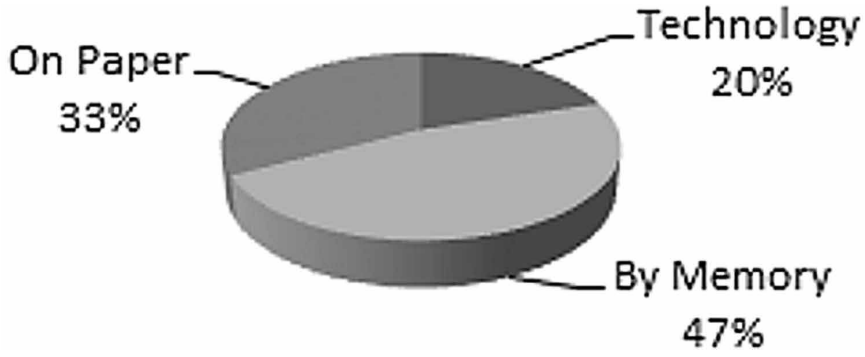
Figure 1. Form of tracking wellness and fitness
(Pew Research Internet Project, 2014).



This chapter extends the conversation about health and wellness use of technology beyond individual use, which is the focus of the Pew research reports. Instead, our focus will be to examine how individuals use online communities to support their health and wellness. The guiding questions for this study include

1. Do the reviewed online communities demonstrate key adult learning characteristics? Specifically, do these communities demonstrate characteristics of adult learning in general, and/or informal learning, self-directed learning, and peer learning?
2. In what ways do the participants indicate the online communities benefit them? and
3. What is the nature of the health education support provided by the online communities reviewed?

THEORETICAL FOUNDATIONS

Four major areas comprise the theoretical foundation of this research. The areas include health education, informal learning, self-directed learning, and peer learning, the use of technology for personal health education, and human/computer interfaces. These areas were selected because of the dual purposes of this discussion and research to explore whether and how several online health education communities 1) incorporate and embody adult learning strategies, and 2) use technology platforms for that purpose.

Health Education

Beginnings

Since the 1800s and throughout the early 1900s, health education was included in U.S.A. public education curricula and continued to build in popularity (Daquin, 2004). Prior to 1830, health or physical training was the primary way that health education was understood and translated into instructional content. Only after that point did attention turn to exploring the areas of anatomy, physiology, and hygiene. However, change happened quickly at that point and within a decade, school programs throughout the U.S.A. included these areas in their health education programs of study (Means, 1962).

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The literature considers the starting point of health education in the United States to coincide with the establishment of the first academic programs that prepared school health educators. Such programs were pioneered in the early 19th century (Allegrante et al., 2004). The nature and scope of health education in United States schools benefited from these concurrent movements: public health, medical inspection, and physical education. The timespan of 1850 to 1900 were especially significant in the expansion and progress of health education across these several areas (Means, 1962).

Despite some isolated occurrences of health education in 1912, most experts agree that in the fall of 1917, the Georgia State College for Women was the first reported academic department of health education (Gilbert & Sawyer, 1995). This department initially offered two courses: "Personal Hygiene" for all freshmen, and "Mothercraft" for all seniors (Means, 1962). Another major step in the development of health education was the establishment of the American School Health Association in 1927 (Gilbert & Sawyer, 1995). Professional associations were responsible for establishing guidelines for health education and accreditation (National Commission for Health Education Credentialing (NCHEC), 2008).

Development and Use of "Health Education"

When "health education" began to be used in the literature and curriculum in the early 19th century, the field's major goal was to encourage a healthy lifestyle. This goal was pursued by educating the general public, and individualized groups (such as schoolchildren) about healthy behaviors. Purposes for these activities included increasing the quality of healthy living, preventing diseases, and/or solving health problems (Gabaldon, 2014).

In 1942, the American Public Health Association defined health education as a process of facilitating people's greater awareness of health problems and, therefore, related their activities to invest in educational activities towards developing health problems. By 1961, the definition's maturation in expanse and specificity is evident as the National Education Association and American Medical Association describe health education as processes which support learning experiences which positively impact understandings, attitudes, and conduct in regard to individual and public health (Simons-Morton, Greene, & Gottlieb, 1995). A more current, 1995, definition of health education stated that health education is the profession principally devoted to employing health promotion process to foster healthful behavior (Simons-Morton, Greene, & Gottlieb).

Humphrey (1988) recognized that Hans Selye's work extended the domain of health education from solely focusing on physical health practices to including psychological and emotional characteristics of individuals' wellbeing. Meanwhile, in 1999, Green and Kreyter described the health education efforts as including a systematic set of learning experiences which lead to change or reinforce voluntary healthy behavior. Furthermore, the field recognizes both the individual and/or group audience for health education efforts.

Today, health education professionals seek to improve the prognosis of individuals with chronic disease, improve health literacy, and promote healthy behaviors among all groups, especially among older adults. Such efforts include school health education, community health education, public health education, worksite health promotion, consumer education, and patient education (Gilbert & Sawyer, 1995), as well as targeted public health concern efforts such as infectious disease control (i.e., H1N1, SARS, etc.), healthy diets, weight control, hygiene, sexually transmitted diseases (STDs) control, etc.

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(Ewing, McDermott, Thomas-Koger et al., 2004; Nutbeam, 2000). Unfortunately, over the last 20 years, our collective memory retains several examples of international needs for broad based health education efforts regarding infectious disease (i.e., H1N1, Ebola, etc.)

Adult Learning Theories Related to Health Education

Adult learning as a formal field of study and practice extends across many different settings, contexts, subjects and needs. Part of the confusion when you mention adult learning is that people generally are not sure if you are referring to adult literacy classes, technical or vocational education, continuing education, leisure education, nontraditional students enrolled in postsecondary education, adult language classes, professional development, graduate studies, or distance learning (to name only a few of the scores of possibilities). Even from this list one can see, however, that what ties adult learning together across such disparate settings is the fact that "adults" are engaged in "learning." Beyond those two widely interpreted and operationalized concepts, there are no limits.

Considering the focus of this article, there are several theories and models relevant to discuss in considering online health education communities. This section presents the background and models of adult learning to provide a foundation for this research.

Foundations of Adult Learning

The term "andragogy" ("andragogik" at the time) was introduced by E. Lindeman in 1926. This milestone resulted from his extensive round of visits and research into German education centers post-World War I. Sixty plus years later, in 1968, Knowles popularized the term and concept in his article "Andragogy, not pedagogy".

The literal definition of andragogy has continued to be, "the art and science of helping adults learn." (Knowles, Holton, & Swanson, 2005). In recent years, as theories of childhood education have advanced, the details and relevance of andragogy has been debated (Merriam, Caffarella, & Baumgartner, 2006). However, even a quick review of the literature will reveal that andragogy's foundational principles continue to be popular in the literature and practice (Grace, 2013; Henschke, 2009).

There were five assumptions of andragogy posed by Knowles (1968); these included:

1. Self-directedness of adults,
2. The role of adults' experiences as a resource for learning,
3. Social role tasks as a basis for learning, and
4. The need for the immediate application of learning.

The most familiar version of these assumptions is the "practices" of adult learning which include, but are not limited to,

- Demonstrating respect of adult learners,
- Engaging adults in active learning,
- Incorporating prior experience in learning, and
- Applying learning to the life needs of learners.

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These principles have been applied with great success to many adult learning contexts. Adult learning principles have been applied frequently in formal and informal education settings including higher education (Fink, 2003), faculty development (Lawler & King, 2000), and, especially pertinent to this article, distance learning (Blondy, 2007). Therefore, this study uses these characteristics to evaluate the selected online community cases.

INFORMAL LEARNING

The theory of informal learning described by Marsick and Watkins (1990) is based on Dewey's work (1938) that recognizes individuals begin to learn when they respond to a trigger. The "trigger" is the factor that leads learners to make choices based on how they make sense of their prior experiences. In other words, informal learning is most often closely related to learning by, or through, experience.

Work related professional development, or informal learning includes those aspects which are not part of formal curricula or course structures (Yanchar & Hawkley, 2014). Instead, informal learning is much more free-form, and organic as it arises out of learners' context, setting, and prior experience. Furthermore, unlike formal education, traditionally, individuals do not earn institutional certificates or diplomas from their participation in informal learning. Instead informal learning necessarily includes determining one's own learning objectives and journey, rather than an externally prescribed course of study.

Characteristics of Informal Learning

The section presents three major models of informal learning which have emerged over the last few decades. In 1990, Marsick and Watkins established the characteristics of informal learning as:

1. Experiential and non-institutional;
2. Control by learner;
3. Non classroom location; and
4. Low predictability of outcomes.

Their model was particularly focused on describing the scope and means of informal learning in workplace settings.

Similarly, Eraut (2004) recognized that informal learning in workplace contexts included both an offset and direct opposite of formal learning. The characteristics Eraut included were:

1. It does not have a prescribed framework;
2. It is not organized;
3. It does not need the presence of an instructor;
4. No credits are given for completion; and
5. There are no external specifications of outcomes.

This paradigm is more specific than Marsick and Watkins' (1990) in describing the absence of an instructor, external rewards (certificates) and predetermined outcomes.

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Addressing the context of "the read/write web," Hall (2009) described informal learning with yet another set of five characteristics. The indicators he discussed included

1. Learning owned and directed by the individual;
2. Independent study;
3. Non-formally timetabled learning;
4. Using non-institutional technologies; and
5. Engaging learning that takes place away from traditional.

These characteristics not only describe the nature of the learner's action, but also the space in which it is conducted.

Jordan (2013) is an example of a study of online discussions which afford a different dimension of informal learning. He described how adults not only engage in informal learning, but also how they share their learning with others, creating a third space. As a result, people may reflect and dialogue together as part of their informal learning experience. The contribution of dialogue in the informal learning process raises new possibilities. For example, dialogue often provides different perspectives for consideration. Therefore, any of the following might also be involved: questioning, critical thinking, negotiating, debate, problem solving, etc. With these possibilities, dialogue has the potential to produce greater, deeper or more significant outcomes than those involving a single individual.

Examples of Informal Learning in Wellness and Health Education

The internet provides a prime example of how people are engaged in informal learning in the areas of health education and wellness. As stated earlier, among Americans who had internet in 2012, nearly three of every four of them sought health information. These data raise the question of how people actually sought information online. In fact, they indicated their independent efforts to acquire health information included the following:

- 77% of them began their last session at a search engine such as Google, etc.,
- 13% began searching at a site specializing in health information, (i.e., WebMD),
- 2% started research at a more general site (like Wikipedia), and
- 1% began searching at a social network site (i.e., Facebook) (Pew Research Internet Project, 2014).

The survey also asked respondents to think about the last time they had a serious health issue and from whom they received assistance. The participants disclosed they obtained information, care and support from the following: 70% from a doctor or other health care professional; 60% from friends and family; and 24% from others who have the same health condition (Pew Research Internet Project, 2014). Considering "care and support" in healthcare situations often includes information sharing, one can understand the role of informal learning in these data. It seems that many Americans rely not only on healthcare professionals, but also (good, or bad) informal learning opportunities with family, friends, and other patients with similar conditions to guide them to greater understanding of their health and wellness needs.

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Research about Informal Learning

In the adult learning literature, informal learning is often linked to organizational benefits such as greater capacity, flexibility and profits (Eraut, 2004; Merriam et al. 2007). The appeal and popularity of informal learning in the workplace is that employees can increase their performance and productivity without interrupting their duties (Yanchar & Hawkley, 2014). For instance, Marsick and Volpe's (1999) research identified ways that workplace informal learning could be enhanced. They recommend that organizations formally train employees about informal learning to increase their awareness and skills. Skule (2004) stated that organizations subject to higher levels of change are more likely to support informal learning. These findings are consistent with considering informal learning as a viable strategy to address adults' needs in the constantly changing landscape of 21st century healthcare and wellness.

SELF-DIRECTED LEARNING

Out of varied roles, responsibilities and emerging needs of today's adult comes the development of the adult as a self-directed learner. As an adult encounters any need or desire to learn something in particular, they take the journey specifically that leads to self-directed learning (SDL). SDL, as a theory, puts the learner at the helm of the experience. Kim et al. (2014) established five tasks of a self-directed learner:

1. "Establish learning goals,
2. Locate and access resources,
3. Adopt and execute learning activities,
4. Monitor and evaluate performance, and
5. Reassess learning strategies progress" (Kim et al., 2014, p. 152).

Through this definition, a self-directed learner is a part of the learning process from beginning to end – guiding its relevance and evaluating its effectiveness.

Equally as important as its definition are the characteristics of a self-directed learner. *What does it feel like or look like to be a self -directed learner?*Guglielmino (1978) pointed out characteristics aligning with the self-directed learner. They are identified as having, "persistence in learning", "responsibility for…learning", increased "curiosity", "strong desire to learn or change…", "[self- confidence]", planning skills, and "a tendency to be goal oriented" (p. 14). Self- directed learners are individuals who are taking learning into their own hands. Whatever the circumstance may be, a self-directed learner understands the importance and value (whether consciously or unconsciously) of following through with their desired learning.

As technology expands, so does the ability for adults to learn new ideas, skills, or information with the click of a button. More than ever, adults are seeking support for their own wellness, as well as for their aging parents and/or sick family members. As SDL suggests, many of these adults looking for online support have developed their own personal goals and are searching for ways to accomplish them. For example, an avid runner can use any internet search engine to seek tips on how to run injury-free. At the time of this writing, the results of such an online inquiry would include almost 47 million possibilities. In another example, for a parent of a sick child, the impetus for their self directed learning is to explore how to identify the illness, provide relief from symptoms, and/or remain alert for complications. Grover

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(2014) reports that a significant reason mothers of children who have had a pediatric stroke pursue the self-directed learner path is because they want to be an advocate for their child. Furthermore, based on his research, these parents become self-directed learners because they fear "missing out on valuable [health related] information" (Grover, 2014, p. 499). In these cases, self-directed learning in health education is not considered optional. Instead, during child related healthcare crises, parents turn to SDL as their lifeline or security.

Similarly, the literature documents that adult facing health concerns is a growing group of self-directed learners participating in an elevated form of self-care. Valente (2011) reported a healthcare process model, which suggested that individuals move through a stage to acquire information and continue on through the cycle to understand and manage their treatments. It is in this stage that adults may choose to individually contribute to understanding their role in living with their illness. Equally, they are interested in ways that they can contribute to the remedy of their current situation and are willing to be partners with their doctors in their own health journeys. Valente (2011) also suggests that a motivating factor for increased SDL in health education is age related issues. As adults face their mortality, there is a heightened awareness that their health is directly connected, such that adults move themselves into the SDL process.

As King noted (2014), there is an increased need for SDL to be considered in healthcare practices. Her autoethnographic study confirmed that patients are self-educating. In turn, it becomes important for physicians to, "respect them [the patients] and discuss their treatment options" (King, 2014, p. 14). It is naïve and dangerous for healthcare professionals to ignore the fact that most adults seek health education online, and outside of their doctor's care.

With the increase in SDL in health education, physicians and other healthcare professionals should consider the promise of leveraging this already popular phenomenon. Furthermore, because SDL relies heavily on the learner accepting responsibility and ownership for the learning process, individuals who are interested in learning for self-care are referred to as, "having a range of behaviors undertaken...with the intention of maintaining or promoting health" (Valente, 2011). These traits are helpful as doctors look for a holistic approach to improving patient health.

Peer Learning

Much of the literature on peer learning is based in education. Peer learning (PL) has been defined as a learning activity that involves "two-way reciprocal learning" (Boud et. al., 2001, p. 3). Similarly, PL as a theory, allows learners - through interactions with others - to expand their knowledge, "build upon what they already know, and gain a range of different perspectives" (Kear, 2004, p. 151). For many educators, PL serves as a helpful learning relationship whereby all persons involved feel consciously connected to their learning experience (Topping, 2007). As such, students involved with intentional PL opportunities, including online formats, have experienced great benefits (Kear, 2004).

Kear (2004) identified four distinct characteristics of PL:

1. Reassurance of similar experiences,
2. Clarification of misunderstood concepts,
3. Collaboration, and
4. Construction of knowledge.

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These characteristics are consistent with other PL theories. According to a study conducted by Comer et al. (2014), the students who posted to the discussion boards the most (the top posters) within a Mass-Open-Online-Course (MOOC), indicated a positive stance towards peer learning, and felt encouraged through the peer communication experience.

Across academic disciplines, there is a growing understanding of the power of peer learning. Specifically within the realm of health education, some methods for peer education include: tutoring, leading classes, one on one discussions, etc. (Turner & Shepard, 1999, p. 236). Further, research by Petosa and Smith (2014) revealed that in-person peer mentors are instrumental in facilitating, "behavior changing activities" (p. 351).

There is limited literature, however, regarding PL modes, models and strategies employed among users as they gain resources, understanding, and/or support through online wellness or health websites, communities and/or blogs. Given the extensive research undergirding the success of peer learning, peer education and community building in online education (Comer et al., 2014; Palloff & Pratt, 2001, 2007), it is a legitimate assumption that if positive outcomes are occurring within colleges and universities, other adult learners might experience similar positive outcomes as a result of health and wellness related online communities.

USE OF TECHNOLOGY IN PERSONAL HEALTH EDUCATION

Technology In order to explore the literature regarding technology use in the pursuit of personal health education, we focused our search on two major areas: what the literature says about technology based health/wellness support groups and the "Internet and health information seeking behavior." The health education literature has been interested in these areas for some time due to their role in public health administration in the Information and Digital Age.

Technology Based Health/Wellness Support Groups

Technology has been a progressively helpful avenue for individuals to reach new levels of wellness. Coupled with the increased internet use worldwide, it is no wonder organizations, institutions, and individuals are turning to online communities/technologies for specialized needs – including wellness. For example, many colleges and universities have reverted to interactive online educational mobile applications and interactive online videos/games to outreach to college aged students for alcohol abuse prevention and intervention. Such programs have assisted in lowering high risk drinking in students by 67% by using technology as a unique medium to interact with student concerns (Kazemi et al., 2014). Many universities in the United States have created, unbeknownst to students, a way of knowing through technology and education that transcends typical learning.

Similarly, in 2001, Reeves analyzed the internet use of individuals living with HIV/AIDS, more specifically in how the internet is used as a coping mechanism. The qualitative study showed that in HIV/AIDS patients' internet use served multiple purposes such as acquiring a range of up-date and useful information. Participants stated the internet was one of the few ways they could keep up with cutting edge information (Reeves, 2001). Furthermore, these same individuals showed signs of making important social connections, and highlight the importance of linking with other people who have had similar

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health experiences as they have. Many of the same benefits of current social media were present then, and today are even more pertinent in our society. Accordingly, the breadth of information available to patients and family members of all kinds has expanded since 2001; and the topic today is even more relevant.

Internet and Health Information Seeking Behavior

With approximately 1 in 3 Americans using the Internet for health related results there exists many opportunities and challenges for users of health websites and virtual online communities (Pew Internet & American Life Project, 2013). Some of the limitations for virtual communities have everything to do with the type of information users have available to them and the accuracy of that which they are reading. Wright and Grabowsky (2011) suggest for adult learners, or any online community browser or member, to always look for "who" is operating the site and the "why" behind the site's existence. In many cases, members will find the communities are led by expert nurses or doctors, and in other cases, the site explicitly discusses its purpose to be a peer-to-peer site where information comes from users. Both are helpful and service a specific purpose -- users must discretion.

Similarly, peer-to-peer interactions for individuals seeking health support may occur though social media, blog interactions, online chats, etc. This type of formed community is one that provides an enormous amount of encouragement, hope, and assists in coping with whichever health complication a person is experiencing, as was experienced by individuals seeking support with food allergies (Coulson & Knibb, 2007). Peer-to-peer learning in these settings also come with its share of challenges, and each person is should seek to ensure they are getting the accurate health information from their personal doctors. However, despite the ability for information to be transferred incorrectly, the amount of social support virtual online communities provides continues to be the central point that brings users back time and time again. Only through this medium, can individuals unable to go to focus groups (White & Dorman, 2001), find encouragement, and commonalities among others they will not find within their homes if not from those communities. White & Dorman (2001), also point out the importance of online communities for members of communities that might include "stigmatizing" illnesses that may preclude individuals from feeling comfortable joining in person communities. Joining online communities, similarly, allows users to be more transparent and honest when communicating with other members. This type of vulnerability is useful in coping, and healing.

Overall, individuals who seek health related information and communities are people with real needs. They either individually are in need or are helping sick parents or children, for example online communities, for example, caregivers of Alzheimer's patients (White & Dorman, 2001). However we categorize the need of users we should be cognizant that regardless of whose need it is – it is still a need being met by online communities.

Human/Computer Interfaces

As most areas of our lives are increasingly dominated by small and large electronic devices, one realizes that there is a great difference among them as far as ease of use. The study of this phenomenon, a un/intentional design, is called Human-Computer Interaction (HCI). This field studies human interaction with anything which relates to computers. To grasp the tremendous scope of these efforts, consider not just the conventional desktop or laptop computer, but anything which has a computer "chip" within it. Furthermore, this field not only investigates how people interact which computer based devices, but also

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strategies to design, evaluate, develop, and implement interfaces which will be most effective (Rosinski, & Squire, 2009). The human/computer interface literature then, provides important background when considering the design and impact of online health education communities.

The term "human–computer interface" (HCI) refers to "the point of contact between the application and the end user" (Sheppard & Rouff, 1994, p. 1402 as cited in Chalmers, 2003, p. 594). Therefore, when considering the formal and informal educational settings in which people might be using online resources to access information, they necessarily use a human–computer interface. Chalmers further explicated the essential role of this relationship when she stated, he human–computer interface "enables the learner to communicate with the computer, and is that which enables the computer to communicate with the learner."(p. 594). As one might expect, HCI is a rapidly changing field with the constant innovations in technology devices and capabilities. There has been an enormous transformation in computer interfaces and usability from the time of character based (i.e., DOS, VAX, etc.), to graphical user interfaces (GUIs) optimized of mobile devices, which we now expect devices to use. The principles behind the specific design recommendations have remained largely agreed upon; however, specific implementation guidelines for new platforms, program updates, and/or devices, necessarily change daily (Lazar, 2006, McCracken, Wolfe, & Spool, 2004; Sharp, Rogers, & Preece, 2007).

Foundational principles of optimal user friendly computer interfaces include recommendations for interface layout, color, spatial display, consistency, and text organization strategies (i.e., advanced organizers, graphic organizers, outline organizers, post and comment organizers, etc.). HCI principles also consider what is known about the intended users' characteristics such as age, gender, level of education and motivation (Chalmers, 2003).

RESEARCH METHOD

This qualitative research study involves examining three different examples of health and wellness online communities. Stake (2006) described the ability of multicase research (or multiple case study research) as being able to examine and report the details of several individual cases closely linked in some way. One of the many strengths of this approach is that rather than focusing on one case for examination, a multiple case study investigates how several cases with a standing relationship better explain the experience/condition/situation/need. For example, in this research study, rather than studying only the BoneSmart.org online community, we investigated three virtual sites. This research design provided a broader vantage point from which to document the contributions of these communities to health education and wellness. In this manner, the trustworthiness of multicase study in describing a phenomenon experienced in multiple settings is greater than that of a single case study (Stake, 2006; Woodside, 2010).

The history of case study research and multiple case study research, in particular, is rooted in social sciences and education research (Stake, 2006; Yin, 2011). These fields are especially interested in understanding and addressing issues related to diversity, individuality, society, policy, opinion, change, environment, etc. Case study research, as a whole, has been helpful in providing systematic accounts of common and singular situations used for clinical and classroom instruction (Stake, 2006; Woodside, 2010). Having such accounts affords the opportunity for learning communities to discuss such critical variables as stakeholders, policies, resources, potential issues, causes and solutions, power inequities, etc.

Woodside (2010) identified the objectives of case study research as "description, explanation, prediction and control of individual process, animal, person, household, group, or organization" (p. 11). In

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this current study, the focus was on description and explanation through analyses of written documents, online community, videos, audio recordings, and discussion boards. The emic interpretation of the communities and their benefits and support were available through the participants' postings (Creswell, 2011; Stake 2006; Woodside, 2010). As researchers, our interpretation of the existing data provided the etic representation.

Yin (2011) presented strong arguments for transparent and public descriptions of research methods in order to increase the trustworthiness of qualitative research. One aspect of this paradigm includes describing the details of the research process and procedures within which authors engage. Such an account also increases the ability and likelihood that future researchers will be able to consistently replicate or extend the study (Creswell, 2011). We developed the idea to research online health education and wellness, in part because of our common interest in the topic and realization that thousands of people used the sites/communities for essential, innovative informal learning. Simultaneously, none of us had heard healthcare professionals offer these resource options. Finally, upon investigation there was little evidence of educational research in this area. In this study, we engaged in the research process more collaboratively than usual since the junior colleagues were less experienced with qualitative research and cross case analysis. Our overall approach was to assign different sections of the work, complete it separately, reconvene to discuss our findings, and move to the next step. Once we completed the literature reviews, we discussed our findings, analysis and syntheses. Our next step was to extract analysis criteria from this work and develop the method for systematically documenting the sites accordingly. Once we had all the site data documented we held another work session to discuss possible themes and trends. It was during this session that we determined the unique patterns among the different sites and recommendations for further study. Early in the process, it had become very clear that this would be but the first in many studies which would be needed to document these sites and participants' experiences in meaningful ways. From this working session, we again assigned writing sections in order to document our analysis and recommendations. The entire collaborative process was very rich in providing different perspectives of the data, educative experiences, and scaffolding our work in each successive step.

Based on the health education needs identified in this paper, the three research questions were posed. The literature review provided criteria to develop a matrix for examining and documenting the health and wellness online communities systematically. The areas of analysis included

- The online community's focus of health and wellness,
- Informal learning characteristics,
- Self-directed learning characteristics,
- Peer learning characteristics,
- Other adult learning characteristics,
- Benefits stated by participants,
- Nature of support provided by the community/site.

The authors examined each site independently to determine the existence and examples of the listed characteristics. Later the data were tabulated in separate matrices, which were then reassembled in the final analysis. The division into multiple matrices provides greater detail of the case specific characteristics. In contrast, the final reassembly provides a comprehensive, holistic view with "broad strokes" of similarities and differences across cases. Both Woodside (2010) and Stake (2006), recognize this process of division and reassembly of data matrices as an effective method for multiple case study analysis.

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In the tradition of thematic analysis, qualitative analysis continued as the researchers collaboratively discussed themes and patterns which emerged within each site and across different sites in data displays (Creswell, 2011; Onwuegbuzie, & Teddlie, 2003; Yin, 2011). Such analysis for multiple cases is more specifically described by Stake (2006) as cross case analysis. Two major areas of differentiation were identified after several iterative cycles of data reduction and analysis. Woodside (2010) describes these different cycles as different levels of analysis or coding.

Researchers' Roles

It is widely understood that in qualitative inquiry, researchers are the investigative instrument (Bogdan, & Biklen, 2007). In regard to this study, providing descriptions of our prior experience, perspectives, and biases regarding health and wellness education through technology is a critical step in publicly and transparently framing our work (Yin, 2011). Each of us has experienced unique personal and professional needs and used different online sites, platforms, and communities over the last several years and months. This section provides a brief introduction to our specific health education and wellness orientations from which each of us approached this study.

The first author, Dr. Kathleen P. King, is a professor of higher education and her research focuses span higher education, international education, policy, adult learning, and innovative technologies. Since 1990, she has taught adults in several types of postsecondary institutions. In 2010, Kathy moved to central Florida; however, she is originally from New England. Her relocation to Florida has been beneficial because she has several chronic conditions, which have been debilitating in the past. In 2010, while rebuilding her ability to walk, and regaining fitness, Kathy personally experienced the power of virtual health education communities.

In 2013 and 2014, when she had both knees replaced, Kathy was reminded of the great impact such communities have on personal health learning, and recovery. She has been a member of BoneSmart.org, and continues to be an active member in SparkPeople.com. Having gained substantial assistance and support from these online communities, she has recommended them for many other patients and several physicians. It is during this stage, that Kathy realized the medical profession and general public had little awareness of the existence and benefits of these virtual health education communities. Rather than just finding information online, these communities had significantly contributed to her and many others' health education, physical recovery, and wellness.

Julie Leos has been a Student Affairs practitioner in higher education for over eight years. She is also pursuing her doctor of philosophy degree in University of South Florida's Curriculum and Instruction, Higher Education Administration program. As a Student Affairs professional, she has been responsible for caring for undergraduate students and their development while enrolled in college, outside of the classroom.

For a number of years, Julie worked within the realm of student housing, where as an entry-level professional she had the unique opportunity of living on campus within the residence halls in order to care for students and respond to after hour emergencies. When academic and administration offices close at 5 pm, it is then that the "night campus" begins on any residential campus. For many housing professionals, learning to balance their day time and night time responsibilities becomes even more difficult because of the blurred lines between work and home.

In her sixth year as a professional, Julie recognized a trend across the field of student affairs – one that did not encourage the idea of self – care. Julie had joined the field in order to help students, both

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striving and struggling. Similar to other helping professions, Julie recognized that her peers were working endlessly to help students and taking little time for their own wellbeing. During this time, some of her colleagues across the country also recognized these trends and began a social media campaign called #SAFIT. This hashtag was used on Twitter and Facebook in solidarity with student affairs professionals on the journey to holistic healthy lifestyles. Quickly, large numbers of student affairs professionals found the community and additional resources, which led to greater understanding of reaching personal wellness. As this virtual community has grown, Julie has found it not only supports health and wellbeing, but also provides inspiration and encouragement for adult student affairs practitioners.

Lu Norstrand is an international student in University of South Florida's Curriculum and Instruction, Higher Education Administration PhD degree program. She has earned both a master's of philosophy from Nankai University in Tianjin, China, a master's of arts in Adult Education from University of South Florida in Tampa, FL. Lu's major areas of research include adult education, globalization and higher education, leadership, as well as Eastern and Western philosophical inquiry. She has worked as a student assistant at Nankai University in China, as well as a graduate assistant and grader in the College of Education at University of South Florida.

Lu and her husband, Daniel, just delivered their first child, Naomi in December 2014. During her pregnancy, Lu used the internet to access online health education information related learning about to Chinese and Western recommendations for pregnancy, health education about pregnancy and child development, as well as insights about child rearing. She has been especially interested in contrasting cultural perspectives, which are easily accessible to her via online resources and communities to understand these bodies of information and comprehend the similarities and differences.

FINDINGS AND DISCUSSION

For this research, the findings and discussion will be presented in two major sections. First a systematic overview of the three virtual healthcare communities will be provided. In the second section, the findings and analysis of the three cases will be examined within and across the cases. This cross case study analysis provides researchers the ability to identify themes of similarity and difference simultaneously (Woodside, 2010). Benefits of this approach include, but are not limited to, a fuller, more accurate portrait of the phenomenon under study, as well a more detailed account upon which future research may build.

Virtual Communities: The Individual Cases

In this multiple case study, we examined three individual cases of virtual health education and wellness communities: BoneSmart.org, SparkPeople.com, and StudentAffairsFit.com. Each of these online communities has a unique history, purpose and design. This section provides an overview of these critical characteristics for each site studied.

BoneSmart

In this chapter's opening scenario, Isabella found and joined BoneSmart.org for information and support as she experienced a hip replacement. As seen in Figure 2, the virtual community BoneSmart® is not fictitious. In fact, a nonprofit organization created, sponsored and sustained this active virtual community

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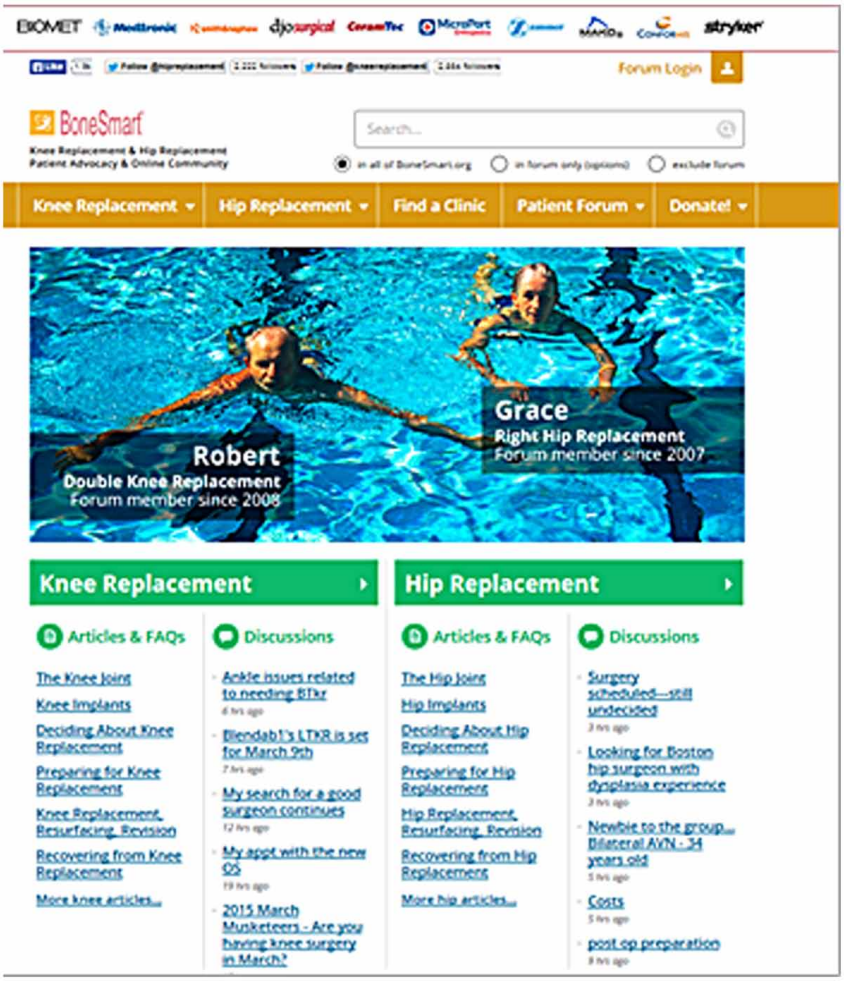
Figure 2. Screenshot of BoneSmart.org homepage
(BoneSmart, 2014c).



since 2004 (BoneSmart, 2014a). The Foundation for the Advancement in Research in Medicine, Inc. (FARM) is described as the nonprofit parent company of BoneSmart.org. This 501(c)(3) non-profit organization is described as a public benefit organization sustained through contributions from individuals and corporate sponsors (BoneSmart, 2014b). However, the site's About page explains BoneSmart.org's identity somewhat differently, BoneSmart.org is a "public-awareness and patient advocacy organization" specifically for people who will be or have undergone knee and/or hip replacement surgery.

The elements that are surprising are

1. The fact that health education is not identified, and
2. The mention of patient advocacy.

Within the scope of the organization's perspective, public –awareness is an aspect of health education. For instance, when people visit the site and learn of resources, activities or procedures to improve the

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quality of their health and life. In addition, many articles have been written about the shift in medical care dynamics in the USA. Contrary to how medical care was practiced 10-30 years ago, healthcare professionals will not tell patients directly what they should or should not do. In addition, no healthcare professional can know all the resources and details of all conditions in their major field of practice. Medicine is practiced in specialty and subspecialty fields. Within this maze, patients must be self-advocates in seeking the care and support they need, as well as seeking resources to make their own healthcare decisions (King, 2014; Kooijman, 1999).

When one visits the BoneSmart.org website, the many embedded resources and features are not readily evident. However, upon closer examination, the brown menu bar above the images of the adults swimming, are drop down menus organized by major resource areas: Knee Replacement, Hip Replacement, Find a Clinic, Patient Forum and Donate! Just by sliding one's mouse over each menu heading, it is evident that articles and forums (discussion boards) are the major divisions of resources. Below the main photo, there are also two major lists categorized by knee and hip replacement. In this section of the screen, one can see at a glance the newest topics for articles, discussion, and Frequently Asked Questions (FAQs). This home page; therefore, provides at least 4 ways to "click" into the major resources, that is, one does not need to search or navigate multiple menus. The ease of use and redundancy of access of this home page is a most favorable design considering that at this time, patients who need knee and hip replacements are generally over 40 years old, and therefore tend to be less technology adept than younger internet users (Pew Research Center, 2014).

StudentAffairsFit.com

In 2013, several USA student affairs professionals realized the need for cultivating their own wellness in the midst of their demanding profession, and began a social media campaign named #SAFIT (Student Affairs Fitness and Health, 2014). Founders and supporters of the movement used the hashtag on Twitter and Facebook in order to draw awareness to and encourage student affairs professionals who were dedicated to sustaining their wellbeing. The campaign also was intended to draw more people into the effort and thereby realize a positive change among student affairs professionals' lives and retention. Quickly, student affairs runners and cyclists found people interested in their sports and created their own Facebook groups for like-minded individuals who understood both their sport and the demands of their careers.

As awareness grew, so did the type of information being shared and asked for by participants. Individuals were looking to their peers for advice, as well as learning best practices about how to get fit and be well from various websites. Soon a blog was developed that combined both peer support and learning. This blog, www.studentaffairsfit.com, was to encourage others in the field to start their journey to wellness. With the help and support of colleagues across the country, members of the community share part of their wellness or fitness journey to inspire others (See Figure 3 for a screenshot of the home page of StudentAffairsFit.com).

The technology and organizing platform for StudentAffairsFit.com (SAFIT) is WordPress. This customizable database provides a rich variety of features, which support user contributions and dialogue. The administrators/owners of a WordPress site are able to select which features to activate and configure for users to access. In the case of SAFIT, the focus has been users posting blog entries (the main website entries) and other users from around the world responding to those. Membership in the SAFIT online community is informal. People find the site and community through word of mouth, online searches or

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Figure 3. Screenshot of Studentaffairsfit.com homepage
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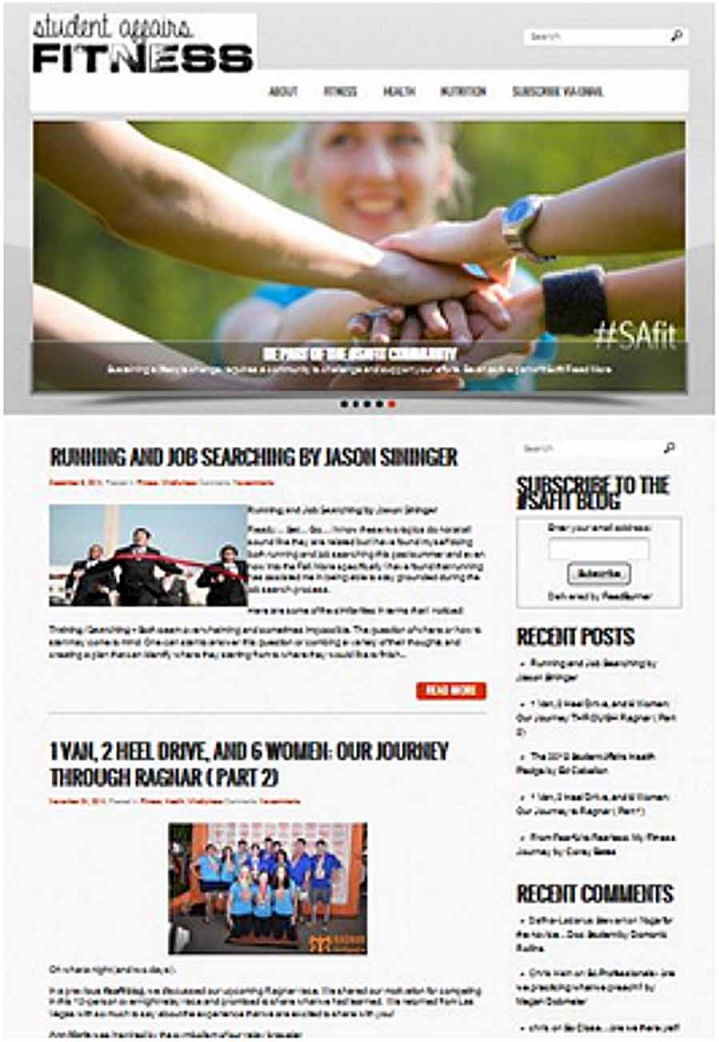

links (Facebook and other social media for instance), and when they want to post a comment, they can. The only requirement to post a comment is that users must input a name and email address. In order to contribute to the blog, prospective writers email requests to the moderators of the site to discuss the opportunity.

The site is entirely sustained by volunteers. From technical needs to fielding inquiries, moderation to content development; the group of people who have banded together around this shared interest and need have shared the work. Therefore, financial, technical and human resources are not in abundance and the site cannot offer 24/7 live support or dozens of new content articles daily. Nonetheless, it is remarkable that there is a steady stream of interest and contribution to a site, which addresses a very specific and targeted need. This phenomenon raises questions as to possibilities for many other communities, which could emerge. SAFIT confirms the viability of grassroots solutions for platforms, which address specific

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health education and awareness needs. The foundation of SAFIT's success; however, is that people took initiative and embraced volunteer responsibility.

SparkPeople

When exploring SparkPeople's descriptive information, one discovers a clearly articulated purpose and scope of service. In addition, prospective users are encouraged to "explore" the community through data points of user accomplishments and testimonies. The mission of this site and organization is to "SPARK millions of PEOPLE to reach their goals and lead healthier lives" (SparkPeople, Inc., 2015a, para 1). In addition, the site succinctly states that it offers, "nutrition, health, and fitness tools, support, and resources that are 100% free" (SparkPeople, Inc., 2015a, para 1). These fitness tools and resources include many integrated features which people are used to paying fees for including, but not limited to fitness trackers, meal plans, nutrition tracking, nutrition analysis, exercise tutorials, exercise videos, fitness competitions, fitness teams, and private blog space. The About Us page explicitly compares this free site to fee-paid ones such as Weight Watchers and eDiets.com, which serve similar purposes and services (SparkPeople, Inc., 2015a); however, it does not mention the many paid fitness applications, which it can replace.

The community uses the introductory material for several purposes. The site shares many examples of the worldwide activities of SparkPeople members. However, as illustrated in Figure 4, the "SparkPeople Activity around the World" page, it is done in a dynamic way, which would not only impress the reader, but also motivate them to become part of the extraordinary mass movement. By joining SparkPeople, users realize they are becoming

1. Part of something much larger than their own personal struggle, and
2. Joining a successful, global health and fitness movement.

This presentation for prospective users is astute since joining a winning team is an especially strong motivation when fighting the relentless fitness battle.

This screen includes live feeds of information, which updates in split second increments with the critical achievements of SparkPeople members. For instance, as illustrated in Figure 4, as of February 13, 2015, 10:50am EDT,

- 31,726,241,283 calories burned;
- 25,688,850 pounds lost;
- 552,891,688 cups of water drunk;
- 16,541 SparkTeams created; and
- 3,178,046 SparkPages created (individual SparkPeople user pages). (SparkPeople, Inc., 2015a).

The SparkPeople homepage (Figure 5) is another carefully planned window into the extensive resources and support community, which is freely available to members. As one scans the page from left to right and top to bottom, a search field is top- center, both pull-down and icon menus provide ready access to most features, colorful headlines and article photos scroll by on the central slideshow, choices

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Figure 4. SparkPeople Activity around the World page
(SparkPeople, Inc., 2015b).

of videos, recipes, health condition sections, discussion topics, and blog headlines also populate the page. Moreover, once people become SparkMembers, they can customize their landing page to include the features they want readily available when they sign in to the community.

Chris Downes founded SparkPeople, Inc. in 2001 as a general website to assist people in setting goals in many areas of their lives and work. In 2002, however, it was more specifically redesigned to focus on nutrition and fitness. From 2002-2005, tracking tools were only available for premium members who paid a fee (SparkPeople, Inc., 2015d). However at that time, it was decided that the site should be entirely free for all users. SparkPeople, Inc. is staffed by a total of 13 staff members, seven of whom are "healthy lifestyle experts" such as trainers, nutritionists, etc. (SparkPeople, Inc., 2015e).

ACROSS CASE FINDINGS AND DISCUSSION

In the previous major section, each of the online community was introduced via an overview of its origin, purpose, online interface and resources. This section provides the multicase perspective of the findings and analysis as the detailed analysis of each online community are examined individually and

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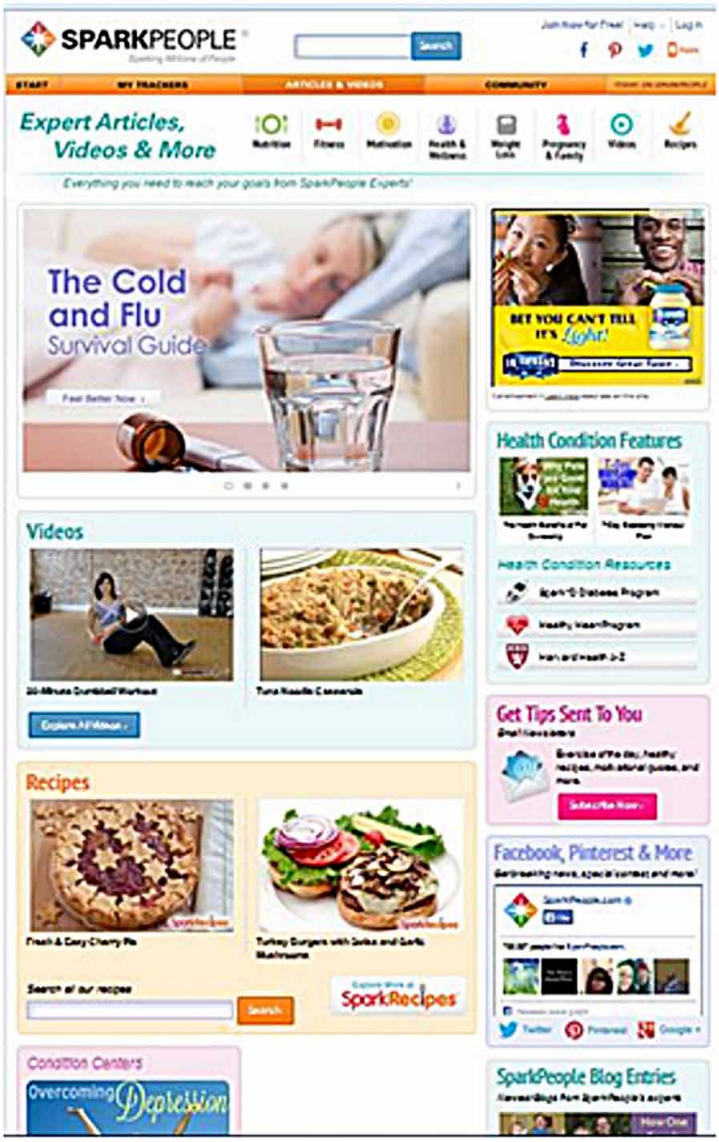
Figure 5. Screenshot of SparkPeople.com homepage
© SparkPeople, Inc., 2015.



collectively. Several figures and tables will guide the discussion in order to provide clarity in how the analysis was conducted and the composite model created. Each figure will be explained and discussed.

The Master Matrix

Table 1 presents the "Comparison Matrix of Three Health and Wellness Online Communities' Characteristics." This matrix was assembled by merging each site's detailed documentation and analysis. As stated previously, the characteristics used in each cell of this matrix are included in the above literature review. The literature review's several models of self-direct learning, informal learning, etc., were converted

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Table 1. Comparison matrix of three health and wellness online communities' characteristics

Virtual Community	BoneSmart.org	SparkPeople.com	StudentAffairsFit.com
Health Education Focus	Information and support regarding knee and hip replacements	Wellness: Weight loss, diet, healthy living, exercise	Well-being for people working in the field of Student Affairs
Informal Learning Characteristics	All characteristics present except Hall's definition "a)" Learning owned and directed by the individual; and "d)" using non institutional technology	All characteristics present except Hall's definition "a)" Learning owned and directed by the individual; and "d)" using non institutional technology	All characteristics present
Self-Directed Learning Characteristics	All characteristics present except "assessment"	All characteristics present except "assessment"	All characteristics present except "assessment"
Peer Learning Characteristics	All characteristics present	All characteristics present	All characteristics present
Other Adult Learning Characteristics	All characteristics present	All characteristics present	All characteristics present
Benefits	All benefits present	All benefits present	Some benefits not present Primary structure is a blog and discussion
Support Provided by Participating in the Community	All support items present	All support items present	Some support items not present: • No experts • No vetting of information • Not a one-stop-shop • Not a comprehensive support center

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into bullet points and used as checklists. Therefore, as researchers examined online communities, they would look for examples of the characteristics and if found check it off, as well as record the specific example and source URL.

When the research team leader received each site's "data table", she merged them in their entirety. When the research group next met, we discussed the data and began "reducing" it to common and different features, patterns and themes (Onwuegbuzie, & Teddlie, 2003). The Comparison Matrix (Table 1) is the end result of that process. At this stage, the similarities and specific differences within and across the cases were still visible, but the information was still too dense to be useful for conclusions. We had not yet accomplished thematic analysis of these characteristics.

Through further discussion of common and varied patterns, several versions of figures, we created Figure 6 to represent the overall relationship among site characteristics. Figure 6, "High Level Schematic of Virtual Communities' Characteristics," displays the two areas that emerged as major groups and patterns of characteristics: Infrastructure and Learning Theory and Applications.

We chose the term Infrastructure to represent the resources, which support the online community. Across the three cases, there were two with comprehensive technical, organizational, financial and human resources. As seen in Figure 7, the third case was limited in every single respect due to its voluntary "staff" and lack of financial support. This pattern underscored the high cost of advanced technology features, and continually refreshed content.

In considering this difference, one must also think about scope of need. For instance, the potential community that could be served by each of the two funded sites is very large. In 2010, the National

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Figure 6. High level schematic of virtual communities' characteristics

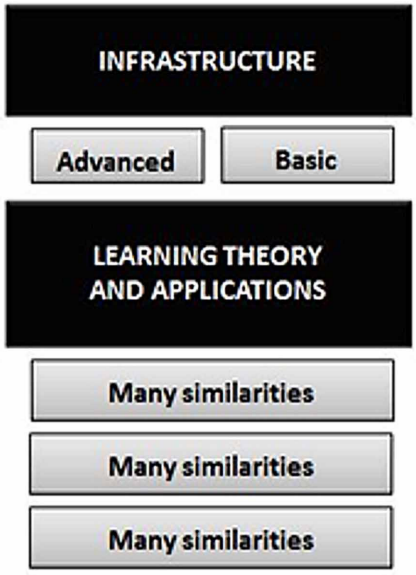
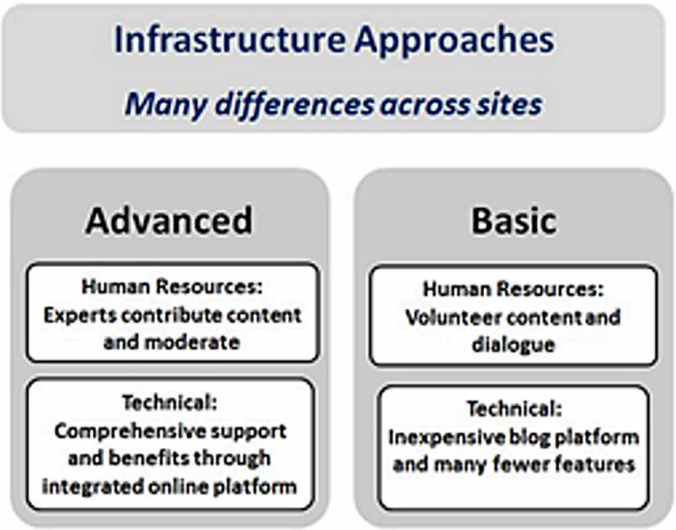


Figure 7. Differences in infrastructure approaches



Hospital Discharge Survey reports that in the USA, 719,000 people had a knee replaced, while 330,000 had a hip replaced (CDC/National Center for Health Statistics, 2014). Therefore, every year up to 1 million *new* people could use BoneSmart.org. Regarding SparkPeople.com, 1999 CDC data revealed 40% of USA adults (approximately 128 million) engage in the recommended amount of activity per day. Compare these populations to the much smaller, highly focused, targeted and specific group who would be interested in a Student Affairs Fitness site.

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As represented in Figure 6, across the dimension of Learning Theory Characteristics and Application, the same patterns clearly appeared in all three cases. As seen in Figure 8, similarities among Learning Theory Characteristics and Application, these parallels extended across nearly all the learning theories we examined. In each of the sites we analyzed, there were abundant examples of the characteristics of self-directed learning, informal learning, peer learning, and adult learning. From discussion boards, individual and group support, articles, to opportunities to track self-identified goals, there are many options for accessing information, engaging in dialoguing, and finding support around a common theme. The around the clock availability and convenience of all of these virtual sites is an inherent, but exceptionally valuable feature.

The one exception to complete agreement of characteristics is in the area of informal learning. In the literature review we identified three major models of informal learning. All the sites had all the characteristics of informal learning according to Marsick and Watkins (1990) as well as Eraut (2004). However, all of Hall's (2009) characteristics were not applicable to BoneSmart and SparkPeople because of their organizational and financial support. The grassroots nature of SAFIT fully aligned with Hall's definition and indicators.

However, Figure 8 did not satisfy the researchers' vision of these data completely. Therefore, Figure 9, "Learner's Choice and Other Similarities among Learning Theory Characteristics and Application" was developed. In this design, the sweeping arrow in the figure represents the dynamic of freedom of choice. That is within these virtual communities, learners have no constraints, none but self-imposed constraints.

As way of illustration, the following list includes a partial list of how leaners may choose to interact with a virtual learning community. This list is certainly not comprehensive and introduces only a small fraction of the options open to virtual community users. In the cases we examined, on the whole, health education and wellness online community users may choose:

Figure 8. Similarities among learning theory characteristics and application

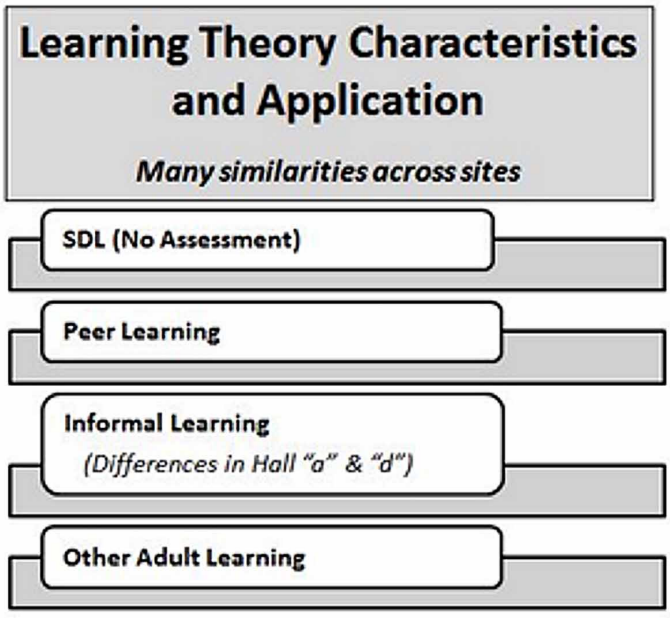

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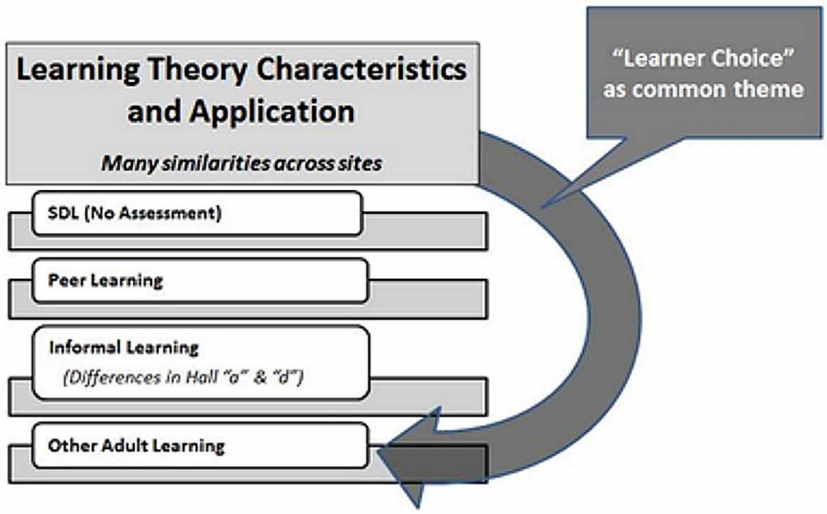
Figure 9. Learner's choice and other similarities among learning theory characteristics and application



- What, when and how to explore the site,
- Which articles to read,
- What order to read those articles,
- Which videos to watch,
- Not to watch videos today, next week, or ever!,
- Who to answer on a discussion board,
- Which "team" to join,
- Whether or not to establish a free user account,
- Whom to "friend", follow, instant message, email or answer,
- Whether to establish goals to track,
- How often to track their goals,
- Whether to use their real identity or remain anonymous,
- When to stay and leave, etc.

DISCUSSION

- **Adult Learning Characteristics:** Recalling the first research questions posed for this study, "Do the reviewed online communities demonstrate key adult learning characteristics? Specifically, do these communities demonstrate characteristics of adult learning in general, and/or self-directed learning or informal learning?" It is clear that all of the sites afford a convenient environment and many opportunities for 24/7 independent adult learning.
- **Benefits:** Regarding research question two, "In what ways do the participants indicate the online communities benefit them?," our study revealed a rich array of data. Users of these types of online virtual sites identified benefits which focused the positive aspects of having others in similar life

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situations share experiences, support, and resources in community. Members of each of the communities analyzed had access to encouragement, and resources that spanned information from individuals sharing personal experiences, to easily accessible health specific knowledge.

Specifically for BonesSmart and SparkPeople, the benefits of joining such a community were emotional, intellectual, and physical. For individuals experiencing life changing health experiences, participating in community with others who were able to help them through the healing timeline was crucial. Patients felt they had an immediate support system comprised of individuals who firsthand understood and could therefore fully relate to their life circumstances. Through those similarities, members participate in direct engagement with one another sharing knowledge, providing support freely, and offering advice that can help with the physical ailments individuals are experiencing.

Similarly, SAFIT bloggers and commenters, frequently quote appreciating the Student Affairs Fitness community, and feeling a sense of togetherness and support through the messages sent through the blog posts. If individual members feel they do not have any immediate local support for their wellness journey, they access an archive and know there are others who have lived similar experiences. Furthermore, members consider the student affairs wellness online community an accountability tool. Participating as a SAFIT blogger places individuals in a unique situation where their public vulnerability adds an extra element to reaching their wellness goals.

- **Support:** One of the most valuable benefits users seek and find in health education and wellness online communities is support in navigating their health issues or reaching their goals. In this study, research question three was, "What is the nature of the health education support provided by the online communities reviewed?" In our analysis of the virtual community cases, they provided many different available strategies and features for providing user support. However, a key pattern among the communities was the freedom of choice, which users had in selecting and participating in support features at any given time. Table 2 provides a summary table for this information.

In analyzing the support feature data of these communities, several patterns and connections emerged. First, planning and design had been invested in each site in order to provide users many health education and wellness related support features. Such features included, but were not limited to

1. User discussions,
2. Common interest teams,
3. Shared goal teams,
4. Personal journal keeping,
5. Individual blog space,
6. "Friending" of other users,
7. Respond to "friends" comments,
8. Emoticons and graphics use to encourage "friends" in posts,
9. Searchable database of expert resources (articles, slideshows, and videos) (SparkPeople and BoneSmart),
10. Customizable personal motivational slideshow (SparkPeople),
11. Instant messaging of other users (SparkPeople and BoneSmart),

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Table 2. Support features across health education and wellness virtual communities

Support Features	BoneSmart	SparkPeople	SAFIT
Information Accuracy			
Information vetting	Yes	Yes	Yes
Access and Scope			
One stop resource for support and information	Yes	Yes	No
24/7 support and information venue	Yes	Yes	No
Guidance			
Guidance by experienced users	Yes	Yes	Yes
Guidance by experts	Yes	Yes	No
Community			
Participants share common lived experienced	Yes	Yes	Yes
Participants share broad common goals of wellness	Yes	Yes	Yes
Participant encouragement	Yes	Yes	Yes
Peer Learning			
Peer dialogue and support	Yes	Yes	Yes

12. RSS feed of site comments (SAFit),
13. Email alerts of new content,
14. Nutrition tracking and reports (SparkPeople),
15. Customizable goal tracking such as weight, water consumption, minutes and nature of exercise (SparkPeople), etc.

These examples provide a partial list of available support choices for site users. However, the list illustrates the extensive scope of choice and personalization available to users to craft a virtual support system which best suits them.

Second, it would appear the designers understood the needs of their users in regard to their specific support needs, because each site offered similar features in different ways. For instance, SparkPeople provides users the capability to customize their landing page (the page they reach once they log into the site) with features to motivate them, assist in tracking their progress, and/or provide information which is refreshed daily. All of these features provide different aspects of virtual, anytime, anywhere (24/7) support and feedback to the community's users. In addition, SparkPeople and BoneSmart not only provide many different ways to initiate new forums on topics of interest, but also highlight the varied support and discussion forums as resources.

The examples above illustrate the link between available infrastructure in the areas of technology and human resources (represented in Figure 6) and each site's level of feature sophistication. The sites with more financial and human resources can provide more options and more extensive versions of support features. As an example, both SparkPeople and BoneSmart have not only developed website platforms, but also unique smart phone applications (apps) optimized for each of the following devices: iOS (Android devices and Apple products (such as iPhone and iPad)).

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SYNTHESIS OF "DISCERNING GUIDELINES"

What do these findings provide as guidelines for adults who are seeking virtual health education resources and support? We believe this analysis readily specifies guidelines which users of health education and wellness online communities should evaluate when reviewing the many communities available to them. The identification of a bone fide, helpful online health education community is a crucial task when the goal is to gain benefit from them. If information is inaccurate, user comments are entirely unmoderated, the experience can be potentially damaging to the user. Moreover, if the site does not allow for user choice of participation and information access, users could be discouraged, frustrated and abort their efforts to gain valuable support and information.

Therefore, based on these findings, it is recommended that prospective health education and wellness users examine sites from the vantage points of both their needs and goals. More specifically, they should consider their information and support needs as well as their personal learning preferences, wellness goals, and immediacy of support.

The first area suggested is for users to consider whether a site has a particular agenda and if the purpose matches their goals and interests. In most cases, this evaluation is easily accomplished by reviewing the site's About Page as well as identifying the sponsors and supporters of the site. Users want to consider the impact on site information and experience if it is commercial, nonprofit, unfunded or organizationally sponsored. For example, a site sponsored by a pharmaceutical company will have a different goal than one hosted by a nationally recognized medical research center (I.e., Mayo Clinic, Joslin Clinic, Emory Medical Center, Moffitt Cancer Center, etc.).

Users could use Figure 7 to determine their preferred or desired learning style for these particular subjects and needs and vet sites accordingly. Table 2 could be used as a checklist for identifying user's support needs and then comparing those to those features available on a given site. In this list the first item, in most cases information vetting should be a non-negotiable criterion.

LIMITATIONS

The idea for this project stemmed from the researchers' personal experiences with online virtual communities over a period of time. As adult and higher educators, we saw the trend of increasing health and wellness online communities, and similarly experienced the benefits. We identified these sites based on our individual knowledge. In this qualitative study we have systematically documented and analyzed the structure, usefulness, and value of each site. We used the knowledge base of three sites to document the nature of and growing need to focus on adult learning within similar online virtual communities. Therefore, having only analyzed three individual websites, there is a need to conduct a wider analysis to discover additional patterns, differences, benefits and recommendations.

Additionally, our study focuses solely on introducing and identifying characteristics of adult learning in the context of online virtual communities. While substantial, at this time our study is not able to examine the validity of all resources, content, and facts on the sites. Health education and medical professionals will be most suited for such inquiry. Additionally, there is a need for health professionals to seek similar additional knowledge from these communities. Such efforts could test and advance understanding of the trends among current patients regarding their use and responsiveness to the resources, knowledge, support, and benefits, which this study has identified.

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RECOMMENDATIONS FOR FUTURE RESEARCH

Because our analyses consisted of cross case analyses this research does not determine whether individual community member experiences have been helpful or transformative. Future survey, interview or focus group research may be conducted with members of the communities to further identify uses of the online communities, where users articulate additional perceived benefits.

Another line of inquiry would be to explore the role and function of the online moderators. Such research could reveal their perspective of what they perceive member needs to be, how they address those demands, and cope with the ever-growing population of individuals actively engaging in online support venues.

The final area we will mention for additional research is using adult learning characteristics as a guide and successful member experiences to identify best practices for comprehensive online virtual health community. Learning areas of success and points of opportunity through research of current sites and their members will greatly advance the direction for intentional health and wellness support of adults in virtual venues.

CONCLUSION

This study examined three free health education and wellness online communities which serve as adult learning venues providing resources, and support in robust and varied ways. Many examples illustrate the creative ways these virtual communities scaffold informal learning, self-directed learning, peer learning and other adult learning characteristics. User choice is a dominant theme among these online communities as participants can become involved as much, or little, as they wish. Moreover, users select which of a myriad features to use at any given time, because each of the three systems reviewed was an open system.

Today, thousands of users benefit from such online communities, yet there exist at least three significant needs. First, as introduced above, there are many possibilities for future research in this uncharted area. Second, current and prospective users need to be educated in how to best evaluate the limitations and benefits of communities in order to identify legitimate sites as well as those best suited for their current needs. Third, healthcare professionals need to become more aware of the helpful online healthcare and wellness communities, which are available as resources and support systems for their patients. In Western society, people still respect their healthcare professionals' suggestions; therefore, providing a list of options would advance individuals' ability to determine if virtual communities would be beneficial for them.

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KEY TERMS AND DEFINITIONS

Informal Learning: This chapter discusses several different definitions and theories of informal learning. Common characteristics in these models include: learner determined order of "instruction", the absence of a teacher who plans and/or delivers instruction, non-sequential (open system) nature of learning (Marsick & Watkins, 1990; Eraut, 2004).

Online Community: People who communicate via internet technologies through a common platform are considered to be a part of an online community. Most often each user creates a username and password to establish an account. Once they are a member, they use that identity (username) in online discussion, instant message, emails, voice over internet protocol (VOIP), avatar simulations (i.e., Second Life) (King, 2014; Palloff & Pratt, 2001, 2007). Many online communities have a specific focus to draws and retain people in them.

Peer Learning (PL): A mode of learning experiences in which people learn from one another, rather than from an instructor or content expert. Peers are defined people who are in the same situation or have the same condition, dialogue, "advise", and/or share common experiences or issues in a reciprocal manner (Boud, Cohen, & Sampson, (2001). Benefits of peer learning are many and the mode is useful for learners of all ages.

Self-Directed Learning (SDL): A learning theory which highlights the volition and direction of the learner without instructor intervention. Self-directed learning is characterized by individuals setting their own learning goals, identifying their resources, exploring new possibilities for resources and information, determining when they want to finish the learning (Knowles, 1968; Merriam, Caffarella, & Baumgartner, 2006). SDL is often intrinsically motivated, although in the case of quality of health, fitness, and surgical recovery, the situation can trigger the SDL experience (Dewey, 1938).

Support: In this chapter, support is specifically discussed within the context of healthcare and wellness. Support in online or virtual communities may include any of the following strands and more: emotional, technical, informational, referral, philosophical, spiritual, etc. In addition, support may be communicated through such means as, comments on a blog discussion posting, instant messages, emails, tracking goals, providing instructions, answers, or activities, and much more.

Virtual Community: See the definition for *Online Communities.*

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Chapter 46
Phenomenology, Epigenome and Epigenetic Influence on the Growth and Development of School-Age Children

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ABSTRACT

This chapter focused on the impact of phenomenology, epigenome, and epigenetic factors in the growth and development of school-age children. The biological and social determinants of human development were explored. Inevitably, the inherited gene–chromosomes play a significant role in human growth and development. The academic institutions are set up to facilitate the process of nurturing school-age children, not only in their physical growth and development, but also in their social adjustment to enable them to become fully functioning adults. By far most important, we explored the role of epigenetics in human aging process, since numerous existential events as weathering, stress, nutrition inclement weather, and chemical/pesticides in our environment contribute to aging.

THE ROLE OF EPIGENOME AND EPIGENETIC INFLUENCES ON THE HUMAN AGING PROCESS

Children are the major repository of human capital for the future. The fact that children are the workers, scientists, parents, leaders, and civil society participants of tomorrow, means that their survival, health, nutrition and educational progress are key issues for reconstruction and development today. - Nelson Mandela, 1996.

At the outset of this chapter, we defined the epigenome as the mechanism that turns individual genes on and off in a cell (National Institutes of Health, 2014). Before delving into a detailed analysis of the process of epigenome and methylation, we emphasized the universal acceptance of the definition of

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health by the World Health Organization (WHO). In assessing the continuity of human life cycle, the WHO recognized this challenge by defining health "as complete state of physical, mental and social well-being and not merely the absence of disease or infirmity." The renowned late Ethel Shanas, professor emeriti of gerontology at the University of Illinois at Chicago, Illinois, had instructed her students that when it comes to the elderly, health can be redefined as "the mere ability to participate in social affairs, Ethel Shanas, 1978, personal communication" No sooner did we quiver than she listed all the health problems which those 65 years and older experience or endure on a daily basis. These conditions are due to weathering and the ever-changing epigenome.

Phenomenology

It seems expedient that our discussion of the epigenome should begin from human philosophical perspective described as phenomenology. Phenomenology is the lived experiences of humans. From a philosophical construct, Husserl (2001) and Merleau-Ponty (2012) defined phenomenology as the study of the structure of consciousness as experienced from the first-person point of view. The behavioral pattern in any society must not be devoiced from the internalized, cultural essence, and the way of life from human historical weaning practices. Therefore, it is most suitable to describe the discipline of phenomenology as the study of experience, or consciousness. Literally, phenomenology can suitably be described as the study of "phenomena." In the first half of the twentieth century, the leaders of this philosophical construct included Edmund Husserl, Martin Heidegger, Maurice Merleau-Ponty, and Jean-Paul Sartre et al.

From a philosophical perspective, phenomenology investigates the study of structure of various types of human experiences, ranging from perception, thought, memory, imagination, emotion, desire for what to eat, what to do, whether one should engage in specific behavior and volition to bodily awareness, embodied action, and specific social activity and linguistic behavior. The activities described are components of human cultural essence and our mode of behavior.

In view of this philosophical analysis, human cultural norms associated with prenatal activities and conception, and what to ingest during pregnancy are influenced in numerous traditional settings worldwide by the acquired cultural practices of people worldwide. As discussed in Chapter 7, under traditional healing, over 75% of the human population is usually provided with prenatal care and delivery of childbirth by traditional birth attendants. Routinely, these healers advise the ingestion of pica to enhance the settling of the conceptus (unborn fetus) in the womb.

Consumption of Pica

Pica is the consistent and compulsive ingestion of nonfood substances. This is not necessarily an eating disorder, but what the traditional birth attendants recommended for the pregnant female to enable the unborn baby to settle properly in her womb. The subdivisions of pica include pagophagia– the excessive consumption of ice, freezer frost or iced drinks; amylophagia– consumption of uncooked starch and dough; plasticophagia– the nibbling and sucking of plastics; and geophagia– the consumption of clay, mud, dirt, and other pieces of the lithosphere (Glickman et al., 1981, Mcloughlin, 1987).

However, in many West African nations the ingestion of pica is associated with medicinal treatment, spiritual and ceremonial behavior, folk medicine, traditional cultural activities, and social customs. Traditional birth attendants engage in maternal and child's health practice, by instructing the use of clay missed with antelope, ground into fine powder, and seasoned with salt to ensure its palatability.

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In other West African cultures, and other parts of the world, pica is used to alleviate psychological upset, physiological changes during pregnancy, and abnormal appetite induced by intestinal worm infestation ((Glickman et al., 1981, Mcloughlin, 1987

In West Africa, many European explorers and missionaries who were not knowledgeable about the ingestion of pica in several parts of the world, mostly in rural areas, were surprised to observe the use of pica in the eighteenth and early twentieth centuries, as a component of their observations, reported about the ingestion of clay pica in Nigeria, Ghana, Sierra Leone, and Southern Africa (Glickman et al., 1981, Mcloughlin, 1987). To them, starvation, poverty, and famine were additional factors in which the pica substances were consumed, as next available agents to supplement insufficient food (Mcloughlin, 1987). In rural Malawi, among the illiterate pregnant women, it was unusual for a pregnant woman not to ingest pica during her pregnancy. In this society, pica was an indicator for pregnancy and the taste of clay was claimed to diminish gestational nausea and enhance a suitable embryonic medium for the fetus (Glickman et al., 1981, Mcloughlin, 1987). At the inception of WHO Primary Health Care (PHC), the Ministers of Health from the 193 WHO member nations were encouraged to intervene.

The World Health Organization had convened the Alma Ata Conference, which was attended by the Ministers of Health of the WHO 193 member nations to deliberate on how best to implement PHC in order to cater for the needs of rural population. The key components of WHO-PHC were discussed at the AlmaAta Convention and Primary Health Care (Ebomoyi, 2011).

Although many nations, worldwide had initiated policies aimed at improving the health status of their general public, no universal health policy is comparable to the laudable challenge of PHC services program launched by the WHO in 1978 for a standard of health for everyone on Earth without distinction of race, religion, political beliefs, or economic or social condition.

In 1978, in a small town called AlmaAta in the former U.S.S.R., the WHO, in conjunction with the United Nations Children's Fund (UNICEF), convened a conference on primary health. Participating delegates from the 193 member nations of WHO proposed a resolution that, the most effective strategy of accomplishing "health for all" involves a Primary Health care strategy.

According to the WHO (1978):

PHC is essential health care made universally accessible to individuals and families in the community by means acceptable to them, through their full participation and at a cost the community can afford. It forms an integral part both of the country's health system of which it is the nucleus and overall social and economic development of the community.

The components of PHC consisted of:

1. Education concerning prevailing health problems and the methods of preventing and controlling them;
2. Promotion of food supply and proper nutrition;
3. An adequate supply of safe water and basic sanitation;
4. Maternal and child health, including family planning;
5. Immunization against major infectious disease;
6. Prevention and control of locally endemic diseases;
7. Appropriate treatment of common diseases and injuries; and
8. Provision of essential drugs.

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After the accomplishment of the WHO "Health for All by the Year 2000," as a component of the eight key components of PHC services, traditional birth attendants were discouraged from using pica owing to the lead content of many of the clay products that many expectant or pregnant women used to consume. Those of us who were coordinators of WHO–Center of Excellence in Community-based medical education used the opportunity to educate all PHC workers worldwide to use the medium of PHC to encourage the beneficial indigenous medical practices of traditional birth attendants retain their benign practices, but discourage and work to eliminate the unsubstantiated but dangerous practices of the birth attendants as most of them were completely illiterate by Western standards (Ebomoyi, 2000).

The practice and ingestion of pica was to be eliminated just as the use of septic finger while a bout to assist the pregnant mother delivers her baby. The use of cow feces for massaging and severing the navel and umbilical cord was to be prohibited because of the risk of tetanus infection. By far most abhorrent and inhuman was the circumcision of female babies in their neonatal age (Ebomoyi, 1986).

PICA

To reiterate, pica is the persistent, compulsive ingestion of food or nonfood substances. Quite succinctly, Swanetta (1986) indicates that it is a worldwide problem which has no barriers in terms of age, ethnicity, gender, or geographical region. Pica consumption is prevalent in the United States, but highly unrecognized. In the age of genomic science, the high lead levels in pica, specifically the clay prototypes (Eko) used in West Africa has very high lead levels, which aggravate the methylation process in the human epigenome. In humans, the epigenome is affected by diet, chemical, environment, stressors and age. Based on the recent report by the National Institutes of Health (NIH, 2014), and Mansuy and Mohanna (2014), although the epigenome is tightly associated with the genome, epigenome represents an ensemble of biochemical marks that are present around the DNA. These marks modulate the DNA's activities and functions. Essentially, epigenetics involves programming of gene expression, which is not dependent on the DNA code (Figure 1). It is relatively stable and it replicates through the process of cell mitosis, and it is transgenerational. The other aspects of epigenetic programming include its characteristically modifiable and it is potentially associated with the current health status of the individual and it functions as predictor of future events (Baccarelli, 2014).

Furthermore, epigenetics are strongly influenced by the physical and biological characteristics of an area, exposure to external factors, like diet, pica, living phenomena, exercise, stress, chemicals, drugs such as thalidomide and associated lethal medications, living conditions, and the toxins tobacco, crack cocaine, and other addictive drugs.

Geneticists and modern genome epidemiologists have also discovered that epigenetics can be affected by negative and positive incentives, which can modulate the epigenome. It is crucial to emphasize how positive incentives such as enriched health enhancing conditions like conducive social interactions, physical activities, and conducive surroundings can promote and improve epigenetic marks. On the other hand, severe stress, famine, locust invasion, or other agricultural chemicals can permanently damage or alter some marks (Portela & Esteller, 2010; Rivera & Bennett, 2010).

In many parts of the world, ignorance about scientifically valid medical care of the pregnant females leads to ingestion of pica and other tasty but lethal nonfood or food items. These unhealthy food products can create lasting precursors for the onset of health challenges for any child. Pica, poor diet, and other stressors can serve as the etiological agents of neurological disease in the newborn.

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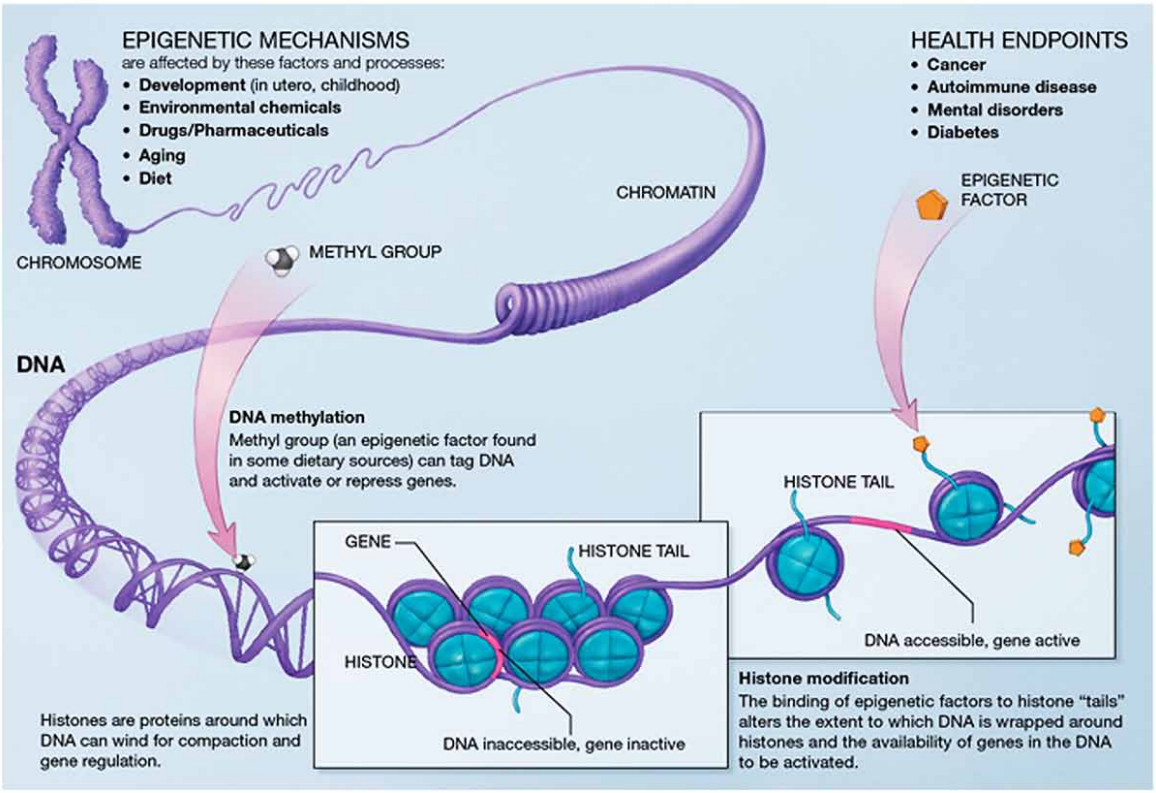
Figure 1. Epigenetic mechanism
Source: *http://www.nih_2014*



The Pregnant Women and the Health Status of their Unborn Babies

Worldwide, pregnant women are encouraged to abstain from tobacco, cocaine, chemical exposures, alcohol, and stress-related activities. However, accidents periodically occur. What of the alcoholic who drinks every day and within the first trimester of the incipient stage of pregnancy she did not recognize that she had become pregnant? What of the crack cocaine addict who has become impregnated and unfortunately incarcerated only to attempt to hide her pregnancy and cocaine use behavior from law enforcement authority? The majority the neurological problems, which many children suffer from, are associated from expose to intrauterine health hazards, environmental assault, and genetic abnormalities associated with epigenetics

The maternal challenge to enhance the health status of the newborn is conscientious efforts to breast feed her child because; epidemiological evidence supports breastfeeding as an effective intervention to enhance mother–child health. Of crucial importance is the timely initiation of breast feeding (within one hour after birth), exclusive breastfeeding for the first six months, and continued breastfeeding until the child is at least 24 months old (1–6–24 model) (Chien, 2007; Okolo et al., 1999; Lee, 2013). Breastfeeding involves mutual benefits for the mother and her baby. For the baby, breast milk is highly nutritious, providing an excellent source of energy, protein, iron, and vitamin A, as well as antibodies and a variety of bioactive components to provide protection against disease (UNICEF, 2010). Children

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who are breastfed have a decreased risk of life-threatening illnesses such as diarrhea, otitis media, and respiratory infections, and a decreased risk for chronic diseases in later life(UNICEF, 2004; Dennis, 1994). If initiated soon after birth, breastfeeding assists the mother's uterus to contract, facilitating the expulsion of the placenta and reducing the risk of severe bleeding and infection (Dennis, 2002). Other benefits include decreased risk of subsequent breast and ovarian cancers and hip fractures and the child is fortified to withstand imminent environmental challenges.

Epigenetics

This process involves the mechanisms that turn individual genes on and off in a cell. In genomic science, the concept of epigenetics was recently revived, owing its relevance to the global understanding of genomics and the human phenomenon of pregnancy. About 50 years before Charles Darwin published his famous book *On the Origin of Species*, Jean-Baptiste Lamarck became the first philosopher-scientist to propose that the surrounding conditions and human environment, which we now consider as the haplotype characteristics can modify an individual's lifetime behavior. In an astonishing manner such behaviors can be passed on to the offspring (Lamarck, 1809). According to his theory, a person's makeup can change within a generation, depending on environmental factors. In recent times, his postulate became the basis of the underlying principles of epigenetics. In fact, it provides a conceptual framework for scientist to analyze and attempt to find out how and in what mechanisms that environment shape or influence an organism and its offspring. There numerous instances whereby people who previously lived in medically isolated villages of West Africa for upward of ten to twenty years, on their remigration to their biological communities and places of birth were perceived as foreigners in their own homes. There characteristic features, accents, and other biological and psychological behavior had changed.

The Cell and DNA

In order to develop permeating insights into epigenomics, it is relevant to understand how the human body consists of trillions of cells. These cells contain the entire genome. The complete set of inherited genetic materials is encoded in our deoxyribonucleic acid (DNA). During reproductive behavior, the parents' sperm and egg (DNA) combine to contribute a genome entire amount of genetic information to the fertilized embryo. Scientifically, since the same amount of genetic information is present in the cells which eventually make up an organism, humans are usually at risk of having single-gene diseases inherited from parents or carry complex diseases which parents have in their genes. Global genomic epidemiology attempts to assess the frequency of occurrence of specific genetic and complex diseases in several parts of the world, whereas genomic epidemiology is the link uniting the intersection between genetic and molecular epidemiology. It focuses on the determinants and distribution of diseases and injuries in human population (Ebomoyi, 2009).

The DNA–Deoxyribonucleic Acid

DNA and RNA are chain-like molecules made up subunits described as nucleotides. In fact, several biochemical facts were already known about the DNA and RNA by mid-1940. By the time that it was recognized by many biologists that DNA was the genetic material and it involved the essence of human life, several scientists became engrossed attempting to characterize the structure of the DNA. One of

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those scientists was Linus Pauling, a theoretical chemist at the California Institute of Technology. Pauling was already famous for many of his discoveries. Suffice it to state, that he characterized the alpha-helix, an important component of protein structure and the clinical distinctions between sickle-cell trait and the doubly homozygous autosomal recessive genes for sickle hemoglobinopathy or sickle-cell disease.

James D Watson's interest in bird watching took him to Cavendish Laboratories in Cambridge England to learn about the DNA. This trip brought him in contact with Francis Crick, a physicist who at the age of 37 years was interested in studying molecular biology. From this relationship, they were able to build a model of the famous DNA structure, which created the springboard for public health genomics after over forty-seven years.

Franklin's X-ray work strongly suggested that DNA was a helix. Also, it revealed some important information about the size and shape of the helix and the dimension of the space between adjacent bands and the distance in the helix. Watson and Crick ingeniously found a way to resolve this contradiction so as to satisfy Chargaff's rules at the same time. Their conclusion was that DNA must be a double helix with its sugar sugar-phosphate backbone on the outside and its bases on the inside (Weaver, 2008).

Since the characterization of the DNA, Watson and other biotechnologists have meticulously advocated the multiple applications of knowledge derived from DNA. The basis of this awareness recently led to the commercialization of genomic science. In fact, the molecular basis of the sugar–phosphate chain and the carbon and nitrogenous entities have been scientifically described.

The United States Department of Energy (U.S. DoE) and the NIH have placed under public domain huge volume of data on the accomplishment of human genome sequencing project. The gene chromosomes associated with various human diseases are provided and through the use of family history and pedigree, trained physicians can use this innovative science to treat their patients using precision medical intervention and a family history approach to prevent deadly single-gene disease such as hemoglobinopathies and complex diseases such as cardiovascular health problems (Figures 2, 3, 4 and 5).

From molecular biological analysis, in comparing RNA to DNA structure, the sugar present in RNA is ribose and in DNA it is deoxyribose. Also, the bases in RNA are adenine guanine, uracil, and cytosine. In DNA, the bases are adenine, guanine, thymine, and cytosine. RNA is not only single stranded, but it also has no helix. In comparison to the RNA, DNA is not only double stranded but it also has a helix (Figure 6).

Human Genome Sequencing and the Health Status of Children

At the outset of the human genome sequencing project (HGSP), between the late 1990sand 2003, the human genome sequencing consortium was charged with the responsibility of generating a high-quality reference DNA sequence for the human genome's three billion base pairs and to identify completely the entire human genes. After the accomplishment of the HGSP March 25, 2003, the International Human Genome Sequencing Consortium (IHGSC), and many organizations publicized the impact of this global scientific initiative. The predictions were that everyone will be affected by the spin-off benefits of technologies associated with genomics. In fact, six out of the G8 nations eventually established numerous biotechnology firms. These nations included United States, Canada, Germany, France, United Kingdom, and Japan. The understanding of human genetics and genomic profile has led to the development of intense research in innovative medicine, agriculture and the various biologic sub disciplines, which could illuminate the inner workings of the entire biological systems.

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Figure 2. a)The DNA structure and the position of thymine, adenine, cytosine, and guanine. b) The double-stranded DNA
Source: *http//www.US_Department of Energy, 2014 Retrieved July, 2014*

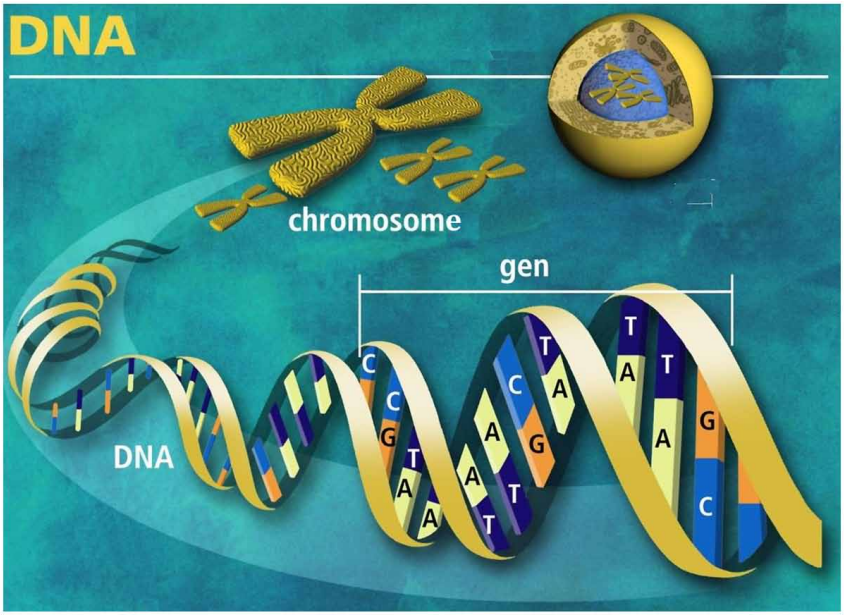

Figure 3. Dr. Ebomoyi presents the importance of DNA in human growth and development

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Figure 4. The key distinction between RNA and DNA

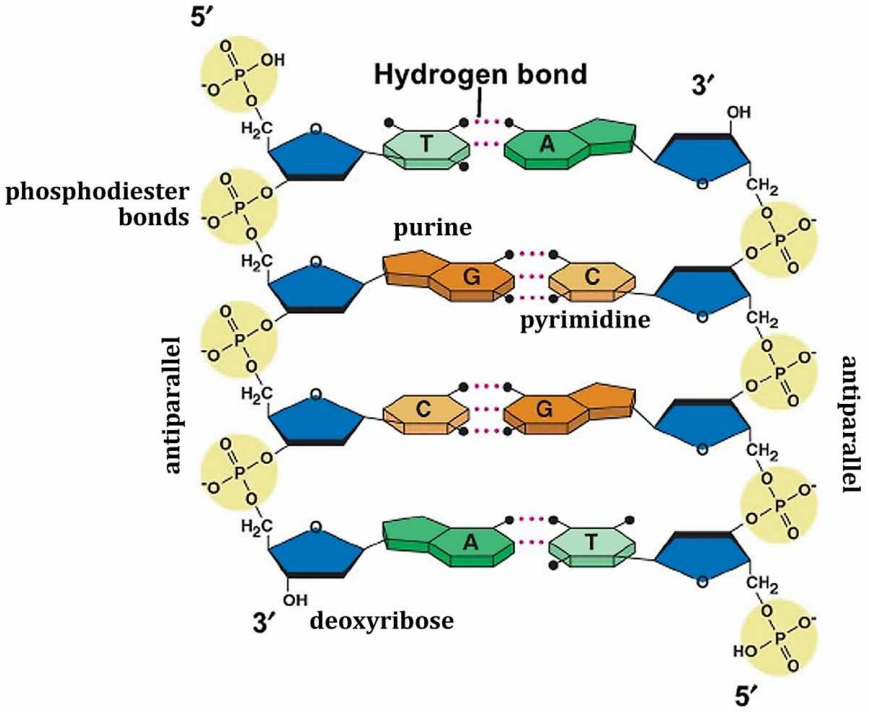

Figure 5.

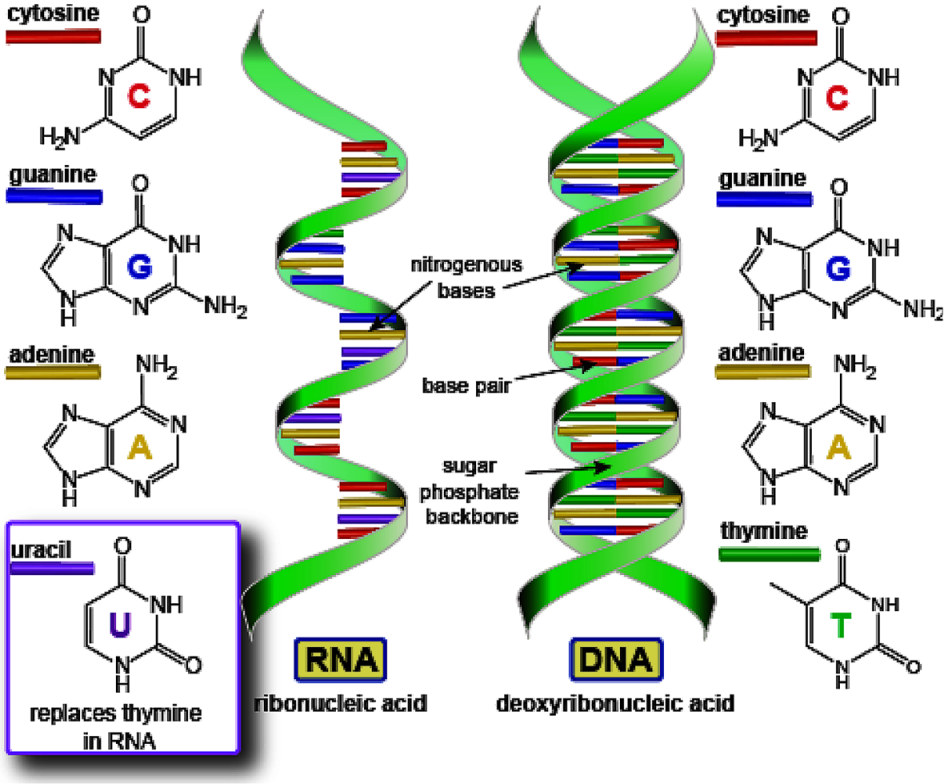

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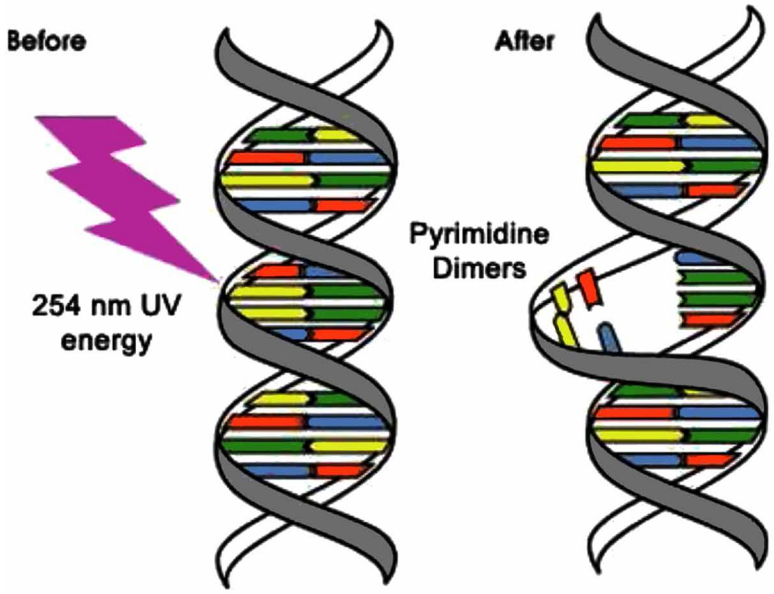
Figure 6. DNA before and after exposure to 254nmUV energy



In the G8 nations, the practical value-added impact of genomics are being realized in commercialization of genomic science, medical sciences, agriculture, forensics, identification science, microbial ecology, toxic waste management, anthropology, sociology, and human migration patterns. Currently, it has become blatant that the international scientific community and world leaders have come to grips that genomics and biotechnology will continue to have profound impact on engineering, biotechnology, computer science, mathematics, ethics, religion, law, agriculture education, pharmaceuticals, instrumentation, nuclear medicine, forensic science, bioremediation, biofuels, and journalism.

The enormous benefits of genomic have been associated with the comprehensive understanding of the most of the leading causes of death in United States and the other G8 nations and the adoption of precision medicine to alleviate the major disease burden of the elderly population. With many school-age children faced with childhood health problems and genetic diseases, the requisite attention has not been devoted to tackle those intractable environmental exposure of children to diseases from the indiscretion of parents, and environmental toxins and neurological and psychological challenges which exposed them to inability to confront the challenges that are associated with schooling in a high-tech and competitive world.

Childhood Diseases in Developed Nations

School-age children are very susceptible to whooping cough, diphtheria, measles, chicken pox, and pertussis. In many of the industrialized nations, children are immunized against many diseases to ensure that school absenteeism rates are reduced. The family pediatrician is always very alert about the child's immunization records.

The three components of school health program illustrated in Figure 7, consist of health services, health instruction and healthful school living. Within the realm of health services are specific appraisal,

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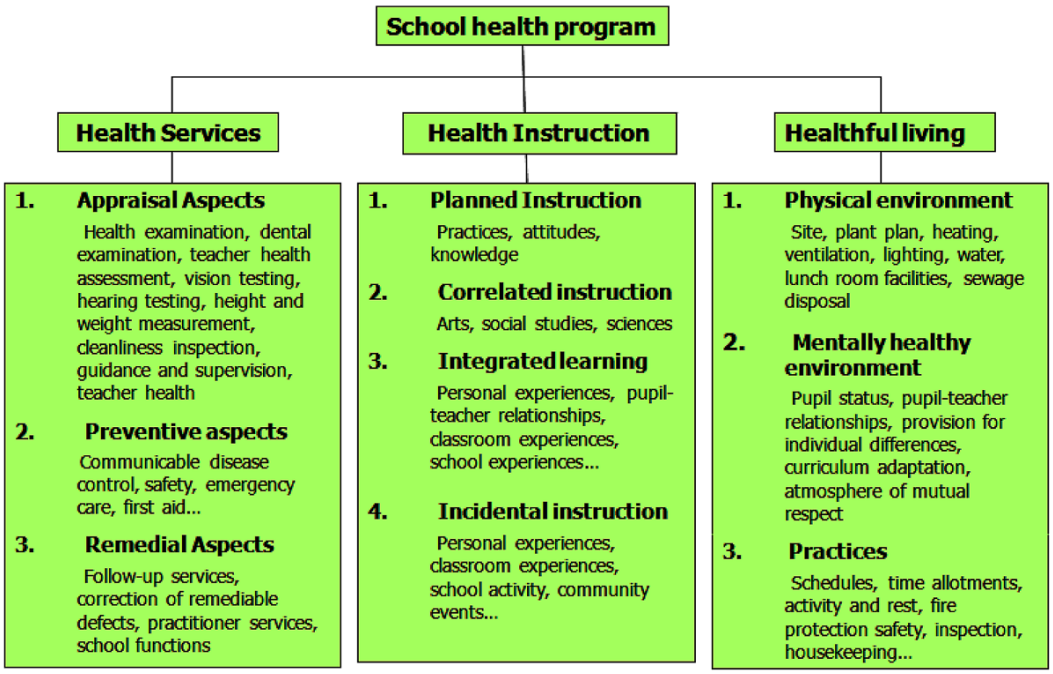
Figure 7. The Three key components of the school health program
Source: Creswell WH, School Health Practice, St. Louis, Mosby Press 1993; p.40.



which involves screening and remedial activities. This component involves follow-up activities to correct remedial defects.

Regarding health instruction, the key contents are planned instruction, integrated learning and incidental instruction which consist of planned instruction and unplanned community events. Healthful school living focuses on the physical environment around the school, mentally healthy environment, and specific practices for the safety of school-age children. Children need to play. Playing enhances the neurological development of children. They become used to reciprocal relationships, group dynamics and the ability to function harmoniously in groups. Reports from an NIH psychologist, Suomi (2012) demonstrates how play can help boost brain function, increase fitness, and improve coordination and teach cooperation.

Also, Golinkoff (2012), language expert at the University of Delaware, also emphasized how without playing, school-age children could lack social skills. Play assists young children to master their emotions and make their own decision. It also teaches flexibility, motivation and confidence.

Currently, genomic applications in school health program transcend the three components of school health program. But by far, most important are the variousscreening programs required to identify the onset of single-gene diseases, which can be corrected with innovative medical interventions.

The major genetic diseases listed in Table1 are common in many communities worldwide. With the practice of consanguinity, and endogamous marries in so many nations, the frequency of genetic diseases will continue to increase. Hence we must continue to recommend the integration of family history approach to public health genomics and assiduously elicit information from the extended family groups to instruct males and females of childbearing age about the strategies to reduce the occurrence of many

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Table 1. List of the most common genetic disorders (single-gene and complex diseases)

	Description	Genetic Link	Incidence of Prevalence
Congenital Heart Defects	Defects in heart function or structure	Multifactorial	5,700
Colon Cancer (Familial Adenomatous Polyposis	Inherited predisposition to colon cancer	Single gene	5,000
Polycystic Kidney Disease	Kidney cysts resulting in death in infant, or another version resulting in varying effects on midlife adults	Single gene	4,000
Hemochromatosis	Treatable metabolic disorder of excessive iron accumulation in the body; varying degrees of severity	Single gene	2,500
Neural Tube Defects	Neural tube fails to close, resulting in anencephaly, hydrocephalus, or spina bifida	Multifactorial	2,000
Hypercholesterolemia	Hereditary high cholesterol		2,000
Diabetes, Type 1	Insulin-dependent diabetes	Single gene	2,000
Breast/Ovarian Cancer	An inherited form of cancer in breasts and/or ovaries found in 1 in 270 women over 50 years in the U.S.	Multifactorial	1,850
Cleft Lip/Palate	Lack of closure in the upper lip and/or palate	Chromosomal	1,000
Down Syndrome	Disorder resulting in mild to severe mental retardation	Single gene	1,000
Noonan Syndrome	Heart defects, mental retardation, hypogenitalism	Chromosomal	700
Fragile-X Syndrome	Disorders resulting in mild to severe mental retardation	Single gene	680
Sickling and Related Blood Disorders	Including sickle-cell anemia, thalassemia, and others	Chromosomal	500
Cystic Fibrosis	Lung disorder usually resulting in death by late twenties	Single gene	400
Alpha 1-Antitrypsin Deficiency	Metabolic disorder, which may result in liver cirrhosis and emphysema	Single gene	350
Trisomy 18	Extra #13 chromosome results in abnormal brain and heart, deafness, with death in first year for over 80%	Chromosomal	333
Neurofibromatosis (Type I)	Disorder resulting in varying degrees of deforming tumors	Single gene	330
Waardenburg Syndrome	Results in deafness and other features	Single gene	250
Congenital Primary Hypothyroidism	Mental, skeletal, and growth retardation, sluggishness	Multifactorial	250
Turner Syndrome	Results in short stature, sexual immaturity in females	Chromosomal	200
Ichythyosis	Multiple forms of scaling skin disease	Single gene	200
Trisomy 13	Extra #13 chromosome results in abnormal brain and heart, deafness, with death in first year for over 80%	Chromosomal	200
Duchenne Muscular Dystrophy	Very disabling muscle loss in male children; results in death by age 20 for most	Single gene	140
Hemophilia A	Blood disorder resulting in excessive bleeding	Single gene	110
Achrondroplasia	Short-limbed dwarfism	Single gene	100
Marfan Syndrome	Connective tissue disorder with varying degrees of severity	Single gene	100
Tuberous Sclerosis	Epilepsy, mental retardation, and features	Single gene	100
Congenital Adrenal Hyperplasia	Dehydration and weight loss, virilization, many die in infancy	Single gene	67
PKU (phenylketonuria)	Metabolic disorder, which may cause mental retardation if untreated	Single gene	60
Huntington Disease	Results in severe mental and physical incapacities in midlife	Single gene	50

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of the lethal genetic diseases such as Tay–Sachs, sickle-cell anemia, and other deadly genetic diseases. The physical and deformed shapesof these abnormalities are illustrated in Figures 8 and 9.

The Coordinated School Program

According to the CDC (2014), the coordinated school health program was advocated as:

…a critical means to improving both education performance and the well-being of our young people and the adults they will become. School health programs typically have four overlapping, interdependent goals. These goals are most effectively and efficiently achieved when all the goals are addressed simultaneously through a coordinated approach that purposefully integrates the efforts and resources of education, health, and social service agencies.

In a systematic faction, the areas were addressed, as shown in Figure 10.

The following is a summary of the key goals and strategies proposed by Lloyd Kolbe (2002) in "Education reform and the goals of modern school health programs."

Increase Health Knowledge, Attitudes, and Skills

School health instruction helps young people improve their health knowledge. For example, students learn nutrition facts and how to read product labels so they can make healthy eating choices.

Figure 8. Illustration of Down syndrome and neurofibromatosis

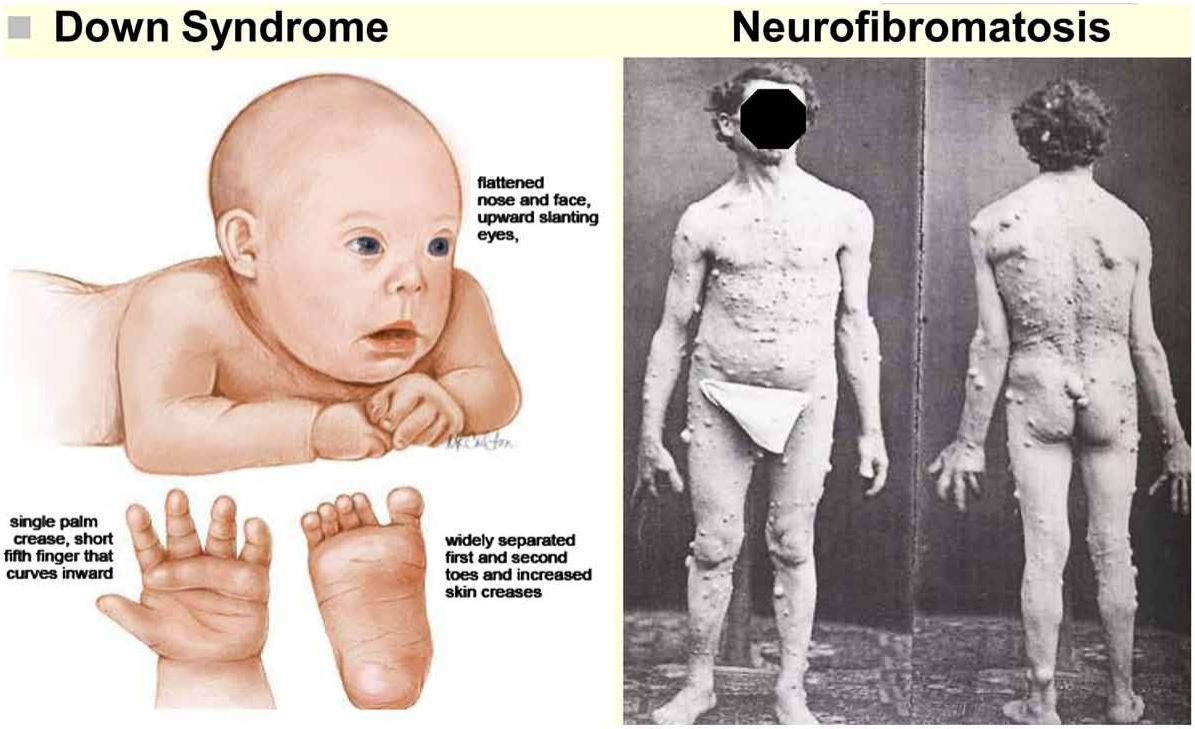

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Figure 9. Multiple genetic diseases –hemophilia and phenylketonuria (PKU)

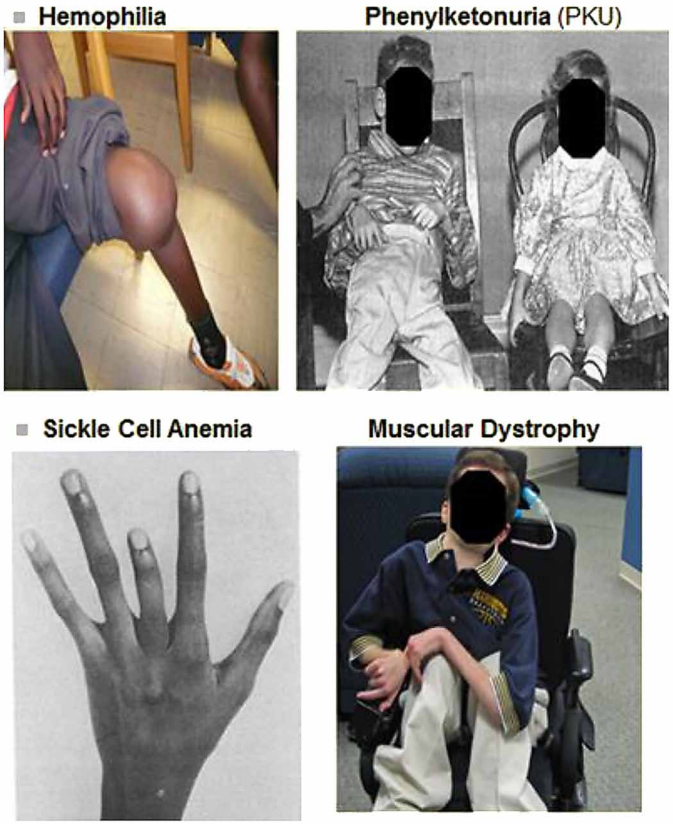

Figure 10. CDC coordinated school health program

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School health instruction helps young people develop related life skills, including communication and interpersonal skills, decision making and critical thinking skills, and coping and self-management skills. For example, students learn a variety of ways to refuse alcohol or tobacco and practice those skills.

Improved communication and life skills can positively affect students' health decisions and behaviors and promote effective citizenship.

Increase Positive Health Behaviors and Health Outcomes

School health programs can be designed to help youth avoid specific risk behaviors, including those that contribute to the leading causes of injury, illness, social problems, and death in the United States; alcohol and other drug use; tobacco use; injury and violence; unhealthy eating; physical inactivity; and sexual risk behaviors. These behaviors, often established during childhood and early adolescence, are interrelated and can persist into adulthood.

Specific school health interventions have proven effective in significantly reducing these risk behaviors, improving health promoting behaviors, and improving health outcomes.

School health programs can also create safer schools and positive social environments that contribute to improved health and learning.

Improve Education Outcomes

Students who are healthy are more likely to learn than those who are unhealthy. School health programs can appraise, protect, and improve the health of students, thus reducing tardiness and absenteeism and increasing academic achievement.

Students who acquire more years of education ultimately become healthier adults and practice fewer of the health risk behaviors most likely to lead to the premature onset of illnesses and death.

Improve Social Outcomes

School health programs can provide opportunities to build positive social interactions and foster the development of students' respect, tolerance, and self-discipline. For example, conflict resolution and peer mediation programs help students learn how to listen and solve problems.

School health programs can reduce delinquency, drug use, and teen pregnancy, increasing the likelihood that young people will become productive, well-adjusted members of their communities.

School health programs can provide access to community programs and services that can help students contribute positively to their family, school, and community (Kolbe, 2002, pp. 4-11).

Innovative Genomic Science Interventions

By the fall of 2003, Dr. Richard Carmona, the first Hispanic Surgeon General of United States had advised members of the National Children federal advisory committee and the large eclectic audiences of scientists from across nation about the singular most important application of family history interventions in addressing our major health problems nationwide. Since the accomplishment of the HGSP, the relevance of family history taking has become very important in the clinical care of school-age children and adults with both single-gene and complex diseases.

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Epigenetic Factors

From the recent publications of the NIH, modern genome epidemiologists and health physicians and health educators now recognize that an eclectic screening programs are required to ensure that some of the intrauterine assaults on the school-age child should be made known through a congenial family history data collection in a very conducive, and thought provoking manner without being judgmental. It is the role of the mother and the entire parents to elicit if the school-age child was conceive under stressful circumstances, what the baby really wanted? Was the baby conceived during stressful financial circumstances? Are there inklings about the genetic diseases and complex diseases such as cardiovascular diseases and any type of lymphoma that grandparents and the biological parents of the school-age child suffered before and during the conception of the school-age child?

Single-Gene Diseases

Single-gene diseases are inheritable diseases that are quite common worldwide. When parents inherit the traits of these single genetic diseases, the probability that they could transmit these lethal genes to their newborn children can be quite high. Suitable illustrations are those of sickle cell and Tay–Sachs, which were comprehensively discussed and analyzed in Chapter 4.

Recent scientific breakthroughs in genomic science have identified the gene chromosome 1 in patients with Tay–Sachs disease, and chromosome 7 was isolated in patients with cystic fibrosis. In patients with the double homozygous recessive genes the chromosomes, recognized were twelve, which had been mapped and treated in patients with PKU. The long arm gene chromosome 13 has also being identified in Wilson disease patients.

With these monumental responsibilities, it seems axiomatic that the role of the school health educators, physicians and the public can no longer be trivialized. Hearing, visual and cognitive impairment are germane to the ability of the school-age child to learn. Early identification of hearing, visual and learning deficits are pertinent to the ability of the school-age children to learn and become economically productive adult in any society. It is quite crucial therefore, for these defects be diagnosed and treated early so as to enable the student to make meaningful adjustment in processing academic information (Gunder&Scott, 2011).

Hearing Impairment

Improvement in neonatal screening for hearing impairment has been accomplished through the HGSP because it was recently detected that mutation in the gene for connexin 26, accounting for 40% of all cases of childhood hearing loss, with a carrier status of 3% in the United States population. A single mutation has been associated for several cases of hearing deficits in a mixed U.S. population. Among the 2% of handicapped students with significant hearing deficit their ability to enunciate could be impeded, because speech patterns depend on hearing ability. Pediatricians can now recommend two-tiered screening in which audiometry assessment is followed by DNA testing for mutation in the connexin 26 gene to detect and treat hearing loss. Early detection will facilitate the possibility for aggressive intervention to significantly improve the client's language skills, and provide cochlear implant screening for hearing difficulties and deafness is a major approach to improving the cognitive skills of school-age children (Creswell, 1993).

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Visual Impairment

A thorough understanding about the extent to which mutations in the rhodopsin gene can influence what and how we see objects. A broad array of amino-acid substitution in rhodopsin can lead to partial or total blindness. From genomic science, at least 29 different single substitutions in the rhodospin gene are the etiological agents for autosomal dominant visual impairment described as retinitis pigmentosa. The incipient sign of this disorder is the early loss of rod function accompanied by slow progressive degeneration of peripheral retina. Retina pigmentation tritanopiared color blindness unequal crossing over and blue cone monochromacy are visual impairment involving mutations in humans. Although about 30,000 individuals in the U.S. population suffer from severe vision difficulties, unless impairment is very severe (beyond 20/70 on the Snellenchart), the elementary pupils can be accommodated in the traditional classroom. Screening of children is germane to their learning activities and comprehensive cognitive skills. Several simple resources exit to accommodate them by making available to them large-type books printed on low-glare paper, use of special dark pencils or felt pens, large-faced type and special computers and searing arrangements in the classroom (Creswell, 1993).

Cognitive Deficits

There is an extricable linkage between screening for hemoglobinopathies, hearing impairment and deafness, vision difficulties and the cognitive abilities of the school-age child. Although severe mental retardation can be a heterogeneous trait in children, it can be caused by many factors ranging from genetic and environmentally induced causes. In fact, one cause being homozygous for a mutation that depletes the activity of a gene encoding such enzyme as phenylalanine hydroxylase.The enzyme that normally converts the amino acid phenylalanine and after birth this build up, interferes normal brain development. Children born without the ability to make phenylalanine suffer from a genetic abnormality described as PKU. Through screening, medical geneticists are able to detect the mutant genotype responsible for PKU. Recommendation of specific procedures to eliminate phenylalanine from the child's diet can prevent mutual retardation (Creswell, 1993).

The development of educational programs for mental retardation and learning difficulties demands an interdisciplinary effort among health educators, physicians, and parents. An individualized educational program (IEP) for the school-age child could involve the collaboration of the child's family, physicians, psychologists, and those teachers who are specialized therapists in the areas of various deficits and disorders(Creswell, 1993).

Genomics in Environmental Health

The environment is the physical and biological characteristics of an area. Recently developed from genomic science is the understanding of microbial organisms and their complex functions in bioremediation and the onset of environmentally induced diseases. Microbes which are nature's most abundant, simplest organisms are ubiquitous, being able to thrive under extreme conditions of heat, cold, pressure and even radiation. It is therefore axiomatic that the ability of this planet to sustain life is mainly dependent on microbes, which to a large extent are not pathogenic (Creswell, 1993).

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The U.S. DoE (2014) has emphasized that microbes are the foundation of the biosphere which is made up of lithosphere, atmosphere and hydrosphere. Microbes control the Earth's natural biogeochemical cycling, affect the nutrient level and productivity of the soil, quality of water and stability of global climate. At present, scientists know less than 1% of these microbes and their sophisticated biochemical benefits can be used to transform various waste products, organic matter, cycling nutrients and as constituents of photosynthetic process, converting sunlight energy and storing carbon dioxide from atmosphere[22]. Insights into microbial genomics have led to the application of bacterial and other microbial agents in tackling various environmental health problems. Based on the current genomic information and genetic engineering, with many toxic waste sites which contain a myriad of contaminants, knowing a bacterium's genome, it is possible to develop "designer bacteria" that possess unique and appropriate ensemble of engineered genes, which can degrade those compounds in such wasteland or landfills. The anticipated benefits of genomic research, most pertinent to environmental health include:

- Rapid detection and treatment of environmentally induced microbial diseases;
- Development of new energy sources (biofuels);
- Monitoring of air, land, and water environment to isolate pollutants; and
- Protection of citizenry from biological and chemical warfare and cleanup of toxic waste safely and efficiently (U.S. DoE, 2014).

Prospects for Genomic Science Applications

With the availability of cutting edge biotechnology and genomic science it is prudent, to predict that genetic variation within the human genome can be characterized and charted for many ethnic groups. Through the use of molecular techniques, microbial genomes can be explored for energy and the environment with the salient goals of identification of the protein machines that perform critical life functions, decipher the gene regulatory networks that control these gadgets and the functional repertoire of complex microbial communities in their natural environment. In addition, it can be predicted that the use of bioinformatics could be integrated, understood, and the copious amounts of data derived used to model complex biological systems.

The Role of Epigenome and Epigenetic Influences on the Human Aging Process

At the outset of this chapter, we defined epigenome as the mechanisms that turn individual genes on and off in a cell (NIH, 2014). Before delving in a detailed analysis of the process of epigenome and methylation, we must remind our readers about the universal definition of health advanced by the WHO. In assessing the continuity of human life cycle, the WHO recognized this challenge by defining health "as complete state of physical, mental and social well-being and merely the absence of disease or infirmity." The renowned late Ethel Shanas, professor emeriti of gerontology at the University of Illinois at Chicago, Illinois had instructed his disciples that when it comes to the elderly Health can be redefined as "the mere ability to participate in social affairs." No sooner did we quiver than she listed all the health problems which those over 65 years old are exposed to and endure everyday due to weathering and the ever-changing epigenome.

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Leading Causes of Death among the Elderly

There numerous diseases that occur among the elderly population owing to their weakened immune system, the process of weathering and the impact changes in human genome. From an epidemiological perspective, the leading causes of death among adults over the age of 65 years are not necessarily the leading causes of death in other age cohorts, mostly those under 30years, of age which attests to the relevance of epigenetic factors. However, regarding the general population, to a large extent, the most common causes of death are about the same for the elderly.

Recent development from genomic interventions, have created improved insights about the most effective means of preventing, diagnosing, and treating these health problems. It is important to understand that many of these diseases can be prevented and treated. However, the at-risk patients must know when and where to seek treatment and the mechanism of engaging your physician, transparently inform your physicians about your family history and devoid which medication you believe you are not able to tolerate genetically. Your biomedical data are relevant to the process of your reaction to pharmacogenetics.

Bear in mind, that there are medications that many physicians correctly prescribe in the clinical setting that periodically will lead to patients' death or additional complications of your health problems. This is the singular most important reasons which protecting your life is your personal responsibility. You must inform your physicians about your allergies and those medications that create terrible side effects and complications when used by people who share intra-familial DNA with you.

1. **Heart Disease** is the leading cause of death among those who are over the age of 60 years. Heart disease includes conditions such as heart failure, heart attack, and congestive heart disease, atherosclerosis, and cardiac arrhythmia that can cause the heart to beat ineffectively and impair circulation. Heart disease is associated with diabetes, high blood pressure, improper diet, and a lack of exercise. The major risk factors associated with heart disease are smoking, the consumption of a diet high in lipids, the use of excessive amounts of salt, a sedentary lifestyle, excessive amounts of exposure to stress, age over 40 years, and genes associated with complex disease, such as cardiovascular disease.
2. **Cancer** is reported to be the second leading cause of death among the elderly. In men, lung cancer and prostate cancer are quite common, whereas among the elderly female population, breast cancer, colon cancer, and skin cancer are highly prevalent. There other cancer-related death statistics that occur at a high rate in the adult population. They include malignant blood and bone marrow cancer and leukemia. According to the American Cancer Society (2014) and other epidemiological findings, cancers occur at a higher rate among those 60 years and older because of weathering, years of exposure to carcinogenic agents from places of gainful employment, and other environmental exposures.
3. **Cerebrovascular disease:** The development of Waulfering carbonate or Coumadin has had an outstanding impact regarding the treatment of stroke. Cerebrovascular disease has such etiologies that either involves a clot or a blockage that shoots off the smooth blood flow to a part of the brain or by hemorrhage. In very serious cases, there can be such symptoms as immobility or death of brain cells that can cause paralysis, speech disorders, leg edema, and immobility.
4. **COPD:** Chronic obstructive pulmonary disorder (COPD) weakens the ability of the lungs to exchange carbon dioxide for oxygen. With the worsening of this disease, the patient becomes unable to maintain effective breathing process the patient can easily feel congested, uncomfortable and

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has to work harder and harder to breath, often feeling as if they are suffocating. Excessive smoking habits and feeding on lipids can complicate this condition as well age. Retiring to bed with plant-based nutrients with high amount of photochemical nutrients can ease the process of breathing among many patients.

5. **Pneumonia:** With many elderly patients again due to age, the immune system becomes weak, and weathering plays a key role in the deterioration of the respiratory process and the functioning of the lungs. In the inclement winter months, most elderly subjects suffer from chronic diseases such as diabetes heart disease and respiratory conditions. The flu and pneumonia shots are recommended for all adults over the age of 55 years to help prevent this killer.
6. **Diabetes:** Adult-onset diabetes is a chronic disease that weakens the immune system and can aggravate the risk of stroke, heart disease, and other circulatory problems. There are many associated conditions with diabetes retinopathies, slow healing infections, and increased levels of high blood pressure.
7. **Accidents:** In the elderly, visual impairment associated with cataract and glaucoma among the elderly create increased risk of accident due to their imbalance, problems with their impaired visual acuity, and slow reflexes.
8. **Septicemia:** In several rural environments and sordid communities septicemia, which involves the presence of pathogenic bacteria in the blood, can create life-threatening problems and possibly death for the elderly.
9. **Nephritis:** Kidney-associated problems in the elderly periodical stem from kidney infections associated with diabetes.
10. **Alzheimer's:** This disease involves forgetfulness and sometimes an inability to recognize your family members and those with whom you have spousal relationships. Innovative genomic medicine has confirmed the genes that are associated with Alzheimer's disease.

The Aging Phenomenon

In the United States and other industrialized nations, the population of 65 years and over continues to increase dramatically from census enumeration. In the United States, it is estimated that one quarter of the population will exceed 65 years of age by 2050.

Sedentary lifestyle continues to serve as the risk factor for acute and chronic diseases and disabilities. Physical inactivity has been indicted for functional decline and the high prevalence of several chronic and degenerative diseases.

A plethora of studies have revealed that with increasing age and intra-familial observations, the deterioration of physical function and neuromotor performances are associated with an increased frequency of falls and disability(Ebomoyi, 2011;Hadsell et al., 2014).

As humans age the DNA code remains the same; however, the epigenome undergoes changes as a result of methylation. The methyl tags are added to the cytosine at the sequence CG and they silence the genes by blocking the transcription mechanism from binding to the DNA. Epigenome modifies the shapes and physical structure of the genome. We must reiterate that the genome includes all the genes present within the DNA

The aging process is a natural phenomenon. The key clinical and behavioral observation from the weathering process is the decrease in maximum cardiac output, a reduction in lung performance, and the loss in skeletal muscle mass. There is a reduction in insulin sensitivity and a decrease in myoglobin

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in muscle cells. There is the incipient onset hearing impairment, and a reduction of bone density and loss of minerals. While the elderly continues with an enhanced long-term memory, there is a decline in short-term memory (Figures 11 and 12). Those elderly cohorts in their late eighties and nineties are able to recall vividly the combatant military assault of the Second and, yet they cannot remember where they placed their car keys just five minutes ago. Therefore, they experience a decline in short-term memory, changes in hormonal regulation, and a diminished integrity of their immune system (Ebomoyi, 2011; Hadsell, 2014).

In order for the epigenome to be able create its modification of the DNA, it relaxes the active genes and renders them easily accessible. To reiterate, the factors that affect the epigenome include diet or nutrition, toxins, physical inactivities, stress, smoking, psychoactive drugs, and living in a hostile environment.

Although we have observed many uniovular twins who experience identical chronic and degenerative diseases; the impact of the epigenome and its methylation effects on siblings appear more pronounced in fraternal twins and other siblings due the impact of environmental variables and haplotype features.

With the aging phenomenon, chromatin structure is not fixed being dynamic; it is subject to extensive developmental and age-linked modeling. Several immutable environmental changes contribute to weathering and the breakdown of nuclear, cell and tissue function. These unavoidable risk factors create the chain of events leading to aging and diseases and death (Seivy, Banumathy, & Adams, 2009). The histone-modifying functions are summarized in Figure 13.

At a molecular level, the methylation processes that lead to aging consist of grief, hostility, imprisonment in a detention camp, and other environmental factors. Rando(2011) has reported that the most widely studied epigenetic changes involve methylation of DNA, and post translational modifications of histones. However, histones are key components of nucleosomes, the fundamental repeating structures

Figure 11. The aging brain, which occurs from an aberrant epigenome

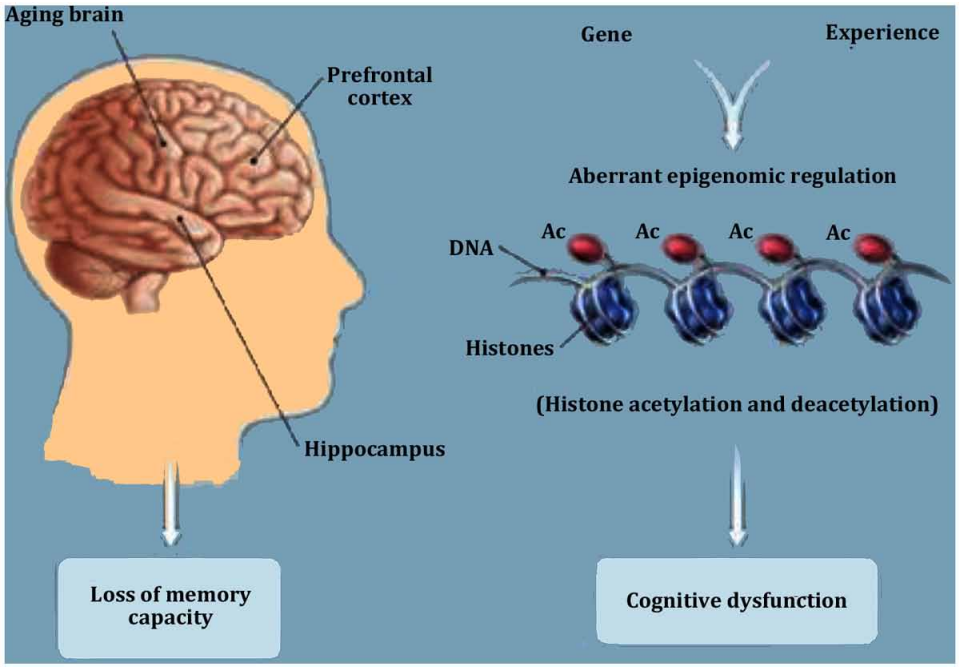

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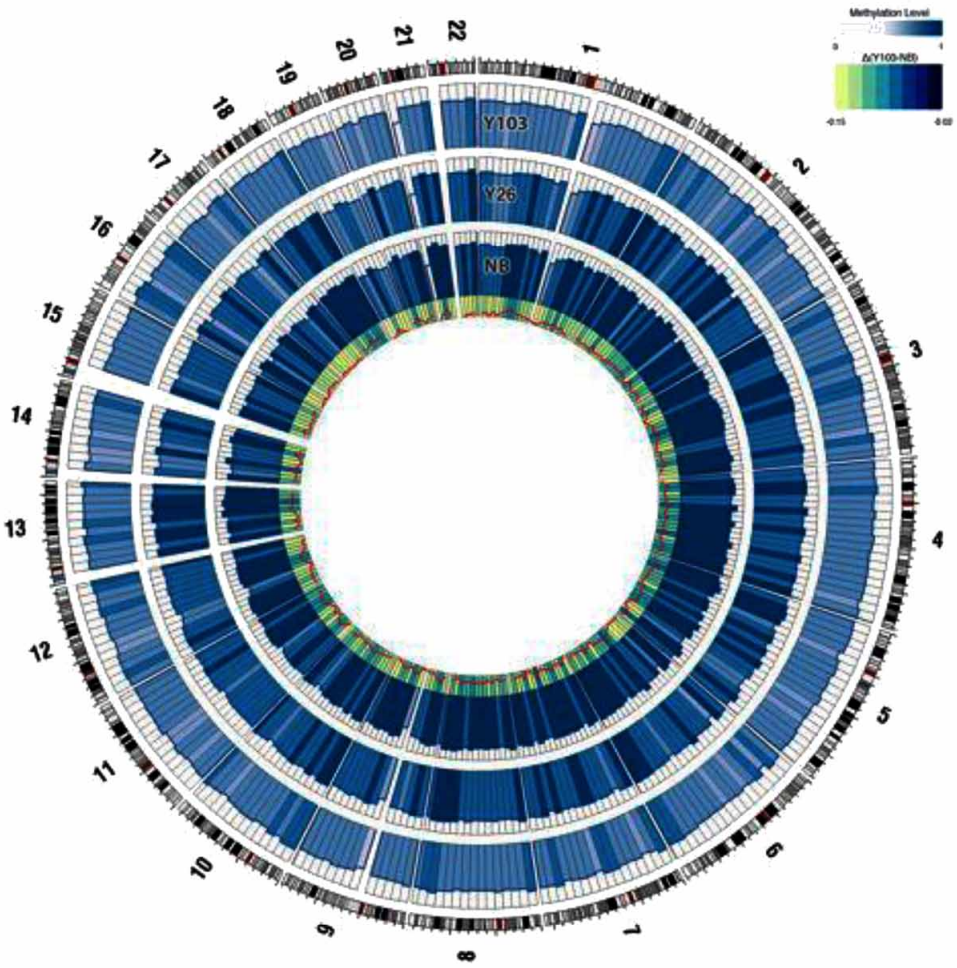
Figure 12. The process of methylation with aging



of chromatin composed of DNA wound around histone octamers. There are many posttranslational modifications of histones, but the modifications that are primarily studied in the context of epigenetic regulation are acetylation and methylation. These epigenetic marks on DNA and histones, and their corresponding methylases/demethylasesand acetylases/deacetylases, enable scientists to define and characterize the patterns of gene expression, which distinguishes one cell type from another, genes that are repressed versus those that are expressed in a given cell, and the code that governs which genes are poised to be expressed (Rando, 2011).

Aging Gracefully

In order to age gracefully, it is of vital importance that one engages in regular exercise on a daily basis. This is an achievable goal because in 1900, the elderly who were just over 65 years old were only 2% of the American population. Currently, there are over 100,000 centenarians in the United States who continue to maintain their independent existence.

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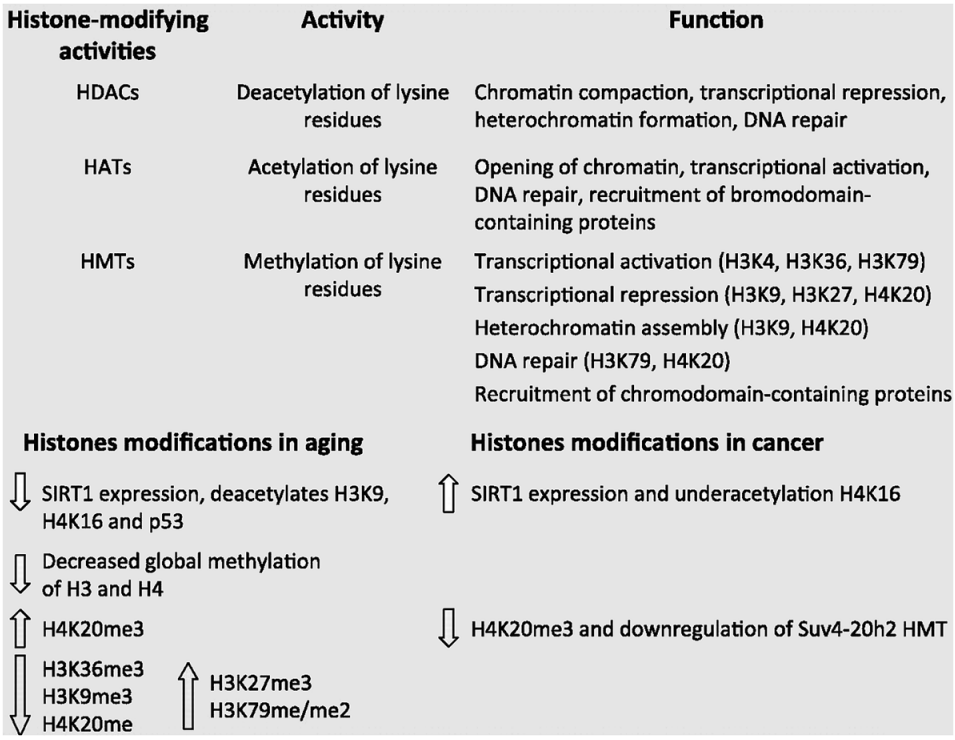
Figure 13. Histone-modifying activities and their functions



The elderly must be able to accept and control unavoidable stress. The strategy is to be discerning elderly who would not dabble or allowed to be lured into stressful undertakings which one is not emotionally and cognitively prepared to participate. The elderly must engage in increased length of sleeping uninterrupted by other. Those elderly who coexist with a caring partner usually live longer and the elderly needs to cherish gardening to cherish the beauty and mysteries of nature in the concentric round bulb of sunflower, the rose flower and the marvelous ways that tress and flower change their coloration on a seasonal basis. The elderly must cultivate the habit of learning innovative technologies. Even the various doctorate qualifications such as the MD, PhD, and EDD are not degrees in life. Therefore, one must continue to learn in life.

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Chapter 47
Employee Welfare Measures in Public and Private Sectors: A Comparative Analysis

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ABSTRACT

Employees' play a key role in the existence and growth of any organisation, therefore their welfare is essential. During the past few years, both public sector and private sector organisations have been contributing towards the employee's benefits and also increase their efficiency. Employees' welfare facilities include housing facilities, free medical facilities, retirement benefits, children and adult educational benefits, welfare measures for the employee's families, loan facilities, etc. If the organisations do not bother about the employees benefit, but expect efficient and high performance from them, it is a mere waste. So there is utmost need for the employee's welfare in any type of organisation. Organizations have to provide welfare facilities to their employees to keep their motivation levels high. A comparative study was undertaken to know the satisfaction level of the employees on the enforceability of various welfare measures in both the public and private sector organizations. The study also throws light on impact of welfare measures on the employees' performance.

INTRODUCTION

The term welfare suggests the state of well being and implies wholesomeness of the human being. It is a desirable state of existence involving the mental, physical, moral and emotional factor of a person. All these four elements together constitute the structure of welfare on which its totality is based. The term welfare is a relative concept; therefore it varies from time to time, region to region and from country to country. According to the traditional economic theory labour can be defined as, "A factor of production which consists of manual and mental exertion and receives some return by way of wages, salaries or professional fees" (Railkar, 1990). In a Resolution in 1947, the ILO defined labour welfare as "such services, facilities and amenities as adequate canteens, rest and recreation facilities, arrangements for

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travel to and from work, and for the accommodation of workers employed at a distance from their houses and such other services, amenities and facilities as contribute to improve the conditions under which workers are employed".

Employee welfare means anything done for the comfort and improvement, intellectual or social, of the employees over and above the wages paid which is not a necessity of the industry. Employee welfare entails all those activities of employer which are directed towards providing the employees with certain facilities and services in addition to wages or salaries. It includes monitoring of working conditions, creation of organizational harmony through infrastructure for health, general insurance, retirement benefits, housing facilities, and education benefits for employees and their children, and so on. Labour welfare implies the setting up of minimum desirable standards and the provision of facilities like health, food, clothing, housing, medical assistance, education, insurance, job security, recreation etc. Such facilities enable a worker and his family to lead a good work life, family life and social life (Sarma, 1996).

According to C.P John (1998) the term labour welfare in its broad connotation refers to a state of living of an individual or a group in a desirable relationship with the total environment - ecological, economic, and social. Welfare helps in keeping the morale and motivation of the employees high so as to retain the employees for longer duration. The welfare measures need not be in monetary terms only but in any kind/forms. Employee welfare is the key to smooth employer-employee relations. A proper organization and administration of welfare facilities can play a vital role in promoting better working conditions and living standards for industrial workers, and also increase their productivity, especially in developing countries (Kohli and Sharma, 1997). In order to increase employee welfare facilities, employers need to offer extra incentives in the form of employee welfare schemes, and to make it possible to pursued employees. The very logic behind providing welfare schemes is to create efficient, healthy, loyal and satisfied labor force for the organization. Welfare measures practiced in any organization, aims or should aim, at improving the working and living conditions of employees and their families.

The present study will present a comparative analysis on the implementation of various welfare measures and the employee's satisfaction level in both public and private sector organisations. It also focuses on the impact of the welfare schemes on the employees' performance and overall productivity of the organisation.

Public Sector and Private Sector

In general terms, the public sector consists of governments and its controlled or funded enterprises. This includes federal, provincial, state, or municipal governments, depending on where the people live. Privacy legislation usually calls organizations in the public sector a public body or a public authority. The private sector is usually composed of organizations that are privately owned and not a part of the government. These usually include corporations, enterprises, companies or business, regardless of size, ownership and structure. It may cover all sectors of the food, agriculture, forestry and fisheries systems from production to consumption, including associated services like financing, investment, insurance, marketing and trade.

In the present competitive environment the private sector organisations are playing major role in the overall development of the economy. So, it is essential to foucs on the welfare measures which enhances the employees quality of work life and also helpful in increasing the organizations productivity. Generally in public sector, the funds are organized and provided either by central or state government. So, they are able to provide the welfare measures effectively to their employees without any hesitation.

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In private sector, large scale organisations can pool more funds and provide the welfare facilities as effectively as public sector organizations provide to their employees. But, small scale organizations may have limited funds, so they may not be able to take care of the welfare facilities effectively, when compared with public sector.

OBJECTIVES OF THE STUDY

The present research starts with the objective of studying the various employee welfare measures provided by the private and public sector organizations in Visakhapatnam district, Andhra Pradesh, India. The objective of this study is:

1. To review the literature related to the employee welfare measures from various research findings and studies.
2. To compare and analyze the satisfaction level of employees on the welfare measures provided in their organizations.
3. To measure the impact of the welfare measures on the performance of the employees'.
4. To suggest measures for improving the overall welfare amenities in both the public and private sector organizations.

LITERATURE REVIEW

A study conducted by Saiyaddin (1983) examined the purpose and cost of non-statutory welfare activities for the organizations. Five public and six private sector organizations were selected for the study. The study brought out an important conclusion that the most predominant theme in the minds of organizations when they think of the voluntary welfare measures was not only the output and efficiency but also increasing loyalty and morale. In respect of cost, the study revealed, that the public sector organizations spend more on welfare activities, as compared to private sector. While public sector spends more on transportation and recreation, private sector was found to be spending more on housing according to the study. Burchardt (1997) examines the balance between public and private sector welfare activity in five areas: Education; Health; Housing; Personal Social Services; and Income Maintenance and Social Security.

In the Report of National Commission on Labour (2002), Government of India, made recommendations in the area of labour welfare measures which include social security, extending the application of the Provident Fund, gratuity and unemployment insurance etc. Karl Aiginger (2005) in his 'Labour market reforms and economic growth, the European experience in the 1990s', has specified the purpose of this paper is to reassess the relative impact of labour market regulation on economic performance. Inflexible labour markets combined with high welfare costs are often thought to be the main cause of low growth in Europe .The main result is that regulation impacts on growth, the impact of regulatory change is, however, less easy to demonstrate.

Mwiti (2007) points out that naturally welfare services may not directly relate to an employee's job but the presence or absence of the services is notable through employee performance, attitude, high or low labour turnover. Mishra & Manju (2007) in a study found that the police service provides essential

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service to the public in Kenya and thus their labour welfare activities need to address the same. Welfare services may be provided for matters concerning employees in terms of supplementing the income of the workers by providing services such as housing, medical assistance, canteens and recreation facilities. Binoy Joseph, Joseph Injodey, & Raju Varghese (2009) in their 'Labour welfare in India' studied in the article points out that the structure of a welfare state rests on its social security fabric. Government, employers and trade unions have done a lot to promote the betterment of workers' conditions. Morwabe (2009) argues that work environment should comprise of issues such as the working hours, employment policy, workers' health and welfare, workplace design and the general conduct of workers at the workplace.

According to Priti (2009) the role of welfare activities is to promote economic development by increasing efficiency and productivity with the underlying principle being making workers give their loyal services ungrudgingly in genuine spirit of co-operation and the general well-being of the employee. Shobha Mishra & Manju Bhagat (2010) in their "Principles for Successful Implementation of Labour Welfare Activities", stated that labour absenteeism in Indian industries can be reduced to a great extent by provision of good housing, health and family care, canteen, educational and training facilities and provision of welfare activities. Manzini & Gwandure (2011) studied that the concept of employee welfare has been used by many organizations as a strategy of improving productivity of employees especially in the mobile industry since work related problems can lead to poor quality of life for employees and a decline in performance. It is argued that, welfare services can be used to secure the labour force by providing proper human conditions of work and living through minimizing the hazardous effect on the life of the workers and their family members.

In a study by Chandrasekhar (2012), found that the employees are the assets of every organisation. The needs of the employee must be satisfied in order to meet the goals of the organization. Any organization would be effective only when there is high degree of co-operation between the employees and their management. Some measures are also suggested that help to increase the quality of work life of employees. Parul & Ashokkumar (2013) concluded in terms of proving that the different welfare provisions provided to the employees working in an organisation under Factories Act 1948 are having positive relation with the employee satisfaction, after analyzing the correlation between these two factors. The reason behind this result is that these are the factors that lead to satisfaction and if these facilities are not present, it sometimes leads to dissatisfaction.

EMPLOYEE WELFARE SCHEMES

In the recent years employee welfare activities have become a key factor for the overall development of the organizations. The organizations provide welfare measures to their employees to increase their efficiency and reduce absenteeism. Employee welfare schemes improve the employee-employer relations also. It helps to improve the recruitment process as the job becomes more attractive and more effective. Voluntary efforts for the welfare of the employees by the management may reduce the thought of government and others parties intervention in future. The employee welfare schemes can be classified into two categories viz., statutory and non-statutory welfare measures.

The statutory schemes are those schemes that are compulsory to provide by an organization as compliance to the laws governing employee health and safety. These include provisions provided in industrial acts like Factories Act 1948, Dock Workers Act (safety, health and welfare) 1986, and Mines Act 1962. The statutory welfare measures include the provisions such as, drinking water, facilities for sitting, first

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aid appliances, latrines and urinals, canteen facilities, spittoons, lighting, washing places, changing rooms, rest rooms, etc. The non-statutory welfare measures differ from organization to organization and from industry to industry. The non-statutory welfare schemes may includes personal health care, flexi-time, employee assistance programs, grievances policy, maternity & adoption leaves, medi-claim insurance scheme, employee referral schemes, etc.

In the study, implementation of statutory and non-statutory welfare schemes is considered to know the satisfaction of the employees and its impact on the employees' performance in various public and private sector organsiations.

RESEARCH METHODOLOGY

Research is a common parlance which refers to search of knowledge. This study describes the various employee welfare measures provided by different public and private sector organizations in Visakhapatnam district, Andhra Pradesh, India. The main objective is to know the various employee welfare strategies and to spotlight on the areas that the management of both the public and private sector organizations needs to pay attention.

The data presented for a comparative analysis on the welfare measures in public and private organizations was collected from both primary and secondary sources. The primary data was collected from the respondents i.e. employees through personal investigation (Questionnaires), direct personal observation and some information was gathered by interacting with Superiors/Executives of various public and private sector organizations. The secondary data was collected from various published sources such as, books, news paper publications, journals, company magazines, official websites of various public and private organizations, and some other sites are also searched to collect the relevant data.

The required data for the comparative study has been collected through questionnaire. This questionnaire was distributed to 300 employees' personally through emails and telephonic interviews to know their views regarding the welfare measures from different private and public sector organizations in Visakhapatnam district. These questionnaires were selected on random basis. The number of valid filled in questionnaires selected for the study from various organizations is 160, out of which 80 respondents are from public sector and 80 respondents from private sector. The collected data is used to compare the opinion regarding the satisfaction of the employees on the provision of welfare measures.

COMPARATIVE ANALYSIS OF WELFARE MEASURES

The employees of different public and private sector organizations are asked whether they are satisfied with the various welfare measures provided to them in their organizations. A questionnaire with both open-end and close-end questions was designed to get the required information from the respondents. The employees' are asked to rate on three point scale i.e. Satisfied (S), Not Satisfied (NS), and Not In-force (NIF). The questionnaire was framed in simple and clear manner such that it enables the respondents to understand and answer the question easily. Based on the questionnaire survey a comparative analysis and interpretation is made on various welfare measures provided by the public and private sector organizations.

A comparative opinion employees' satisfaction regarding the provision of statutory welfare measures in both public and private sector organisations are shown in Table 1.

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Table 1. Comparison of employee's opinion towards statutory welfare measures

Sl. No.	Perception		Public Sector			Private Sector		
			S	NS	NIF	S	NS	NIF
1.	Canteen & Store Facilities	#	64	13	3	42	26	12
		%	80	16	4	53	33	15
2.	Medical and Health Benefits	#	75	4	1	4	15	61
		%	94	5	1	5	19	76
3.	Drinking Water & Sanitary Facilities	#	65	6	9	60	17	3
		%	81	8	11	75	21	4
4.	Rest Room & Locker Facility	#	68	1	11	30	17	33
		%	85	1	14	37	22	41
5.	Workmen Compensation	#	65	6	9	22	41	17
		%	81	8	11	28	51	21
6.	Safety Measures	#	62	11	7	44	25	11
		%	78	13	9	55	31	14

From the comparision of employees' opinion towards the staturory welfare measures as shown in Table 1 and Figure 2 the following are the major findings.

1. It is found that regarding the canteen and store facilities 80% respondents are satisfied and only 16% are not satisfied in public sector, but in private sector 53% are satisfied and 33% are not satisfied. Whereas, only 15% from private sector and only 4% from private sector responded that these facilities are not in-force in their organisations.
2. Regarding the medical and health benefits 94% responded as satisfied in public sector where as only 5% responded as satisfied in private sector. 5% of employees are not satisfied in public sector and 19% are not satisfied in private sector. It is observed that in public sector only 1% and in private sector 76% responded that these benefits are not in-force in their organisations.
3. In public sector 81% employees are satisfied, only 8% are not satisfied and11% reported that the drinking water facilities are not in-force in their organisations. In private sector 75% are satisfied, 21% are not satisfied and only 4% reported this facilitiy is not in-force in their organisations.
4. In case of rest room and locker facilities 85% employees from public sector and only 37% from private sector responded satisfied. In public sector only 1% is not satisfied and 22% are not satisfied in private sector. 14% from public sector and 41% in private sector responded that these facilities are not in-force in their organisations.
5. It is observed that 81% of public sector and only 28% of private sector employees have responded that they are satisfied with workmen compensation benefits. 8% from public sector and 51% from private sector employees reported that they are not satisfied. Whereas only 11% from public sector and 21% from private sector resported that these facilities are not in-force in their organisations.
6. Regrading the safety measures 78% from public sector and 55% from private sector responded as satisfied, whereas in public sector 13% and in private sector 31% responded not satisfied. It is also found that in public sector only 9% and in private sector 14% responded that these benefits are not in-force in their organisations.

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Figure 1. Comparison of employee's opinion towards statutory welfare measures

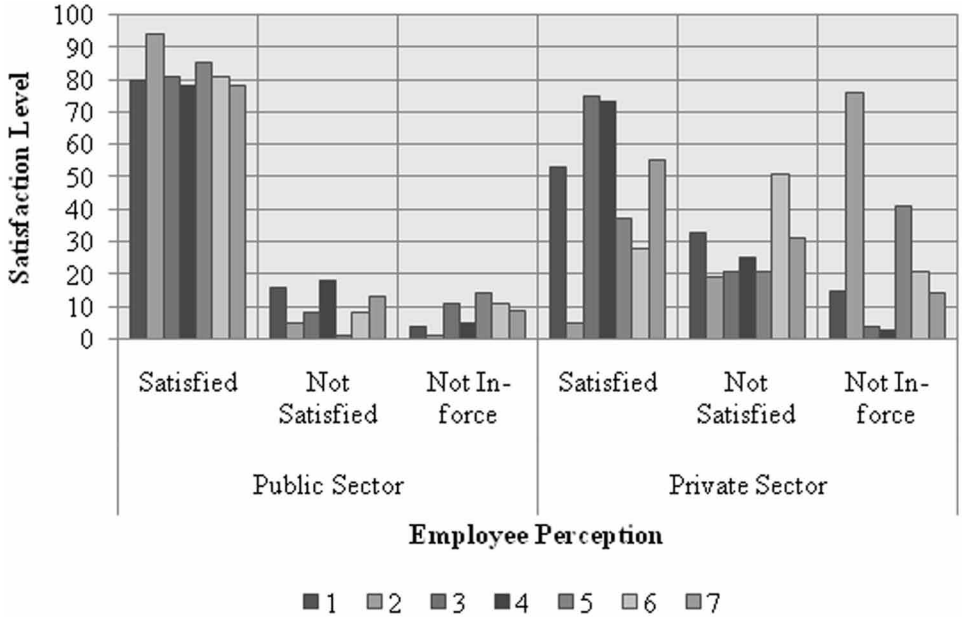
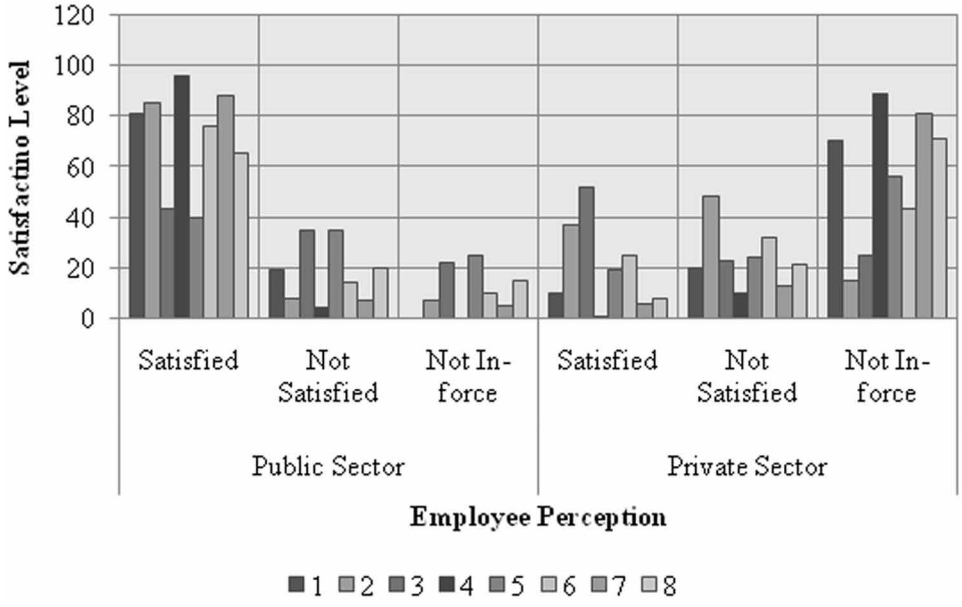


Figure 2. Comparison of employee's opinion towards non-statutory welfare measures



The above analysis regarding the responses of employees' on the provision of statutory welfare measures shows that almost 70% of the public sector employees are satisfied and only 20% are satisfied in private sector (shown in Table.3).

A comparative analysis on the satisfaction of employees regarding the provision of non-statutory welfare measures in both public and private sector organisations are shown in Table 2 and Figure 2.

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Table 2. Comparison of employee's opinion towards non-statutory welfare measures

Sl. No.	Perception		Public Sector			Private Sector		
			S	NS	NIF	S	NS	NIF
1.	Housing Facilities	#	65	15	0	8	16	56
		%	81	19	0	10	20	70
2.	Educational Benefits	#	68	6	6	30	38	12
		%	85	8	7	37	48	15
3.	Transport Facilities	#	34	28	18	42	18	20
		%	43	35	22	52	23	25
4.	Retirement Benefits	#	77	3	0	1	8	71
		%	96	4	0	1	10	89
5.	Recreational Facilities	#	32	28	20	16	19	45
		%	40	35	25	19	24	56
6.	Grievance Handling Forums	#	61	11	8	20	26	34
		%	76	14	10	25	32	43
7.	Retention Policies	#	70	6	4	5	10	65
		%	88	7	5	6	13	81
8.	Other Facilities	#	52	16	12	6	17	57
		%	65	20	15	8	21	71

The Table 2 gives a clear picture on the comparison of employees' opinion towards the provision non-statutory welfare measures.

1. Regarding housing facilities, it is observed that in public sector 81% are satisfied, 19% are not satisfied and no one said that these facilities are not in-force in their organisations. Whereas in private sector only 10% are satisfied, 20% are not satisfied and 70% reported that these facilities are not in-force in their organisations.
2. It is found that in public sector 85% are satisfied, 8% are not satisfied and only 7% responded as not in-force regarding the Educational benefits. But in private sector only 37% are satisfied, 48% are not satisfied and 15% said these facilities are not in-force in their organisations.
3. In public sector 43% are satisfied and 35% are not satisfied, whereas in private sector 52% are satisfied and 23% are not satisfied regarding the transport facilities. 22% in public sector and 25% in private sector reported that transport facilities are not in-force in their organisations.
4. In case of retirement benefits almost 96% of public sector employees are satisfied and only 4% are not satisfied, whereas in private sector only 1% is satisfied and 10% are not satisfied. Almost 89% of employees said that the retirement benefits are not in-force in private sector organisations.
5. It is observed that, regarding the recreation facilities 40% satisfied and 35% are not satisfied in public sector. In private sector 19% are satisfied and 24% are not satisfied. Whereas 25% in public sector and 53% in private sector responded that these facilities are not in-force in their organisations.
6. The employees' satisfaction on grievance handling forums is 61% are satisfied and only 11% are not satisfied in public sector, whereas in private sector 20% are satisfied and 26% are not satisfied.

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It is identified that 34% employees in private sector and only 8% in public sector responded that these facilities are not in-force in their organisations.

7. It is identified that 88% are satisfied and only 7% are not satisfied in public sector whereas, only 6% are satisfied and 13% are not satisfied regarding the retention policies. It also shows that only 5% in public sector and 81% in private sector responded that retention policies are not practiced in their organisations.
8. Finally, regarding the other facilities like bank, cooperative societies, employee-employer relations, etc., 65% are satisfied and 20% are not satisfied in public sector. In private sector only 8% are satisfied and 21% are not satisfied. It is identified that 15% in public sector and 71% in private sector reported that these facilities are not in-force in their organizations.

The comparative analysis reveals that more than 80% of public sector employee is satisfied and only 46% of private sector employees are satisfied with the non-statutory facilities provided in their organizations.

The overall comparison of the employees' satisfaction towards the provision of both statutory and non-statutory welfare measures in different public and private sector organizations are shown in Table 3.

From the above Table 3 and Figure 3 related to overall comparison of employees' opinion towards the welfare measures, it is observed that in public sector almost 77% and in private sector only 32% of the employees are satisfied with the implementation of the welfare measures in their organisations. In public sector 14% and 26% in private sector responded that they are not satisfied with implementation of these facilities, whereas only 9% from public sector and 42% from private sector reported that these welfare schemes are not in-force in their organisations.

Based on the above findings and discussions with the employees of both public and private sector organizations, the impact of these statutory and non-statutory welfare schemes on employees performance are discussed.

IMPACT OF WELFARE MEASURES ON EMPLOYEES PERFORMANCE

An employee can be happy with his employment only when he has job satisfaction. The welfare facilities provide better physical and mental health to employees and thus promote a healthy work environment. This makes the employees to pay more attention towards work and thus increases their performance.

Table 3. Overall comparison of employees' opinion towards welfare measures

Perception		Public Sector			Private Sector		
		S	NS	NIF	S	NS	NIF
Statutory Measures	#	459	113	68	128	152	360
	%	72	18	10	20	24	56
Non Statutory Measures	#	461	55	44	260	161	139
	%	82	10	8	46	28	26
Overall Welfare Measures	#	920	168	112	388	313	499
	%	77	14	9	32	26	42

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Figure 3. Overall comparison of employees' opinion towards welfare measures

The study focuses on the various dimensions of welfare measures that have an impact on the employees' perormance and overall productivity of the organisation.

Provision of Housing Facilities

Housing facility is the basic human necessity and it needs a very high priority in any scheme of National Planning and Industrial Development. A healthy accommodation includes proper quarter facilities, adequate space, ventilation, electricity facilities, water facility and maintenance facilities such as roads, lighting, drainage systems, lavatories, and other sanitary arrangements should be provided so that the efficiency of the employees increases.

It is observed that almost all the public enterprises have either provided or are in the process of providing housing facilities to their employees but they are lacking in providing the basic facilities such as water facility, electricity facility and other maintenance facilities, etc. At the same time, majority of private organisations are not providing housing facilities to their employees. The employees have viewed that proper quarter facilities with basic amenities at low cost or housing allowances shall be provided by the organizations.

Availability of Education Schemes

Education plays a very important role in motivating and enabling changes necessary for accelerated progress of employees for their mental and physical development. The educational needs in any sector are two-fold i.e., adult/employees education schemes and schools/colleges for their children. The education centers enable the employees to acquire more knowledge and gain social awareness. The education facilities for children of the employees should also be provided, so that it helps them to obtain better employment opportunities.

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The management of both public and private organisations is providing the training and development facilities to the employees in their organizations to some extent, but it is not sufficient to motivate them and increase the work efficiency. The public sector organizations are either sponsoring or reimbursing the amount for higher education of employees. They are also providing reimbursement of tuition fees for their children. The private enterprises are encouraging for employee's higher education, but not providing any financial support and the education facilities for children are not provided when compared to the public sector.

Medical and Health Benefits

The health of the employee is of cardinal importance not only to him but also to general organizational development. Health care for employees helps to reduce the incidence of sickness, absenteeism and increases efficiency and productivity. Medical benefits include maternity benefits, medical camps, medical reimbursement, and benefits after retirement, etc. The private or public organistions have to provide medical facilities for the employees and their family members also.

The public sector employees are provided with medical facilities like emergency services, treatment at company's hospital, medical reimbursement for treatment, referral for major treatments, frequency in medical checkups and maternity benefits, etc. But in private sector most of the organizations are lacking medical facilities and in some organisations these facilities are not available. The private sector employees suggested that the basic medical facilities like first aid center or medical checkups have to be provided to them.

Cheaper Transport Facilities

The provision of adequate and cheap transport facilities to the employees residing at long distance from the place of their work is essential as such facilities relieve the workers form strain and anxiety provide relief and relaxation and reduce the absenteeism on account of late arrival. Employees should be enabling to reduce the time spent in travelling between their homes and their work. Transportation is particularly necessary to those employees who work in shift basis.

In public sector many organizations are not providing transport facilities but the employees are provided with transport and other travelling allowances. In private sector the transportation facilities are provided to some extent by the organizations but allowances are not given. The employees suggest that proper transport facilities should be provided, so that it reduces the travelling time and relieve them from stress and strain.

Recreation/Sports Activities

Recreation is one of the important dimension of welfare, which relaxes and refreshers the mental and physical fitness of an employee after going through the strings and stresses of daily busy work schedule. In the case of a very few exceptional individuals who find their work so absorbing and satisfying, work itself may be the recreation. These facilities are to be necessarily provided in all organisations whether public or private sector.

It is observed that public organisations are providing recreation facilities but this has no effect on the employees. In private sector the employees are not satisfied with the recreation facilities provided by

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their organisations. As recreation facilities releases the stress of work, the organizations should provide the facilities such as sports, parks, screening of movies for children and employees, picnics, and so on. The organisations should also arrange for get together with employees and their family members with entertainment.

Encourage Retention Policies

The current challenge faced today by the organizations is retention of good and talented employees. Recognizing the most talented, skilled and the best employees who can fit within the organisation culture and contribute to the organisation and retaining them is an important task of the organizations. The retention policies include increments, promotions, incentives, awards, gifts, rewards, job security, performance appraisals, and so on. Retention policies help the employees to feel secure for their job and work for the betterment of the organisation.

In public sector generally, the retention policies are implemented that is why employees do not leave the organization. Moreover new aspirants are looking for jobs in public sector because the job conditions are very attractive and always there is chance for job security till retirement. But in private sector implementation of retention policies are very remote because the management always thinks of organisations benefits. This is one of the reasons why majority of the employees are not satisfied with private sector and change the company's frequently. The private organizations should gradually encourage the retention policies by giving the employees good salaries, incentives, and other facilities.

Subsidized Canteen Facilities

Canteen or store facilities includes the cost of food items, quality of food items, variety of items, hygiene, and service of bearers, furniture or seating arrangement in the canteen, drinking water and so on. Provision of good canteen facilities helps in maintaining good health of the employees which in turn increases their performance.

Many majority of the employees in public sector are of the opinion that they are getting better canteen facilities such as subsidized supply of tiffin's and meals. In private sector more than half of the employees are dissatisfied the way they are getting the canteen facilities as the rates may be high, the quality and quantity are also not up to the mark. But a small section of employees felt that their organization is providing them with good canteen facilities. Some employees viewed that the canteen facilities in private sector also should be improved.

Provision of Retirement Benefits

Retirement benefit is one the important activity of providing welfare measures to the employees in the organizations. Retirement benefits include pension, retirement/death gratuity, loan, leave encashment, general provident fund and incentives, contributory provident fund, employee's group insurance schemes, voluntary retirement compensation, etc. These benefits increase the satisfaction level of the employees towards the organizations and motivate them to achieve the organizational objectives.

A lot of employees in public sector are of the opinion that the retirement benefits are far better than private sector. In private sector majority of the employees are not satisfied with the retirement benefits,

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as the management is not even providing employee's provident fund and some are not regularized also. So, majority of the employees are in view that their services are to be regularized and all retirement benefits should be provided to them as in public enterprises.

Grievance Handling Forums

Grievance Handling Forums plays a vital role while providing the welfare measures to the employees in the organisations. Grievance handling means solving the disputes or problems of the employees with the interference of the management, trade unions or enactment of statutory laws by the government. There is a systematic way of dealing with grievance problems. The judgments are to be abided both by the employer and the employees.

It is the opinion of majority employees in public sector that grievance handling procedures are good. In the case of private sector the employers will take upper hand, so the employee's grievances are not given much importance. They will always think of punishments rather than redressal of grievances. This is why a lot of employees are not satisfied with the grievance handling forums in private sector. They have suggested that the government should apply statutory laws to the private sector organizations also as it increases the employees morale and performance.

Provision for Safety Measures

The safety measures are the activities and precautions taken to improve safety, i.e. reduce risk related to human health. It includes first aid, risk assessment, insurance, general health and safety advice, etc. It is a good practice for all the organisations to practice the safety policies for the improvement of the employee's quality of work life. The organisations should assess systematically any potential risks or hazards to staff, volunteers and public.

It is observed that almost all the public and private enterprises are providing the safety measures for the welfare of their employees. Majority of the public sector employees are satisfied with these measures, whereas in private organizations many of them are not satisfied with these facilities. The private sector employees have suggested that proper safety measures with basic amenities should be provided by their organizations.

Drinking Water and Sanitary Facilities

Drinking water and sanitary facilities are essential for human beings to lead a healthy and quality life at work place. In every organization effective arrangement shall be made at suitable places for sufficient supply of clean drinking water. Sufficient latrine and urinal accommodation are to be provided at the office or work premises which should be easily accessible to employees. Separate enclosed accommodation should be provided for male and female employees with adequate light and ventilation.

The analysis states that almost all the employees of public and private sector organizations are getting pure and clean drinking water. The employees are satisfied with the sanitary facilities provided to them at the workplace. Some employees suggested that the mangement need to concentrate on improving the clean and healthy sanitary facilities.

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Workmen Compensation

Workmen's compensation act is one of the important social security legislation passed by government of India to give protection to employees. It aims at providing financial protection to workmen in their departments in case of accident resulting to injury, death, and partial or total disablement in the course of duty, by means of payment of compensation by the employers. It is the additional benefit given to the employees other than salary, which gives more satisfaction to lead a healthy life.

In public organizations almost all the employees are satisfied with the compensation benefits provided to them. Majority of the employees are not satisfied with the compensation provided by the private organizations. The employees suggested that public sector organizations should gradually improve these benefits and private organizations have to put much effort in providing these facilities for their better performance.

Rest Rooms and Locker Facilities

Adequate changing and rest rooms are to be provided for employees in the office or work premises with provisions like water supply, wash basins, toilets, bathrooms, etc. Locker facility should also be provided to the employees to keep their belongings. Separate rest rooms for male and female employees should also be provided. These facilities increase the morale of the employees.

In public sector these facilities are provided adequately. In case of private sector organizations also these facilities are provided, but not up to the mark. As these services are necessary and increases the job satisfaction, the employees of private sector viewed that these facilities are to be taken utmost care and improved.

Other Facilities

The other facilities such as post office, bank facilities, credit cooperative societies, telephone exchange facilities, guest house, employee-employer relations, work environment, etc., also help in motivating the employees towards the management and increase their work efficiency.

Regarding other facilities majority of the employees in public sector are fully satisfied because in almost all organisations these facilities are undertaken where as in case of private sector organizations these facilities are very remote. That is why majority of the employees in this sector are not satisfied. They viewed that these facilities or benefits must be provided to them which in turn will help them as it will increase their quality of work life and performance.

RECOMMENDATIONS

As per the comparative study and the suggestions given by the employees during the survey, certain recommendations are made for further improvement in welfare activities in the organisations:

1. The organisations have to explain about the welfare measures provided to the employees and suggest them how to utilize these benefits.
2. The management should conduct stress reducing events like yoga and meditation for the employees.

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3. The management can think of formulation of a problem solving committee including the employees and administration for the better solution of the welfare problems of the employees.
4. Improvements should be initiated in the field of grievance handling, recognision and service awards, recreation activities and other motivating facilities.
5. The management should concentrate on employee's facilities outside the work place like quarter facilities, health & medical benefits so that they can perform better.
6. The private sector organisations must try to provide subsidized canteen facilities to their employees.
7. The public and private sector organisations have to provide separate restrooms for both male and female employees.
8. The organisations have to provide better drinking water and sanitation facilities to the employees.
9. Incentives, allowances, promotions, overtime payments, etc., should be provided to the employees based on their performance rather than their experience.
10. Both the public and private sector organisations must set up a reading room or library for employees to make use of their leisure time and enhance their knowledge.
11. Steps must be taken to conduct job training programmes, seminars and workshops to update the knowledge of the employees.
12. The organisations can appoint a welfare officer to solve all the problems of the employees and maintain good relation between the employee and employer.
13. The managements of private sector must take initiative in providing the retirement benefits to their employees.
14. The organisations should maintain better relations and communication between the employers, employees and other departments.

The welfare measures should be properly implemented so, that they may increase job satisfaction, which in turn may help increase the employees' performance.

CONCLUSION

Generally, welfare measures are recreational, medical, educational, housing, drinking water, sanitation and so on. Every organization whether private or public sector have to provide these welfare measures. This will help the management to retain the employees and increase their work efficiency. It is observed that the private sector organizations are not providing some of the welfare facilities to their employees when compared with the public sector organisations.

A satisfied employee is the key factor, who acts as the organization's ladder for success. Employee's satisfaction relates to two aspects i.e. job related and facilities oriented. Any organization must see to it that both these aspects are provided by it so that its employees are fully satisfied and that they join hands with management, so that they whole heartedly march forward in achieving the organization's objective. Welfare helps in keeping the morale and motivation of the employees high so as to retain the employees for longer duration.

After the comparative analysis of the whole data it can be stated that the overall satisfaction of employees on both statutory and non-welfare measures in the public sector organizations is satisfactory. However, the private sector employees are not satisfied with welfare measures implemented in their

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organizations. Therefore it is suggested that the existing welfare measures may be improved further as they enrich the employee's standard of living and their satisfaction levels. An employee welfare facility is the key dimension to smooth employer-employee relationship. The welfare facilities improve the employees' morale and loyalty towards the management thereby increasing their happiness, satisfaction and performance.

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Chapter 48
Organizational Leadership and Health Care Reform

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ABSTRACT

Policies, health, and government regulations affect various Health Care organizations and their members. One such policy, the Health Information Technology for Economic and Clinical Health (HITECH) Act, attempts to improve the performance of health care systems through the use of technology, such as Electronic Health Records (Bluementhal, 2010). The most critical task of leadership is to establish a mindset at the top of the organization and function to infuse a culture of excellence throughout the organization (Bentkover, 2012). Health organizations can only progress if their members share a set of values and are single-mindedly committed to achieving openly defined objectives (Bentkover, 2012). This chapter investigates organizational leadership in relation to health care reforms to include trends in health care leadership, Stratified Systems Theory (SST), Systems Thinking, and regulators perspectives. The chapter will consist of the following sections: background; issues controversies, and problems; solutions and recommendation; future research directions; and conclusion.

INTRODUCTION

Researchers emphasize the significance of organizational leadership. Others talk about being central to the fulfillment of firms especially for industries such as health care that are international and vibrant worldwide (Chathoth & Olsen, 2002). Policies, health, and government regulations affect various Health Care organizations and their members. The Health Information Technology for Economic and Clinical

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Health (HITECH) Act of 2009, attempts to improve the performance of health care systems through the use of technology, such as Electronic Health Records (EHRs) (Bluementhal, 2010). Technology is an important tool for health plans to provide better care and quality assurance. Regulators closely monitor health plans, such as the Department of Managed Health Care (DMHC), the Centers for Medicare & Medicaid Services (CMS), Independent Medical Reviewers (IMR), and the National Committee of Quality Assurance (NCQA), and other independent entities (IMRhelp & DMCH, 2015). These regulators are constantly looking at electronic data and regulating health plans' performance. Based in health care reports and audits results, the outcomes reflect quality assurance for members to assure overall compliance. The HITECH Act is focused on health organizations using certified EHRs. The HITECH Act was enacted to expand the federal government's ability to establish a national electronic patient records system by 2014 (APA Practice Organization, 2014). According to the requirements of the Patient Protection and Affordable Care Act (PPACA), this deadline not been met. Therefore, organizations are to comply with the Act and are in a situation of influx that has to be addressed (ACA, 2015).

The HITECH Act of 2009 has the ability to involve health consumers, hospitals in their own care, and connect entire communities into more patient self-awareness. Leadership is critical for transforming these challenges into opportunities. Some of the opportunities would promote preventive care at an affordable price, rather than paying higher premiums, depending in an individual's health care needs. The most critical task of leadership is establishing a mindset at the top of the organization and functioning to infuse a culture of excellence throughout the organization (Bentkover, 2012). Health care organizations progress if they treat their members with integrity, value, and are single-mindedly committed to achieve openly a defined objective for better health (Bentkover, 2012). This chapter investigates organizational leadership in relation to health care reforms to include trends in health care leadership, Stratified Systems Theory (SST), Systems Thinking, and regulators perspectives. The chapter will consist of the following sections: background; issues controversies, and problems; solutions and recommendation; future research directions; and conclusion. This will enhance the field of research on effective communication, leadership and conflict resolution and society in general.

BACKGROUND

Prior to 1994, the standards were comprised of chapters on management, governance, regulators, medical staff, and nursing services. Basically, each division in the health organization essentially had their own standards. These standards were based on individual divisions; and all related policies and procedures complied with that division (Schyve, 2009). Essentially each division was operating as an organizational silo for the good of that individual division's, governance, accountability, ethical conduct. These regulators have their own threshold languages (SB853) that cover about 20 different languages. However, the languages covered are primarily Spanish and Chinese in health care (Wu, 2015). These threshold languages are anticipated to guarantee the success of the division and better patient understanding (Schyve, 2009).

The Joint Commission pursued the guidance from the country's foremost healthcare management experts and clinical leaders to redesign this division-by-division. One of the main themes discovered was that healthcare organization should not be viewed as a corporation of divisions and should be considered a system that provide quality of care among patient care (Schyve, 2009). A system is a mixture of internal policies, national policies, federal policies, procedures, individuals, and assets that work together to accomplish the common goal for better patient care and HITECH 2009 (Schyve, 2009).

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With this in mind, information management in health organizations use of oral, electronic, and written communications to connect health care providers, patients, and family members. As organizations move into a patient and family-centered approach to health care, effective communication will prove to be the best approach for patient and family members. Schyve (2007) suggests it is essential to recognize the patient's standpoint and to include the patient in the management plan in order for it to be effective. However, in order for a provider and/or a family member to act as a legal representative for a patient, an Appointment of Representation (AOR) form must be complete and on file. The AOR must have the patient's signature to act on his or her behalf (DMHC, 2015). Senate Bill 853 (SB 853) was enacted to bolster improved patient care through active discussion with patients' for better patient communication and translation in different languages at no cost (Wu, 2015). Without this provision, attempting to provide health care could be problematic for the patient, precluding access to, and interfering with quality of care.

Evidence-based practice must be merged into a restructure of the work processes of the system or subsystem of which it is to be a part. Case in point, it is more operationally effective to integrate a language clarification service into a restructured work processes in the Emergency Room (ER) to ensure a language barrier does not impede providing necessary services to a person whose primary or only language is Chinese. Here, it is clear, using the SB853 is better than using existing system of operations. This integration will be smooth and efficient without disturbing others' work processes (Schyve, 2007). In the absence of this process, patients use the Urgent Care services to save money and higher hospital co-payments, also saving money to health plans. Creating a systems approach to generating patient safety is a major goal of health organizations, which allows leadership to be involved and make better profit decisions (Schyve, 2009). The need for efficiency in the processes facing health organizations is substantial pressure to implement Health Information Technology (HIT) systems.

Health organizations, such as larger hospitals located in urban and rural areas, are constantly coaching their provider affiliates, urgent care facilities, and other vendors in the implementation of EHRs (Jha, DesRoches, Campbell, Donelan, Rao, Ferris, Shields, Rosebaun, & Blumental, 2009). The EHR applications have to be certified to fulfill the federal government's definition of "meaningful use" or risk significant financial penalties. To offset the pressure and cut the cost of every hospital in the United States, the government has provided avenues for access to the additional finances for larger facilities. Making hospitals eligible for more funds to purchase and incorporate EHRs works to increase the viability of the institution (Bau, 2011).

Utilization of HIT technology would signal efficient, safe, and higher quality of care. There are no reliable estimates of the occurrences of adoption of EHRs of hospital in the United States (Jha et al, 2009). In 2014, research found approximately 38% of eligible hospitals achieved meaningful use EHR implementation by the end of 2012 (Diana, Harle, Huerta, Ford, & Menachemi, 2014). Concurrently, 61% of the facilities provided some type of EHR status in the 2012 survey. According to Diana, Harle, Huerta, Ford, and Menachemi (2014), 38% of these facilities still remain with meaningful use EHRs. Hospital adopting incentives were different and had unique characteristics for profits status, and better techniques in membership. The facilities receiving incentives were located in urban areas, joint Commission-accredited for teaching, and larger facilities.

The HITECH Act of 2009 is driving fundamental market and industry changes that health organizations need to be strategically poised to implement health care reforms. It is essential to health organizations' leaderships to have characteristics that support nourishing a competitive advantage in an international and vibrant atmosphere. The responsibility of scale and complexity is necessary for changes and leader-

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ship demands to occur. Using robotic facility care and a robotic quality assurance monitoring plan will be essential to embrace change and holding everyone accountable. Technology can only assist in the necessary changes to the health care system; it does not initiate large scale change.

MAIN FOCUS OF ORGANIZATIONAL LEADERSHIP AND HEALTH CARE REFORM

Organizational leadership is a two-fold management tactic—one that works in the direction of what is best for individuals; the other for what is best for a group as a whole (TDK Technologies, 2015). It is also an approach and a work ethic that enables an individual to lead from the top, middle, or bottom of a health care organization (TDK Technologies, 2015). When describing and discussing leadership requirements are to lead an effective organization, it is imperative to look at leadership competencies. It is also the opportunity to look for potential challenges of the organization's innovations. Leadership competencies are talents and activities that lends to greater performance (Society for Human Resource Management, 2015). These competencies are crafting a distinctive leadership brand via capabilities that yield results for stakeholders. These processes can also be used by organizations to gain a competitive advantage and strategic innovation for patient care (SHRM, 2015). Investigators at the Center for Creative Leadership have recognized vital leadership competencies that are constant among organizations. They split the total structure into competencies for leading the organization, leading the self and leading others in the organization (Society for Human Resource Management, 2015) and DMHC, NCQA, IMR (IMRhelp & DMHC, 2015), regulators. These are shown in the Table 1:

At its staple, performance improvement processes spawn Quality Improvement (QI), a team process. In the correct conditions, a team couples the knowledge, skills, experience, and viewpoints of different individuals within the team to make lasting improvements. A team approach is most effective when:

Table 1. Developmental assignments: Creating learning experiences without changing jobs. Greensboro, N.C.: Center for Creative Leadership Press Adapted from (McCauley, 2006)

Leading the Organization:	Leading the Self:	Leading Others:
Managing Change	Demonstrating ethics and integrity	Communicating effectively
Solving problems and decision making	Displaying drive and purpose	Developing others
Managing politics and influencing others	Exhibiting leadership stature	Valuing diversity and difference
Taking risks and innovating	Increasing your capacity to learn	Building and maintaining relationships
Setting vision and strategy	Managing yourself	Managing effective teams and work groups
Managing the work	Increasing self-awareness	Leading with efficiency
Enhancing business skills and adding knowledge	Developing adaptability	Implementing new government and cultural strategies
Understanding and navigating the organization	Practicing ethical standards	Leading with integrity

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1. The process or system is complex.
2. No one person in an organization knows all the dimensions of an issue.
3. The process involves more than one discipline or work area.
4. Solutions require creativity.

The role of a health care organization and the leadership implementations are to sustain continuous performance improvement, as it is essential to patient-centered care. Leadership and change-management strategies, comprised of patient, staff, chair-side chats, and clinician board engagement are effective ways to reinforce the foundation for patient-centered care (Frampton, Guastell, Brady, Hale, Horowitz, Bennett Smith, et al., 2008). The purpose of these communication approaches are the direct contacts they afford between management, frontline staff, regulators, and patients (Australian Commission on Safety and Quality in Health Care, 2010). Continuous improvement necessitates a transformation from the way health care organizations have customarily provided care. Health care Organization leadership must improve and devise strategies and processes for connecting patients. This is especially important for families and health care professionals in their own care and, at a best service level, in procedure, program, and quality improvement/assurance. Leadership has to be involved with patient safety inventiveness and healthcare strategy (Australian Commission on Safety and Quality in Health Care, 2010).

Trends in Health Care Leadership

The current health care trends have changed; they tend to be more complex, unpredictable, and volatile. The leadership skills have also changed and require leaders to adapt to change and possess critical thinking abilities for organizational decision making. The "methods currently used to change leadership have not changed much" (Petrie, 2014, p. 5). Management strategies such as mentoring, coaching, and training remain important. Leaders have a major challenge in these areas, as they are not developing quickly enough to adapt to the new environment. The future challenge is not simply leading, but how to grow bigger in the leadership role. Managers seem to become more adaptive to a leadership role of their own development.

Leadership needs to concentrate on the current challenges and environments in building leadership in an unpredictable world. More developed "exploration of leadership development trends and emerging applications of leadership that could shape the basis of subsequent developmental programs" (Petrie, 2014. p. 5). Therefore, a leadership style that focuses more in common goals, rather than a single leadership development style, will prove to be of greater value and utility. Simple programs or existing models appear to be insufficient for providing high-level leadership to address the unpredictable requirements of leadership demands. A fast pace innovative methodology will be needed for health care organizations to meet needs the culturally diverse and inclusive environment of the workplace. Petrie (2014) suggested under normal circumstances "businesses that embrace change are better prepared for the future, than those that avoid or resist change" (p. 5). Kahn (2015) stated that the 21st century requires a paradigm shift in healthcare. Leaders and professionals need to prepare to lead with empathy, work in teams, and apply emotional intelligence in the workplace. Petrie (2014) posits thinking out of the box for new improvements and to build programs based on critical thinking and assumptions. When making assumptions one must consider the following questions:

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1. What are the current healthcare strategies that could be most effective in this field?
2. What needs to be done regarding the development emphasis in health care leadership?
3. What a health plan needs to minimize, do more, or stop doing?
4. What is the goal/ vision for health care leadership development in the future?

Petrie (2014) explains "technology is a huge infrastructure and a driven change in this case" (p. 5). Normally, businesses that embrace change will do great in the future, than those that avoid the change (p. 5). Nevertheless, leadership is not a "one size fits all" approach; frequently, leaders must become accustomed to their approach to fit the circumstances (Mind Tools Ltd, 2015). Therefore, a fast pace innovation demand will be needed in health care organizations. Organizations need to be prepared to try new approaches that will create a cultural and diverse change to share with subordinates and clients. Kahn (2015) stated that the 21st century calls for a healthcare paradigm shift and innovation demands. Leaders and professionals need to prepare to lead with empathy, work with teams, and apply emotional intelligence in the workplace. Staff commitment and buy-in are needed (U.S. Department of Health and Human Services, 2011).

Whether a health care organization is attempting to improve patient wait times or telephone service, it helps a team strengthen an organization to attain enduring improvements (U.S. Department of Health and Human Services, 2011). Leadership stereotypically delivers inspiration, objectives, operational oversight, and other administrative services to a health organizational business. This leaves the prospect of the United States being reliant to an extent to its leadership capabilities. History reveals that empires have been erected and crumbled due to inoperative and fragile leadership respectively (Rao, 1991). To investigate organizational leadership in relations to health care reforms it is imperative to understand and include Stratified Systems Thinking and Systems Thinking.

Stratified Systems Theory (SST)

Stratified Systems Theory (SST) is a formative theory associated to strategic leadership and organizational hierarchy. This involves a bureaucracy that serves as a vital structure for understanding the prominence of cognitive capability of strategic leaders (Browning Leadership Model, 2013). Established by Elliott Jaques, SST concentrates on a person's cognitive ability and capacity to reason over an explicit period of time. The SST is designed to deliberate through multifaceted and collaborative structures of cause and effect (Browning Leadership Model, 2013). A fundamental concept in the development of executive-level leaders is the changing nature of performance requirements at the organizational level of leadership (National Defense University, 1997).

There are three broadly defined strata of leaders in most large-scale organizations: the top-level (strategic), the mid-level (organizational), and the lower-level (production or action-oriented). Relatively inexperienced leaders are at the lower level of responsibility; their responsibility for the success of the organization is limited; therefore, they are action-oriented. They have little latitude in the decisions they make, procedures they use, and the degree of innovation they can employ. Lower-level leaders may improvise, but rarely innovate because, at their level of leadership, consistency of action is important. The mid-level leader is responsible for establishing intermediate goals, directing and developing plans, procedures, and processes used by the lower-level leaders. Plans, policies and procedures, and specified processes are major tools for coordinating effort, particularly in large-scale organizations with many independent parts. The mid-level leaders are also responsible for prioritizing missions and allocating

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resources to tailor capability at the lower levels. This includes supervising resource allocation plans that implement concepts developed at higher levels, as in the Department of Defense's Planning, Programming, Budgeting, and Execution Systems. The term "strategic" implies broad scale and scope, to a vision extending over very long time spans-in some cases out to fifty years or more. Strategic leadership and decision making is a process by which those responsible for large scale organizations. The set long-term directions and obtain, through consensus building, the support of constituencies necessary f or the commitment of resources. The following regulators are involved in any strategic change in patient care, the DMHC, IMR, NCQA, and CMS. These regulators have a common goal to improve lives in health care, employment, child care, and to manage innovative health. In which allow human service programs to strength communities, and transform lives in a better healthy environment (IMRhelp & DMHC, 2015).

These regulators are focused on research accomplished with senior Army officers and government (Zaccaro, 2001). Elliot Jaques and Owen Jacobs argued that leadership in enormous portion necessitates a greater cognitive ability and creative problem-solving process (Zaccaro, 2001). Through the use of SST, the research available supports this assertion. Understanding that as a person moves up in an organizational leadership hierarchy, problem types and resolutions selection becomes complicated and ambiguous. This organizational leadership environment necessitates a multifaceted cognitive capacity at each level of leadership and a more profound need at the higher levels of leadership. Jaques and Jacobs recognized seven stages or strata of organizational work. As a leader moves to an advanced level, the leader added novel value at that level (Browning Leadership Model, 2013). They clustered these seven stages in three stratums, reflecting strategic, organizational or general management, and tactical supervision (Browning Leadership Model, 2013). The top two stratums reflected ancillary leadership and the bottom layer reflected direct leadership. Table 2 displays an overview of SST for a large -scale organization.

If there is a single, "most important" theme in SST, it is that "cognitive power" is astonishingly important. The critical tasks associated with higher organizational levels are simply more difficult than those experienced at lower organizational levels. Mastering them necessitates a threshold of proficiency to understand complexity, and that threshold level increases by level. This has significant implications for succession planning and leader development (Jacobs & Clemet, 2013). Presently, health care organization should not anticipate a competitive advantage, unless it can recognizes fledgling leaders with advanced leadership potential and provide them with responsible and opportunity before they are needed (Jacobs & Clemet, 2013). An assessment process pioneered by Gillian Stamp at Brunel University enables early identification of high potential in future leaders (Jacobs & Clemet, 2013). As part of the assessment process at one of the Joint/Senior Service Colleges, Jacobs and Clement (2013) developed:

1. **Concept Formation:** One part of the assessment is a concept formation task. People differ in how they approach the task. Some strategies are more effective than others. Rapid trial and error is much less effective than stopping to think more holistically about the task. This is a self-awareness dimension that appears critical to successful performance at the highest organizational levels.
2. **Curiosity and Openness to New Experience:** A second key part of the assessment is a measure of attraction to complexity and innovation. Most of our high-capacity general officers were interested in a broader range of topics beyond the military. They spent a lot of time "exploring" and their enhanced awareness frequently aided the performance of primary tasks.
3. **Reflective Awareness:** This is fundamental to learning from experience. The top-level generals were more reflective than the others. The Center for Creative Leadership at Greensboro, NC, found

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Table 2. Level of Organizational Stratification Proposed by Stratified Systems Theory (SST) Adapted from (Zaccaro, 2001)

			Task Requirements and Characteristics						
			Type of Unit with Civil Service an Business Correlates			System Resources and Policy Task Requirement	Scope of Work		SST Time Span of work
Stratum	**Domain**	**Rank/Grade**	**Military**	**Civil Service**	**Business**		**Number of Subordinates**	**Sphere of Influence**	
VII	Indirect	General	Unified or Specified Command	Cabinet Secretary	C-Level	Creates integrate complex systems; organize acquisition of major resources; create policy	500.0000-1,000,000	International	20+ Years
VI	Strategic Systems	Lieutenant General	Corps	Deputy Secretary	Group	Oversee directly operation of subordinate divisions; allocate resource; apply policy	50,000-60,000	National	10-20 Years
V	Organizational/ Operational	Major General	Division	Under Secretary	Full DMS	Direct operation of complex systems; allocate assigned resources; implement policy	11,000-12,000	Regional	5-10Years
IV		Brigadier General	Separate Brigade	Assistant Secretary	Medium Sized Business	Direct operation of systems; organize resources allocations to interdependent subordinate, programs and subsystems policy	5000	Sector	4-7 Years
		Colonel	Division Brigade				2,500	10-15 KM	
III	Direct	Lieutenant Colonel/ Sergeant Major	Battalion	Principal Staff	One-Man Business or Unit	Develop execute plans and tasks; organize subsystems; priorities, resources ; translate and implement policy and assigned missions	500-600	4,000-5,000 M	1+ Years
		Major	Battalion ORT Level				100-200	1500 M	
II	Tactical/ Command	Captain First Sergeant	Company Platoon	Assistant Principal	Section	Supervise direct performance of subsystems; anticipate solve real time problems; shift resources; translate and implement policy	3-40		3+ Months
I		Lieutenant NCO	NCO's And Ors	Office Supervisor	Supervisor	Direct performance of work; use practical judgement to solve ongoing problems			Less than 5 Months

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much the same thing in their study of executives. The developmental implication is that organizations should "grow" managers and leaders by encouraging reflective analysis of experience. (p. 203-204).

Systems Thinking

According to Rouse (2015) system thinking can be defined as an approach that contrasts with traditional analysis, which study systems by breaking them down into their separate elements (para 1). System thinking is used in any area of research and to the study of medical, environmental, political, cultural, religious, economic, and educational systems (para. 1). Leaders maneuver in an environment of ambiguity and overwhelming density. Problems are no longer simple; they are complex and at times with no clear answers. These types of problems have required a novel approach to the thinking process for effective leaders to maintain success (Reed, 2006), problems have to be viewed differently. From this perspective, it is easier to introduce a new system, rather than attempting to retrofit an existing system into the situation for which the approach may initiate inefficient, ineffective, and frustratingly slow processes. Sociologist Robert K. Merton coined the phrase "goal displacement" to define conforming to rigid procedures becoming the goal, rather than looking at the whole organization (Reed, 2006). The world was imagined by theorists such as Isaac Newton, as having the features of a clock. The mechanisms of the clock could be understood by the progression of exploration and the methodical method (Reed, 2006).

According to Reed (2006) the fundamental premise is: Identify a system. After all, not all things are systems. Some systems are simple and predictable, while others are complex and dynamic. A common indication of a non-system thinking leader is one who takes unwise risks, and demands ease and certainty in a difficult situation. The effective systems thinker leader maintains focus on the organization as a whole, and at the same time understands the interworking's of the systems of that constitute the organization. Effective leaders using "system thinking" is essential to the success of a healthcare organization (Schyve, 2009).

Regulatory Perspectives

Regulations are orders prescribed by authority to regulate conduct (Meriam Webster.com, 2014). The correlation of relations in health care, are health care reforms (e.g., PPACA and Health Care and Education Reconciliation Act of 2010). These regulations are the most extensive change in the United States healthcare system, since the passage of the Medicare and Medicaid in the mid-1960s (Penno, 2014). The HITEACH Act gives Health and Human Services (HHS) the authority to write regulations (U.S. Department of Health & Human Services, 2014). The HHS has a Regulatory Agenda that is published in the Autum and Spring of each year; its purpose is to regulate the development of a national health information technology infrastructure. Areas under the regulatory control of the HHS include the Affordable Care Act, Health Information Privacy, and Human Research protection regulations (HHS.gov, 2014).

The Affordable Care Act works as a conditional tax for Americans who do not purchase insurance coverage. Under this provision, those who do not have coverage will be taxed approximately $60 per month for Bronze coverage—the minimal and least expensive coverage under the act. If this insurance plan is not affordable, exemptions are built into the provision to assist individual in unique financial circumstances (Friedman & Becker, 2012). The Centers for Medicare and Medicaid Services (CMS) created the "Duals Program" to assist patients with chronical illnesses, and who have low income. The

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Duals Program is designed for patents in need of specialty services that other Medicare members do not need. The program is a combination of Medicare-Medicaid and Prescription Drug. The benefits include a number of services such as home services, cleaning, grooming, self-care, cooking, and other great services to improve someone's life (Centers for Medicare and Medicaid Services [CMS.GOV], 2013). Therefore, the PPACA may be advantageous for members who do not have insurance and low income. The Duals Program may be advantageous for those who are in the need of unique critical care, limited income, and no another means for financial assistance.

ORGANIZATIONAL LEADERSHIP AND HEALTH CARE REFORM ISSUES, CONTROVERSIES, PROBLEMS

Governments, societies, and actions with the major intent to endorse, renovate, or uphold health as defined by the World Health Organization (WHO) is a health system (Bloland, Simone, Burkholder, Slutsker, & De Cock, 2012). Public health is a hazardous part of the grander concept of health systems. Public health and has been defined as "what we as a society do collectively to assure the conditions in which people can be healthy" (Committee for the Study of the Future of Public Health IoM, 1988, para. 1). The United States (U.S.) health care system can be said to have numerous systems that operate independently and collaboratively as the situation dictates (Rice, 2013). To appreciate this concept, it is imperative to understand the U.S. public health infrastructure. The infrastructure includes three key goals: A capable and qualified workforce, up-to-date data and information systems, and public health agencies capable of assessing and responding to public health needs (HealthyPeople.gov, 2010).

By the year 2020, there is expected to be a deficit of 250,000 public health workers, a significant number of this population will be retiring members of the corporate suite. These executives will take with them experience, knowledge, and work ethic that is sorely needed in the workplace. According to Grimm, Johansson, Nayar, Apenteng, Opoku, and Nguyen (2015), the average age of a state public employee is 47 years; the average age of a health department executive is 53 years. Critical to this discussion understands that individuals in each of the aforementioned instances are at or past the age to retire from their current position. The Association of Schools and Programs of Public Health (ASPPH) suggests that colleges and universities, which graduate learners from the schools of Public Health and Human Services, would have to graduate and train "three times the current graduate to meet the projected shortfalls" of public health workers (para. 3). An additional challenge for the health care system will be ensuring the incoming executive structure is culturally adapted to deal with the inclusive nature of the future. With the largest population of the U.S. being Hispanic/Latino and Asian, the leadership will have to be bi-lingual, preferably, multi-lingual, and culturally aware and sensitive to the needs of this demographic. Concomitantly, leaders, technicians, and general labor workers in mid-level positions in the health care system will require a level of proficiency to meet the needs of the patients "at the door". To meet this need, health care practitioners will be required to possess leadership skills for the required disciplines (e.g., respiratory therapy, phlebotomy, dental hygienist…etc.) and linguistic prowess to help the target clients.

In every area the health care system there is mid-level of responsibility critical the success of the health care organizations. McLarty and McCartney (2009) reported, "discretionary decision-making is common at the point of care on matters that impact day-to-day operations" (para. 13). Therefore, it is essential that personnel who may be making decisions be optimally trained and equally functioning in

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this mid-level position of responsibility. Unfortunately, the person or people normally situated to provide the training may be absent or retired. Concurrently, there are other traits needed for mid-level leadership that cannot be taught, but must be modeled—empathy, approachability, and emotional intelligence. These affective habits are indispensable when providing services for the public, especially in health care. Many of the people coming into the health care system of Spanish-speaking and Asian in origin who's English mastery is under-developed; in this case, patience, empathy, and emotional intelligence are a priori.

Title VI of the Civil Rights Act of 1964 requires personnel in Health and Human Services to provide services for all people regardless of race, color, or national origin. Consistent with this requirement, state governments are mandating cultural competency training and education in medical and nursing schools (Hoffman, 2011). Ensuring that mid-level leaders and supervisors are equipped with these essential tools, allow the health care facility the opportunity to meet the needs of the patients, boost the morale of service providers, and enhance the work performance of all employees (Hoffman, 2011).

The quantum advancement in information technology has allowed the health care industry to make significant improvements in the type and quality of care that facility may provide. Nano-technology allows physicians to access patient information at the blink of an eye, translate prescriptions measures and doses with a few keystrokes, and reach other colleagues for operations without breaking the stride of an operation. Tactical and strategic enterprises of the health care industry using IT stand the probability of making substantial change in the way business is conducted in the health care space (Wager, Lee, & Glaser, 2013). However, wisdom warns, when introducing "new" technology into an organization, caution, and humility is required.

In introducing "new" technology into a health organization, it is imperative to remember that until the technology is relatively interwoven into the infrastructure of the organization, it could be problematic. Wager, Lee, and Glaser (2013) suggest that when introducing new technology into an environment, micro-projects should be undertaken. Through this process, the learning curve of familiarization with the technology can occur without far-reaching negative impacts of mistakes (that are a part of the learning process) will be frustrating for the patients and equally frustrating and embarrassing for the practitioners. As technology has becomes normalized in the workplace, comfort with processes, and changes will coalesce into a high functioning facility.

SOLUTIONS AND RECOMMENDATIONS

There is a necessity for collective approaches encompassing health care for patients and their family members. This is including but not limited to managing care, accentuating value, and monitoring quality of care outcomes. This is digitally linked so that patient-provider-caregiver teams have complete, shared patient information and access to pertinent medical research and care protocols (Bentkover, 2012). Research increasingly associates patient learning and engagement to improved health outcomes, lower costs and an enriched care experience. Patient associations include reduced cost and better quality of care. The HITECH Act of 2009 supports health care quality improvement and cost reductions. This falls in line with the Patient Protection and Affordable Care Act (PPACA). The PPACA was designed to reduce the large number of under and uninsured people in the U. S. by mandating that individuals obtain health insurance.

An example is the required functions of EHRs being aligned to requirements for emerging models of health care delivery improvement, including patient-centered medical homes. According to Bau

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(2011) Accountable Care Organizations (ACO) is a term "used for health care providers, who emphasize partnerships between patients and their physicians" (p. 1). The HITECH Act of 2009 has the ability to involve patients and health consumers in their own care, even enthuse entire communities into more patient self-awareness. Campbell (2000) denotes the organization's external atmosphere as being the source in terms of the actions taken by leadership, while setting standards of performance. Expectations are a direct result of the influence of the external environment on the health organization.

The leadership must have "alignment of expectations around a small set of core values and ideals that define the organization's culture, such as service, innovation, teamwork, and achievement" (Campbell, 2000, p. 63). Public Health Institutes (PHIs) are non-profit organizations that increase the public's health by modernization. Public health Institutes are leveraging resources, and building partnerships across sectors, including government agencies, communities (National Network of Public Health Institutes, 2010). Health System Strengthening (HSS) has become a major focus of the U. S. (Bloland, et al, 2012). The Role of Public Health Institutions in Global Health System Strengthening is critical in achieving major health goals in preventive care in the community. Health care can be provided through public and private sectors and providers.

Public health care is usually provided by the government through national healthcare systems. Private health care can be provided through "for profit" hospitals and self-employed practitioners, and "not for profit" non-government providers, including faith-based organizations (Basu, Andrews, Kishore, Panjabi, Stuckler, 2012). The financial impact can be severe for uninsured families that struggle financially to meet basic needs and medical bills can quickly lead to medical debt (Kaiser Family Foundation, 2013). Normally, health care services would be offered through employers. Conversely, not everyone can afford health care market coverage. Many companies have amended hours to permit them not to have to offer health insurance to full time employees. This has made some Americans unable to afford coverage on their own through the market. Since, some American have not bought their insurance, they have been penalized by the government yearly for not signing up through PPACA (Kaiser Family Foundation, 2013).

The scale and density of compulsory changes demands for leaders, who are able to identify weaknesses. Leaders need to articulate a vision for the future, lay out a path, enthuse change and embrace the overall health organization responsibility (Bentkover, 2012). Adopt new technologies for accumulating and employing clinical data to advance performance at the point of care. Technology can only expedite enormous scale changes. Organizational leadership is an essential agent for transforming these challenges into opportunities. Incremental changes are deficient to achieve the goal of delivering higher quality care at a reasonable rate. It is clear that citizens need health care's stakeholders to commit to forming a cohesive, patient-centered system that embraces continuous improvement, promotes teamwork and transparency (Bentkover, 2012).

Due to the complexity of health care, multidisciplinary teams and strategies are essential. Multidisciplinary teams from participating centers/units need to work closely together, taking advantage of communication strategies such as face-to-face meetings, conference calls, and dedicated e-mail, List- Serv applications, and utilize the guidance of trained facilitators and expert faculty throughout the process of implementing change initiatives when possible (R. Bucci, personal communication, April, 15, 2015). Leaders in the health care industry must be able to balance governance and accountability and use a common language, when instilling a culture of quality and safety. Health organizations can capture a plethora of wisdom and talent through systems thinking and use it to solve complex issues and reduce risk factors in health care sectors (R. Bucci, personal communication, April, 15, 2015).

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For instance, the CCL works with numerous organizations and over 20,000 leaders from roughly 100 countries yearly (CCL, 2015). Through researching the needs of the health care organization business needs, CCL strategizes and provides wide-ranging leadership strategy and execution (CCL, 2015). Through the use of state-of-the-art strategy design and cutting-edge development programs to ongoing support and evaluation resources, CCL offers proven solutions for an all-inclusive range of individual and health organizational challenges (CCL, 2015).

FUTURE RESEARCH DIRECTIONS

There needs to be further research into the area of Emotional Intelligence (EI) and the role it plays in the decision making process for health care. According to Mayer, Caruso and Salovey (2004), EI is the capacity to reason about emotions, and of emotions to enhance thinking. Emotional Intelligence "includes the abilities to accurately perceive emotions, to access emotions, and generate emotions" (p. 267). Based on the assumption that EI is "to assist thought, to understand emotions and emotional knowledge, and to reflectively regulate emotions so as to promote emotional and intellectual growth" (p. 267).

Intelligence "refers to the capacity to reason validly about information" (University of New Hampshire, 2012, p. 1). The term emotional intelligence in this fashion is consistent with scientific literature in the fields of intelligence, personality psychology, and emotions presented by Sternberg (2000). The four branch model of emotional intelligence designates four zones of abilities that together style numerous areas of emotional intelligence (Mayer & Salovey, 1997). More specifically, this model defines emotional intelligence as involving the abilities to:

- Accurately perceive emotions in one-self and others.
- Use emotions to facilitate thinking.
- Understand emotional meanings.
- Manage emotions.

The four-branch model represents what today is called the ability model of emotional intelligence. The branches are organized from the areas explicitly connected to the emotions-area (perceiving emotions) to the area's general to personality (managing emotions) (University of New Hampshire, 2015). Inside each branch, abilities can be recognized that are early-developing (e.g., in childhood) and abilities that await more development (University of New Hampshire, 2015). University of Toronto (2013) study suggested "an emotionally intelligent approach to making decisions is if one is feeling anxious, because of something unrelated to the decisions, to not make the decisions right away" (p. 1). Based on the study by University of Toronto (2013) found that "learning to pay attention only to those feelings that are relevant to the decisions being made is what counts" (p. 1).

National Defense University (1997) research led to a vital question: "Is the leader of the future going to control technology or is the technology going to control the leader?"(p. 1).

What will be the new demands and pressures placed on senior leaders of the future?

- How can leaders hope to cope with this "permanent white water" environment?
- How can leaders absorb and use the vast amounts of information needed for the complex, fast moving, decision making environment?

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- Do leaders know that they have the cognitive skills required to process massive amounts of information for competent decision making in the strategic environment (National Defense University, 1997, p. 1 Chapter 3)?

Leading Continuous Change explains the "4Ds" (Discovering, Deciding, Doing, and Discerning) structure for a new mindset that assists leaders with leading continuous change more successfully. Keen leaders know that today's pressures for change come from all directions and rarely come from one direction at a time (CCL, 2015). Leaders need to understand:

- Understand how leading complex, continuous change is different and therefore requires a different approach than leading one simple change at a time.
- Apply the "4D" framework that lays out the four actions and four accompanying mindsets that must be adopted to lead continuous change more successfully.
- Point to examples of organizations that have succeeded or failed at undertaking complex change.
- Help prepare their organization to lead complex change successfully by using a comprehensive checklist that will be provided in the session. (CCL, 2015 para. 1).

Effective leadership builds a bridge between hope and sustainable, relevant impact. Leadership is required at all levels of society. Confronting the world's most tenacious problems in health care necessitates work at all levels, not just from at the top of the most powerful health organizations (CCL, 2015). Leadership development can meet each person where they are and open the door for transformative change (CCL, 2015. Transformational leaders have reliability and elevated emotional intelligence (EI). They motivate individuals with a collective vision of the future and they communicate well (Mind Tools Ltd, 2015). Transformational leaders normally are self-aware, genuine, and compassionate (Mind Tools Ltd, 2015). Transformational leaders convince members be responsible, because they anticipate the best in individuals, and hold themselves responsible for their actions, while simultaneously treating their members with respect and integrity (Mind Tools Ltd, 2015). This leads to high efficiency and commitment towards patient care and communication (Mind Tools Ltd, 2015). Nevertheless, leadership is not a "one size fits all" concept; frequently, leaders must adapt to their approach to fit the circumstances and must make rational decisions (Mind Tools Ltd, 2015).

CONCLUSION

This chapter investigated organizational leadership in relations to health care reforms to include trends in health care leadership. The Stratified Systems Theory (SST), Systems Thinking, and regulators perspectives are included to provide different perspectives of leadership in health care. The chapter consisted of the following sections: background; main focus of the chapter, issues controversies, and problems; solutions and recommendation; and future research directions. Prior to 1994, the standards were comprised of chapters on Management, Governance, Medical Staff and Nursing Services. Basically each division in the health organization essentially had their own standards, based on the division itself (Schyve, 2009). Essentially, each division was operating as an organizational silo. The main strategies were: division, governance, accountability and their own languages of SB853 that were anticipated to guarantee the success of the division (Schyve, 2009). The Joint Commission pursued the guidance from the country's

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foremost healthcare management experts and clinical leaders to redesign this division by a by-division approach. One of the main themes discovered was that healthcare organization should not be viewed as a corporation of divisions and should be considered a system (Schyve, 2009). A system is a mixture of procedures, individuals, and assets that, work together, to accomplish one goal (Schyve, 2009).

Petrie (2014) explains "technology is a huge infrastructure and a driven change in this case" (p. 5). Normally, businesses that embrace change will do great in the future, than those that avoid the changes (Petrie, 2014, p. 5). Nevertheless, leadership is not a "one size fits all" thing; frequently, leaders must become accustomed to their approach to fit the circumstances (Mind Tools Ltd, 2015). Therefore, a fast pace innovation demand will be needed in health care organizations. Organizations need to be prepared to try new approaches that will create a cultural and diverse change to share with subordinates and clients. Kahn, (2015), stated that 21st century calls for a healthcare paradigm shift and innovation demands. Leaders and professionals need to prepare to lead with empathy, work with teams, and apply emotional intelligence in the workplace. Staff commitment and buy-in are needed (U.S. Department of Health and Human Services [HRSA], 2011).

SST is a formative theory associated to strategic leadership and organizational hierarchy. This involves a bureaucracy that serves as a vital structure for understanding the prominence of cognitive capability of strategic leaders (Browning Leadership Model, 2013). Established by Elliott Jaques, SST concentrates on a person's cognitive ability and capacity to reason over an explicit period of time. The SST is designed to deliberate through multifaceted and collaborative structures of cause and effect (Browning Leadership Model, 2013). Leaders maneuver in an environment of ambiguity and overwhelming density. Problems are no longer simple they are complex and at times with no clear cut answers. This has created a new thinking process for effective leaders to maintain success (Reed, 2006).

The problem has to be viewed differently. From the system view, which have a habit of enduring, even when everything else changes. With this view it is easier to create a new system, than fixing or eliminating an old system. Sociologist Robert K. Merton devised the phrase "goal displacement" to define conforming to rigid procedures becoming the goal, rather than looking at the whole organization (Reed, 2006). The world was imagined by theorists such as Isaac Newton, as having the features of a clock. The mechanisms of the clock could be understood by the progression of exploration and the methodical method (Reed, 2006).

A fundamental concept in the development of executive-level leaders is the changing nature of performance requirements as a utility of the organizational level (National Defense University, 1997). Leaders maneuver in an environment of ambiguity and overwhelming density. Problems are no longer simply they are complex and at times with no clear cut answers. This has created a new thinking process for effective leaders to maintain success (Reed, 2006). The problem has to be viewed differently, from the system view which have a habit of enduring, even when everything else changes. With this view it is easier to create a new system, than fixing or eliminating an old system. Sociologist Robert K. Merton devised the phrase "goal displacement" to define conforming rigid procedures becoming the goal, rather than looking at the whole organization (Reed, 2006).

Regulations are orders prescribed by authority to regulate conduct (Meriam Webster.com, 2014). When it relates to health care, they are also called health care reforms. An example is the Patient Protection and Affordable Care Act (PPAC) and Health Care and Education Reconciliation Act of 2010. These are the most extensive changes of the U. S. healthcare system, since the passage of the Medicare and Medicaid in the mid-1960s (Penno, 2014). For example the HITEACH Act gives Health and Human Services (HHS) the authority to write regulations (HHS.gov, 2014). The purpose of the regulations is

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to regulate the development of a national health information technology infrastructure. The HHS has a Regulatory Agenda that is published each fall and spring. In the fall a regulatory plan that condenses main concerns for the year. The HHS has regulatory authority that includes: the ACA, Health Information Privacy (HIPPA) and Human Research protection regulations (HHS.gov, 2014).

Governments, societies, and actions with the major intent to endorse, renovate, or uphold health as defined by the World Health Organization (WHO) is a health system (Bloland, Simone, Burkholder, Slutsker, & De Cock, 2012). This has been defined as "what we as a society do collectively to assure the conditions in which people can be healthy" (Committee for the Study of the Future of Public Health IoM, 1988, para. 1)". The U.S. health care system can be said to have numerous systems that operate independently and collaboratively at times (Rice, 2013). It is imperative to understand the U.S. public health infrastructure, which includes 3 key goals: improvement of health. Health care creation of environments promotes good health, and promotion of healthy developments, and behaviors (HealthyPeople.gov, 2010).

There is a necessity for collective approaches encompassing patients and their family members. Involve patients and families in managing care, accentuate value and care outcomes that are digitally linked so that patient-provider-caregiver teams have complete. The shared patient information and access to pertinent medical research, and care protocols (Bentkover, 2012). Research increasingly associates patient learning and engagement to improved health outcomes, lower costs and an enriched care experience. Patient associations include reduced cost and better quality of care. The HITECH Act of 2009 supports health care quality improvement and cost reductions. This is consistent with the Patient Protection and Affordable Care Act and Duals (PPACA). The PPACA was designed to reduce the large number of under and uninsured people in the U. S. by mandating that individuals obtain health insurance. The Duals programs are for patients with chronic illnesses that may require personal aid beyond typical assistance.

Further research is needed in the area of Emotional Intelligence (EI) and the role it plays in the decision making process for providing health care. According to Mayer, Caruso and Salovey (2004), EI is the capacity to reason about emotions, and how emotions to enhance or inhibit thinking. EI includes the "abilities to accurately perceive emotions, to access and generate emotions" (p. 267). Based on that assumption EI is "to assist thought, to understand emotions and emotional knowledge, and to reflectively regulate emotions so as to promote emotional and intellectual growth" (p. 267). The four-branch model represents what today is called the ability model of emotional intelligence. The branches are organized from the areas explicitly connected to the emotions-area (perceiving emotions) to the area's general to personality (managing emotions) (Meyers, 2012). Inside each branch, abilities can be recognized that are early-developing (e.g., in childhood) and abilities that await more development (e.g., adulthood) (Meyers, 2012).

Leading continuous change focuses on the "4Ds" (Discovering, Deciding, Doing, and Discerning) structure for a new mindset that assists leaders with leading continuous change more successfully. Keen leaders know that today's pressures for change come from all directions and rarely come from one at a time (CCL, 2015). Suggestions alone cannot initiate change. Effective leadership must build a bridge between hope and sustainable, relevant impact. Leadership is required at all levels of society. Confronting the world's most tenacious problems in health care necessitates work at all levels, not just from at the top of the most powerful health organizations (CCL, 2015). Leadership development can meet each person where they are and open the door for transformative change (CCL, 2015.

Transformational leaders have reliability and elevated emotional intelligence. They motivate individuals with a collective vision of the future, and they communicate well (Mind Tools Ltd, 2015). Trans-

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formational leaders normally are self-aware, genuine, compassionate, and unpretentious (Mind Tools Ltd, 2015). Transformational leaders motivate members because they anticipate the best in individuals; concomitantly, they hold themselves responsible for their actions (Mind Tools Ltd, 2015). These types of leaders set vibrant goals and have equally adroit conflict-resolution skills. These leaders, mindsets, and high expectations lead to highly efficient and committed organizational environments (Mind Tools Ltd, 2015).

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KEY TERMS AND DEFINITIONS

Appointment of Representation (AOR): A form of power of attorney.

Australian Commission on Safety and Quality in Health Care (ACSQHC): A commissioner agency that leads and coordinates health care improvements across Australia.

Centers for Medicare & Medicaid Services (CMS): Medicare and Medicaid Services.

Department of Management Health Care (DMHC): A health plan regulator for High Maintenance Organizations plans.

Emotional Intelligence (EI): Motivates individuals with a collective vision of the future to communicate well.

Health Insurance Portability and Accountability Act (HIPAA): Makes the ability to transfer and continue health insurance coverage for patient care to millions of citizens and families that lose their jobs, and protects the patients' privacy.

Independent Medical Reviewers (IMR): An Independent Medical Reviewer that works along with the DMC to regulate health plans.

Medicare Urban (MU): A program that covers hospitals in urban areas.

National Committee of Quality Assurance (NCQA): A non-profit organization to improve quality in health plans.

Patient Protection and Affordable Care Act (PPACA): This is an act created by Obama Care to maximize quality and affordability of insurance plans.

Quality Improvement (QI): The main goal is to make sure that all policies and regulations are implemented in health plans.

Senate Bill 853 (SB853): This Senate Bill provides various threshold languages and making language barriers to more understandable.

Systems Thinking: A holistic approach analysis to leadership and decision making.

TDK Technologies: Vendor for Technology and Management for e-commerce.

World Health Organization WHO: A health system for profit and non-profit organizations.

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Chapter 49
When the System Fails:
Challenges of Child Trauma on Adoptive Families' Social and Emotional System

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ABSTRACT

Guided by the lens of psychodynamic theory, Ford (2015) investigated the challenges faced by adoptive families of traumatized children. Fifteen families were randomly selected to participate in this study from a group of 30 parents who adopted traumatized children in Arizona. Thematic categories were drawn and summarized. Textual descriptions evolved from the thematic groups acknowledging their experiences and how these lived experiences guided their decision to adopt a traumatized child. Verification techniques, data mining, journaling, clustering, brainstorming, and peer reviews were used to ensure the quality of data. Emergent themes emphasized the need for adoption-focused training specific to traumatized children. Ford's (2015) study revealed that these adoptive families desired to be equipped with specialized therapeutic training before and after their adoptions.

INTRODUCTION

Adoption in the United States has become one of the most instrumental tools to alleviate the increasing number of children raised within the public welfare system. Adoption has an impact on everyone involved, and there are many benefits to adoption (Child Welfare Information Gateway, 2012). The benefits resulting from adoption tend to vary. The child perceives a sense of hope, love, and a sense of belonging and a place to call home (Child Welfare Information Gateway, 2012). The adopting parents view adoption as a solution (i.e., solution for their inability to bear a child or the desire to help a child). The community's perception of the adoptive family differs (Wegar, 2000). Adoption causes a reduction in homelessness, teenage pregnancy, addiction, criminal behavior, and suicide (World Association for Children & Parents, 2012). Therefore, adoption affects everyone involved.

The effects of adoption tend to change after its finalization (Child Welfare Information Gateway, 2013). Support, services, and resources that once existed are no longer available to the newly adoptive

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parent. Adoptive families struggle to find the necessary resources needed in raising their newly adopted child. Meyers (2011) suggested that sometimes adoptive parents are unable to meet their child's needs because they are too damaged. Post (2013) suggested that prior adoptive trauma has a negative effect on the adoptive family while they are attempting to create an ideal and harmonious family unit. Although prior adoptive trauma can affect the parents' ability to establish permanency for the traumatized child, researchers have addressed ways to train and equip adoptive parents in meeting this challenge.

Ford's goal was to understand the challenges faced by the adoptive families in order to empower them in finding solutions to help the child in bonding within the new family unit. With the increasing number of children exposed to traumatic experiences, finding more effective strategies to support the adoptive family is imperative (Child Welfare, 2012; James, 1994).

Adoptive families agree that emergency foster placement is necessary; however, they perceive the necessity of finding a permanent home outweighs temporary placement. According to the U.S. Department of Human Health Services (2013), 94,626 of the 400,540 children were adopted from the public welfare system. The permanency placement of some children was not always successful (Child Welfare, 2010; Festinger & Maza, 2001; McDonald, Propp, & Murphy, 2001; Ruggiero, 2010). The urgency for placement cannot outweigh permanency. More emphasis must be placed on adoption (Mapes, 2012; McDonald et al., 2001; Smith, 2010). Preservation of the adoptive family can occur when placement supports exist (Forbes, 2008; Mapes, 2012; Smith, 2010). Barriers exist among professionals who provide direct and indirect services (e.g., therapy, support, and subsidy) to adoptive families (Casey Family Services, 2003b; Mapes, 2012; Smith, 2010). These barriers continue to challenge the successful adoption of traumatized children. When any serious disturbance and trauma exist within the nucleus of the family, the child may suffer from attachment issues to the adoptive parent (James, 1994; Pickert & Shuster, 2012).

The risk of adoption failure has increased among adoptive families of traumatized children (Brodzinsky, 1992; Casey Family Services, 2003b). Agency adoption failure can occur before or after it is legally finalized. Meyers (2011) revealed that disrupted adoption occurs before the adoption is legally finalized. The rate of "disruption is 10% to 20%" (Meyers, 2011, p.83). Dissolution occurs after the child has been legally adopted. The approximate "dissolution rate is 1% to 10% "(Meyers, 2011, p.83). In both cases, failure occurs, and the child is returned to the public welfare system (Brodzinsky, Smith, & Brodzinsky, 1998; Grotevant & McDermott, 2014; M. A. Baker, personal communication, August 15, 2013; Mapes, 2012; Meyers, 2011; Smith, 2010; Wilke-Deaton, 2005). Such results could be due to the lack of services and resources readily available in meeting the adoptive family's needs (McDonald, 2001). A lack of supportive services may impede successful adoption outcomes (Child Welfare, 2013; Mapes, 2012; McDonald, 2001; Pickert, 2010). Adoption permanency of traumatized children is the least studied by researchers (Brodzinsky, 1992; McCormick, 1991; McDonald, 2001; Pickert, 2010). In order to address the factors associated with thriving post adoptive experience, more research is required in cultivating healthy relationship among adoptive families. James (1994) suggested that many adoptive parents do not understand what it takes to care for the traumatized child. It takes more than the will to survive and thrive in challenging adoptions. James noted that, as the fetus must be in the womb to survive, so must a child have human attachment relations in which to develop, feel protected, nurtured, and become a productive human. Healthy human attachment develops as the child's circle of security grows through the trust with their new primary care giver. As the relationship develops, the child can master this developmental stage.

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BACKGROUND

Many researchers have sought to understand the challenges that disrupt the developmental balance in the child's ability to form healthy attachments. Scholars question whether the problem lies in the child's behavior or the adoptive family's parenting style (Brodzinsky et al., 1998; Grotevant & McDermott, 2014; M. A. Baker, personal communication, August 15, 2013; Ruggerio, 2012; Wilke-Deaton, 2005). Children removed from their original caregivers tend to present with challenges in adjusting to or establishing a new attachment (Brodzinsky et al., 1998; Grotevant & McDermott, 2014; M. A. Baker, personal communication, August 15, 2013; McDonald, 2001; Pickert & Shuster, 2010; Wilke-Deaton, 2005). Some children perceive the loss of their primary caregiver as devastating and confusing. They tend to be in denial. They perceive their loss as a "loss of love, safety, protection, even life itself, and prolonged unavailability of the primary attachment" (James, 1994, p. 7). Some children tend to question their importance in the eyes of their parents. Some question what they did and if they are able to change what went wrong. Unfortunately, the mind of the child is still developing. Therefore, their internal perceptions of why the loss occurred maybe convoluted or fragmented. Their first primary attachment no longer is available to them and thus the child denies their emotional responsiveness which causes the relational hub to become damaged. The relationship between the child and its primary caregiver is crucial. Bowlby (1969) claimed intimate attachment between human beings acts as the "hub" from which a person's life revolves. Bowlby suggested that these same dynamics are true of other attachment relationships in life. Humans require intimacy. Bergin (2009) indicated that attachment is the foundation of the child's socioemotional well-being. Intimate socialization promotes healthy and secure relationships in life.

Secured, attached relationships allow the child the opportunity to balance their need, exploration, and growth within their environment (The Early Years Foundation, 2007). Bowlby (1969) suggested that healthy child and parent (caregiver) relationships are essential. Relationships are the foundational threshold that allows the child to formulate healthy attachments through which the child is able to gain a secure base in order for exploration both physically and emotionally (Schore, 2003a, 2003b). Bowlby focused on helping children through the attachment process while helping the parents (Bretherton, 1992). Bowlby (1958) explored the difference between insecurity and attachment and the beginning of attachment theory and questioned the first developmental stage as being oral and the first relationship as being analytic. The attachment theory, in essence, describes the long-term interpersonal relationship that exists between humans. Bowlby (1958) attempted to understand separation anxiety and distress in children when they were separated from the mother (primary caregiver). Children develop cognitive impressions through early experiences and attachment to their primary caregiver. When the child is removed from their caregiver, they present threatened and lost. Separation anxiety is a result of unconscious internal conflicts. Bowlby (1958) viewed the reaction of a child being separated from their primary caregiver evolves in three stages: protestation (adult anxiety); desperation (depression); and detachment.

The exploration of early relationships between the mother and child was viewed from various perspectives. Child development in attachment theory includes the interaction between the environments, as well as genetic predispositions (Hart, 2011). In the past, the effects of child trauma and adoption were well-researched topics. Researchers sought to understand that phenomena using a systematic and psychodynamic theoretical approach. The psychodynamic approach that is used with traumatized children generally is cognitive behavior therapy (CBT). Cognitive Behavioral Therapy is used to promote safety and stabilization. The psychodynamic approach helps the child in processing their traumatic memories.

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Many organizations have attempted to resolve the issues in child trauma and adoption by providing resources and rendering support through psycho-education to adoptive parents (Adoption Learning Partners, 2010; APAC-Alabama Post-Adoption Connection, 2010; Casey Foundation, 2010). Scholarly articles have been replaced with blogs on the challenges of child trauma on the adoptive family's social and emotional system that leads to disruption/dissolution. Berger (2012) discovered that no national data exist on disruption/dissolution in adoptions. There is a need to equip adoptive families in overcoming the challenges of failed adoption (i.e., disruption/dissolution) continues to exist.

Adoptive families, along with the adopted children, face many challenges. Actual challenges formulate when the child has experienced traumatic events during his or her life prior to adoption (Brodzinsky et al., 1998; Grotevant & McDermott, 2014; Mapes, 2012; Wilke-Deaton, 2005). Most adoptive families do not fully understand the requirements of raising a traumatized child (James, 1994; Mapes, 2012; Pickert & Shuster, 2010; Post, 2006; Ruggerio, 2010). Once the adoption is completed and challenges begin to arise, many adoptive families realize that they are not fully equipped to handle the reality of the presenting issues (James, 1994; Pickert, 2010; Post, 2013; Ruggerio, 2010). The newly adopted child, now living apart from his or her biological parents, tend to struggle with forming new attachments as the child wrestles with questions of disloyalty and estrangement (Forbes, 2008; Park, 2010; Ruggerio, 2010).

Adoptive parents revealed they sought out professional services to address the child's pre adoptive traumatic challenges, as these factors have an impact on the entire family (Ford, 2015; Park, 2010). Cohen, Coyne, and Duvall (1993) suggested that adoptive parents tend to refer their adopted children for clinical services, which are unrelated to general marital or family dysfunction. Miller, Finn, and Grotevant (2000) noted that many adoptive parents refer their adoptive children for clinical services at a higher rate than nonadoptive parents. Adoptive families face many challenges when attempting to work through their child's issues with the assistance of clinical services. Some parents found the only solution was to remove the child from the home (Cohen et al., 1993; Grotevant & McDermott, 2014; Mapes, 2012; Pickert, 2010).

Foster, pre adoptive, and adoptive parents undergo a rigorous amount of training to become a foster parent. Training includes first aid, CPR, disciplining, love and logical, mini map, and other state-required classes. Adoptive parents do not receive many of the needed specialized classes. Classes on attachment, crisis response, parenting the traumatized child, grief and loss, and working with neglected/abused children are rarely given. Adoptive parents struggle to find courses to address these concerns (Child Welfare Information Gateway, 2013). These specialized trainings are essential to help maintain permanency when working with adoptive families and traumatized children (Casey, 2003). Adoptive families require both professional and natural supports in order to be prepared for this challenge. Professional services such as therapy, respite care, crisis intervention, psycho-education courses, and direct family support helps the family work throughout difficult adjustment periods (Child Welfare Information Gateway, 2013). The traumatized child tends to lack sensitive responsiveness, especially when he or she has been a part of the child welfare system. Secure attachments develops internal working models which direct the child's thoughts, feelings, and emotions and helps in their future relationships (Grotevant, 2014; Hartman, 1984; M. A. Baker, personal communication, August 15, 2013; McDonald et al., 2011; Post, 2006, 2013).

Adoption in and of itself can be a powerful tool for social change because the adoption process allows the individuals involved the opportunity to grow into a new family unit. The number of children exposed to domestic violence, physical abuse, sexual abuse, and neglect has increased. It is imperative to find more effective strategies to support the adoptive family in assisting the child (Child Welfare League of America, 2010, 2013; Post, 2013; Smith, 2012, 2013).

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Adoptive families may find themselves being challenged more than ever before. One experienced area they are challenged in is failed adoption. Failed adoption (disruption/dissolution) affects the adopting family and child, as well as the community. Homes, schools, and community settings have been affected by the increase in the number of children being removed from their biological homes and being placed into the public foster care system. Failed adoption builds a pressure within the family unit to conform to the expectations and requirements of Child Protective Services (CPS) while facing scrutiny and stereotyping from society.

Failed adoption can be explained through the psychodynamic theory. In the area of psychotherapy, the psychodynamic theory was considered to be the most dominant school of thought among clinical psychology and psychiatry practice in the early 20th century. This approach includes a focus on the unconscious thoughts of the individual in order to formulate an understanding of his or her relationships, experiences, and how he or she sees the world. Failed adoption (disruption/dissolution) and the psychodynamic theory are connected through the examination of the adoptive family's unresolved conflicts and symptoms that arise from dysfunctional relationships, which may lead to a dissolved adoption. Adoptive families may find themselves being challenged more than ever before. Failed adoptions occur by the child's inability to attach to their new family.

The attachment theory is widely used to explain relationship development between a child and its primary caregiver. Bowlby's (1969) theory of attachment derives from the psychodynamic theory. According to the theory of attachment, the infant/toddler must develop a secure base with a primary caregiver before age 2-years-old. Thus, adoptive parents who are ill-equipped or non-versed (e.g., lacking information necessary) to understand and approach the child's needs unconsciously find themselves harboring painful and vulnerable feelings. These thoughts may stay in the unconscious because they are too difficult to deal with (James, 1994; Hushion, Sherman, & Siskind, 2006). This maladaptive process of repression, denial, and rationalization develop as a means to defend oneself and tend to cause the adoptive parent more harm than good. Adoptive parents need to examine their perspective or understanding of grief and possible narcissistic injury, while consistently remaining in tuned to their child's lived experience as an adoptee (Marsh & Ruth, 2008).

According to the psychodynamic theory, human behaviors and feelings are impacted by unconscious motives rooted in childhood experiences. The psychodynamic approach used in the area of adoption is Bowlby's (1969) theory of attachment. Attachment theorists illustrate the dynamics of maintained long-term human relationships. In this theory, Bowlby examined the relationship development between the infant/toddler and at least one primary caregiver by age 2-years-old. Bowlby and Ainsworth (1969, 1973) addressed the dynamics of long-term human relationships and explained the importance of the parent/primary caregiver's role, especially during the social and emotional stages of the infant/child. Bowlby (1969) suggested that child relationships are essential. Attachment theorists suggest that, in healthy child development, it is imperative that interaction take place in various environments (Hart, 2011). Understanding the attachment element experienced from the adoptive parent's perspective could enhance the therapeutic alliance. The therapeutic alliance is what Sonkin (2005) revealed about the therapist attachment development while building an alliance in the therapeutic relationship. In providing the child an opportunity to learn to trust again within a healthy relationship, he or she is afforded a chance to attach to his or her new caregiver. Bowlby believed that this form of attachment figure could happen without the child's awareness. The attachment theory includes four characteristics: proximity maintenance, separation distress, haven, and secure base (Hazan & Zeifman, 1999). Bowlby suggested that these same dynamics are true of other close attachment relationships in life.

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Attachment theory is used to clarify how the parental relationship influences the child's development. The traumatized child lacks in sensitive responsiveness, especially when he or she has been a part of the child welfare system (Child Welfare, 2010; Grotevant & McDermott, 2014; M. A. Baker, personal communication, August 15, 2013; National Child Traumatic Stress Network [NCTSN], 2005, 2012). These children are not afforded the opportunity to consistently attach to a secure base because they are moved from house to house, causing an unsecure base for exploration. Secure attachments help the child to develop internal working models which direct the child's thoughts, feelings, emotions, and hope in their future relationships (Grotevant & McDermott, 2014; M. A. Baker, personal communication, August 15, 2013). Attachment is one area that challenges the adoptive parent.

Traumatized children and their adoptive families are more at risk for failure due to a lack of services and resources readily available in meeting the needs of the child and family (Casey Family, 2003). More independent studies need to be conducted to understand the issues that the adoptive families experience (Keck & Kupecky, 2009; Post, 2013; Smith, 2010). Forbes (2008) revealed that the adoptive parent must live at a higher level of consciousness when parenting the traumatized child in order to stay attuned to their emotional state. Forbes suggested that the only way bonding and attachment can occur was by maintaining positive emotional experiences, which can allow the healing process to take place. Professionals question what can be done to help adoptive parents in gaining more understanding and confidence in raising their newly adopted child. Brodzinsky's (1998) stress and coping theory is used to screen adoptive families to ensure the existence of compatibility (good fit) and to make certain that the adoptive family is emotionally regulated. Bowlby's (1969) attachment theory places emphasis on the primary caregiver's responsiveness to the child's needs. Bowlby's attachment theory explores proximity maintenance, safe haven, and secure base (ensuring closeness or a type of intimacy where the child can explore from and return to) as well as separation anxiety, which is considered to be normal and adaptive in infants and is a part of their survival tools (Collins & Feeney, 2000).

The number of children being adopted from the public foster care system has increased. In the Adoption and Foster Care Analysis and Reporting System (AFCARS), the U.S. Department of Human Health Services (2013) revealed that 94,626 of the 400,540 children in the foster care system were adopted through the public welfare system. This number does not include the 14,213 children designated to pre adoptive licensed homes possessing a signed agreement with the state to foster and adopt (U.S. Department of Health and Human Services, 2013). However, the number of children adopted from the public welfare agency during 2011 was 50,516 (U.S. Department of Health and Human Services, 2013). In the past, the criteria for adopting a child differed then the criteria that is in place today, and the characteristics of the adoptive parent were primarily of middle socioeconomic status, upper-socioeconomic status, married, infertile, and nondisabled European American couples between the ages of 30s to 40s (Brodzinsky, Patterson, & Vaziri, 2001; Derdeyn, 1990).

The characteristics of adoptive parents have expanded to include individuals from low-income families, older individuals, single parents, and same-sex couples (Brodzinsky et al., 2001; Derdeyn, 1990; Smith, 2011). These changes surfaced due to the Adoption Assistance and Child Welfare Act (1980) and The Adoption and Safe Families Act (1997). The Child Welfare Act afforded an opportunity for special needs children (i.e., older age at placement, minority, racial, status, multiple sibling group, exposed to neglect and/or abuse, chronic medical problems, and mental and psychological disturbance) along with non-traumatized children to be adopted (Administration for Children and Families, 1980). The Adop-

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tion and Safe Families Act was passed with the purpose of reaffirming a commitment to permanency planning for foster children through reunification with the birth family or a concurrent plan for severance and adoption. From the standpoint of the adopted family, the reasons why they may struggle in receiving professional alliance within the home, school, and community, all of which are essential in order to survive and thrive in the midst of a difficult adoption. Providing knowledge from the adopted family's perspective renders additional insight into an effective intervention that takes into account the challenges that trauma etches on the adoptive family's social and emotional system (Adoption and Safe Families Act, 1997). With the increasing number of children exposed to domestic violence, physical abuse, sexual abuse, and neglect, finding more effective strategies to support their adoptive family in assisting their child, not only to survive but also to thrive, is imperative (Brodzinsky, 1992; James, 1994; Mapes, 2012; McDonald, 2001; Pickert, 2010; Ruggerio, 2010; Smith, 2010).

- **Disruption/Dissolution:** Refers to interruption within the family unit. A disruption occurs before the adoption has been legally finalized resulting in the child returning to the foster care system (Child Welfare, 2012; Meyers, 2011). Dissolution occurs when the legal relationship between the adoptive parents and the adopted child is severed, either voluntarily or involuntarily after the adoption is legally finalized (Child Welfare, 2012).
- **Pre Adoptive Placement:** "The placement of a foster child, for whom the permanency plan is adoption, with people who have been approved as an adoptive resource, pending the child becomes legally free for adoption" (Adoption Legal Risk- Child and Family Policy Manual, 2007, p. 1).
- **Unprivileged Information:** Complete medical, mental health, developmental, psychological, educational, and social information about the child and his or her biological family (Child Welfare Information Gateway, 2013).
- **Well-Informed/Unprivileged Information:** Information given or received by potential adoptive parents before making a legally finalized decision to adopt (Child Welfare Information Gateway, 2013).
- **Wrongful Adoption:** Accusations of undisclosed information withheld from adoptive parents by adoption agencies leading to an adoption. Undisclosed information can include a variety of things, such as serious physical emotional or psychological defects or deficiency (Meyers, 2011; National Adoption Information Clearinghouse, 2012).

Trauma is unique. Every individual who experienced such an event experiences it differently (Lee & James, 2011). Trauma is defined as any event that imposed a life altering or life threatening experience in such a way that the individual is deemed unable to function (Smith, 2012). The United States experienced an increase in children being placed in the public welfare system due to various traumatic situations of violence, neglect, and abuse. Foster children in the United States escalated over the last two decades making up the vast number of children adopted (Child Welfare Information Gateway, 2013; Smith, 2010). Adoption is used to reduce the number of children growing up in the public welfare system.

Adoption continues to be a valuable solution for the growing number of children living within the public foster care system. The U.S. Department of Human Health Services (2012) reported that over 400,540 children were adopted from the public welfare system. This number does not include the 14,213

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children who were designated to pre adoptive homes (U.S. Department of Health and Human Services, 2012). In September 2012, the number of children in the foster care system reached 399,546 (Children's Bureau, 2013). In 2012, over 83,905 children were adopted in the United States alone (Children's Bureau, 2013). The number of children being adopted from the foster care system reveals adoption is one valuable solution. The desire is to have children raised in a loving and caring environment and not the foster care system.

In the adoption literature, failed adoptions are referred to as disruptions. While these acts were found to be complex and emotionally charged, they have occurred more often than reported (Mapes, 2012; Smith, 2010). Although statistical data may vary, the University of Minnesota and Hennepin County (2010) conducted a study of the U.S. adoption practices and found that between 6 to 11% of all adoptions faced disruption before the adoption was finalized. The University of Minnesota and Hennepin County revealed that age was one critical variable in the rate of disruption. Children older than age 3 had a likelihood of disruption between the ranges of 10 to 16% (The University of Minnesota and Hennepin County, 2010). The rate of disruption is worse for teens, ranging as high as 24%, or 1 in 4 adoptions (Barth, Berry, Carson, & Goodfield, 1986; Festinger, 1990; Schmidt, Rosenthal, & Bombeck, 1988; Westhues & Cohen, 1990).

Researchers have attempted to determine the cause of disrupted adoptions. Barth and Berry (1988) suggested that older children were washed over from the initial success of permanency planning. Grotevant and McDermott (2014) revealed that, when disruptions or dissolution occurred in the adoptive home, the child is then at a higher risk for problems with adaptation, especially in the area of internalizing, externalizing, and attention. Another layer of trauma occurs in the area of trust, bonding, and attachment. Foster children develop negative behavior associated with bonding and attachment due to loss, deprivation, abuse, and physical development problems (Keck & Kupecky, 2009; Rushton & Monck, 2009; Spangler, Johann, Ronai, & Zimmermann, 2009; Wilke-Deaton, 2005). Trauma is defined as any stressful event, which was prolonged, overwhelming, or unpredictable (Lee & James, 2011; Post, 2012; Smith, 2012; Wilke-Deaton, 2005). Trauma can also be defined as a life-threatening and life-altering set of events or experiences in which the individual has no control over and is an actual or perceived threat of danger where the individual feels overwhelmed and/or in an incapacitated state in which he or she is unable to cope as usual (Brodzinsky et al., 1998; James, 1994; Karp & Butler, 1996).

Non infant foster children are categorized as special needs due to age and racial characteristics in various entities (Brodzinsky et al., 1998; Children's Bureau, 2013; Forbes & Dziegielewski, 2003; James, 1994; Karp & Butler, 1996; NCTSN; 2012; Smith, 2010; Wilke-Deaton, 2005). Lived experiences are causational factors that escalated the child's confrontational reasoning ability with their newly adoptive parents (Brodzinsky, 2008; Brodzinsky et al., 1998; Grotevant & McDermott, 2014; Smith, 2012). Adoptive parents of these children may be at a disadvantage from the onset. They adopted more than the child itself; they took on the child's pre adoptive experiences as well (Forbes & Dziegielewski, 2003). As the traumatized child attempts to bond, he or she tends to struggle with mistrust and uncertainty, which is embossed on the forefront of their mind from past experiences (Wilke-Deaton, 2005). When mistrust and uncertainty transfers into placement the effect impacts the adoptive family's relationship as well (Brodzinsky, 2008; Brodzinsky et al., 1998; Grotevant & McDermott, 2014; Smith, 2012). While the adoptive family attempts to engage the child in their family, the child continues to struggle with past inner conflicts, which make parenting the child more difficult (Smith & Howard, 1998).

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MAIN FOCUS OF THE CHAPTER

Challenges in Attachment

Case Scenario: *A married couple adopted a child (age 7) from the foster care system. The child presented with attachment issues. He had already formulated a healthy bond to his biological mother. The couple refused to stop loving the child although the child stated he could not call them mom and dad. These parents indicated that they had no professional training or alliance within the adoption/mental health arena. They primarily relied on friends and family members from their church for encouragement and direction. For years, they were challenged with rejection from their son. Finally, around age 16, the child realized that his parents really cared for him. He began calling them mom and dad. The husband recalled, "We faced a number of challenges that others might have walked away from. But we were committed to him way before he committed to us!"*

The development of human attachment begins within the first years of life. Bowlby (1969) suggested that the relationships between the child and the primary caregivers are essential. Relationships are seen as the foundational threshold that allows the child to formulate healthy attachments (Brodzinsky et al., 1998; Grotevant & McDermott, 2014; Schore, 2003a, 2003b; Wilke-Deaton, 2005). As the secure base is instilled for exploration, the child's increased need and ability to navigate in both the psychological and physical world develops (Schore, 2003a, 2003b).

Bowlby suggested helping children to find their way while helping the parents to feel secure was vital (Bretherton, 1992). From this point on, a difference between insecurity and attachment between the mother and child was explored (Bowlby, 1958). According to the attachment theory, the development of childhood includes the interaction between environments as well as genetic predisposition (Hart, 2011). Understanding the attachment element experienced from the adoptive parent's perspective was vital to enhance the therapeutic alliance. In fact, Bowlby (1969) felt that the intimate attachment between human beings acted as the hub from which a person's life revolved.

It is those initial relationships that Bowlby believed the individual attached to a personal therapist. Bowlby (1969) noted that attachment happened without the child's awareness, and the attachment theory developed four characteristics: proximity maintenance, separation distress, haven, and secure base. Bowlby suggested that these same dynamics were true of other close attachment relationships in life. Wilke-Deaton (2005) suggested that when the professional is looking to understand attachment theories or even attachment, in general, it is important to realize that children tend to have more than one primary caregiver. Past researchers focused on the relationship with the mother and child. Yet this has been noted as only one of the primary caregivers (Brodzinsky, 2008; Grotevant & McDermott, 2014; Smith, 2012; Wilke-Deaton, 2005).

Attachment theory is used to clarify the impact on how the parental relationship influences the child's development. Traumatized children tend to lack in sensitive responsiveness when raised in the foster care system (M. A. Baker, personal communication, August 15, 2013; Wilke-Deaton, 2005). These children lack a secure base because they moved from house-to-house, causing an unsecure base from which they can explore (Brodzinsky, 1992; McCormick, 1991; McDonald, 2001; Pickert, 2010; Rushton & Monck, 2009). Secured attachments help the child to develop internal working models that direct the child's thoughts, feelings, emotions, and hope in his or her future relationships (Brodzinsky et al., 1998; Grotevant & McDermott, 2014; M. A. Baker, personal communication, August 15, 2013;

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Wilke-Deaton, 2005). The internal working model of each traumatic event influences the outcome of the organization and functional capacity of the adoptive family's outcome depending on the complexity or longevity of each experience (Grotevant & McDermott, 2014).

Within attachment theory, James (1994) defined attachment as a reciprocal process by which the child and his or her caregiver endure emotions and physical affiliation. In addition the reciprocal processes engage each party (caregiver and child) into the bonding and attachment approach (Wilke-Deaton, 2005). One facet of the reciprocal approach resembles the action of the primary caregiver establishing or instilling trust, morals, beliefs, and love in the form of bonding, which allows the child to begin to formulate an attachment relationship with the caregiver (Wilke-Deaton, 2005). When applied to traumatize children, it is easier to understand why children who are removed from their original caregivers tend to present as challenged in adjustment or establishment of new attachments.

When the attachment is severely disrupted, the child's physical, social, and mental developmental balances are interrupted as well (Grotevant & McDermott, 2014). These disruptions are displayed in academia and other school areas, adjustment within various environmental settings, externalizing and impulsive displayed symptoms, hyperactive behavior, conduct problems, and substance abuse issues (Anda et al., 2006). These misunderstood challenges stigmatize the adoptive family unit and render many of them ill-equipped because these families tend to lack information about their child's past traumatic experiences which is required to advocate for the needs of their new family. The lack of background information and parental stressors are the strongest service-related predictors of disruption (Groze, 1996; Rosenthal, 1993). Family preservation is crucial in order to maintain the relationship of the pre-existing family unit and provide the child with stabilization and permanency in a safe and secured environment (Brodzinsky, 1992, 2008; Grotevant & McDermott, 2014; James, 1994; McDonald, 2001; Smith, 2012; Wilke-Deaton, 2005). Therefore, it is necessary that placement supports be established allowing the child to generate a new bond of trust with his or her new caregiver. When the circle of security (trust) is generated, and a healthy relationship (nurturance and protection) with the caregiver is created, the child's psychological human development is constructed (James, 1994).

Challenges of Well-Informed Decision Making

Case Scenario: *A married couple adopted another child. "We adopted this little girl straight out of the hospital. We did it because we had already adopted her brothers a few years back. We thought that we knew what we were getting ourselves into because we had her brothers. We knew that the mother had been on drugs. However, we were not prepared at all to deal with these challenges. Our daughter presented with life-threatening medical issues. She presented with sensory, speech, attachment, and behavior issues that were magnified to the tenth power. We were not given any information to make a well-informed decision."*

Research is needed to explore evidence-based strategies for working with adoptive parents of traumatized children. Adoptive parents may not receive well-informed documentation about the child before the adoption was finalized. Agencies may withhold vital information as seen in *(Burr v. Board of County Commissioners of Stark County, 1986)*. Funding needs to be allocated for preadoption training to ensure the adoptive parents are equipped with understanding and knowledge of the challenges that present in adopting traumatized children. Postadoption services (therapies, respite care, subsidies, and support groups) must exist to empower the stability of the parent and the family unit as a whole. Of particular

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importance is the need for the awareness of the knowledge and understanding of the challenges of child trauma on the adoptive family's social and emotional system. As the child's social, emotional, and behavioral problems manifest, the parents' unrealistic expectations of the child may cause disruptions within the new family unit (Barth & Berry; 1988). These gaps laid the foundation for this study by pointing out the challenges that adoptive parents faced in the area of attachment. Adoptive families are apt to be challenged with new stressors just to face the child's rejecting behavior (Barth & Berry, 1988; Wilke-Deaton, 2005).

All states suggest that adoptive families receive information about the potential adopted child and the circumstances that placed him or her in the welfare system. However, receipt of such information happens less often (B. Troupe, personal communication, April 16, 2014; National Adoption Information Clearinghouse, 2013). To make well-informed decisions on whether to adopt or not, this information has been found to be essential (B. Troupe, personal communication, April 16, 2014 (National Adoption Information Clearinghouse, 2013). According to the Child's Bureau (2012), accurate information about a child's background, to the extent allowed by law, should be shared. Initially, this is done with an introduction of a limited scope of information. If the family still shows interest, then the limited scope is continued through full disclosure of obtainable information (Child's Welfare Information Gateway, 2012; Mapes, 2012; Smith, 2012).

Well-informed decision making is a realistic exploration of adoption. The Child Welfare Information Gateway (2010) revealed that this process is a relevant resource for ensuring a legal permanent, nurturing family for every child. When such information is received, the adoptive families are equipped with information on how to advocate for the needs of their potential child. Also, some foster care and adoption agencies have used such information to cross-match potential adoptive families to certain adoptive children. Adopting parents have the opportunity to preview potential genetic defects, generation, and environmental experienced events. Such genetic defects could have an impact on the child's medical, behavioral, social, and emotional mental health. Therefore, such information needs to be shared before the adoptive parent commits to a life-long relationship with the child. Some agencies find this to be a detrimental step in finding a good home for some children. However, it is not enough just to place the child in a home where disruption or dissolution can take place. The goal of this decision-making process is to alleviate further potential trauma. Adoptive families cannot meet the needs of the adopted child being ill-equipped (Child Welfare Gateway, 2010, 2012; Forbes & Dziegielewski, 2003; Grotevant & McDermott, 2014; Smith, 2012; Wilke-Deaton, 2005). When the informed decision-making process is carried out, it allows the potential adoptive family the chance to obtain the necessary training to raise a traumatized child (Child Welfare Gateway, 2010, 2012).

Such training can be in various areas. Training in adopting traumatized children is required for there to be stability and permanency (Brodzinsky, 2008; Forbes & Dziegielewski, 2003; Grotevant & McDermott, 2014; Smith, 2012). The National Academy of Sciences reported the consequences of abuse (trauma) has been found to reshape the brain of the traumatized child. The results of this reshaping leave a long-lasting effect, especially when the child is untreated (Schulte, 2013). The effects influence the child's physical behaviors as well as their mental health behaviors (Schulte, 2013). In fact, many states require adoption agencies and attorneys to collect medical and genetic information on the child that can be shared with the adoptive parent (Dinwoode, 2014).

In adoptions, the adopting parent is required to sign consent where they agree to take and raise the child with the same privileges as their birth child (Child Welfare Gateway, 2010, 2012). Every state

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regulates their consent to adopt. Consent to adopt is not governed by federal laws. However, consents to adopt are required by all states (Children's Bureau, 2013).

Although adoption consent is designed to ensure the protection of all parties involved (child, birth parent, and adopting parent), it was not designed to protect adoptive parents from wrongful adoption. Wrongful Adoption is a legal term that refers to the failure of an adoption agency or worker to disclose known information about a child to the prospective adoptive parents (Child Welfare Information Gateway, 2013). Valuable information which includes known medical or psychiatric. Wrongful adoption occurs when adoption workers stand unclear on adoption law and what is to be disclosed. Many adoption agencies are attempting to obtain placement of the child in a permanent home. Although unprivileged information regarding the child is required at the time of placement, sometimes the pertinent information has been knowingly omitted. Some families receive less than accurate preplacement (well-informed/unprivileged) information (Arizona Revised Statues, 2013). Well-informed decisions are only capable of being made when adoptive parents receive all relevant information about the child. Well-informed decisions derive from information gathered on the child and his or her biological family. The Child Welfare League of America (CWLA, 2013) proposed that a standard of excellence be in place for all adoption services. The adoptive family should receive complete unprivileged information on the child, their birth family and other birth relatives two generations back (CWLA, 2013). Therefore, included in the well-informed decision-making process is unprivileged information. The Arizona's Revised Statues 8-514 (2013) viewed unprivileged information to include but was not limited to: demographic information; type of custody and previous placement; pertinent family information including the names of family members who, by court order, may not visit the child; known or available medical history including but not limited to (a) allergies, (b) immunizations, (c) childhood diseases, (d) physical handicaps, (e) other idiosyncrasies (e.g., psychological, mental health, etc.), and (f) the child's last doctor; and a summary of the child's history of adjudication on acts of delinquency, as may be public record and available in the file of the clerk of the superior court (pp. 1-3).

Sometimes adoption agencies have limited knowledge of the child's past traumatic experiences. Therefore, they too are challenged with understanding the complexity of the child's trauma (Wilke-Deaton, 2005). Many adoption agencies have learned that all prospective parents are required to have disclosed non-identifying information where with an informed decision to adopt can be made. Adoptive parents are commissioned not to assume they received all medical, psychiatric, and social information about their potential adopted child (Child Welfare Information Gateway, 2013; Riggs & Kroll, 2004). One historical case of a wrongful adoption was Burr vs. Board of County Commissioners of Stark County (1986) in Ohio. In this case, the adoptive parents struggled with challenges of their child. It was discovered that known; unprivileged information was purposefully withheld about the birthmother's mental illness. The agency's worker knowingly withheld information and misrepresented the child as a child who was healthy (Combs, 1986). The adoptive parents were led to believe that the 17-month old baby was being placed up for adoption by his 18-year-old mother. Allegedly, the grandparents were said to have abused the child and the mother's desire to make a better life for herself in another state (Combs, 1986). The adoptive parents immediately proceeded with the adoption based off of the information received. Their lives and that of their sons throughout his childhood indicted a myriad of physical and mental health problems. This case pointed out how necessary it was for adoptive parents to inquire about their child's past in order to have obtained child abuse, medical, psychiatric, and placement history.

Adoptive parents need to advocate to receive complete historical information, both known and unprivileged, to formulate a well-informed decision about adoption. Such information includes medical

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and mental health issues, social and emotional, behavioral, educational, legal, and any genetic predisposition information that could have an adverse effect on the development of the child and the stability of the new family. All of this information should be granted prior to the finalization of the adoption to alleviate any further disruptions in the child's life or dissolution of the new family unit. When knowledge of the child's past is received, the adoptive parents are equipped in making well-informed decisions in adopting. This knowledge prepares the adoptive parents and allows for them to advocate for the needs of their child, thus reducing the challenges associated with adopting a traumatized child.

Due to the increase in the number of children in the public welfare system and in out of home placement, child protection agents may strive for placement over permanency when they seek out residency for a child. The gaps in the research laid the foundation for this study by pointing out the challenges that adoptive parents face in the area of well-informed documentation. When the release of medical and mental health disclosures is not discovered until after the adoption finalized, the adoptive family is challenged. Disclosure failure could result from a lack of undocumented information unrevealed even to the child protection service workers.

Challenge of Placement versus Permanency

Case Scenario: *A single mother shared her story about adopting her son. She stated "In the beginning it they just wanted me to keep my son and work with him on his problems. I was his home because he had nowhere else to go. No one wanted him. But I grew to love him. He had been in so many placements, He had experienced years of rejection, and abandonment issues from various foster families in addition to his own." The re-traumatization this child experienced continues to wreak devastation. "To some, it was about placement, but as I grew to love him it was all about giving this child something he has never experienced……a permanent place to call home!"*

Permanency is stemmed from active participation between a youth and an adult who have searched in finding a permanent connection. The adult is committed to providing the youth with a safe, secure, and stable relationship demonstrated with unconditional love and lifelong support (Brodzinsky et al., 1988; Forbes & Dziegielewski, 2003; M. A. Baker, personal communication, August 15, 2013; Smith, 2012).

Over the last 2 decades, the number of adoptions from the public welfare system in the United States has increased (Child Welfare Information Gateway, 2013). The Children's Bureau (2013) reported that on September 30, 2012, there were an estimated 399,546 children in the public foster care system. Close to half of those children (47%) resided in nonrelative placement, and of this 47%, 24% of these children had a goal of adoption (Children's Bureau, 2013). There must be a paradigm shift from placement towards the direction of achieved permanency and assured supports, which are needed to transition these children from disrupted relationships to a healthy adulthood outcome (Donaldson, 2010). This shift is needed because many children are placed in homes that are not equipped to deal with the challenges these children present, such as abuse, neglect, multiple placements, and other preadoption experiences that inflict physical, psychological, emotional, and developmental harm on them (Donaldson, 2010).

There are few families that willing to adopt traumatized children. With the number of children who are still waiting to find their forever home, these homes are fewer. These special needs children require specialized parenting once they are adopted into their permanent home (Forbes & Dziegielewski, 2003; Keck & Kupecky, 2009; Smith, 2012). Forbes and Dziegielewski (2003) claimed that there are many reasons provided required for specialized parenting; however, the common thread is found in the mental

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and behavioral health arena. Mental and behavioral health issues, such as oppositional defiant disorder (ODD), conduct disorder (CD), reactive attachment disorder (RAD), posttraumatic stress disorder (PTSD), and/or depression are common in special needs children (Forbes & Dziegielewski, 2003).

The child welfare system is mandated with the responsibility of placement of children who are wards of the state (National Association of Social Workers, 2009). The Adoption Assistance and Child Welfare Act (1980) renders the goals of family preservation and permanency as priority goals (National Association of Social Workers, 2009). Every adoptive home is required to be screened before placement and supervised monthly while the child is placed in the home. Although, in the beginning, the targeted objective is placement, researchers have shown that this not sufficient enough (Barth & Berry, 1988; Forbes & Dziegielewski, 2003; James, 1994). Best practices for adoption entail not only establishing the formulation of the family, but also cultivating their success (Donaldson, 2010). However, in order for this goal to be carried out, policy makers and professionals must revisit state and national priorities to strengthen and sustain the adoptive family (Keck & Kupecky, 2009; Petra & Kohl, 2010; Randall, 2009; Smith, 2012).

Professionals and policy makers must define, alter, and advocate for the resources necessary to strengthen and sustain the adoptive family unit. Through obtained knowledge and supportive resources, the adoptive parents will be equipped with the essential tools needed to assist their child in enjoining the family unit, causing stabilization to take place on the child and family. This knowledge prepares the adoptive parents and allows for them to advocate for the needs of their child, reducing the challenges associated with adopting a traumatized child (B. Troupe, personal communication, May 2, 2014; Barth & Berry1988; Brodzinsky et al., 1988; Forbes & Dziegielewski, 2003; James, 1994; Keck & Kupecky, 2009; M. A. Baker, personal communication, August 15, 2013; Petra & Kohl, 2010; Randall, 2009; Smith, 2012; Wilke-Deaton, 2005).

Many adoptive parents lack understanding of the various forms of the trauma their adopted child may have experienced. Prolonged exposure to neglect, domestic violence, multiple placement, and trauma within the home and system become a challenge for these parents (James, 1994; Wilke-Deaton, 2005). The adoptive parents face challenges in the area of placement versus permanency. Placement is not enough (Brodzinsky et al., 1988). Policy makers, along with other federal officials, must begin to look at the long-term effects that trauma has on the child, as well as the family unit as a whole. Forbes and Dziegielewski (2003) revealed that researchers have not examined the outcomes or effects on the adoptive family. Yet, understanding the challenges and perspectives of adopting children of trauma needs to be studied in order for the adoptive parent to obtain the specialized training in parenting traumatized children (Forbes & Dziegielewski, 2003).

Challenges in Understanding Endured Trauma

Case Scenario*: "As an adoptive parent of four different adopted children, I never understood the forms of trauma which abused children endured. Every child I adopted had experienced sexual trauma, abandonment, their biological parents were substance abuse. These children did not attach to their families. Each one presented with attention seeking cravings. They presented victims from within. Due to the sexual abuse of the girls, the family was challenged with vindictive and hurtful scapegoat behaviors towards all males. Until they grow up, I realized that they present with a 'you owe me' mentality instead of seeing everything that I have sacrificed for them."*

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Researchers found that the direct impact of experienced trauma from 40% of CPS cases was unknown (U.S. Department of Health & Human Services, ACF, 2010). Acts towards children produce complex traumatic experiences with extended consequences. These acts affect the child, their families, and the community (English, 2005; Higgins & McCabe, 2003; Sabol, Coulton, & Polousky, 2004; Wulczyn, 2009; Zielinski, 2009). These children often experience multiple forms and incidents of abuse or neglect. The National Child Abuse and Neglect Data System (NCANDS) revealed that 40% of the substantiated victims received preventative services within their homes (U.S. Department of Health & Human Services, ACF, 2010). Researchers have revealed the events in which children are traumatically affected. Although these events cause psychological-threatening or physical threats that fuel the child to launch their flight, fight or freeze responses, the child may not qualify for the diagnosis of PTSD (American Psychiatric Association, 2000; James, 1994; M. A. Baker, personal communication, August 15, 2013; Wilke-Deaton, 2005). PTSD in these children occurs because the child's neurophysiological responses continue to linger in a chronically aroused state, even though the intimidation, risk, or danger has ended (Terr, 1992). Traumatic events, such as domestic violence, car accidents, neglect, physical and sexual abuse, national disasters, or even medical procedural trauma cause lingering effects which incapacitate the child's ability to function or self-regulate physically and emotionally (Brodzinsky, 1992; Grotevant, & McDermott, 2014; James, 1994; M. A. Baker, personal communication, December 15, 2013; McDonald, 2001; Pickert, 2010; Ruggiero, 2010). In their presentation, physical and emotional dysregulation are masked by a range of behaviors, which include the following: dissociation, enuresis, eating issues, hyper arousal, heightened startle response, elimination issues, focusing/concentration challenges, sleeping problems, sensory issues, and isolation and attachment issues (Grotevant & McDermott, 2014).

In the past, the criteria for adopting a child differed then the criteria that is in place today (Adoption Assistance and Child Welfare Act (1980). In the past, the adoptive parents were primarily middle socioeconomic status, upper socioeconomic status, married, infertile, and European American couples ages 30s to 40s without any form of disability (Brodzinsky et al., 2001; Derdeyn 1990). In the past, when a couple went to adopt a child, their reasons may have stemmed due to their inability to conceive a child. Today, individuals from low-income families, older individuals, single parents, and same-sex couples adopt children from the public welfare system (Brodzinsky et al., 2001; Derdeyn 1990). These changes surfaced with the Adoption Assistance and Child Welfare Act (1980). This act afforded an opportunity for special needs children (i.e., older age at placement, minority, racial, status, multiple sibling group, exposed to neglect and/or abuse, chronic medical problems, mental and psychological disturbance) along with non-traumatized children to be adopted (Administration for Children and Families, 1980). The Adoption and Safe Families Act (1987) passed with the purpose of reaffirming a commitment to permanency planning for foster children through reunification with the birth family or a concurrent plan for severance and adoption.

Many parents fail to understand or gain the knowledge about the challenges endured when adopting a traumatized child. The basic training that families receive only begins to scratch the surface of what is to come. Lavner, Waterman, and Peplau (2014) suggested that the services rendered to adoptive parents should be required throughout the transition to parenthood. These services need to promote the well-being of the family unit as well as the child. James (1994) revealed that it is not enough to merely survive and thrive in difficult adoptions; adoptive families needed to understand how equipped they must be to establish a healthy relationship when parenting the traumatized child.

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I remember going through the basic training, which didn't teach me about anything that I was going to experience with raising other people's children as my own. I have been horrified at some of the things that I have experienced and appalled at other things. Basic training is not enough! Taking on children is one thing, but when they have gone through so many layers of trauma, it has been another. I had no one to help me. As a single full-time working mother barriers were faced especially when the professional providing direct and indirect services failed to meet the needs of my family .i sought and received support outside of the professional arena in order to meet the needs of my family. Yet this is not the way the challenges of postadoption services should have been met. As an adoptive parent, I was doing a service to the state in addition to making a contractual commitment to love another's child as my own. No I would not change anything that I have experienced. I have learned a lot while on this journey. My four children have taught me life's lessons of what it means to raise and stand beside an individual who has experienced childhood trauma. Before them, I thought my life was 'normal' yet going through the roller coaster ride of life with them, I gained the necessary knowledge to help teach other adoptive parents how to help their adopted children to maintain permanency while being members of a supportive network. I am sincerely grateful to all of the foster parents, kinship placements, and adoptive parents who decided to take on the rewarding challenge of providing a traumatized child a chance at a new life, in a new environment where the risk of trauma recurring is reduced. And to all of the adopted children who have experienced childhood trauma and have learned to trust again, your strength and experiences are there to help another child in overcoming their past and achieve new life within their new families.

Many adoptive families experience more challenges in the lack of postadoption services. According to Casey Family Services (2003b), continuous barriers exist among professionals who provide direct and indirect (e.g., therapy, support, and subsidy) services to traumatized children and their adoptive families. Ruggiero (2010) believed that families face three challenges in attempting to parent traumatized children. Two of these challenges deal primarily with the foundation that equips the parent for his or her new task. Ruggiero suggested that adoptive parents are unprepared in the preadoption phase for raising children who struggle emotionally from traumatizing experiences; currently, there is a lack of postadoption services, especially in the area of behavior supports. These children and their adoptive families are at risk for failure. Failure in an adoptive home is perceived as the child being admitted in long-term therapeutic placement or even being returned to the welfare system (Casey, 2003b). Such results may be due to the lack of services and resources readily available in meeting the needs of the children and their families. Forbes (2008) acknowledged that parenting traumatized children are different from parenting non-traumatized children. Forbes contended that adoptive parents often face various issues that have a connection to the child's past traumatic experience or event. These challenges often are the cause of a significant alteration of the family's life, which causes an imbalance. Forbes revealed that stress and demands of special needs adoption range around 1/5 to 1/4 of the unsatisfactory reported adoptions. This contributes to 10% of disruptive adoptions which leads to the child returning to the foster care system. These hurdles highlighted some of the critical issues in adoption failure. Constant challenges in adoption permanency (e.g., remaining, maintaining, and integrating as an active member of the new family) of the traumatized child are the least studied. Therefore, researchers must address the needs and factors associated with strong, vigorous, and thriving post adoptive experiences (Forbes, 2008; James, 1994).

Researchers have looked to understand the issues or challenges that disrupt the developmental balance in the child's ability to form healthy attachments instead of viewing the challenges through the lens of the adoptive family. McGlone, Santos, Kazama, Fong, and Mueller (2003) conducted a study

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to understand the nature and the extent of parental stress endured by adoptive parents of special needs children. Adoptive parents revealed that they sought out clinical services to address their child's pre-adoptive factors (e.g., biological and earlier experiences or abuse and neglect), which had an influential impact on the entire family. Adoptive families face challenges where the only solution to the problem was to remove the child from the home (Cohen, Coyne, & Duvall, 1993). Multiple placements increase additional layers of trauma.

SOLUTIONS AND RECOMMENDATIONS

Researchers have examined the challenges that adoptive parents have faced when adopting a child who has experienced trauma. However, scholars must also understand from the adoptive family's perspective and not just the child's perspective of the causes of failed adoption. Scholars have provided insight to the challenges of child trauma on the adoptive family social and emotional system. Researchers have revealed the importance of the foundation for human preservation within the family unit. Research is needed to explore evidence-based strategies for working with adoptive parents of traumatized children. The ultimate goal of prevention services appears to center around the child and family's environment. Here the catalyst is focused on positive changes among the primary family. The traumatic effects that an adoptive child experience affect the entire family unit; therefore, professional services are required for the whole family (Higgins & McCabe, 2003).

The significance of this topic aims to understand, from the perspective of the adopted family and their children, the reasons why they may be challenged with receiving professional alliance within the home, school, and community. The results added additional insight to actual knowledge for intervention while taking into account the impact of trauma etched on the adoptive family's social and emotional system. Adoption can be a powerful tool for social change. With the increasing number of children exposed to domestic violence, physical abuse, sexual abuse, and neglect, finding more efficient strategies to support their adoptive family in assisting their child, not only to survive but also to thrive, is imperative.

FUTURE RESEARCH DIRECTIONS

Adoption in and of itself can be a powerful tool for social change (Meyers, 2011). The number of children exposed to domestic violence, physical abuse, sexual abuse, and neglect has increased (Child Welfare League of America. 2010, 2013; Post, 2013; Smith, 2012, 2013). There is a need for more individuals to take on the challenge of adoption. There are many individuals who are willing to take on this challenge. However, it is important for adoption workers to understand that family unity does not always occur once the adoption paperwork is completed. In fact, this is often the time when many of the social and emotional challenges begin (Donaldson, 2013). Desire is not enough. It is imperative for individuals to be equipped with knowledge, coping skills, and support. Thus moving families beyond thriving to surviving in difficult adoptions (Child League of America, 1996; James 1994). Understanding the adoptive family's perspective could contribute to providing more effective treatment and supports. This population of individuals is in need of psychoeducation, supportive services, insurances and financial subsidies. Such positive outcomes can promote permanency in their adoptive homes after placement (Child Welfare, 2010, 2012; McDonald, 2001; Rushton & Monck, 2009).

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CONCLUSION

Many adoptive parents are willing to take on the challenge of raising a child who has experience trauma. However, they desire to be trained and to have supportive resources in place to take on the task. Adoptive parents are committed to raising the children that they have adopted. Adoptive parents desire to be informed of the trauma the children have faced. Supportive resources prepare the adoptive parent for potential challenges that they will face. Social change begins with one action. The ripples of change could extend to professional agencies and down into these homes by equipping adoptive parents with essential tools. These adoptive families can begin to reach out and form bonds that originate trust and attachment between the adult and child within the family unit. As attachments adhere, the family unit thrives and survives within difficult adoptions.

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Section 5
Critical Issues and Challenges

This section contains 10 chapters, giving a wide variety of perspectives on Public Health and Welfare and its implications. Within the chapters, the reader is presented with an in-depth analysis of the most current and relevant issues within this growing field of study. Crucial questions are addressed and alternatives offered along with theoretical approaches discussed.

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Chapter 50
The Crisis of Public Health as a Media Event:
Between Media Frames and Public Assessments

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ABSTRACT

The focus of the present article is on the analysis of the influence exercised by media narratives on the Romanian audience's reconstructions of social movements from January-February 2012. The analysis was interested to show what are the aspects involved in the publicizing of this media event in Romania, by focusing on the event narrative built in such a way to transmit a particular significance related to the protest movements related to the crisis of the health public system in Romania. Two research methods were used in collecting the data: a survey on two hundreds Romanian respondents and quantitative content analysis of five national Romanian newspapers. As the results show, the high consumption of mass media messages does not determine whether the public adopts the media narratives concerning the events from the beginning of year 2012. At the same time, the analysis shows that in the case of the media events that took place in Romania in January-February 2012 the impact of the media narrative on the way in which the audience from Romania rebuilt those protests was a minor one and other factors had played a major role in triggering massive mass protests in Romania.

INTRODUCTION

In the analysis of the relationship between media and society a widespread thesis is the one according to which mass media can influence people's perception of certain issues and, at the same time, it has the role to reconstruct these issues in the public space (Bernays, 2011, p. 79). If the newspapers publish fewer articles on a certain topic, it can mean that the respective topic is not as important as the other topics published by this media (Frangi & Fletcher, 2002, p. 27).

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Far from being the identical reflection of reality, the news represent a reconstruction of social events and processes, also including, together with real facts, a collection of new elements among which are facts or people, images as well as the experts' comments. The finite product of the work of journalists, the news, is, in fact, only that which the journalist wants their audience to see (Monhan, 2010, p. 4). As Murray Edelman (Monhan, 2010, p. 21) said, news constructs the social world, history, evoking the worries, hope and assuming of the events that are observed or ignored (Monhan, 2010, p. 21).

The specific of the Academic approaches regarding the relation between communication and health consists of using the interdisciplinarity on the theoretical and methodological levels. The problems encountered in different medical systems and finding the solutions to these problems are the foundation of constructing certain research combining medicine and public policies (in general those in the administrative sphere, but also from an economic perspective) and sociology (Mechanic, 1996, p. 238).

A study on the issue of health in Romania (MedLife, IMAS, April 2012) shows that 70% of the Romanians do not intend to make a private health insurance (MedLife, IMAS, April 2012). According to this study (MedLife, IMAS, April 2012), in the last years, Romanians have changed their attitude regarding going to the doctor. If in 2011 a share of 58% of the Romanian respondents did not go to routine medical checkups, one year later, 75% of the respondents declared that they went to these checkups on a regular basis. Young people (30-44 years old) were the ones who declared that they went to medical checkups the least often, the most concerned with health being the women, old people and those living in urban areas (MedLife, IMAS, April 2012).

The present article aims to identify the impact of the media narrations regarding the events that took place in Romania in January-February 2012 on the way in which the Romanian public reconstructed these protests.

THEORETICAL FRAMEWORK

The Social and Media Construction of a "Media Event"

The focus of the present article will be on the analysis of the influence exercised by media narratives on the Romanian audience's reconstructions of social movements from January-February 2012. To be more precise, we are interested in the analysis of the aspects involved in the publicizing of this media event, by focusing on the event narrative built in such a way to transmit a particular significance related to the protest movements related to the crisis of the health public system in Romania.

As Couldry stated (2003, p. 59–69), we considered that in the case of the events of January-February 2012, the relation between the media and the community had as main characteristic the presentation and the manipulation of certain fundamental schemes and categories through images and written texts.

In the context of the mass media image all the three aspects of the sign according to Pierce (iconic, indexical, symbolical) function simultaneously in order to support the interpreting and framing of particular news. In the case of the image a number of factors functions in order to limit the polysemy. According to Goldman and Beeker's analysis (1985, p. 351–361; Hall, 1973, p. 176–190), we perceive images on a daily basis and that is why we see them as "naturally produced artifacts", whose significance is neither built nor contested. At the same time, visual symbolism is often based on metaphorical relations that are fundamental for our cognitive system, becoming thus invisible (Lakoff & Johnson, 1980, p. 115–123.).

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Moreover, the people producing and the people reading a newspaper can function, in Fowler's terms (Fowler, 1991), on the basis of a "shared competence" of the interpretation which developed over the years and could make one's favorite significance of a text inherent and much more automatized.

Healthcare System Crisis in Romania

Before presenting the hypothesis and the research project we need to clarify a few elements pertaining to the Romanian healthcare system crisis. Romania's post-communist evolution in the field of health involves several attempts of decentralisation of the management of the national health system, for a better administration of hospitals and for a better use of financing of the system. Immediately after the revolution of 1989, the World Bank intervened in Romania to help the reform of the Romanian health care system. The successive strategies that were adopted in this respect included the dismantling of the old communist system, known as Semashko that provided only a tiny fraction of the country's GDP was allocated to health. Because of the low salaries and the poor equipment of the hospitals, the Romanian doctors were not motivated and appeal for most of the time at bribe. All this led also to the increase of unequalities between social classes and different regions (Vladescu, Radulescu & Cace 2005, p. 452). Between 1992 and 2000 in Romania there were initiated a series of programs, reforms that were meant to change the form of payment of fees for health (Vladescu, Radulescu & Cace 2005, p. 467). One can easily notice a constant instability in decisions, a difference of opinions between the World Bank and the Romanian Government and a very serious difference between what the reform states and what happens in reality. Numerous laws of financing the Romanian health care system have been proposed, as well as changes of the medical insurance laws, changes that are still developing, due to the lack of efficiency of the system.

In the "Romanian Presidential Commission Report for Analysis and Policy Making in the field of Public Health" (Presidential Commission for the analysis and development of Public Health Policy in Romania, 2008), there are still a number of possible options for a reform of the Romanian healthcare system. In the framework of an analysis of health in the world, presented by the Presidential Commission, Romania ranked 99 in the performance of healthcare systems (Presidential Commission Report for Analysis and Policy Making in the field of Public Health 2008, p. 7). Among the weaknesses of the Romanian healthcare system we find: the poor financing of the field (The Presidential Commission Report for Analysis and Policy making in the field of Public Health 2008, 15): the material support of the hospitals-the hospitals usually get half of the revenues of CNAS (Presidential Commission Report for analysis and Policy Making in the field of Public Health, 2008, p. 31): the high consumption of drugs; the lack of doctors. In 2008 in Romania there were about 100 localities without doctors (Presidential Commission Report for analysis and Policy Making in the field of Public Health, 2008, 31). Although this medical system shows a profound economic and social crisis the peoples' reaction towards this topic could not be gauged with only one exception, namely in the case of social movements from January 2012. Chronologically, by the end of 2011 a new law in the field of health was unveiled in public debate, a law that gives a larger part to the private sector in healthcare. Public discussion on this topic reaches a climax on January 11, 2011, when, as a result of the televised debate with the Romanian President Basescu, the State Secretary in the Ministry of Health, Raed Arafat, resigned from Office. The next day, on January 12, 2012, the first protest in favor of Raed Arafat took place in Bucharest and in Targu Mures, the action initiated on Facebook gathered between 2000 and 4000 people (Antoniu, 2012; Ramadan, 2012; Giurgea, 2012).

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In less than three days-12- 15th January, 2012 – as a result of the national mobilization through Facebook several demonstrations took place in favor of the Romanian emergency service in Bucharest and other twenty Romanian cities. These moves have been generated on-line in the mid range given – on January 13th, 2012-controversial Bill was stripped of Raed Arafat had asked him to return to the previous function of the Ministry of health (Adevarul Local Network, 2012).

Started as a movement with a strictly social purpose, in favor of an individual and a social service (the Romanian emergency service) – the action became after 17 January 2012 a political movement against the Government. The manifestations from various Romanian cities, were held daily until February 2012 (RADOR, 2012), then they moved into a pure political plan leading to the change of Government in March 2018.

Although the issue of the reform and the new health law is addressed together and currently in Romania approach of health is less public and more visible in the national plan of public policies (politicians, experts, doctors, NGOs in the field) and in the media.

As a result, we can considered the Romanian healthcare system crisis a typical case where the impact of media narratives and the narratives of Romania public revolts (from January 2012) were reconstructed both in mass media and at the level of audience's understandings.

METHODOLOGY

The Operationalization (Codification)

The general form of the narrations used in the news is based on the five Ws and one H: who, what, when, where, why, and how. The narrative structure of the news must "convey the impression that a news story is a relatively independent unit, because it appears to contain complete information of an event with a beginning, a climax, and an end" (Pan & Kosicki, 1993). The news discourses are narrations because they are "arbitrarily chunked concretes in a continuous flow of history" (Pan & Kosicki, 1993).

In this regard, the analysis of the articles published in the Romanian online newspapers and media focused on the news narrations (the five Ws and one H) referring to the coverage of the crisis in the health system (Pan & Kosicki 1993). Even though Pan and Kosicki (1993) analyzed the narrative structure statement by statement, in the case of the present study this analytical decomposition was avoided, the analyzed Ws and H being considered as a whole. This time, the focus was on the emphasis placed on some of the elements of the above mentioned "chain" while the repetition or the omission of these elements was considered an indicator of the influences exerted by the professional and organizational variables present in the Romanian journalistic field.

Research Hypotheses

In exploiting January–February 2012 we started off from questions such as: "Was there any connection between the new health law in 2012 and he protests from January 2012?" What opinions dominated the Romanian society regarding this law? Was there any influence exercised by the media on the opinions regarding the events that took place in January (the social movements and the proposal of a new health law)?"

As general hypothesis for the study we had the following statement:

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GH: The high consumption of mass communication messages determined the adoption by the public of the narrations dominating in the media regarding the events from January-February 2012.

Based on this, depending on each sample that was studied (mass media and public) we had, thus, the following specific hypotheses:

H1: The events from January-February 2012 are presented in a significant percentage (over 50% of the total of the studied sample) in opinion articles and by quoting the political sources (political parties).

H2: A high percentage (of more than 50% of the total of the studied sample) of opinions expressed by respondents who use media daily will support the role of a person responsible for launching the events that took place in the winter of 2012.

The Method and the Data Sample

In order to validate (or not) the research hypothesis and to offer an answer to the problems being researched, we used two main methods: a questionnaire survey and a quantitative content analysis.

We considered that both the content analysis and the questionnaire survey allows for an objective, systematic and quantitative presentation of the topics included in the interest theme – the Romanian media contents and the opinions of he interviewed subjects (Berelson, 1954; Krippendorff, 2004).

In the case of the sociological survey, we used the non probabilistic sampling of availability. The sample of the questionnaire survey used two variables as selection criteria: the respondents had to be employed during the survey and, at the same time, to be registered to a family doctor. The final volume of the sample was of 200 respondents, all of them living in the capital city of Romania (Bucharest).

The analyzed media content sample included 125 articles published in five central newspapers with national coverage during January 1-30, 2012 (approximately one week before and seven days after the movements from January 2012). The newspapers where the selected articles were published were “Adevarul”, “Evenimentul Zilei”, “Gandul”, “Jurnalul National” and “Romania Libera”. The selection criteria for the articles was centering them around three essential themes: “health reform”, “health law”, “health” – only the articles which had these themes as main themes were included in the final sample.

FINDINGS AND DISCUSSIONS

The content analysis indicated that, in the case of the Romanian media, the majority of the articles regarding the ”health reform”, ”health” and ”health law’’ - 28.8% - were published in the ”Jurnalul National” newspaper, followed by ”Romania Libera” – with 23.2% - and ”Evenimentul Zilei” - 20%. In the last places came “Gandul” newspaper – with 18.4% - and ”Adevarul” - with 9.6%.

Of the total of the survey, 68.8% articles were news and 72.8% contained images as well. At the same time, 64.8% of the articles were published in the section dedicated to internal politics – internal politics. As far as the theme of the articles included in the analyzed sample in concerned, 93.6% of them referred to the implications of the future health law, 51% - referred to the resignation of the state secretary from the Ministry of Health (n.n. Raed Arafat), 40% - referred to the social protests.

The media reconstruction of the possible consequences the new law was extremely vague, half of the articles only referring to the general “implications of the new law” – 51.56%.

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Table 1. Opinions on the consequences / impact of the new health law – The total of the analyzed articles sample

The News Makes Reference To	Percent
The implications of the new law	51.54
The implications of the private health insurances	1.32
Social factors	1.32
Economic factors	0.44
Others	0.44

A high percentage of articles 93.6% - were centered on the exclusive analysis of the health system (including the reform and the new health law) in Romania, only France is mentioned in 4 articles as an external bench-mark of an analysis. There weren't presented any comparative statistics of the Romanian health system vs. health systems from other countries and only 4 articles (of the entire sample) made direct reference to individual cases of sick people.

The most frequently mentioned institution was the Health Ministry – 35.5% of all the articles making reference to it – and 62.4% of the articles didn't make any reference to the political parties. Of the total of 37.6% articles that made reference to the political parties, the most frequently was mentioned the leading party at that time (PDL) – with 28% of the total of analyzed articles for this sub-item.

As far as the identity of the sources is concerned, the public person most often quoted was the Health Ministry state secretary – Raed Arafat – with 19% of the total of the articles quoting a public person. However, a significant percentage of the total of the analyzed articles – 41.6% - approached in a neutral way the issue of the new health law and the protests that followed the government's attempt to implement it by assuming the responsibility.

Thus we assisted to the invalidation of the first research hypothesis. In other words, a significant percentage (over 50% of the total of the studied sample) of the articles published by the Romanian media was news and the quoted sources were institutional – especially from the Health Ministry.

If the media discourse regarding the public discussions, the protests and the manifestations caused by the new health law (January – February 2012) was rather neutral - general, what do the data regarding the opinions of the respondents regarding this new health law and the protests that accompanied the attempt to change the sanitary legislation indicate?

Of the total of the sample, 94.4% declared that they read about the health reform in the media, 75.9% of these indicating the TV as the main source of information about this case.

The dominating opinion regarding the situation of the Romanian sanitary system was predominantly a negative one, 46.2%, of the respondents considered that "Romania is way behind in the sanitary field". As far as the new financing system proposed by he law is concerned (introducing private insurances beside the mandatory ones), 36.9% of the respondents were against it (while 39.6% of them didn't have an opinion about this subject). Another significant percentage of the total of the sample - 81.8% - declared that the percentage allocated to health from Romania's GDI is too low. Over half of the interviewed sample – 52.4% - agreed that a higher level of transparency regarding the way the money from the sanitary system is spent would be possible through the introducing of the electronic card and the electronic medical prescription. As far as the corruption from the Romanian sanitary system is concerned, 87% of

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the respondents declared that the small salaries of the doctors and the medical staff generated this situation and 89.9% of the interviewed subjects agreed to the necessity of a reform within the sanitary system.

Regarding the opinions about the intentions and ways to improve the sanitary system, the survey showed that 70% of the respondents agreed to the need for a raise in the salaries of the doctors and the auxiliary medical staff, 89.3% of the total of interviewed subjects declared that more money from the budget should be allocated for health and 56.1% of the respondents said that there should be more free medication and free medical treatments for the population. The privatization of the Romanian sanitary system was only supported by 30% of the respondents, 70% of these declaring that the private health insurances should not be mandatory (as the state ones are) and 84% of the total of the interviewed subjects did not agree to the establishing of some private hospitals that would take over the tasks of the state hospitals. The opinions regarding the increasing of the employment level in the state system were mixed, 49.2% of the subjects agreeing to the fact that the number of doctors hired in the sanitary system must grow, while 50.8% did not agree to this option. Only 23% of the total of the respondents said they agreed to the introducing of the electronic monitoring of the treatments and 70% of the total of the sample did not agree to the establishing of other state hospitals.

Given the maximum support (almost 90% of the total of interviewed subjects) of a reform in the Romanian medical system, what were the opinions regarding the relation between the proposing of a new health law and he social protests from January-February 2012? In other words, what does the "narration" constructed by the answers to the survey regarding this social (and media) event look like?

The survey data indicate the clear disjunction of the answers – person vs bill - regarding the identifying of the motivations that determined the protests from the winter of 2012. On the descriptive statistics level we therefore assisted to the validation of the second research hypothesis. Thus, 52.5% of the respondents considered that the resignation of the Health Ministry State Secretarty, Raed Arafat, was the foundation of the protests from January-February 2012. These opinions are strengthened by the relatively close percentage - 51.8% - of interviewed subjects who considered that Raed Arafat is "a hero for the Romanian protestants". However, 42.5% of the respondents believed that the proposing of a new health law – and, implicitly, the partial privatization of the medical system proposed by this – was at the basis of the protests from the beginning of 2012.

As far as the gender dimension is concerned, 53.7% of the respondents who believed that the resignation of Raed Arafat was at the basis of the street movements from January-February 2012 were women while 52% of those who appreciated that the proposing of a new bill was at the foundation of these movement were men.

As far as the relation between the media narrations on this event and people's own narrations regarding the street movements from January-February 2012 is concerned, the survey data showed that the subjects who say that the resignation of the State Secretary in the Health Ministry was the cause of the street movements from the winter of 2012 are, at the same time, heavy consumers of both TV news (52.1%) and talk-shows (52%).

However, the way the public's "narrations" are influenced by media variants is different. Thus, the daily consumption of TV talk-shows is causally dependent only on the opinion according to which the protest movements from the winter of 2012 were caused by the health bill (see Table 2). At the same time, for the subjects that listened to radio news daily, the influence was exercised in such a way that led to the opinion that it was Raed Arafat's resignation that caused the protest movements from January –February 2012 (See Table 3).

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Table 2. The relations between the gender of the respondents, the daily TV consumption and the opinions on what caused the events from January-February 2012 (Bivariate correlations)

		Watch TV News Daily	Watch TV Talk-Shows Daily	Subject Gender
The cause of the protest movements that took place in winter is Raed Arafat's resignation	Pearson Correlation	,026	,009	,014
	Sig. (2-tailed)	,712	,902	,842
	N	200	200	200
The cause of the protest movements that took place in winter is the new health bill	Pearson Correlation	,053	,109	,070
	Sig. (2-tailed)	,459	,126	,328
	N	200	200	200

** Correlation is significant at the 0.01 level (2-tailed).

Table 3. The relations between the gender of the respondents, the daily consumption of radio shows and he opinions on the cause of the events that took place in January-February 2012 (Bivariate correlations)

		I Listen to Radio News Shows Daily	I Listen to Radio Talk-Shows Daily	Subject Gender
The cause of the protest movements that took place in winter is Raed Arafat's resignation	Pearson Correlation	-,137	-,062	,014
	Sig. (2-tailed)	,071	,416	,842
	N	174	173	200
The cause of the protest movements that took place in winter is the new health bill	Pearson Correlation	,048	,092	,070
	Sig. (2-tailed)	,528	,227	,328
	N	174	173	200

** Correlation is significant at the 0.01 level (2-tailed).

Table 4. The Logistic regression models for the relation between mass media exposure and the opinions on the cause of the social movements from January-February 2012

	The Cause of the Protest Movements in Winter is the Resignation of Raed Arafat			The Cause of the Protest Movements in Winter is the Bill of the New Health Law.		
Variables	Exp(B)	Wald	Sig.	Exp(B)	Wald	Sig.
The type of respondent	1,100	,076	,783	1,362	,799	,371
I watch news on TV daily	,850	,107	,743	1,230	,159	,690
I watch talk shows on TV daily	,807	,440	,507	1,745	2,853	,091
I listen news on radio daily	,611	2,157	,142	1,022	,004	,949
I listen to talk shows daily on the radio	,905	,068	,795	1,376	,721	,396
	Hosmer and Lemeshow test = 0.364 (−2Log likelihood = 231.034); *The type fits the data significantly;* Nagelkerke R Square = 30% (Method = Enter); 61.3% of the cases classify correctly			Hosmer and Lemeshow test = 0,739 (−2Log likelihood = 230.290); *The type fits the data significantly;* Nagelkerke R Square = 41% (Method = Enter); 60% of the cases classify correctly		

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When we built an explanatory model of the relation between the exposure to the media narratives concerning the events in winter 2012 and the opinion about the cause of the social movements from that period, the highest explanatory power, we faced the disproval of the second specific hypothesis. Therefore, even though 52.5% of the respondents considered that the resignation of the Secretary of State from the ministry of Health, Raed Arafat, was the cause of the protest movements from January-February 2012, the explanatory model shows that in this case it was more important the fact that the interviewed respondent was a man that lived in the urban area, media consumption had a low predictive power. If however the respondent watched TV shows daily, then there was a probability of 1.74 for him to consider that the events from winter 2012 were the cornerstone of a new health law. At the same time, if the interviewed person watched news programs daily, the probability for him to consider that the new health bill was the cause of the street movement was of 1.230.

CONCLUSION

News production is influenced by both the organizational variables and professional variables (professional norms, individual and professional values) existing in the journalistic field. Whether they are individual or they belong to a group, professional values are adapted to the ideological requirements of the society and can be found at the level of the institutional, occupational and cultural practices that make up the mass media. The mass media content no longer appears as an "isolated" product but as a profoundly social product, organizationally determined. The occupational routines thus relate to ideological requirements on a larger scale. Therefore, the media content is a work corpus relevant for understanding the nature and importance of the content effects on people and society (by knowing the media content one can anticipate its effects on the public).

The "labels" with which journalists define events are mere conventions meant to put in order an oversaturated, anxious informational reality. Leo W. Jeffres (1986, p. 106-108) mentioned two sets of conventions, both of which having functional roles. The first set is made up of the objective norms of the professional culture: the actuality and the proximity of the event, events that bring general progress, disasters, the primacy the personalities involved, the conflict potential, the dramatic potential of the event, the consequences it involves, the human interest. The second set of conventions refers to: frequency and intensity, ambiguity, the capacity to signify, consonance, the elitist dimension applied to nations, personalization factors and the negative nature of the event (Jeffres, 1986, p. 106-108).

If news reconstructs the social world, as Monhan suggests (2010), then the image we have of society at a certain moment is also the result of this reconstruction. At the same time, the orientation of the media coverage of a certain event – negative, neutral or positive – represents an important instance in report to which one can assess the neutrality of mass media within democratic societies (Gunther, 1998). Journalists can influence the orientation of the coverage by their choice of a certain vocabulary, tone and the experts they decide to interview or quote (Christen, Kannaovakun & Gunther, 2002). Deliberately, or not, this orientation in media coverage of an event structures the way the members of the audience interpret the media events and can help shape public opinion (Jeon & Haider-Markel, 2001).

The analysis the empiric data invalidated both the first and the second specific hypothesis. Over 50% of the total of the articles that were analyzed were not political, but institutional. Generally, the written media, did not offer specific information, did not contextualize the events and did not offer comparisons to the situation in other countries in the health system. If at the level of descriptive statistic (frequency)

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we assist the validation of the second specific hypothesis. (A second high percentage (over 50% of the total sample that we studied) of opinions expressed by the respondent that consume media daily, will consider the role of a person involved in triggering the events from winter 2012) the explanatory models that were made subsequently, allowed us to disprove this. Therefore, daily media consumption (radio and TV shows) did not contribute significantly to explaining why people support the idea of a primary role of a personality (in this case the Secretary of State from the Ministry of Health, Raed Arafat) in triggering the events from January-February 2012.

As it is indicated by the data of the explanatory model built on the basis of the data gathered from the field investigation, daily consumption of news and talk shows broadcast both on the radio and TV, had a reduced predictive impact in structuring the opinion according to which a person had a decisive role in triggering the events in the winter of year 2012.

On a general level of the study, we can thus state that regarding the events from January-February 2012, the impact of the media narrative on the way in which the audience from Romania rebuilt the protest from January-February 2012, was a minor one. Actually, as the results of the study show, the general hypothesis of the study was invalidated; the high consumption of mass media messages does not determine whether the public adopts the media narratives concerning the events from the beginning of year 2012.

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Chapter 51
Exacerbating Health Risks in India due to Climate Change: Rethinking Approach to Health Service Provision

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ABSTRACT

While climate change is expected to exacerbate human health risks, it also provides an excellent opportunity for defining and implementing preventive actions. Developing nations like India, with low infrastructure facilities, limited resources, varied development priorities and, often with large population, are particularly vulnerable to health impacts - more so under the climate change regime. The greatest challenge facing the current Indian health service provisioning system is that it has to cater to the health service needs of its large population within a short time and with sustainable impact. Limited health 'cure infrastructure' (low per capita availability of doctor, hospital beds, etc.), lack of qualified health practitioners, absence of a strong monitoring system in disease surveillance and rising cost of 'cure infrastructure' are some of the major drawbacks of the existing system in India. There is therefore, a need for mainstreaming more preventive measures which will enhance human health resilience and make the population less exposed and more resilient to the predicted impacts of climate change. To provide preventive care to the Indian population, a paradigm shift in strategy is required. The new regime needs to emphasize on an integration of 'traditional preventive health care systems' with modern cure targeted pharmaceuticals and non-health sector interventions. Such a system is expected to reduce the long term demand for cure infrastructure and will provide a more holistic inclusive solution to the Indian problems.

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INTRODUCTION

Human health status determines individual and societal wellbeing. Climate change induced health impacts are expected to put additional stress on human wellbeing and equity through intra-generational and inter-generational health outcomes. Understanding the climate change-human health interaction is imperative for following a pathway of sustainable development. In India, there is paucity of evidence, assessment, research based knowledge and communication on climate change induced health risks, and intervention need assessments. Simultaneously, there is a fair degree of inadequacy in the infrastructure for provisioning healthcare services. In our view the gap will become critical in the face of emerging climate induced health risks in India.

Past research shows that the most important threat to India's sustainable development is poor performance in the health related indicator (Roy, Chatterjee, & Basak, 2008) (Roy, Bhowmick, & Dolui, 2014). Climate change will make it additionally worse due to the lack of preventive approach in the health sector (Roy & Netinder, 2010). In this perspective, we argue that, to ensure sustainable development in India and address the emerging health risks in a cost effective way, and for integration and strengthening of traditional scientific practices, there is a major need for development of a National Preventive Health Care Mission (NPHCM[1]) under the umbrella of NAPCC (National Action Plan on Climate Change). This mission mode can facilitate the sustainable development process in the country through targeted preventive actions that can reduce impacts on health and, to a large extent, reduce the accelerating pressure on the health infrastructure delivering cure-based solutions. The goal of this article is to develop the concept and arguments towards the development of NPHCM based on multi-disciplinary, multi-sectoral and multiple health systems approach. A holistic social welfare based system that combines the best approaches in both traditional preventive and modern cure health systems and is governed by the socio-economic realities, is suggested.

Research Strategy and Rationale

This article is based on primary information gathered through expert consultations and data collected from secondary sources. The expert consultations are, by nature, unstructured and exploratory interviews. Experts with national and international experiences in the healthcare provisioning, healthcare policies, climate sciences, economic development, etc. have been consulted during the research process. Further, experts from both public and private sector, together with those from the bilateral and multilateral financing agencies have been interviewed.

We propose institutionalization of climate change induced disease category-wise multidisciplinary action research groups (ARGs). These ARG scan lead, plan and execute a holistic and preventive health care system. This will address climate change induced health risks in the country. With a goal towards sustainable development, the 2009 NAPCC and the Indian Network for Climate Change Assessment (INCCA) of the Government of India are providing a platform for multiple stakeholders to address climate change related problems in the country. However, there is no separate action plan to target reduction of health impacts in the NAPCC. We propose that given the dearth of strategy and the immediacy of the problem, addressing the issues related to health impacts in mission mode would have the advantage of expediting the action through planned steps and targets while, simultaneously, generating ample scope for large scale mobilization of finance from public and private sources as well as global adaptation fund to enhance resilience.

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Climate data shows, unambiguously, a rising trend in the mean surface temperature of the earth. Recent projections under different representative concentration pathways (RCP) scenarios predict that this global warming will continue and further accelerate in the future (IPCC, 2013). According to the IPCC (Intergovernmental Panel on Climate Change), if the global society continues to emit greenhouse gases (GHG) at current rates, the average global temperature could rise by 2.6°C to 4.8°C by 2100 (IPCC, 2013). Research indicates that one of the major fallouts of temperature trend can be heat stress (Samet, 2010), (Kjellstrom, Lemke, & Hyat, 2011), (Mathee, Oba, & Rose, 2010), (Roy, 2010), (Roy, Chakrabarty, Mukhopadhyay, & Kanjilal, 2011). Health risks are also posed by exposures to other extreme events like floods, droughts, cyclones, storm surges etc., whose incidences and frequencies are likely to increase due to climate change. These events result in death, disease, mental trauma and malnutrition through water scarcity, loss of food security, increased transmission of infectious diseases as a result of the influence of climate change on disease vectors, societal and economic disruptions due to migration, etc. (McMichael, Woodruff, & Hales, 2006), (Haines, Kovats, Campbell-Lendrum, & Corvalan, 2006) (see Table 1 and Figure 1).Several epidemiological studies assert that occurrence of floods are often ensued by the outbreak of diarrhoea, cholera, typhoid, epidemics, rodent and vector borne-diseases, death, mental disorders, etc. (Kunii, Nakamura, Abdur, & Wakai, 2002), (Ahern, Sari Kovats, Wilkinson, Few, & Matthies, 2005), (Du, FitzGerald, Clark, & Hou, 2010). Droughts cause malnutrition and affect hygiene as water is used mostly for cooking rather than washing, further malaria outbreaks may also follow as droughts impact the vector breeding grounds (Haines & Patz, 2004).

Given the multidimensionality of the problem, there is a growing commitment – among government and policymakers, to integrate health considerations into efforts to mitigate and adapt to climate change at different national and regional levels. But such efforts are still limited (Rumsey, et al., 2014), (WHO SEARO, 2007). To strengthen our arguments for a more concerted and expansive effort to cope with the health impacts of climate change in a demographically expanding country like India, in section 2, we present select examples of first hand research results on health impacts of climate change -heat stress related direct impact on human workability and impact on water quality in urban India[3]. Such specific examples establish why preventive measures/policies/adaptive strategies can enhance resilience to climate change related health impact, and in no way indicates the boundary of the problem. Given the multiple and interrelated health impacts of climate change and space limitations, the authors have tried to limit the examples to manageable proportions.

Table 1. Potential health impacts of climate change

Threats	Consequences
Increase in the frequency and intensity of heat waves	Increased mortality from heat waves, especially among the elderly
Change in the distribution of aeroallergens[2]	Increased frequency and severity of allergic diseases and symptoms
Altered distribution of infectious disease vectors	Increased frequency and spread of infectious diseases
Increased air pollution	Increased morbidity and premature mortality
Change in agricultural yields	More undernourished people in low-income countries
Social and economic disruptions due to extreme events, wars, etc.	Water borne diseases, malnutrition

Source: Based on a number of literature review: (Samet, 2010) (McMichael, Woodruff, & Hales, 2006) (Haines, Kovats, Campbell-Lendrum, & Corvalan, 2006)

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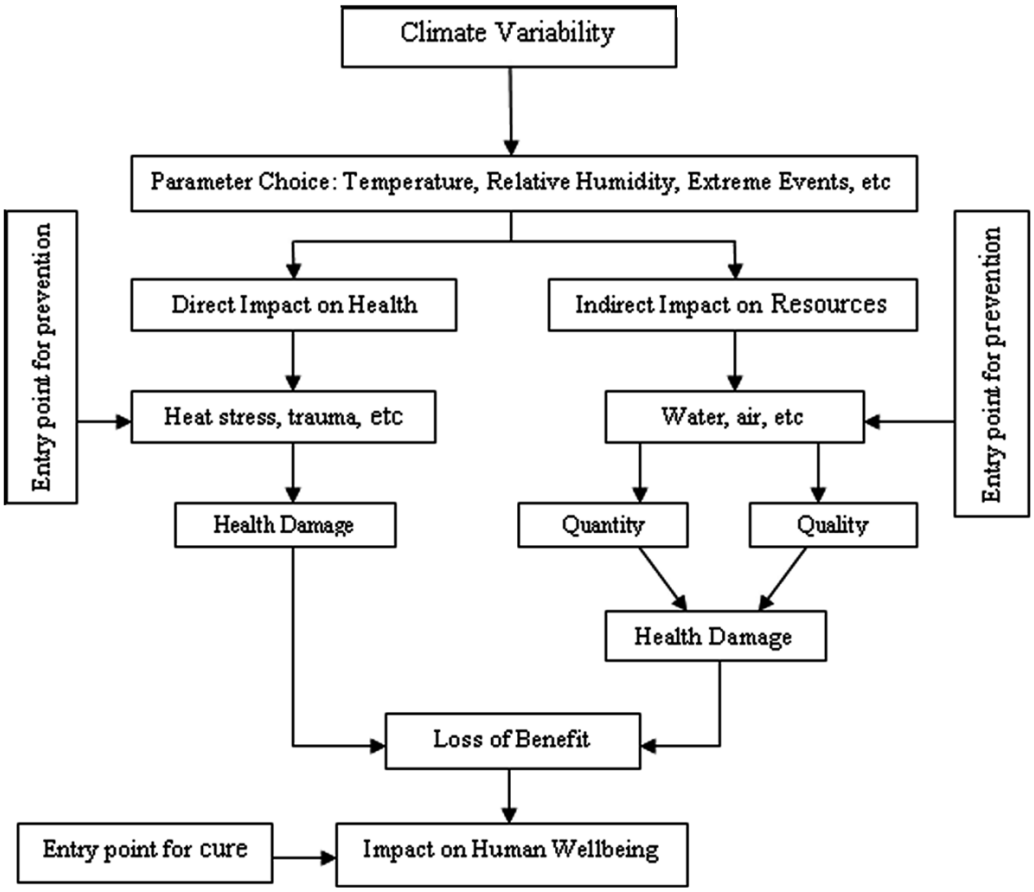
Figure 1. Health impacts of climate change



Section 3 presents expert interview based assessment of barriers and gaps in the current cure-focused healthcare regime. The intent is to propose in section 4, an institutional arrangement that might efficiently integrate strategies to combat the climate risks to human health with the extant health care system in the country.

The conceptual framework that has been used to formulate the problem and design a holistic system to manage health impact risks better is guided by an integrated approach (Figure 1) that connects climate variability to human wellbeing loss. We consider preventive care as process intervention and cure as end of pipe intervention. The latter, essentially following the philosophy of "pollute now clean up later approach" is relatively costly as such approach can have many external costs.

CLIMATE CHANGE AND SOME THREATS TO HUMAN HEALTH: INDIAN CONTEXT

India, a major demographic and economic entity among the South Asian nations, covers almost 2.3% of the world's land area while being home to nearly 18% of the world population (NATCOM, 2012). Em-

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pirical evidences show that the biggest threat to sustainable development in India comes from relatively worse performance and slow progress in the health sector (Roy, Chatterjee, & Basak, 2008). Analysis of the sustainability indicators in India conducted during 2008-09 show that 28 out of the 35 states and union territories[4] in the country need to prioritize environmental and pollution related health issues in order to be on a sustainable development pathway. The states that need to prioritize environmental issues include Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Punjab, Haryana, Delhi, Rajasthan, Sikkim, Arunachal Pradesh, Bihar, Meghalaya, Tripura, Mizoram, Manipur, Nagaland, Jharkhand, Chhattisgarh, West Bengal, Orissa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh (Roy & Netinder, 2010). Many of these states show that most of their health issues involve vector and water borne diseases together with air pollution related health impacts[5]. Under the projected climate scenarios, the vulnerability to these health risks is likely to increase. Thus addressing the health outcome is a major entry point for integration with climate response strategies[6].

Since the Indian independence in 1947, there has been considerable improvement in the life expectancy of Indians. Life expectancy has more than doubled from 32 years in 1947 to 66 in 2004 (NATCOM, 2012). Mortality and fertility rates have been simultaneously reduced (see Table 4). While these information underscores the benefits accruing from improvements in cure focused medical system, it does not guarantee that vulnerability to climate induced health risks has been or will be adequately managed. Table 2 gives a brief account of the multiple health concerns in India due to climate variability. The magnitude of the problem can be gauged from the fact that India accounts for about 8% of the malarial cases that are reported globally per annum (GOI, 2011). Within the South-east Asian region, 70% of all malarial cases reported annually are accounted for by India. Dengue, identified by WHO as one of the 17 most neglected tropical diseases, is endemic in 31 states and union territories in the country. Of the 350 million global population exposed to the risk of developing kala-azar, about 129 million reside in India. According to the World Health Organization, worldwide, diarrhoea is the second major cause of death among children under five years of age (GOI, 2011). In India 10% of the infants and 14% of the children in the age group 0-4 years die annually due to diarrhoea (UNICEF, 2009). Since the burden of these diseases is expected to proliferate with climate change, therefore, the health risks in India are likely to accelerate if immediate actions are not taken to reduce vulnerability.

Vulnerability to climate change impacts is a function of exposure, sensitivity and adaptive capacity (IPCC, 2001). Preventive measures reduce exposure and, hence, vulnerability directly. Depending on the geographic, demographic, socio-cultural, economic characteristics of a place, the vulnerability

Table 2. Climate induced health risks in India

Health Concerns	Vulnerabilities due to Climate Change in India
Temperature related morbidity	Heat and cold related illness Cardio vascular illness
Vector-borne diseases	Changed pattern of disease; malaria, dengue, filaria, kala-azar, Japanese encephalitis and dengue caused by bacteria, virus and other pathogens
Extreme weather events	Diarrhoea, cholera and poisoning caused by biological and chemical contaminants in water Damaged public health infrastructure owing to cyclones, floods, etc Social and mental health stress owing to disaster and displacement
Effects due to insecurity in food production	Malnutrition and hunger especially among children

Source: (NATCOM, 2004)

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to climate change varies. In India the vulnerability is high given the diverse geographic features of its large landscape, high population growth rate and an economic system that is predominantly developing[7] in nature. A largely rural society, about 70% of the rural population in India is directly dependent on climate sensitive sectors like agriculture, forestry, and on natural resources such as water, biodiversity, mangroves, coastal zones and grasslands for the continuation of their livelihood (Majra & Gur, 2009). Thus the vulnerability to the adverse impacts of climate change appears high. Natural adversities like heat waves, droughts, floods along with incidences of malaria, malnutrition, diarrhoea, heat related mortality and morbidity, asthma, heart diseases, are some important human health issues that are likely to rise owing to climate change (Majra & Gur, 2009). Our goal is to show - in selected cases how exposure can be reduced by adopting preventive measures.

SPECIFIC EXAMPLES OF HEAT RELATED HEALTH IMPACTS

Heat related illness is often recognized as a major health issue (Kjellstrom, Lemke, & Hyat, 2011) (Dapi, Rocklöv, Nguefack-Tsague, Tetanye, & Kjellstrom, 2010). Given the rising temperature trends and increasing frequency of heat events, health issues like heat exhaustion, heat cramps, heat stroke and death, etc. are on the rise (Luber & McGeehin, 2008), (McMichael, Woodruff, & Hales, 2006). The impacts of heat stress differ depending on factors like adaptive capacity, occupational pattern of the people and hence exposure, age structure, etc. (Table 3).

Between 1980 and 1998, as many as 18 events of heat waves[8] were reported in India. The one in 1988 affected about 10 states and resulted in 1300 deaths. Between 1998 and 2000, several heat waves caused an estimated 2120 deaths in Odisha and 198 deaths in West Bengal. In 2003 the heat wave in Andhra Pradesh caused more than 3000 deaths while West Bengal recorded 52 deaths (IPCC, 2007).

Table 3. Population most vulnerable to heat stress-Global Indicators

Vulnerable Population	Risk Factor
Elderly (above 50years)	• Poor thermoregulatory mechanism • Impaired cognitive function
Children	• Greater surface area to body mass ratio leading to greater heat gain than adults • Produce more metabolic heat per unit of mass when engaged in physical activity • Less physiologic capacity to sweat • More time to acclimatize than adults
Participants in athletic events	Dehydration
Outdoor workers (street vendors, rickshaw pullers, poor and subsistence farmers and pastoralists)	• Inadequate cooling off or rest periods • Insufficient water consumption • Dehydration • Inappropriate clothing • Excessive sun exposure
Medically compromised and socially isolated	• Mental illness which accompanies social isolation • Inability to avoid heat exposure owing to lack of social contact who can intervene on their behalf

Source: (English, et al., 2007)
(Sahni, 2013), (MMWR Morbidity and Mortality Weekly Report, 2010)

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Table 4. Health indicators of India since independence

Health Indicators	1951	Current	Source
Crude Death Rate (per 1000 population)	22.8	7.9 (2012)	(WHO, 2014)
Birth Rate	41.7	22.1 (2010)	(SRS Bulletin, December 2011)
Infant Mortality Rate (both sexes)	146 per 1000 live births	44 (2012)	(WHO, 2014)
Life Expectancy at Birth (both sexes)	32.1	66 (2012)	(WHO, 2014)
Total Fertility Rate (per woman)	6.0	2.5 (2012)	(WHO, 2014)

Between 2001 and 2008, the number of accidental deaths due to heat stroke gradually increased in different states in India, with specific concentration in some particular states like Andhra Pradesh, Orissa, Uttar Pradesh, West Bengal, Bihar and Punjab. The death toll due to heat stress continues to rise (Table 11 in appendix), so much so that in 2010 the percentage share of deaths from heat stroke to total deaths in India was 5.1% (GOI, 2010). Based on data published by India Meteorological Department (India Meteorological Department, 2014), it has been observed that regions with average annual temperature above 25˚C are particularly susceptible to heat waves. Hence states like Andhra Pradesh, Orissa, West Bengal, Uttar Pradesh, Bihar, Jharkhand and Gujarat are highly vulnerable to heat stress.

A case study of Kolkata (Roy, 2010) on the direct impact of heat stress on workability shows that anticipated temperature trend will exacerbate heat stress. During the last forty years in Kolkata, days in April have become warmer by 0.01˚C-0.7˚C per decade whereas days in January have become cooler by 0.04˚C-0.5˚C per decade (Roy, 2010). On the other hand nights in January have become warmer by 0.02˚C-0.9˚C per decade and nights in April have become warmer by 0.02˚C-0.6˚C per decade. Such changes are going to be more in the warming direction in the coming decades. Hence, exposure to heat and related health disorders are assuming importance.

The human body functions best within a narrow range of "core" internal temperature that varies from 36˚C to 38˚C. Increase in the core internal temperature leads to heat disorders in human beings. An individual can work safely in an environment for extended periods of time only when the balance between the heat gain due to metabolism and the heat lost to the environment is maintained. Heat related disorders are a group of illnesses caused by prolonged exposure to hot temperatures, restricted fluid intake, or failure of the body's ability to regulate its temperature. Heat stress has direct implications for human workability through reduced work performance as tired, fatigued workers perform with reduced accuracy, and efficiency (Dash & Kjellstrom, 2011), (Coris, Ramirez, & Van Durme, 2004). (Roy, Chakrabarty, Mukhopadhyay, & Kanjilal, 2011) have used WBGT index (ACGIH, 1995) and measured 100% workability window for Kolkata using 2009 data[9]. The estimates show that for outdoor work categories, e.g. construction workers, traffic police, rickshaw pullers, joggers, walkers, gardeners and cyclists, even in 2009 climate condition and without any adaptation strategy, is failing to provide 100% workdays for more than 9 days in 365 days and even 25% work days are possible for only 44 days without creating any heat stress related health impact (Table 12 in the appendix).

The impacts of heat stress vary depending on adaptive capacity, and occupational pattern of the people (Roy, 2010).The effects of climate change on disease and mortality is expected to have a greater impact

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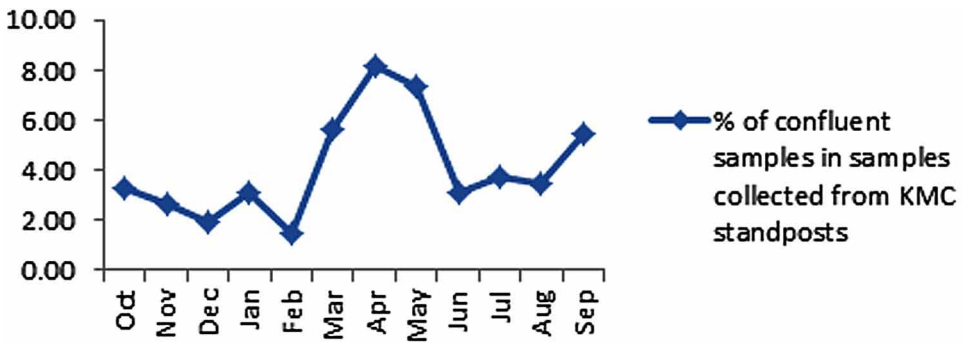
on impoverished people who cannot afford minimum living quality (Frakson, 2009). Urban poor are particularly vulnerable to "urban heat island" effect. Excessive heat exposure affects people with certain pre-existing medical conditions like cardio-vascular disease, respiratory illness and obesity.

The working population who are exposed to heat for most of the day time are highly susceptible to the heat related morbidity and mortality. Poor and subsistence farmers and pastoralists are not only vulnerable to the heat stress due to their outdoor exposure but also vulnerable to the impact of heat on crop yield and livestock. During the 2003 heat wave in the southern Indian state of Andhra Pradesh, when temperatures rose to almost 49˚C, over 1,200 people died. Majority of the dead were poor daily wage labourers, rickshaw pullers and construction workers (UK Met Office, 2011). Other than the exposure of the working population to heat stress, the elderly population is at higher risk due to reduced ability to acclimatize to changing temperatures and higher likelihood of pre-existing chronic health conditions –the thermoregulatory mechanisms in older adults often do not function optimally, even when the individual is relatively healthy (Nag & Nag, 2009), (Brahmapurkar, et al., 2012), (English, et al., 2007).

Under such circumstances, the conventional, cure-based health care system cannot, possibly, be a solution to combat the emerging risks. A preventive health care system would be more appropriate as that can reduce vulnerability by reducing exposure. Various simulation results show that exposure levels can be reduced by changing clothing type (adaptive capacity), providing shades (exposure reduction), indoor work space (exposure reduction, adaptive capacity enhancement) and air conditioning (adaptive capacity enhancement), and changing work timings (exposure reduction) are possible preventive measures to address heat stress related occupational hazards (Roy, Chakrabarty, Mukhopadhyay, & Kanjilal, 2011) . Costs vary with preventive measures and actions need not always fall under the purview of the health care sector but can lie in formulating innovative labour rules, work hours, dress code, work space design, etc.

A second case study using the Kolkata Municipal Corporation (KMC) data base was also conducted to study the impact of climatic variability on piped water supply to various categories of consumers (Roy, 2010). KMC undertakes regular water sample collection from stand-posts all across the KMC area, outlet points of the booster pumping stations and end-use points in public schools, hospitals and government offices. These are tested for quality in their own laboratory where the physical parameters such as turbidity, taste and odour, colour, chemical parameter such as dissolved chlorine and bacteriological tests are executed. An analysis of the data (Table 13 in the appendix and Figure 2) shows that the percentage of confluent samples (i.e. samples in which coliforms of faecal/non-faecal origin are found) is found to increase significantly in summer and monsoon seasons. Discussion with the KMC scientists revealed

Figure 2. Seasonal variations in quality of piped water in KMC area



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that in summer, with rise in temperature, the amount of dissolved chlorine in piped water reduces. This increases the likelihood of bacterial growth in the piped water.

The quality aspect of the piped water supplied by the KMC has long-term sustainability implications in view of climate change. Under the climate change scenario a significant prediction is that summers will be prolonged (Roy, 2010). This may lead to a significant deterioration of water quality for a long period, thereby increasing the consumers' vulnerability to health risks. Preventive health care - by maintaining water quality with additional efforts from KMC, can save both public and private cost of curing water borne diseases like diarrhoea, cholera, hepatitis and typhoid. These examples show that preventive health care measures can happen across sectors to deliver benefits in the health sector.

INTEGRATING "CLIMATE CHANGE" AND "HEALTH ISSUES": GAP IDENTIFICATION

It is important to understand gaps in the existing system to suggest any institutional reform. We present current cure system focused institutional adequacy and an assessment of climate change induced health impact awareness among health sector decision makers.

Brief Overview of the Indian Health System and Policy

The Indian healthcare system has witnessed a sea change since independence in 1947. The transition of the Indian health system has basically been a combination of demographic transition (shift from high mortality and fertility to low mortality and fertility), epidemiological transition (from mal nutrition to communicable diseases of childhood to chronic diseases of adulthood), social transition (from low to high knowledge and expectations about the health services) and technological transition (both diagnostic and therapeutic) that have contributed to shift in policies and programmes with cure focus in the health sector (Peters, Rao, & Fryatt, 2003). The National Health Policy (NHP) formulated in 1983 and then revised in 2002, puts forward the basic goal to improve health, and further deliberates on the methods and policies to achieve the same. The long term goal of the NHP is to achieve, by 2045, a stable population that is consistent with sustainable economic growth, social development and environmental protection. After more than half a century of independence, the performance of the Indian health system has been satisfactory with respect to these goals (Peters, Yazbeck, & Sharma, 2002), yet a lot more needs to be achieved.

The greatest challenge facing the current Indian health service system is that it has to cater to the health service needs of a large population within a short time with sustainable impact. With 21.92% of the population, living below the poverty line, it is undoubtedly a tough challenge (GOI, 2013). Since independence, the primary goal of the policy makers has been to ensure regional and demographic equity in the distribution of health services in the country. So far, the Indian health policy has accorded importance to visible issues like maternal mortality, maternal health, infant mortality and child health, malnutrition and under-nutrition, and reducing the incidence of certain communicable diseases like malaria, dengue and cholera that can lead to the outbreak of epidemics. These have been the main concerns of the policy makers particularly in the poor and less developed regions of the country (Peters, Yazbeck, & Sharma, 2002). However, the significance of the integration of climate change impact control measures and health strategies – an important aspect of sustainability, has been lost (Patil, Somasundaram, & Goyal, 2002). After over fifty years of independence, 40% of the deaths in rural India are due to infectious diseases

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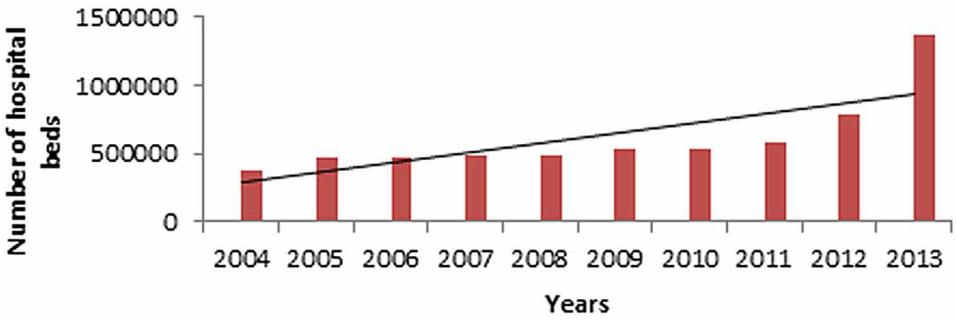
and 80% of the sickness is due to waterborne diseases (Patil, Somasundaram, & Goyal, 2002). While the immediate problems loom large, preparing for preventive care or planning for the emerging risks due to climate change have been rather peripheral to the health policy of India. To combat the emerging health risks arising due to climate change there seems to be an immediate necessity for a redefinition of priorities and for renewed focus.

A robust cure oriented health system calls for a strong focus on health infrastructure and healthcare personnel. The ratio of doctors to Indian population stands at 1:1800. According to the Medical Council of India, the total number of doctors registered in the country upto 31st March 2012 was 8, 52,195 (Medical Council of India Annual Report (Ammended), 2011-2012). The situation is considerably better in urban India where the doctor-to-population ratio is almost six times than that in the rural areas (Gangolli, Duggal, & Shukla, 2005). Health Statistics shows that India had only 0.7 physicians per 1000 population (OECD average being 3.2) and less than one nurse in 2010 (OECD average being 8.7) per 1000 population in 2011. While the global ratio of hospital beds per 10,000 people is 30, it was only 9 per 10,000 people in India during the period 2005 to 2012 (WHO, 2013). This is despite the fact that during 2004-13, there has been a significant increase in the number of beds in government hospitals (excluding AYUSH hospitals[10] and ESI[11] hospitals). Thus it is evident that the increase in hospital beds has not been commensurate with the population growth rate. Further, an average nursing home and private health facility in India has only 22 beds which is significantly low compared to other nations (Jain & Sandeep, 2009). WHO had estimated that India will need an additional 80,000 hospital beds each year for the next five years to meet the demands of its population (Bhat, 2006). Again the availability of health facilities in India has a distinct urban bias (Gangolli, Duggal, & Shukla, 2005). Since more than 70% of the population live in rural India (Census of India, 2011), this excludes a large chunk of the populace from the benefits of modern medicine in the country. Thus there appears to be immense scope for investment in the healthcare system in the country. It is also necessary to take a relook at the type of investments being made in healthcare in the country so as to ascertain whether climate resilient investment has been an objective of the health policies so far.

Health Infrastructure in India

Over the years the public health investment in India has traditionally been low (GOI, 2002).Health expenditures computed on the basis of a few selected list of National Health Account indicators for the years

Figure 3. Number of beds in the government hospitals in India (including community health centres)
Source: Compiled from statistics published by the (Ministry of Health and Family Welfare, 2014)



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2000 and 2011) (Table 6) show that during the last decade there has not been any satisfactory improvement in expenditure on health in the country. The contribution of public funds to total health expenditure has been consistently lower than private expenditure. In most developed economies, the general norm is that health services are largely funded by the government. In India however only about 30% of the total expenditure on health is contributed to by the government, the rest is financed privately. An idea about the public healthcare system can be had from the country's HDI ranking (UNDP, 2014). The HDI is calculated taking into consideration factors like health, education and per capita income. According to the UNDP, out of 187 member countries, India's HDI ranking is 135. A comparative analysis (Table 5) of some major health statistic across countries both developed and developing shows that there is

Table 5. Hospital beds (per 10,000 population) during 2005-2012

Country	Hospital Beds per 10000 People
Global	30
Japan	137
Australia	39
Norway	33
UK	30
USA	30
Sri Lanka	36
Brazil	23
China	39
Malaysia	18
Pakistan	6
India	9
Bangladesh	6
Niger	…
Ethiopia	63
Nepal	50
Senegal	…

Source: (WHO, 2013)

Table 6. Measured levels of expenditure on health in India

Selected National Health Accounts Indicator	2000	2011
Total expenditure on health as % of GDP	4.3	3.9
General Government expenditure on health as a % of total expenditure on health	26.0	30.5
Private expenditure on health as a % of total expenditure on health	74.0	69.5
General government expenditure on health as a % of total government expenditure	7.4	8.2
External resources for health as a % of total expenditure on health	0.5	1.1

Source: (WHO, 2014)

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considerable scope for government action in the healthcare system in India. This scenario has encouraging possibilities for the future of healthcare as there is still immense possibility for the government to intervene with policies that can henceforth mainstream climate responsive health infrastructure into the health care framework of the country.

A further analysis of the recent health policies in the country reveal that improved rural healthcare and access to affordable public health systems have been accorded necessary priority in the country. The National Rural Health Mission: 2005-2012 (NRHM) is a major initiative by the Indian government that seeks to provide effective healthcare to the rural population throughout the country with special focus on 18 states that have weak public health indicators and/or weak infrastructure. The NRHM programme is also aimed at improving public health infrastructure and access at the community level through increased decentralization of health functions (Table 8). Furthermore, the Government of India launched the Rashtriya Swasthya BimaYojana (RSBY) program in April 2008. The initiative is aimed at providing low-cost health insurance coverage to BPL (below poverty line) patients and to those engaged in the unorganized sectors, who might not have previously been insured or been able to afford medical treatment. Under the RSBY scheme, beneficiaries are entitled to health insurance coverage of up to Rs. 30,000 per year. Patients covered under the scheme can avail cashless transactions to gain access to treatment in hospitals and healthcare centres registered under the RSBY scheme. The scheme entails a public-private partnership between the government and private insurance companies. Although the scheme is fairly recent and still operating at a small scale, RSBY has attained some success in states such as Maharashtra, Uttar Pradesh and Bihar.

Recent trends in health policies in India emphasize the need to incorporate climate oriented health systems in the country. Ensuring accessibility to health systems and improving rural health infrastructure

Table 7. Health indicators (2011) and health spending (2010) in selected countries

Country	HDI Rank 2013	Life Expectancy at Birth (Years)	IMR	Total Health Spending as a % of GDP	Govt. Spending on Health as a % of Total Spending on Health	Private Spending on Health as a % of Total Spending on Health	Govt Spending on Health as a % of Total Govt Spending	External Resources for Health as a % of Total Spending on Health
Norway	1	81	3	9.3	85.5	14.5	17.7	…
Sweden	12	82	2	9.6	81.0	19.0	14.8	…
Japan	17	83	2	9.2	80.3	19.7	18.2	…
USA	5	79	6	17.6	48.2	51.8	19.9	…
UK	14	80	4	9.6	83.2	16.8	15.9	…
Malaysia	62	74	6	4.4	55.5	44.5	9.2	0
Brazil	79	74	14	9.0	47.0	53.0	10.7	0.3
Sri Lanka	73	75	11	3.5	45.6	54.4	6.9	2.2
India	135	65	47	3.7	28.2	71.8	6.8	1.3
Pakistan	146	67	59	1.0	76.6	23.4	3.4	10.2
Niger	187	56	66	4.8	49.2	50.8	11.1	32.7

Source: (WHO, 2013), (UNDP, 2014)

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Table 8. Goals and strategies of NRHM (2005 -2012)

Goals	• Universal access to public health services such as women's health, child health, water, sanitation & hygiene, immunization and nutrition • Prevention and control of communicable and non-communicable diseases, including locally endemic diseases • Increased access to integrated comprehensive primary healthcare • Population stabilization, gender and demographic balance and promotion of health lifestyles • Reduction in Infant Mortality Rate (IMR) and Maternal Mortality Ratio (MMR)
Core Strategies	• Train and enhance capacity of Panchayati Raj Institutions (PRIs) to own, control and manage public health services • Promote access to improved healthcare at household level through the female health activist (ASHAs) • Health plan for each village through Village Health Committee of the Panchayat • Strengthening sub-centre through an untied fund to enable local planning and action and more Multi-Purpose Workers (MPWs) • Strengthening existing Primary Health Centres (PHCs) and Community Health Centres (CHCs) and provision of 30-50 bedded CHC per lakh population for improved curative care to a normative standard (Indian Public Health Standards defining personnel, equipment and management standards) • Preparation and implementation of inter-sectoral District Health Plan prepared by the District Health Mission, including drinking water, sanitation hygiene and nutrition. • Integrating vertical Health and Family Welfare programmes at National, State, Block and District levels • Technical support to National, State and District Health Missions for Public Health Management. • Strengthening capacities for data collection, assessment and review for evidence based planning, monitoring and supervision • Formulation of transparent policies for deployment and career development of Human Resources for Health • Developing capacities for preventive healthcare at all levels for promoting healthy life styles, reduction in consumption of tobacco, alcohol etc • Promoting non-profit sector particularly in underserved areas.

Source: (Ministry of Health and Family Welfare, 2005-2012)

ensures the equity goals of the country's national health policy. However, besides distributional and regional equity there is both necessity and possibility for incorporating climate driven systems that while ensuring the immediate equity and accessibility issues; also guarantee the long term/ inter-generational equity and sustainability criteria. In this regard there is already in place a traditional medical system that through restructuring and proper administration might address the sustainability goals of the Indian health system while being both affordable and accessible to all.

GAPS AND CHALLENGES

Based on the expert interviews (Roy & Netinder, 2010) and supplemented by secondary information the gaps that impede the capacity of the Indian health sector to combat the emerging climate induced health risks have been identified (Tables 9, 10). The gaps mainly emerge due to the absence of proper integration of climate change related stresses in designing approaches and policies for the health sector in India. Table 9 represents a summary of the barriers while table 10 summarizes the gaps.

ALTERNATE HEALTH POLICY REGIME AND SUSTAINABLE DEVELOPMENT IN INDIA

Health is often regarded as capital as it increases human productivity and thus augments income generation capacities and social welfare. It is, therefore, imperative to ensure both public investment in health

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Table 9. Barriers in mainstreaming climate change in the Indian health sector

Area	Observations Concerning Climate Change and Health
Integrating climate change and health at the policy level	• Issue of climate change is yet to "seep down" to people who matter – the politicians, policy makers, etc.; impacts of climate change are often considered as "distant". • Awareness about the "phenomenon" called climate change may be existing at the highest level (the government) but there may be absence of "realization" among decision makers about exact impacts at the local level impeding area specific intervention(s). • Although it is important to start planning to tackle the emerging risks from climate change in the health sector, recognition of this requirement, especially, at the policy and the budget level is still awaited. • There may be a view at the policy making level that there is not enough evidence (of how climate change will affect health) to plan for interventions. • So far, there is almost no programmatic approach at the policy level to devise strategies for the health sector with climate change as a perspective. • The issue of climate change is often recognized as an "additional burden" and "an issue with uncertainty in scientific knowledge and understanding." For the present health system of India, already plagued with a number of problems – maternal mortality, infant mortality, malnutrition, etc., it may be too ambitious to plan for an uncertain issue. • NAPCC is yet to consider all the health effects of climate change - only a few diseases like dengue and malaria are addressed under the disaster management strategy of NAPCC. • Governments, both at the centre and states is yet to declare an integrated action plan in the health sector incorporating the emerging health risks due to climate change.
Integrating climate change and health at the operating level	• Decision makers at the operating level are "yet to internalize" the scientific information on climate change and health risks for deciding on the local actions for mitigation and adaptation. • Doctors and health workers delivering health services are not specifically aware of the relation between climate change and the emerging health impacts. • Medical curriculum in the country is yet to factor-in climate change as a determinant of health. • The health delivery system is yet to be prepared to deal with climate change induced health impacts.
"Approach" of the present "health system"	• In India, the health delivery mechanism spends more time in treating the conventional diseases. The approach is primarily "curative" rather than "preventive". Climate change related health impacts need more preventive approach and is a public health issue as the impact is expected to be more on the poorer section of the society. • While a sound public health policy should focus on reduction of preventable diseases, in India, this philosophy has limited evidence in the health related programmes. • The public policies and systems in India are still saddled by the debate on according importance and attention between the burden of classical diseases and the emerging health risks. As on date the planning for emerging health risk is treated as a peripheral activity. • Actions to increase the awareness among communities and strengthen the participation of communities for "preventing" diseases have less-than-required emphasis. • The present approach of curative care is not adequate to increase the preparedness of the system for fighting climate induced health risks.

Source: (Roy & Netinder, 2010)

infrastructure and management, as well as private investment for the maintenance of personal health. In literature, investment in both public and private health is advocated to ensure sustainable development in the long run.

In India, for a very long time, an alternative health system that stresses on man-nature interaction– AYUSH, has prevailed. Over centuries, this traditional system had effectively provided health care to a large section of the population. More a preventive medical regime, the popularity of AYUSH can be attributed to its low cost and its "individual" or one-to-one form of treatment (Moreno Leguizamon, 2005). Climate change impacts and adaptation strategies which call for more preventive actions for certain disease types needs to be newly embedded in the existing system. Existing preventive measures focus only on strengthening of immunization programmes. In India, the Primary Health Centres (PHCs) that act as the first contact point between the villagers and the medical officers in the rural areas, were envisaged to provide an integrated curative as well as preventive health care to the rural masses with a

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Table 10. Climate change and health in India: gap analysis

Disease Surveillance System	In India the system of gathering consolidated information about incidence of diseases may be less than efficient. A good monitoring and evaluation system is the need of the hour – disease records are to be managed efficiently to generate early warning systems. The information base can be used to identify the emerging health risks
Manpower in the health sector and Psyche of the population	• Adequacy of training/awareness among the health workers at the grass-root for delivery of public health is questionable. The number of trained doctors/nurses working at the government facilities at the grass-root level is far from adequate. • Poor people spend money and end up visiting a quack. • Citizens are oblivious of the fact that health is a right • Illiteracy and poverty leads to faulty health-seeking behavior among the population. Myths and misconception leads to reliance on religious customs for cure. • Poor rural population is often afraid of approaching the organized healthcare facility as they are thwarted by the rude behaviour of the doctors and nurses.
Institutional Capacity within the country	• The issue of the absence of "inter-sector convergence" is an important barrier and there may be less than adequate collaboration among ministries and departments (meteorology, social welfare, rural and urban development, veterinary, water and sanitation, health, environment, etc.) in preparing the health sector in India to combat the climate induced health risks. Ministries are yet to identify their own contributions to design a prepared health system in the perspective of climate change. • Urban India, primarily, is increasingly serviced by the private players in the health sector; there is little confidence in the government infrastructure for health care. • Healthcare is becoming increasingly less affordable to large number of population. • • Health insurance is not supported by the state. Health insurance for the rural poor has just started but the coverage, as yet, is low. • Access to health services – best in the city, poorest in the rural areas. Often, factors like difficult terrain, insurgency, etc. pose a challenge in delivering health facilities • Rural areas in the country face serious constraint in the form of inadequate availability of medicines • Availability of doctor per capita is miserably low; so also is the availability of hospital beds (and other such infrastructure)
Absence of a desired "Bottom-Up" Approach	• Stakeholders, particularly, at the grass-root are, very often, not consulted while devising strategies and policies for the health sector. • The current system may be plagued with a "one size fits all" approach for delivery of health care in India. There are both spatial and temporal variations in the problems. Specific regional problems are to be analyzed and understood and the results to be used by policymakers in addition to involving communities for policy design .Hence, innovation has to be inbuilt in the policy design. • Health care system is yet to recognize that morbidity and mortality have to be managed through the interplay of multiple disciplines.
Absence of region specific information and evidence	• There are many districts in India which are experiencing temperature and precipitation change for the past few years. What have been the effects (of such change) on the vector borne diseases? Is there a chronic heat effect? Is there an evidence of child mortality/ neo natal mortality with temperature rise? Are there evidences of the emergence of new viruses due to temperature rise? Evidences and case studies are missing. • One cannot say how the public health system should respond to the emerging health risks if one does not know with more confidence on exact cause-effect relationship between climate change and health with a region-specific focus. • Prospective studies on the health effects of climate change are yet to be commissioned. Answers to some of the following questions are still awaited: o What will be the health impacts of extreme heat /flood in the future (say, 2030/2050/2080)? o What will be the vulnerability profile of the districts and regions as a consequence of different scenarios of climate change? o What could be the adaptation strategies? What technological solutions are possible? • Research needs to be directed at finding out "local" evidence(s) and possible impacts. It is only then policy makers can be convinced and proper planning will be possible. • Also there is need for evidence based policy briefs for different levels of government(s) for initiating action for mitigating health effects of climate change and scaling up adaptation capabilities. • As on date, there exists gap in communication between scientific research and communities at the grass-root. This gap needs to be bridged. Findings from scientific research (relation between climate change and health) are to be communicated to the communities in the language they understand.
Political will	Politicians gain from planning for the immediate problems showing immediate results in economic gain. More attention, therefore, is directed towards the conventional problems rather than new emerging issues with uncertain outcome
"Prevention" and "Climate Change" – not top of the mind recall among the population	A large proportion of the population does not recognize the preventive measures. Further, common people are yet to recognize and realize the threat to health posed by climate change.

strong emphasis on the preventive and promotional aspects of healthcare. As on March 2012, there are about 24,049 PHCs functioning in the country (Ministry of Health and Family Welfare, Government of India, 2012). Their activities mostly involve providing curative, preventive, promotive and family welfare services.

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Post 1947, the Indian health policy, encouraged by the western system of modern pharmaceuticals, had focused more on a curative health system. Consequently, with policy and institutional patronage, a curative regime with appropriate supply chain and network penetrated fast to compete away the traditional preventive system. Further, with the advancement of medical science, a number of wonder drugs that effectively treated hitherto incurable diseases flooded the market providing mass scale relief for specific illness. Consequently, the traditional health management systems were marginalised. However, climate change induced health impacts have revived the demand for investment in preventive health care as a possible adaptation policy (Haque, Louis, Phalkey, & Sauerborn, 2014). Research shows that indigenous medical systems provide safe and effective therapies, are readily accessible even in remote rural areas and are more capital and energy efficient than modern pharmaceuticals as the former are based on locally available resources that requires little transport and preservation costs (Carlson, 2000).

To provide preventive care to a large population it is necessary to develop a holistic health care medical system. Paucity of health workforce in rural India along with lack of interest in modern allopathic graduates to serve the rural poor has worsened the situation in India (Samal, 2013). The challenge therefore is to revive the traditional medical systems, make them less individual oriented and integrate them with the public health system. To do this, it is necessary to understand the science behind such systems as this will help mainstream the traditional systems in the policies designed for preventive care. A holistic preventive health care system may come into existence through a successful co-existence of two regimes -the traditional health care systems and modern pharmaceuticals. The concept of mainstreaming AYUSH was an idea in the IXth five year plan before it was actually implemented in the country by NRHM in 2005. The NRHM put forward an innovative concept of mainstreaming AYUSH doctors at various rural health facilities such as community health centres and primary health centres (Samal, 2013). The rationale behind mainstreaming AYUSH was to strengthen the public health system in the country at all levels by engaging practitioners of alternate medicine. These practitioners have a good presence especially in the rural communities as well as good acceptability from a cultural perspective in the rural areas (Gopichandran & Kumar, 2012). In their paper, Gopichandran and Kumar have put forward a few important challenges in mainstreaming of AYUSH in the existing healthcare system:

1. **Cross Referral of Patients:** There are examples were AYUSH provides a better treatment to an ailment as compared to allopathy. The importance of cross referral, discussions between Ayurvedic and allopathic doctors and arrival at a common point is important in mainstreaming AYUSH in the existing healthcare system.
2. **Prohibition of Cross Practice:** Although legally cross practice has been prohibited by the Supreme Court of India, in many states like Uttar Pradesh, Chhattisgarh, Bihar many AYUSH practitioners are practising allopathic medicine. Since there is a legal restriction on cross practice in India, its implications on mainstreaming have to be assessed.
3. **Distinct Philosophical Orientation of Two Systems:** The philosophical orientation of the two systems viz. AYUSH and allopathy are distinct. While the basis of treatment in allopathy is identification of symptoms and causes of illness based on biomedical model, ayurvedic approach to treatment of illness is completely holistic and places health in the larger context of social, economic, environmental, and psychological situations. The diversity in approaches of the two should very well be kept in mind while integrating the two systems viz. allopathy and ayurveda into the present healthcare system.

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In India, the delivery of public health rests on the health workers working at the community level - the Auxiliary Nurses & Midwives, ASHA[12] workers, etc. Most health workers in India are not much aware of the impacts of climate change on health and are hence not skilled enough to prepare communities under their care to cope with such impacts and reduce their vulnerability. Preparing a plan for imparting training to health workers on climate change, its health impacts and possible coping strategies is, therefore, necessary. Furthermore, community participation in developing adaptation plans and capacity building are key components in building climate resilience in rural and economically backward areas that are highly vulnerable to the impacts of climate change. Capacity building through knowledge dissemination and training at the community level is essential to achieve a prepared and responsive health system with an inbuilt principle of preventive care.

In India the apparent dichotomy between "climate change" and "health" (at the policy level) exists because there are serious research gaps regarding the exact relation between climate change and possible health impacts and the care needs. Focused research in building up case studies at the local level, experiments for exploring efficient and effective coping strategies and adaptive capacities are required to initiate actions at the policy level. Not only historical studies but also prospective studies are required to map disease data and climate data for predicting the likely scenario in the future. This is because response cannot be formulated without taking into account evidence. Also, such research is required to develop an "early warning system" in order to increase the preparedness of all the stakeholders exposed to the risk of climate change induced health risks. Some recent experiences of extreme weather events have brought into focus the lack of preparedness – physical infrastructure such as water and health testing facilities for water borne diseases, testing centres to detect new types of diseases, trained medical staff, preventive medicine advisory dissemination institutions, etc. Healthcare technology development for rapid detection, diagnosis and prediction is still at a nascent stage in the country. This enhances vulnerability.

The role of the health administration in health infrastructure management need to be professionally developed and strengthened in India in order to achieve a comprehensive preventive health service delivery system. The current regime advocates a skewed healthcare system that lacks managerial efficiency. New diseases, mutation of pathogens and allergens, changing disease patterns, increase in the spatial spread of disease incidence due to the increase in the frequency and intensity of extreme events, etc. has made it crucial that the managerial aspect of generating quality health services be recognized as a dedicated action plan. This will mean revisiting existing public health laws such as the District and Village Health Plans of the National Rural Health Mission (NRHM) program and charting effective pathways to enforce these regulations. Further, the capacity to provide a holistic health system that incorporates traditional and modern practices need to be incorporated into the agenda of the institutions that provide health care in India.

Health is not an isolated issue but is intensely linked with the drinking water quality, sanitation and air quality both indoor and outdoor. Managing water for drinking purpose and air quality both at public provisioning level and household level needs special attention. There is also need for technology development and deployment, and monitoring of health infrastructure and health indicators for human wellbeing.

Accordingly, a set of action programmes have been considered in envisaging a road map for initiating actions by the Government of India to integrate health and climate change. The aim of the roadmap is to promote sustainable effort to combat vulnerability of the health sector in the face of climate induced health risks. The focused approach, as suggested in the roadmap is not only aimed at improving the existing public health system but to also generate adequate adaptive capacity to cope with climate change induced health risks. The suggested approach incorporates "preventive" measures as an integral

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component and is called National Preventive Health Care Programme (NPHCP). The NPHCP, through training, advocacy and mainstreaming the preventive healthcare into the existing system aims at reducing the burden of climate induced health risks at a relatively low cost. Bringing into forefront the traditional healthcare approaches like AYUSH is the core strategy of the NPHCP. The programme is envisaged to work in tandem with the existing cure based infrastructure and with various stakeholders – both public and private, and the civil society. The goal is preventive care and not curative treatment. The NPHCP is expected to generate a set of knowledge that may be used to formulate an "approach programme" for building a nation-wide National Preventive Health Care System (NPHCS) or National Preventive Health Care Mission (NPHCM). The goal of NPHCP is to mainstream NHPCS as a planned activity both at the national and the state levels. NPHCP is a research-driven, goal-oriented and strategic programme that is envisaged to have three pillars – knowledge generation, infrastructure planning, and training. The main activities under each of these pillars are presented in Table 11.

Management of the human capital, of which health is an integral part, has very large externalities besides private benefits. Given the public good component of health the government's role cannot be negated. To augment the Indian health system with the principles of preventive care in the light of climate change induced health impacts it is required that multiple agencies work in close tandem. A close cooperation between the ministries will play a crucial role in implementing the programme and mainstreaming it in the national policy.

Given the vastness and variability of a country like India, there is expected to be variability in the effects of climate change on health across population groups and geographical areas. Hence, it is important to formulate "local" studies to develop appropriate and efficient response functions. The control groups may be decided upon based on the known vulnerability of the regions and/or social groups.

Table 11. Suggested activities in NPHCP

Knowledge Generation	Infrastructure Planning	Training
• Formation of a nation-wide network of institutions and individuals focusing on research related to the issues in "climate change and health" in working groups mode • Linking this network to the international knowledge and experience by bringing together mutually complementary research / training /technology /knowledge sharing institutes and pool of human capital • Developing a collaborative research capacity for modelling the local incidence of disease for designing early warning systems • Building institutional collaboration for exchange programmes for students, researchers, professionals/ bureaucrats, policy makers	• Facilitate preventive health care through devising a programme for information management – a data bank capturing climate parameters, health outcomes/ stresses, hospital data and provide access to researchers to this databank for analysis, decision tool development to help policy making on a continuous basis • Preparing a plan and mechanism for cross country technology diffusion with an aim to promote preventive care • Establishing a collaborative mechanism for development and deployment of technology for preventive cure • Preparing risk management strategy(ies) in the domain of public health in the developing country context keeping in view the size, spread and density of the population • Creating institutional capacity for infrastructure including access to relevant data sets, computing and communication facilities • Designing a plan to complement efforts under the various national missions (in the health and other sectors) through global cooperation (for sharing experiences in different countries)	• Facilitate an improved understanding and awareness of the key drivers of health risks under climate change, especially among the existing and future pool of workers delivering health services in the country • Fostering professional attitude and incorporating preventive care in the health system • Building awareness to improve quality of data - hospital data, disease data, etc. i.e. all kinds of epidemiological data

Source: (Roy & Netinder, 2010)

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CONCLUSION

There is consensus in climate science literature that climate change will have exacerbated impact on human health. It provides a scope to enhance preventive actions to combat and minimize the anticipated adverse impacts on health through exposure reduction. Developing nations like India, with low infrastructure facilities, limited resources, diverse priorities and often with large population are particularly vulnerable to the likely health impacts of climate change. Public health care strategy for adaptation can be geared towards mainstreaming preventive, traditional, indigenous health care methods as complementary to the current cure based systems. This approach, if formalized, will include the already existing complementary system which function informally. It is particularly necessary in countries like India that has a much stratified income-educational and social categorization and is currently not covered by modern cure system but is served by informal traditional systems. In this scenario, if the diverse socio-economic structure is neglected while framing future health policies, it will be difficult to impart an integrated and holistic health care to all social strata. The objective is to create and integrate health mission that is target driven, policy oriented and action driven. The traditional Indian health system is largely based on providing preventive health care. Further, it is relatively cheap and individual based. Integration of these two different health care paradigms- traditional and modern, can provide the right kind of inclusive approach to addressing health issues in a developing country under the existing climate change scenario. Once such a holistic system is designed based on the bottom up approach, it will find universal acceptance among all socio-economic classes across nations thus ensuring the future success and robustness of the health system.

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ENDNOTES

1. The idea was presented for consideration in a report submitted to SIDA (Roy & Netinder, 2010). The report was prepared based on an extensive literature review and detailed interview of national and international agencies and stakeholders.
2. An aeroallergen is any air borne substance which triggers an allergic reaction. Aeroallergens include pollen grains, spores etc. Aeroallergens pose a direct threat to many people who already suffer from respiratory illness and people who develop problems after exposure.
3. While, there are numerous ways through which, climate change is expected to have impacts of human health in India, because of the paucity of space and goal we are not being able to provide a literature review of health impacts. We have restricted our attention to issues concerning heat stress and water quality as specific example to drive the message of need for preventive care through this paper.
4. In 2008-09, India had 28 states and 7 union territories. However, with effect from June, 2014, the country has been reorganized and the state of Andhra Pradesh has been divided into two sates – Andhra Pradesh and Telangana. Therefore, at present the country has 29 states and 7 union territories.
5. The distribution of issues is shown in detail in (Roy & Netinder, 2010).
6. As mentioned earlier, only some threats are being considered so as to keep the focus firmly on possible adaptation measures rather than digressing into long discussion on the interrelated and numerous health impacts from different types of climate variabilities.
7. Characteristic features of a developing economy includes low income levels, distributional inequality, poor health, inadequate education, low productivity, high population growth and dependency burden, substantial dependence on primary sectors, imperfect markets and limited information (Todaro & Smith, 2007).

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[8] According to India Meteorological Department (IMD), a heat wave occurs when maximum temperature of a station reaches at least 40˚C for the plains, and at least 30˚C for the hilly regions. When normal temperature of a station is less than or equal to 40˚C, heat wave departure from normal is 5˚C-6˚C and severe heat wave departure from normal is 7˚C or more. When normal temperature of a station is more than 40˚C, heat wave departure from normal is 4˚C -5˚C and severe heat wave departure from normal is 6˚C or more. When actual maximum temperature remains 45˚C or more, irrespective of normal maximum temperature, a heat wave is declared by IMD

[9] This can be done for any year. Our detailed research does have such information.

[10] Hospitals specializing in alternative medicines -Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH)

[11] ESI – Employees' State Insurance Corporation's Hospitals

[12] ASHA: Accredited Social Health Activists are trained female health workers who act as an interface between the community and the public health system.

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APPENDIX

Table 11. Accidental deaths due to heat stress in India 1998-2010

States/UTs	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Andhra Pradesh	78	51	56	46	80	100	52	105	125	128	124	262	197
Arunachal Pradesh	0	1	0	0	0	1	0	0	1	4	5	5	1
Assam	4	8	5	7	2	4	16	13	7	7	8	0	1
Bihar	94	94	19	47	22	70	32	68	52	58	28	46	95
Chhattisgarh	-	-	-	5	20	22	9	14	4	15	7	6	10
Delhi (UT)	128	26	34	28	45	18	20	19	14	26	7	40	41
Goa	0	0	0	6	0	0	0	0	0	0	0	0	0
Gujarat	51	38	19	24	47	30	12	13	7	16	6	9	58
Haryana	11	11	7	1	17	2	4	19	13	75	31	34	60
Himachal Pradesh	0	0	1	2	0	8	0	3	1	0	0	1	0
Jammu & Kashmir	0	0	0	0	0	3	2	2	2	1	0	0	6
Jharkhand	-	-	-	2	6	8	19	60	37	38	48	50	49
Karnataka	5	4	5	2	4	6	7	15	5	1	2	9	15
Kerala	7	20	1	0	0	4	1	0	0	1	0	1	2
Madhya Pradesh	109	41	36	8	32	39	158	24	45	41	11	20	46
Maharashtra	66	33	12	43	50	77	62	69	33	70	30	79	137
Manipur	0	0	0	0	0	0	0	0	0	0	0	0	0
Meghalaya	0	0	0	0	0	0	1	0	0	0	0	0	0
Mizoram	0	0	0	0	0	0	0	0	0	1	0	0	0
Nagaland	0	0	0	0	0	1	0	0	0	0	0	0	0
Orissa	112	48	74	60	77	98	76	94	51	55	69	101	130
Punjab	55	28	52	55	39	38	43	87	69	129	64	150	170
Rajasthan	58	25	22	19	57	44	37	38	35	56	29	55	54
Sikkim	0	1	0	0	0	0	0	0	0	0	0	0	0
Tamil Nadu	14	27	25	27	26	54	14	5	23	14	15	31	18
Tripura	2	6	6	4	0	2	0	15	5	0	9	10	12
Uttar Pradesh	137	88	115	52	134	126	95	199	87	108	80	117	118
Uttaranchal	-	-	-	0	0	0	0	2	1	2	0	0	0
West Bengal	85	68	45	66	62	52	96	211	137	86	43	45	54
States	1016	628	534	504	720	807	756	1075	754	932	616	1071	1274

Source: (GOI, 2010)

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Table 12. Number of productive days in Kolkata without adaptation in the year 2009

Month (Number of Days)	Number of Days with Productive Time				
	100%	75%	50%	25%	No Work
January(31)	2	6	7	11	5
February(28)	0	2	3	12	11
March (31)	0	0	0	3	28
April(30)	0	0	0	0	30
May(31)	0	0	0	0	31
June(30)	0	0	0	0	30
July(31)	0	0	0	0	31
August(31)	0	0	0	0	31
September(30)	0	0	0	0	30
October(31)	0	0	0	0	31
November(30)	0	3	5	3	19
December(31)	7	3	3	15	3
Total: 365	9	14	18	44	280

Source: Measure of heat stress and loss of productivity – case study of Kolkata, (Roy, 2010)

Table 13. Seasonal variation in piped water quality in KMC area (January – November 2007)

Season	Month	No. of Total Samples Collected	No. of Confluent Samples	% of Confluent Samples In Total
Winter (Oct-March)	Oct	836	29	3.32
	Nov	840	30	2.65
	Dec	623	17	1.93
	Jan	508	16	3.1
	Feb	657	10	1.46
	Mar	890	50	5.66
Summer (Apr-June)	Apr	636	73	8.12
	May	662	87	7.35
	Jun	708	35	3.12
Monsoon (July-Sep)	July	621	52	3.7
	Aug	632	56	3.48
	Sep	776	55	5.41

Source: Socio-economic survey in (Roy, 2010)

Note: Table shows the seasonal variations in water quality at the end-use point at public stand- posts across 128 wards of the KMC area

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Chapter 52
Climate Change Effects on Human Health with a Particular Focus on Vector-Borne Diseases and Malaria in Africa:
A Case Study from Kano State, Nigeria Investigating Perceptions about Links between Malaria Epidemics, Weather Variables, and Climate Change

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ABSTRACT

Malaria is currently affecting more people in the world than any other disease. On average, two members of each household suffered from malaria fever monthly, with females and children being most vulnerable to malaria attacks. This chapter assessed communities' perception about malaria epidemic, weather variable and climate change in metropolitan Kano. Information was extracted related to communities' perception about malaria epidemic and climate change. Socio demographic characteristics of respondents in the study areas were extracted and analyzed. 75% of the participants were males, while 25% were females, malaria disease affected 79.66% and 59.66% respondent perceived that heavy rainfall, floods and high temperature are better conditions to the breeding and spread of malaria vectors. Hospital records revealed that Month of March and April (2677 and 2464, respectively) has highest number of malaria cases recorded between December 2010 to June 2011. Further research is recommended for in-depth information from health officials related to raising awareness.

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INTRODUCTION

This chapter covers the effect of climate change on human health with a particular emphasis on vector-borne diseases and malaria with focus in Kano metropolitan Nigeria with a view to investigate community perceptions about links between malaria epidemics, weather variables and climate change.

BACKGROUND

Malaria is currently affecting more people in the world than any other disease. It is currently endemic in over 100 countries and one of the 10 most prevalent and deadly diseases in the world (WHO, 2002). Apart from being one of the world's dreaded killer diseases, its prevalence has become a local and an international public problem. Malaria causes about 273 million clinical cases and 1.12 million deaths annually. More than 40% of the global population (> 2.1 billion people) are exposed to the malaria (Toure and Oduola, 2004). Malaria is caused by five distinct species of plasmodium parasite (*Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium ovale, Plasmodium knowlesi*) and is transmitted by Anopheline mosquitoes. (IPCC WGII AR5, 2013)

The current distribution of malaria is currently confined to tropical areas and poorer countries. The burden of mortality is unevenly distributed, with approximately 85% of all deaths and disease occurring in Africa. The distribution of malaria in the 1870s was at the peak of its global spread. This was when global trade routes had allowed the infections to be spread to the New World, and before the development of active control measures allowed disease reduction (McMichael et al., 2000). In Africa, malaria is responsible for up to 50% outpatient department (OPD) cases and 20% admission (WHO, 2006). Many families spend a significant portion of their income on malaria treatment. For example, estimates indicate that the direct cost of a single episode of malaria to a household was US$ 6.87 in Ghana, US$ 4.8 in Uganda and US$ 4.5 in Mali (WHO, 2006).

The relationship between economic development and malaria is two-way. Poor economic development is an effect of malaria as well as a cause. The direct costs of treating and preventing malaria morbidity and lost productivity are considerable, in relation to available funds in a developing country. Further, malaria has been shown to slow economic growth in low income African countries creating an ever-widening gap in prosperity between malaria-endemic and malaria-free countries. The reduced growth in countries with endemic malaria was estimated to be over 1% of GDP per year. The cumulative effect of this ''growth penalty'' is severe and restrains the economic growth of the entire region (Sachs, 2001).

The health impacts of climate variability and change are increasing. Studies in South Africa have focused on climate sensitive health outcomes including diarrheal, respiratory, cardiovascular health, and vector-borne infectious diseases such as malaria (Myers et al, 2013, Myers et al, 2011). Long-Term Adaptation Scenarios (LTAS) indicate climate change's potential impact on vector borne disease (DEA, 2013). Although the incidence of vector-borne infectious diseases, especially malaria, has declined in the South African context over recent years. Modeling predicts no overall increase in malaria incidence for sub-Saharan Africa but a shift from west to south and east driven by climate change impacts (Peterson, 2009; Byass, 2009).

Malaria was associated with rainfall and minimum temperature (with the strength of the association varying with altitude). In Ethiopia, temperature determines the timing and abundance of mosquitoes following adequate rainfall, which contributes to the availability of breeding site. For rainfall to have a

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positive effect on malaria cases, the temperature must be warm enough to support mosquito and parasite development (Bodker et al 2003). Worrall and colleagues (Worrall et al, 2007) used rainfall and maximum temperature at a lag of four months to fit a biological transmission model for malaria in a district in Zimbabwe. Craig and colleagues (Craig et al, 2004) linked inter-annual differences in malaria to rainfall and temperature in South Africa. In 2014, Evans and his colleague used poisson regression model and negative binomial regression model to study trends in malaria prevalence in Minna Niger state, Nigeria. The results revealed that malaria prevalence increased by 6% on a monthly basis (Evans & Adenomon, 2014).

In Nigeria, malaria is highly prevalent. 50% of the population has at least one episode of malaria each year and children under five years have up to 2-4 attacks annually (FMOH, 2005). The disease is responsible for 60% outpatient visit to health facilities, 30% of childhood mortality and 11% of maternal deaths (FMOH, 2005).

In Kano metropolis, a detailed study of 278 household made up of 3071 individuals (living around non – water outlet ponds) revealed that malaria is the most common disease (Yusuf, 2008). On average, two members of each household suffered from malaria fever monthly, with females and children being most vulnerable to malaria attacks (Maigari, 2005). A descriptive study of temporal variation of malaria occurrence in Kano municipal showed that high temperature, high congestion and improper waste disposal were contributors to disease transmission. In addition, the presence of stagnant water in ponds and open gutters contributed to mosquito breeding (Tukur, 2010)

Assessing the potential impact of climate change on human health requires an understanding of both the vulnerability of a population and its capacity to respond to new conditions. The vulnerability of a population to a health risk is dependent on various factors including:

- The local environment and social conditions.
- The level of resources.
- The effectiveness of governance and civil institutions.
- The quality of public health infrastructure.
- Access to relevant local information on extreme weather threats.
- Adaptive policies.

There is growing evidence that climate change will have profound effects on the health and wellbeing of citizens in countries throughout the world. The 2009 Lancet Commission report states that climate change will affect the key determinants of human health. Changing climate will inevitably affect the basic requirements for maintaining health: clean air and water, sufficient food and adequate shelter.

CLIMATE CHANGE AND ITS IMPACTS

Climate change is considered the most pervasive and global of all issues affecting humanity as it poses a serious threat to the environment as well as to economies and societies. Changes in land use (e.g. deforestation) and the burning of coal, oil and natural gases are some of the activities that increase the amounts of greenhouse gases, especially carbon dioxide, emitted into the atmosphere. The accumulation of greenhouse gases in the atmosphere due to human activities is changing the climate by enhancing the natural greenhouse effect, leading to an increase in the Earth's average surface temperature. Through

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economic and social development, industrial and agricultural emissions of carbon dioxide, methane and other greenhouse gases are increasing. Reducing these gases will require a fundamental shift in industrial and manufacturing processes, agriculture and energy production.

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) forecasts an increase in average world temperature by 2100 within the range 1.4° – 5.8° C. The increase will be greater at higher altitudes and over land. In addition, IPCC projects that average annual rainfall will increase globally, with precipitation events and flooding becoming more severe, whereas, many middle and lower latitude land regions will become drier.

Climate change is expected to impact:

- Sea level – causing sea-level rise.
- Ecosystems.
- Human health.
- Agriculture.
- Tourism.
- Water resources.
- The poor.

Whilst it is clear that the impacts of climate change are varied, scientists have agreed that its effects will not be evenly distributed and that developing countries and Small Island developing States (SIDS) will be the first and hardest hit. Small island developing States, many of whom have fewer resources to adapt socially, technologically and financially to climate change, are considered to be most vulnerable to the potential impacts of climate change (IPCC, 2007).

Additionally, it is expected that climate change will pose a significant threat and drain public resources in many Caribbean States. Today, countries in the Caribbean continue to grapple with issues related to macroeconomic stability, reducing poverty levels and trade liberalization, to name a few (IPCC, 2007).

Climate change is expected to affect ecosystem services in ways that increase vulnerabilities with regard to food security, water supply, natural disasters, and human health and will, in turn, affect socio-economic development. (IPCC, 2007b; Stern, 2006; WHO, 2003; WHO, 2008). Furthermore, it was reported in the IPCC Third Assessment that, while developing countries are expected to experience larger percentage losses in GDP, global mean losses could be between 1-5% GDP for 4° C of warming.

Climate change is also expected to cause a further rise in sea level of about 20cm by the year 2030 (IPCC, 2007). Forecasts of rising sea levels are based on climate model results which indicate that the earth's average surface temperatures may increase by 1.5° – 4.5° C over the next 100 years. The warming can cause the sea to rise in two ways: through thermal expansion of ocean water, and through the melting and sinking of ice caps and mountain glaciers.

Furthermore, extreme climate events are expected to become more frequent with climate change. These events are expected to have their greatest impact in poor and/or developing countries and in Small Island developing States. Climate change is also expected to affect the health of populations. In fact, the World Health Organization (WHO) in *Protecting Health from Climate Change* (2008) states that the continuation of current patterns of fossil fuel use, development and population growth will lead to ongoing climate change, with serious effects on the environment and, consequently, on human lives and health.

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Climate change is considered by the Lancet Commission to be "the biggest global health threat of the twenty-first century". Their 2009 Report, entitled *Managing the Health Effects of Climate Change* states that the effects of climate change on health will affect most populations in the upcoming decades, and will put the lives and well-being of billions of people at increased risk.

Therefore, the development paths that the world chooses will have a strong influence on this increase in greenhouse gas emissions. According to the Stern Review (2006), the scientific evidence points to increasing risks of serious irreversible impacts from climate change associated with business-as usual (BAU) paths for emissions. If, for example, high priority is placed on sustainable energy use, temperatures are expected to rise by 1.8° C (likely range: 1.1°–2.9° C). If societies place a lower emphasis on sustainability measures, temperatures are expected to rise by about 4.0° C (2.4°–6.4° C), with a greater probability of abrupt or irreversible impacts (WHO, 2008).

Climate change is likely to be associated with multitude of effects:

1. Climate change has been associated with a shift in the composition and geographical distribution of many ecosystems (e.g. forests, deserts, coastal systems) as individual species respond to changing climatic conditions, with likely reduction in species diversity and agricultural yield.
2. Climate change will lead to an intensification of the global hydrological cycle and may affect regional water resources.
3. Additionally, climate change and the resulting sea-level rise can have a number of negative effects on energy, industry and transportation infrastructure, human settlements and tourism (IPCC, 2007).

Generally speaking, "the various potential health effects of global climate change upon human health can be divided into direct and indirect effects, according to whether they occur predominantly via the impacts of climate variable upon human biology, or are mediated by climate-induced changes in other biological and biogeochemical systems".(Martens et al, 1999).

Temperature and precipitation changes might influence the behaviour and geographical distribution of vectors, and thus change the incidence of vector borne diseases, which are major causes of mortality and morbidity in many tropical countries. Increase in non-vector-borne infectious diseases such as cholera, salmonellosis, and other food-and water-related infectious diseases could occur, particularly in tropical and sub-tropical regions, due to climatic impact on water distribution, temperature and proliferation of microorganisms (UNEP, 2003).

Measuring the health effects from climate change can only be very approximate. Nevertheless, a WHO assessment, taking into account only a subset of the possible health impacts, and assuming continued economic growth and health progress, concluded that climate change is expected to cause approximately 250 000 additional deaths per year from malnutrition, malaria, diarrhoea and heat stress (Okogun et al, 2005). The direct damage costs to health (that is excluding costs in health-determining sectors such as agriculture and water and sanitation), is estimated to be between US$ 2-4 billion/year by 2030 (Okongun et al, 2005).

Areas with weak health infrastructure – mostly in developing countries – will be the least able to cope without assistance to prepare and respond. Climatic conditions strongly affect water-borne diseases and diseases transmitted through insects, snails or other cold blooded animals. Changes in climate are likely to lengthen the transmission seasons of important vector-borne diseases and to alter their geographic range.

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MALARIA AND WEATHER CONDITIONS

Malaria and its prevalence in Africa and Asia continue to be a public health concern. Climatic factors such as temperature and rainfall have great influence on the geographical spread and seasonal incidence (Epstein, 1999). Disease vectors reproduce within certain optimal climate conditions such as a combination of rainfall and temperature. Changes in these conditions can greatly alter disease transmission. Minimum as well as maximum temperatures are often critical to the survival of disease causing pathogens and their vectors. Temperature controls the rate of larval and parasite development. Higher temperatures shorten the development time of the larvae and parasites in the mosquitoes. Malaria epidemic risk is related to both warm temperatures and the following rainy season months. Climatic events that create these conditions could result in disease epidemics. Variability in precipitation may have direct consequences on disease outbreaks as increased precipitation may increase the size of the mosquito population by creating new breeding grounds and expanding the size of existent larval habitat (Caroline 2012, Wandiga et al., 2010).

The El Niño-Southern Oscillation (ENSO) cycle is a key factor affecting the emergence and prevalence of vector-borne infections (Pherez, 2007). Rainfall in particular is important, not only through its quantity and timing, but also through its effects on relative humidity and on human activity patterns, as well as its relevance to control activities. For example, the rainy season is the period of active farming in most rural communities in Nigeria (Opara et al, 2008) and is associated with higher mosquito net use compliance in Burkina Faso (Okrah et al,2002). Larviciding of breeding sites a month before onset of rainfall is recommended for vector control in Nigeria (Okogun et al 2005). While El Niño events have been suggested as a potential predictor for malaria epidemics in Sri Lanka, on the long-term, these associations break down (Zubair et al, 2008). ENSO is one of the numbers of climate indices, each reflecting temperature or pressure changes at different locations on the earth's surface. In western sub-Saharan Africa, rainfall is related to seasonal shifts of the Inter-Tropical Convergence Zone (ITCZ), which moves northward early in the year, retreating in the second half of the year. Onset and retreat dates for four locations in Nigeria— Ibadan, Ilorin, Kaduna and Kano have been reported in the literature (Odekunle, 2004) and were linked to variation in malaria transmission mediated by the vital role of rainfall on the distribution of mosquito breeding sites (Onwuemele, 2013).

CLIMATE CHANGE AND MALARIA

While climate change will alter the patterns and spread of malaria transmission, other important drivers of the disease include socioeconomic status, type of vectors available, population immigration and vector dispersal. Africa will continue to carry the greatest burden of the disease and in particular Eastern and Southern Africa (Andrew, 2009). Mountainous regions in South Asia are likely to experience an increase in transmission. The same applies to highland regions of South East Asia and Pacific countries. The United Kingdom, Europe, Canada and New Zealand are unlikely to be affected in the near future (Andrew, 2009).

Climate Change and Malaria in Africa

All the drivers of malaria transmission are found in abundance in Africa and climate change is a new addition. Since the late 1980s, there were reports of malaria epidemics particularly in the East Afri-

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can Highlands (Andrew, 2009). In many of these regions there was widespread parasite resistance to chloroquine, (Abeku et al 2003, Zhou et al 2004, Pascual et al 2006) and virtually no vector control. At that time, it was not clear whether the epidemics were a result of environmental change or due to the effects of drug resistance and lack of vector control. A detailed study of climate and malaria epidemics indicated that epidemics were associated with incidents of El Nino (Kovats et al 2003, Anyamba et al 2006), characterized by abnormal warming and wetness. Weak and late interventions failed to contain the outbreaks leading to severe health outcomes. Kenya, Uganda, Burundi, Tanzania, Eritrea, Ethiopia and Rwanda reported severe malaria epidemics in the late 1980s to 2003 (Andrew, 2009). This period had two very strong El Nino events and a number of weak events (1982, 1988, 1990-1994, 1997-8, 2003) (Andrew, 2009).

Climate change will contribute to increased malaria epidemics throughout Nigeria, with the highest impact in the Mangrove and Rainforest zones (Abiodun et al 2011). It should be noted that these zones have the highest population density in Nigeria, indicating population-based vulnerability in these regions. This implies that climate change would further strain the already poor public health resources in Nigeria, especially in the cities located in the Mangrove and Rainforest zones. We suggest that this might heighten the conflict in the Niger Delta region. Hence, adaptation options that would improve public health facilities and services are crucial in these areas (Abiodun et al 2011).

Statement of the Problem

Malaria parasite is growing at a rapid pace. The roll back malaria (RBM) campaign launched in 1998, with the stated goal to halve malaria deaths worldwide by 2010 was confronted by problems of drug resistance (Raghunath, 2004). In Kano state, the programme encountered the following challenges: poor symptom recognition, outdated malaria treatment, improper treatment practice and poor acceptance of insecticide treated Nets (ITNs). In addition to cross cutting issues such as ineffective advocacy and communication skills among malaria control programmes, low status and poor appreciation for communication, inadequate time and resources for strategic communication and lack of procedure evaluation. Currently, malaria prevalence in Kano state is increasing and a number of epidemics have been reported. In 2001-2005, 16,601 people were infected by malaria in Kano municipal (Tukur, 2010). A prevalence study in Wudil and Gaya hospitals in Kano state showed that the highest prevalence rate was detected in children aged 1-3 years (85.4% and 46.6%, respectively) (Yahaya et al,2014). A study in the community showed that 30.59% of children (1-5 years old) were infected with malaria (Gobir & Tukur, 2014).

- **General Objective of Study:** This study objective was to assess communities' perception about malaria epidemic, weather variable and climate change in metropolitan Kano.
- **Specific Objective:**
  - To assess communities' perception about malaria and climate change.
  - To find out the level of awareness and integration of climate change in public health.
  - To make recommendation based on the findings.
- **Significance of the Study:** It is hoped that the study could contribute to further research on malaria and climate change in Nigeria. Local governments' public health officials should consult research findings and include these in decision making processes, especially for effective malaria control and the health sector adaptation to climate change.

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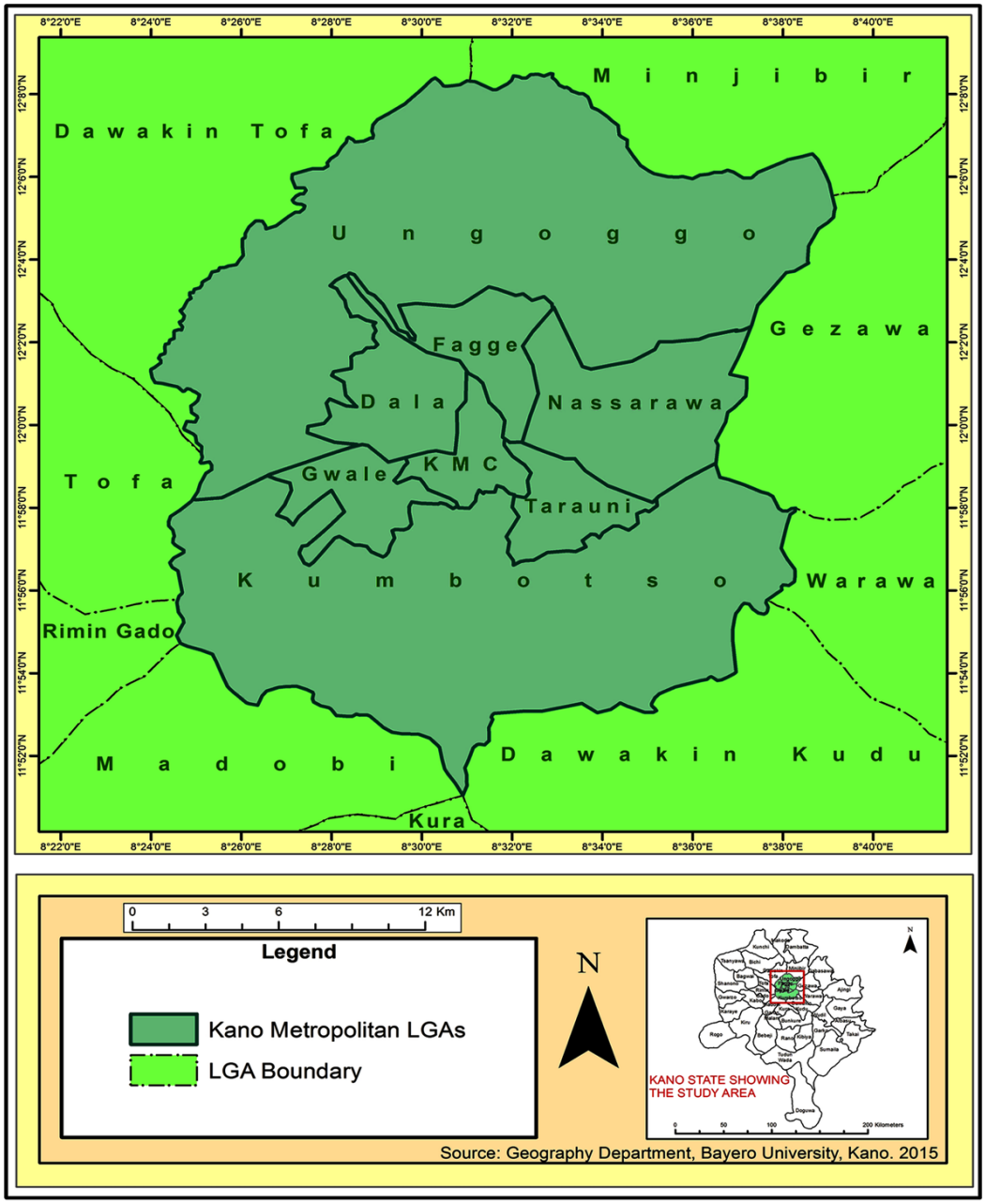
- **Study Area:** The study area is the Kano Metropolis comprising of the following local government areas of Dala, Tarauni, Kano Municipal, Gwale, Fagge, Kumbotso, Nasarawa and Ungogo. It is located at the central western part of the state between latitude 11°59'N and 12°2'North of the equator and between longitude 8°33'E and 8°31'East of the Greenwich meridian (see Figure 1). The population was 2826307 as at 2006 population census (NPC, 2007). The area has a tropical

Figure 1. Map of Kano metropolitan showing the study area
Source: Geography Department, Bayero University Kano (2015).



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dry and wet climate. Almost 40% of the annual rainfall occurs in August, which is the peak of the wet season. The temperature regime is warm to hot throughout the year, even though there is a slightly cool period between November and February. The mean annual temperature is about 22°C in the coolest months (December or January) and 31°C in the hottest months (April or May). The mean annual potential evaporation, sunshine, and relative humidity are about 1,772mm, 8.5 hours per day, and 50% respectively (Olofin, 1987). The natural vegetation of the area and indeed most of the Kano region is Sudan savanna.

Methodology

In this study, qualitative and quantitative methodological approaches were used in order to assess the opinions of the local people. It involved interviews, discussions, and narratives to get more details about events, tendencies and situations regarding malaria outbreaks in relation to climate variability and other risk factors such as large influx of non-immune people into an area of transmission, high mortality rate etc., in addition to communities' awareness and perceptions and coping strategies. Quantitative research was used to look at relationships between age, education level, gender and place of residence and outcomes.

A survey using a questionnaire was used in six out of the eight local government areas that make up the Kano metropolitan (see figure 1). The six local governments were selected randomly through the lottery method (names of the local government were written on a paper, thoroughly mixed; put in a bowl and without looking six papers were selected). The selected areas for study were Nassarawa, Kano municipal, Gwale, Fagge, Tarauni and Dala. In each locality respondents were selected purposively because of their history of previous malaria infection. In addition, 6 health officials were interviewed 1 from each hospital namely; Sunusi hospital, Abdullahi wase hospital, Jidda hospital, Murtala Mohammed hospital, Arewa Surgery hospital and Aminu Kano teaching hospital, across the 6 local government areas, about vulnerabilities strategy and policy related to climate change and human health, with a focus on malaria. A total of 600 questionnaires were administered (100 questionnaires at each local government). The questionnaires were administered during a period of 7 months (December 2010 to June 2011). A questionnaire sample is provided in appendix. The data gathered were collected and encoded into a computer and descriptive statistics were used to analyze the data.

RESULT AND DISCUSSION

Demographic Characteristics of the Respondents

75% of the participants were males, while 25% were females (Table 1). As shown on Table 2-5, the respondents are representative of the general population. However, the majority were married, aged 25-44 years old, with good educational level and professional.

The result of the investigations showed that 98.17% of people living in the metropolitan area consider that climate change poses a significant threat that result in the deterioration of human health, mostly due to the increased presence of vector-borne tropical diseases, such as malaria and dengue fever and prevalence of respiratory illness in urban Kano.

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Table 1. Gender distribution of respondents

Gender	Respondents	%
Male	450	75
Female	150	25
Total	600	100

Table 2. Marital status of the respondents

Marital Status	Respondents	%
Single	105	17.5
Engaged	44	7.33
Married	410	68.33
Divorce	25	4.17
Widowed	16	2.67
Total	600	100

Table 3. Age structure of the respondents

Age	Respondents	%
16-24	47	7.83
25-34	235	39.17
35-44	205	34.17
45-54	76	12.67
55 or above	37	6.16
Total	600	100

Table 4. Educational status of respondents

Education	Respondents	%
Primary	85	14.17
Secondary	253	42.17
Tertiary	215	35.83
Informal	47	7.83
Total	600	100

Table 5. Occupational status of respondents from metropolitan

Occupation	Respondents	%
House-wife	71	11.83
Civil servant	207	33.5
Trading	223	37.17
Faming	80	13.33
student	25	4.17
Total	600	100

The question investigating the relevance of malaria in the study area showed that 79.66% respondents indicated that malaria disease affected them very much, 15.5% were affected a little and 4.84% not affected at all by malaria but they were aware that malaria cases are rampant in their community. The majority of respondents (78.66%) knew the effect of environmental factors on malaria prevalence, which is judged to be common knowledge.

When investigating the impact of high rainfall and hot temperature on increasing mosquito population, 41.84% of people living in metropolitan Kano strongly agree, 24.33% agree, 20.16% neither agree nor disagreed, 6.67% disagree and 7% strongly disagree (see Table 6).

Table 7 showed that 59.66% respondents agree that heavy rainfall, floods and high temperature are conducive conditions to the breeding and spread of malaria vectors. The respondents believe that malaria epidemics have partly coincided with periods of high rainfall and flood (El Nino occurrence).

Table 8 reveals that 431 (71.82%) respondents believe there is a link between malaria incidence and climate change in Kano metropolitan.

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Table 6. Perceptions about the effect of climate change on health

	Nassarawa	Kano Municipal	Gwale	Fagge	Tarauni	Dala	Number of Respondents	%
Strongly agree	80	81	75	90	85	80	491	81.84
Agree	18	17	21	10	13	19	98	16.33
Neither agree or disagreed	2	2	2	2	2	1	11	1.83
Disagree	0	0	0	0	0	0	00	-
Strongly disagreed	0	0	0	0	0	0	00	-
Total	100	100	100	100	100	100	600	100

Table 7. Association of climate change with heavy rains and increase in temperature as conducive conditions for the breeding and spread of malaria vector

	Nassarawa	Kano Municipal	Gwale	Fagge	Tarauni	Dala	Number of Respondents	%
Strongly agree	29	35	32	34	71	40	241	40.16
Agree	12	24	20	22	12	27	117	19.5
Neither agree or disagreed	28	21	35	21	11	16	132	22
Disagree	13	10	8	9	1	8	49	8.17
Strongly disagreed	18	10	5	14	5	9	61	10.17
Total	100	100	100	100	100	100	600	100

Table 8. The relationship between malaria incidence and climate change in Kano metropolitan

	Nassarawa	Kano Municipal	Gwale	Fagge	Tarauni	Dala	Number of Respondents	%
Strongly agree	64	58	34	25	47	46	274	45.66
Agree	20	21	28	25	33	30	157	26.16
Neither agree nor disagreed	13	17	28	25	15	19	117	19.5
Disagree	2	3	6	14	4	3	32	5.33
Strongly disagreed	1	4	4	8	1	2	20	3.33
Total	100	100	100	100	100	100	600	100

Table 9 showed that there are low levels of climate change integration and community awareness on issues of climate change and health due to lack of awareness. The implication of low level of awareness could put the communities involved at more risk of contracting malaria and delayed treatment seeking, which will contribute to increased disease burden.

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Table 9. climate change integration in public health in Kano metropolitan and level of community awareness about climate change and malaria

	Nassarawa	Kano Municipal	Gwale	Fagge	Tarauni	Dala	Number of Respondents	%
Strongly agree	10	8	10	9	6	7	50	8.33
Agree	5	2	6	12	2	1	28	4.67
Neither agree or disagreed	9	14	10	13	8	8	62	10.33
Disagree	15	8	20	15	11	14	83	13.83
Strongly disagreed	61	68	54	51	73	70	377	62.83
Total	100	100	100	100	100	100	600	100

To supplement the primary data, secondary data were collected for January-December 2011 to show trends of rainfall and temperatures as well as monthly records of malaria incidence from hospitals in Kano metropolitan (Tables 10 and 11).

The hospital records of malaria and corresponding meteorological conditions showed a clear association. The highest number of cases were recorded during March and April (2677 and 2464, respectively) corresponding to the hottest months of the year in terms of both maximum and minimum temperature associated with low rainfall. It was observed that the study areas were very congested with an unplanned pattern of buildings and indiscriminate waste disposal which provide breeding sites for mosquitoes.

Table 10. Climate data for Kano metropolitan (2011)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Temp.high °C	26	27	32	33	31	29	27	27	28	29	27	26	28.5
Average Temp. low °C	22	24	29	29	28	26	24	24	24	26	23	22	25.1
Average precipitation days	0	0	1	1	2	2	7	6	3	2	1	1	26

Source: Metrological station Aminu Kano International Airport (2012).

Table 11. Monthly malaria incidence in Kano metropolitan

	Nassarawa	Kano Municipal	Gwale	Fagge	Tarauni	Dala	Total
Dec. 2010	168	183	153	200	124	101	933
Jan. 2011	124	216	208	103	114	156	921
Feb. 2011	111	208	234	117	135	202	1007
Mar. 2011	328	406	397	412	581	616	2677
Apr. 2011	201	336	460	442	541	485	2465
May 2011	197	263	211	187	217	264	1339
Jun. 2011	174	210	283	209	235	214	1325

Source: Hospitals Records, 2011.

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Health Officials' Perspective

In total six health officials were interviewed. Health officials were invited to participate in the interview voluntarily depending on their availability. The interviewees include one medical officer (medical doctor) and five nurses, all have worked in the hospital for more than ten years. The medical officer holds a bachelor degree in medicine and the other officials have either diploma or certificate in nursing. The age ranges from 28 to 61 years.

Most of the health officials interviewed at the local governments acknowledged the relationship between climatic factors and increasing malaria epidemic in the study area. Some reported that "malaria outbreaks occur during periods of dry seasons". A senior official from the malaria control unit reported that "high rainfall periods do not usually have mosquitoes because breeding grounds are disturbed" he further stated that mosquitoes increases significantly as temperature increases. A hospital worker with 20 years working experience observed that "Malaria today is common and increasing unlike in the past. I believe this has to do with changing climate in Kano, people are coming to hospital every day reporting sickness, after a test the result showed presence of malaria".

Some respondents explained that "there is a low level of awareness between climate variability and malaria". They attributed the low level of awareness in the communities to the "I don't care attitude of people" about awareness programs and funding challenges that these programs experience.

This case study showed that, overall, the respondents were well aware of the burden of malaria in their localities and its intimate association with weather variables. The impact of climate change on disease transmission and malaria incidence were well understood in a high proportion of respondents. However, better community knowledge through awareness and communication campaigns as well as integration of climate change in public health strategies are urgently needed.

CONCLUSION

Malaria occurrence will be influenced by climate change. Other factors such as personal hygiene, poor sanitation, and inadequate knowledge on the disease are likely to contribute significantly to the disease burden. At present, there is no clear answer to the problem of malaria because climate will keep on changing in the foreseeable future and influencing transmission. One solution is to integrate climate change in health policy and other relevant sectors in order to enable effective adaptation strategies.

Recommendation for a way forward are:

- NGOs, ministry of health and other organizations such as Society for Family Health, should continue to promote prompt and effective malaria case management at the health facility, community and household levels. In addition, vector control including Long Lasting Insecticidal Nets (LLINS), indoor residual spraying, use of intermittent preventive treatment (IPT) of malaria in pregnancy, insecticide treated mosquito nets (ITNs) and environmental management are also recommended.
- Climate change awareness and adaptation strategies in Kano metropolis are seriously needed. It is important that climate change and health policies are developed to protect communities. There should also be an effort to plan and establish a communication strategy detailing the risks, which should be targeted at vulnerable communities, NGOs, and all stakeholders.

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- The author recommends further research in the study area by conducting more elaborate interviews with health officials in order to get more details and in depth information related to raising awareness and implementation strategies.

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APPENDIX: QUESTIONNAIRE ON PERCEPTIONS OF PEOPLE LIVING IN METROPOLITAN KANO ABOUT LINKS BETWEEN MALARIA EPIDEMICS, WEATHER VARIABLES AND CLIMATE CHANGE

Please tick appropriate on the options in Sections 1 and 2.

Section 1: Demographic Information

Table 12.

Serial Number	Questions	Coding Categories
01	Are you ……..	1. Male 2. Female
02	What is your current marital status?	1. Single 2. Engaged 3. Married 4. Divorced 5. Widowed
03	Please indicate the age bracket you are in:	1. 16-24 2. 25-34 3. 35-44 4. 45-54 5. 55 or above
04	What is your highest qualification (level of Education)	1. Primary 2. Secondary 3. Tertiary 4. Informal
05	Do you have an occupation which one is applicable to you	1. House-wife 2. Civil-servant 3. Trading 4. Farming 5. Student

Section 2

1. Changes in the weather (e.g. rainfall and temperature) have affected human health in your community.

   Strongly Agreed (). Agree (). Neither agree nor disagree (). Disagree (). Strongly disagree ()

2. How does malaria disease affected you or any member your family?

   Very much (). Little (). Not affected ().

3. Increase in rainfall and temperature brings an increase in mosquitoes in your area.

   Strongly Agreed (). Agree (). Neither agree nor disagree (). Disagree (). Strongly disagree ()

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4. Changing climate is associated with the warmer condition (increase in temperature) and it gives mosquito's better breeding ground and spread of malaria disease.

   Strongly Agreed (). Agree (). Neither agree nor disagree (). Disagree (). Strongly disagree ()

5. There is a relationship between malarial incidence and climate variability in Kano.

   Strongly Agreed (). Agree (). Neither agree nor disagree (). Disagree (). Strongly disagree ()

6. Climate change issue is fully integrated in public health sector and the communities in metropolitan Kano are informed about the links between malaria epidemics, weather variables and climate change.

   Strongly Agreed (). Agree (). Neither agree nor disagree (). Disagree (). Strongly disagree ()
   General comments**:**

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Interview Guide for Health Officials

1. What can you say about the malaria disease occurrences in Kano?
2. What is your perception on the relationship between climatic factors and increase in malaria epidemic and when do you experience reports on malaria case?
3. Are people in the community aware about the relationship climate variability and malaria?
4. What period you usually have mosquitoes most in Kano?

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Chapter 53
The Idea of Human Rights in Conditions of Hospital Treatment

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ABSTRACT

The aim of this chapter is describing of the influence of universal human rights and civil liberties on the formation of standards for hospital care. The authors present definition of the right to life and the right to health. Moreover in the section it is discussed modern standards of hospital treatment under the provisions of the International Covenant on Economic, Social and Cultural Rights: availability, accessibility, acceptability and quality. The authors discuss in detail about selected examples realization of human rights in the treatment of hospital and forms of their violation. During the presentation of these issues, the authors analyze a provisions of the International Covenant on Civil and Political Rights and European Convention on the Protection of Human Rights and Fundamental Freedoms and use a number of judgments of the European Court of Human Rights issued in matters concerning human rights abuses in the course of treatment and hospitalization.

INTRODUCTION

The Right to Health in the System of Human Rights

The human rights is defined as a "minimum standards of legal, civil and political freedoms which guarantee dignity to people" and "the elementary, natural and inalienable rights attributed to all on account of their existence as human beings" (W. Kirch, 2008). Added that "the human rights represent the institutionalized legal, philosophical, political and moral considerations about the inherent dignity and equal rights all human beings are entitled to and which the state has to respect and protect". Moreover

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"the human rights aim to provide individuals with the basic personal, political and property rights as well as the basic freedoms" (G. Grabowska, 2014).

Human rights constitute the direct consequence of the dignity of the human person – common and inherent - granted to all citizens. The necessity of respect for and guarantee of the human dignity underlies the actions taken by countries and international organizations as well as it is confirmed and properly guaranteed in their law systems. Protecting the dignity of the human person a country has to provide its citizens with proper life conditions, both material (nourishment, clothes, accommodation, treatment) and mental (education, helping out in illness and misery, active involvement in society) (G. Grabowska, 2014; A. Zieliński, 2003).

The right to help is an important value resulting from human rights. On the basis of its degree of achievement, the development of rule of law standards (C. Byk, 2000, K. Prokop 2011).

The right to health is inseparably connected with the aforementioned dignity of the human person. The dignity of the human person is the right and fundamental value which is not dependent on their health condition, membership of particular organizations and political groups, wealth, poverty, etc. It is emphasized that there are some situations in case of which violation to the social, economic, cultural (the right to food, water or health care) rights decreases the standard of a human and his family's life to such a degree that it leds to humilitation, causes dehumanization and sense of helplessness, and deprives of dignity (G. Grabowska, 2014).

The close relations between health and human rights may be proved by indicating the negative consequences of a damage to health that appear in the field of protection of fundamental human rights. First, human rights violations can directly affect health: for example, torture, slavery, violence against woman and children and harmful traditional practices. Secondly, the promotion of human rights, in particular those connected to the social determinants of health, for example rights to education, to food and nutrition, shelter and employment, lead to reduced vulnerability to ill health and promote health. Thirdly, health development can involve promotion of violation of human rights depending on how it affects right such as the right to participation, freedom from discrimination, right to information and right to privacy (A. Taket, 2012). There is a reciprocal impact of health and human rights. The promotion, protection, restriction or violations of human rights have direct and indirect impacts on health and wellbeing, in the short, medium and long term (J. Cohen, T. Ezer, 2013).

The right to health is considered to be one of the most important human rights which is reflected in many sources of international law.

The special attention deserves The Universal Declaration of Human Rights from 1948 and the Article 25(1) according to which: everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control. In bibliography one may find the opinion that The Universal Declaration of Human Rights only mentions the word "health" once, yet to a health professional, the entire document is full of health-related messages and meaning. So much so that a new health and human rights movement is now under way, exploring the many vital consequences which flow from recognizing that health and human rights are inextricably connected (J. Mann, 1998).

Sometimes the right to health stated in The Universal Declaration of Human Rights is connected with the right to educate which is stated in the Article 26(1) of this Act. The Universal Declaration of Human Rights thus framed both health and education to be fundamental rights of human beings that are to be provided to individuals irrespective of their nation of origin or place of residence (G. Sankaran, 2010).

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The Article 12 of International Covenant on Economic, Social and Cultural Rights from 1966 includes regulations crucial for respecting the right to health. According to the point 1 of this law act The States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health. Ustęp 2 doprecyzowuje, że The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for:(a) The provision for the reduction of the stillbirth-rate and of infant mortality and for the healthy development of the child; (b) The improvement of all aspects of environmental and industrial hygiene; (c) The prevention, treatment and control of epidemic, endemic, occupational and other diseases; (d) The creation of conditions which would assure to all medical service and medical attention in the event of sickness.

Fundamental are also the provisions of the document of General Comment No. 14 (2000) to The right to the highest attainable standard of health (article 12 of the International Covenant on Economic, Social and Cultural Rights) – Substantive issues arising in the implementation of the International Covenant on Economic, Social and Cultural Rights, in which the concept of "health" was defined. According to this document health is a fundamental human right indispensable for the exercise of other human rights. Every human being is entitled to the enjoyment of the highest attainable standard of health conducive to living a life in dignity. The realization of the right to health may be pursued through numerous, complementary approaches, such as the formulation of health policies, or the implementation of health programmes developed by the World Health Organization (WHO), or the adoption of specific legal instruments. Moreover, the right to health includes certain components which are legally enforceable.

The aforementioned law act explains also the concept of "the right to health" indicating that the right to health is closely related to and dependent upon the realization of other human rights, as contained in the International Bill of Rights, including the rights to food, housing, work, education, human dignity, life, non-discrimination, equality, the prohibition against torture, privacy, access to information, and the freedoms of association, assembly and movement. These and other rights and freedoms address integral components of the right to health. At the same time, it is claimed in the point 8 that the right to health is not to be understood as a right to be healthy. The right to health contains both freedoms and entitlements. The freedoms include the right to control one's health and body, including sexual and reproductive freedom, and the right to be free from interference, such as the right to be free from torture, non-consensual medical treatment and experimentation. By contrast, the entitlements include the right to a system of health protection which provides equality of opportunity for people to enjoy the highest attainable level of health.

The importance of the right to health in the system of human rights is confirmed by the fact that this issue is raised in many law acts among others in article 5 (e) (iv) of the International Convention on the Elimination of All Forms of Racial Discrimination of 1965, in articles 11.1 (f) and 12 of the Convention on the Elimination of All Forms of Discrimination against Women of 1979 and in article 24 of the Convention on the Rights of the Child of 1989. Several regional human rights instruments also recognize the right to health, such as the European Social Charter of 1961 as revised (art. 11), the African Charter on Human and Peoples' Rights of 1981 (art. 16) and the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights of 1988 (art. 10). Furthermore, the standards of the rights of a human related to the right to health are also stated in the provisions of the International Covenant on Civil and Political Rights (ICCPR) and European Convention on the Protection of Human Rights and Fundamental Freedoms (J. Mann, S. Gruskin, M. Grodin & G. Annas, 1998).

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IMPLEMENTATION OF THE RIGHT TO HEALTH AND HOSPITAL TREATMENT ORGANIZATION

According to the point 12, substantive issues arising in the implementation of the International Covenant on Economic, Social and Cultural Rights: the right to health in all its forms and at all levels contains the following interrelated and essential elements, the precise application of which will depend on the conditions prevailing in a particular State party – availability, accessibility, acceptability and quality. There is no doubt that these standards shape patterns in the field of hospital treatment organization. The conclusions related to organizational sphere of providing health benefits in hospitals were drawn on the basis of the analysis of source materials: organizational regulations of hospitals and their wards, statutes and proceedings taking into consideration the general lines of quality policy.

Availability

Availability in the hospital treatment means that functioning public health and health-care facilities, goods and services, as well as programmes, have to be available in sufficient quantity within the State party. Substantive issues arising in the implementation of the International Covenant on Economic, Social and Cultural Rights in the point 12 state that the precise nature of the facilities, goods and services will very depending on numerous factors, including the State party's developmental level. They will include, however, the underlying determinants of health, such as safe and potable drinking water and adequate sanitation facilities, hospitals, clinics and other health-related buildings, trained medical and professional personnel receiving domestically competitive salaries, and essential drugs, as defined by the WHO Action Programme on Essential Drugs.

The availability of health service undoubtedly fits in the broad concept of health policy of a country that consists of the activities conducted by public authorities in order to preserve or improve health condition of society by satisfying health needs, providing health benefits, disease prevention, health education and health promotion. One of the methods used in order to fulfill these assumptions is connected with construction and development of hospital infrastructure such as building of new hospital objects, modernizing older hospital complex as well as providing hospitals with medical equipment that allows helping patients effectively and efficiently.

Taking into consideration the fact that providing all patients with health care benefits on analogous rules and on the same level is almost impossible because of financial, organizational and political reasons, particularly significant for the subject of the availability of hospital treatment is adhering strictly the rules of qualifying the patient to admission as well as the order to provide health care benefits. Patients should be admitted around-the-clock, the situation of refusing admission of a patient because they „went to hospital too late" shall not be accepted. The admission or refusal of it should be predicated only by a doctor who is authorised to such activities in case they familiarized themselves with a patient's health condition. The basis for the refusal should not be, e.g. the subjective evaluation of the financial condition of a person who comes forward to cover eventual costs of hospitalization. In case of lack of places, scope of benefits provided by the hospital or for epidemiological reasons a patient committed to the treatment is refused to be admitted, the hospital, after providing the substantial medical care is obliged to assure the patient with transporting the patient to another hospital in case of necessity and after receiving the agreement of this hospital. It should be also clearly emphasized that in case the

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admission is not a case of emergency, the situation of a direct threat to health or life does not occur and the hospital cannot admit the patient on the spot, the heads of hospital wards should appoint the date when the patient is to be admitted.

Accessibility

The *accessibility* standard refers to health facilities, goods and services have to be accessible to everyone without discrimination, within the jurisdiction of the State party. Accessibility has four overlapping dimensions.

1. Non-Discrimination

Health facilities, goods and services must be accessible to all, especially the most vulnerable or marginalized sections of the population, in law and in fact, without discrimination on any of the prohibited grounds. Any discrimination concerning the decisions made on admission or its refusal in relation with gender, age, disability, race, religion, nationality, political views, union membership, ethnical origin, beliefs or sexual orientation is unacceptable. It is possible to make some exceptions in this field that concern the place of work or profession, especially as far as military hospitals are concerned. In that case, soldiers and people working for army would have priority to admission and it would be difficult to qualify this situation as contrary to the rule concerning indiscrimination of patients. Similarly to that situation, some modifications related to certain social groups in the term of having priority to receiving health care benefits or the system of its receiving, e.g. out of turn. It will especially concern blood donors, transplants donors, military and martial invalids as well as combatants and their spouses. However, it should be noted that these privileges should in no way limit or violate other patients' right to health care benefits.

2. Physical Accessibility

Health facilities, goods and services must be within safe physical reach for all sections of the population, especially vulnerable or marginalized groups, such as ethnic minorities and indigenous populations, women, children, adolescents, older persons, persons with disabilities and persons with HIV/AIDS. Accessibility also implies that medical services and underlying determinants of health, such as safe and potable water and adequate sanitation facilities, are within safe physical reach, including in rural areas. Accessibility further includes adequate access to buildings for persons with disabilities. Taking into consideration these issues in the field of organization of hospital treatment it should be noticed that physical accessibility of health care comes down to the proper localization of hospitals in the certain area accordingly to the number and density of population. The infrastructure of country or its certain part should consider suitable access to hospital for anyone who has to use health care benefits. Moreover, the building or the complex of buildings should be adjusted to the needs of disabled and aged people and it should assure the non-problematic entrance to and leave of a hospital as well as moving between wards or hospital rooms. It should be remembered that physical accessibility is not only the possibility of self-reliant access to hospital but also direct phone or Internet contact with the hospital as well as assurance of transport to hospital by ambulances in any conditions and from any place.

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3. Economic Accessibility (Affordability)

Health facilities, goods and services must be affordable for all. Payment for health-care services, as well as services related to the underlying determinants of health, has to be based on the principle of equity, ensuring that these services, whether privately or publicly provided, are affordable for all, including socially disadvantaged groups. Equity demands that poorer households should not be disproportionately burdened with health expenses as compared to richer households. Health protection constitutes an element of social right appropriate for a certain country. Many models and systems of health protection function in the world and they are dependent on the political system or the level of economic development of the country. Such differentiation leads to the situation in which patients are entitled to the right to health protection on various rules. Health care benefits may be provided free of charge, for a payment or for a partial payment and the access to certain health benefits, however, will be possible freehand or will depend on signing in a queue for a determined date. It also relates to the so called health benefits in kind such as medicines, medical products and aids that are connected with the process of treatment. Unquestionably the benefits that aim at preventing sudden health threats should be provided immediately. It is the condition that relates to sudden or foreseen in a short period of time appearance of symptoms that suggest deteriorating health which may result directly in serious damage to organism functions or body harm or life loss requiring immediate medical rescue actions and treatment. In this context it may be stated that benefits aiming at rescuing life fulfill the universal right to health best. As far as the distribution of remedial products, foodstuff intended for particular nutritional uses and medical products are concerned, undoubtedly the most important factor limiting their availability is a prize. Therefore, health policy of countries comprises different types of reimbursement systems for patients which attempt to consider the financial abilities of national health protection system. Taking into consideration the system, only the products that should be refunded are the ones which are proved to be used efficiently and safely and which are much more beneficial in case of their therapeutic effect and costs when compared to other available variants of therapy. Counteracting the expectations of different groups of stakeholders should take place according to the rules that were clearly stated. The privilege of patients according to the criteria of age or financial condition will always meet the opposition and accusation of unequal treatment of the ill. Indeed, there may appear the situation in which the treatment of a child would require much higher investments than, e.g. of an aged person who suffers from the same disease. The same protests will be aroused by the refusal of reimbursement of a medicament or medical product in case their prize exceeds the financial criteria in a symbolic amount. Independently of that, it is demanded to guarantee free of charge access to medicines and medical products at least for the hospitalized patients especially for those who are treated because of cancer and undergo chemotherapy as well as the patients who stay in the determined clinical conditions. Providing the access to particularly expensive therapies may be done through therapeutic health programs which ensure reliable qualification of patients as well as providing clinical effect and obtaining the indicator of effects to costs acceptable taking into consideration health care system. In this situation necessary is both strict monitoring of patients' treatment in the program and periodic evaluating programs which may be related with some inconveniences for patients and increase of frequency of the conducted examinations.

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4. Information Accessibility

Accessibility includes the right to seek, receive and impart information and ideas concerning health issues. However, accessibility of information should not impair the right to have personal health data treated with confidentiality. The medical subjects should make available to their patients all demanded data concerning their health condition and the process of treatment and the form of making the data (documents) available should be chosen by a patient. Moreover, providing a patient with this data or information should not be dependent on previous indication of the legitimate interest in obtaining them or précising the aim for which a patient claims for them. It should be remembered that people using the provided health benefits confidentially to medical subjects are exposed to unpleasant consequences of unlawful process of making their data available that occur in many aspects of daily life, starting with the family sphere, then going through official sphere and ending with financial sphere. The subjects that create data bases in the scope of health protection are obliged to create such organizational and technical conditions which ensure the protection of processed data especially preventing data from the unauthorized access, illegal revealing or collecting as well as from modifying, damage, destruction or loss. As far as medical data is concerned, this term should concern personal data and other data of natural person connected with provided and planned health care benefits, health condition as well as other data processed in relation with planned, providing and provided health care benefits as well as health prevention and realization of health programs. Therefore, medical data would be e.g. disease classification, medical events that qualify the patient to health benefits of a certain kind, recommended medicines, the results of radiological and laboratory examination. The basic repository of single medical data are the documents containing the data related to certain periods of the realization of treatment process: starting with patients' data registration and planning of appointments, going through referring patients to specialized examination and medical leaves, to the data concerning hospitalization of a patient (e.g. casebook). Taking into consideration the most important requirements of the policy concerning data protection in hospitals, the so called clear screen policy should be mentioned as first because it requires from a worker the destruction of redundant paper documents (prints) and electronic documents obtained from informatical systems (e.g. previously generated folders saved on the desktop) containing data obtained in the process of its transforming in such a way that this data cannot be identified. The crucial issue that is included in the safety policy is also the fact that the agreements between medical subjects and external subjects and direct performers (e.g. non-public HMOs or doctors having their own internship) comprise the clause that oblige them to protect personal data that is transformed by this subject. Moreover, also attracting the attention to the necessity of the proper supervision over, e.g. the economic or security staff and workers employed by external subjects that are facets of the civil law agreements (surgery) spending time in the building of medical subject after working hours stated in the regulations. The other issue raised in the safety policy is excluding access of the unauthorized people to the fields of data processing in the buildings and rooms of medical subject. The only excuse is possible for rooms in which patients or other clients are admitted and in case these rooms are equipped with the devices with the access to data base systems, appropriate precautions should be taken among others the order stating that patients or clients should enter the room only individually and stay in the room only in the presence of a worker of a subject, prohibition of leaving insecure electronic mediums that may be available for the unauthorized people, the requirement of placing monitors in such a way that their screens are not visible for the unauthorized people, placing printers and outlying devices in such a way that they are far from the space where the unauthorized people move, determining the detailed regulations of stating the emergency by

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a worker in case of the attempt to access the data is revealed. The rooms defined as the fields of data processing should be equipped with a lock or an electronic lock that is used each time when workers employed in order to process data leave the room. Moreover, the assigned part of the room defined as the field of data processing the equipment should be placed in such a way that it is impossible or really difficult to have the access to this space for the unauthorized people (D. Wąsik, 2015).

Acceptability

Acceptability comes down to all health facilities, goods and services must be respectful of medical ethics and culturally appropriate, i.e. respectful of the culture of individuals, minorities, peoples and communities, sensitive to gender and life-cycle requirements, as well as being designed to respect confidentiality and improve the health status of those concerned. Health care benefits should be provided in the conditions ensuring discretion and confidentiality and the medical staff should be emphatic, patient towards patients as well as they should be understanding in relation to their health condition. Men should not be allowed to stay in the rooms intended for women and women should not be allowed to stay in the rooms for men. The patient who is hospitalized should have the chance to perform religious practices or at least meeting with a cleric that is of their beliefs. Moreover, the discussed standard suggests that the doctors in each situation, even in case of rescuing patients' lives, try agree the patients will with legal rules, rules of ethics and Hippocrates oath. It is common that there is the rule according to which respecting patient's will is restricted to life protection being of higher value than individual will. Life protection has got a value of public order and normative character. It should be mentioned that the activities taken by doctors who in case of the situation when it comes to patient's life and lacking alternative therapeutic method take the activities that are necessary to rescue patient's life even if it is not in accordance with patient's will or against, e.g. their religious beliefs. Such situation may take place, e.g. in case of blood transfusion as the benefit saving life of Jehovah Witnesses (M. Nesterowicz, 2012).

Quality

Quality is introduced in the statement that as well as being culturally acceptable, health facilities, goods and services must also be scientifically and medically appropriate and of good quality. This requires, *inter alia*, skilled medical personnel, scientifically approved and unexpired drugs and hospital equipment, safe and potable water, and adequate sanitation.

In the treatment of patients should be used only medicinal products that meet the universally quality requirements of the pharmaceutical, their effectiveness is confirmed in clinical trials, and spectrum of adverse reactions are known or foreseeable. Moreover, medicinal products may be marketed at a fixed expiry date for them. Likewise, do not share, installation, commissioning and use of medical devices that pose a threat to the safety, life or health of patients, users or other persons, exceeding the acceptable limits of risk, as determined by the current state of knowledge. Medical devices should be properly supplied, installed, maintained and used in accordance with their intended use. It is unacceptable to providing, installing, commissioning and use of medical devices for which it has expired or has been exceeded time or times the safe use, as specified by the manufacturer. In the health care sector, particularly in hospitals cannot be run and used medical devices which have a defect that may pose a risk to patients, users or others. In this situation, enough even hypothetical (potential) risk. The scale of the threat is irrelevant to the assessment of the situation. In order to avoid any dangers in the use of medical equipment in hospitals

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should be implemented medical equipment management system. It is a coordinated policy in the field of medical equipment operators in the medical equipment and devices, including, among others, make current analyzes of the equipment in specialized diagnostic equipment, its condition, the utilization and availability of diagnostic tests (A. Sopel, 2014).

Medical equipment management system consists in particular:

A. The examination of medical devices (e.g. determine the status of inventory, identification scheme of medical devices, medical equipment records and its distribution according to the destination installation and commissioning on individual departments, facilities or clinics, determine the wear level of the equipment according to the criteria of the date of purchase, date of first start time and the number of tests of the device);
B. The use of medical equipment (in particular to ensure proper inventory numbering, instructions in the appropriate language, and the time for the increased use of the device);
C. Management and reporting (including cost reporting process of handling and use of the purchasing modes, operation and maintenance, creation of technical passports, export data to a spreadsheet program);
D. Service (including the appropriate response time to failure, its reporting, timely periodic inspections of equipment and the ability to support remote).

It is also worth added that in the case of medical devices for in vitro diagnosis, get rid of, collection and use of tissues, cells and substances of human origin should be in accordance with the ethical principles relating to the protection of human rights and dignity of the human being.

REALIZATION OF SELECTED HUMAN RIGHTS AND CIVIL LIBERTIES IN TERMS OF HOSPITAL TREATMENT

Hospital treatment is not only associated with the need to ensure the right to health, but also connects with the obligation to respect the medical staff of other human rights, which - at first sight - with the treatment they have nothing in common. We cannot forget that hospitalization does not deprive of universal rights which must be guaranteed even in these special conditions. A selection of these will be discussed on the example of the provisions of the International Covenant on Civil and Political Rights (ICCPR).

THE RIGHT NOT TO BE TREATED IN AN INHUMAN OR DEGRADING WAY

According to Article 7 ICCPR no one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment. In particular, no one shall be subjected without his free consent to medical or scientific experimentation. Inhuman treatment means treatment causing severe mental or physical suffering. Degrading Treatment means treatment that is grossly humiliating or undignified. In practical examples of violations of these rights in terms of hospital treatment are: a) physical or psychological or other types of harm, b) soiled or unchanged clothing or bedding, c) leaving food for service users or patients when they are unable to feed themselves, d) personal care carried out in view of other people

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(see *Draft Charter of rights for people with dementia and their carers. A consultation document* - Appendix 2: *Examples of human rights in health and social care*, Alzheimer Scotland. Action on Dementia).

Respect for human dignity is expressed, among others, in the regulations of international law defining standards of conduct in clinical trials and medical experiments. The term clinical trial should be understood as designed and planned systematic study on human subjects, taken in order to verify the safety or performance of a specific medical device, equipment, medical device or active implantable medical device. The literature indicates that clinical trials are recognized standard to verify the effectiveness of medical devices. Modern medicine is based on a well-proven fact hypotheses, in accordance with the paradigm of evidence-based medicine, as the art of decision-making in clinical practice and health care, taking into account the data of the research, the clinical situation and preferences of patients (W. Nowak, 2014). An example of attempts to regulate the issue clinical research in relation with the fundamental human rights are provisions of the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine (1997).

The Convention provides that the interests and welfare of the human being shall prevail over the sole interest of society or science. The article 4 of the Convention specifies that any intervention in the health field, including research, must be carried out in accordance with relevant professional obligations and standards. The guiding principle clinical research, as expressed in article 5 of the Convention, is that an intervention in the health field may only be carried out after the person concerned has given free and informed consent to it. This person shall beforehand be given appropriate information as to the purpose and nature of the intervention as well as on its consequences and risks. The person concerned may freely withdraw consent at any time. According of the article 12 of the Convention tests which are predictive of genetic diseases or which serve either to identify the subject as a carrier of a gene responsible for a disease or to detect a genetic predisposition or susceptibility to a disease may be performed only for health purposes or for scientific research linked to health purposes, and subject to appropriate genetic counselling. It is worth noting that, in accordance with Article 16 of the Convention research on a person may only be undertaken if all the following conditions are met: I) there is no alternative of comparable effectiveness to research on humans; II) the risks which may be incurred by that person are not disproportionate to the potential benefits of the research; III) the research project has been approved by the competent body after independent examination of its scientific merit, including assessment of the importance of the aim of the research, and multidisciplinary review of its ethical acceptability; IV) the persons undergoing research have been informed of their rights and the safeguards prescribed by law for their protection; V) the necessary consent as provided for under article 5 has been given expressly, specifically and is documented. Such consent may be freely withdrawn at any time. Article 17 of the Convention, in relation to patients who can not independently, knowingly consent to participate in research, clarifies that clinical research on a person without the capacity to consent as stipulated in Article 5 may be undertaken only if all the following conditions are met: 1) the conditions laid down in Article 16, sub-paragraphs 1) to 4), are fulfilled; 2) the results of the research have the potential to produce real and direct benefit to his or her health; 3) research of comparable effectiveness cannot be carried out on individuals capable of giving consent; 4) the necessary authorisation provided for under Article 6 has been given specifically and in writing; and 5) the person concerned does not object.

Exceptionally and under the protective conditions prescribed by law, where the research has not the potential to produce results of direct benefit to the health of the person concerned, such research may be authorised subject to the conditions laid down in paragraph 1, sub-paragraphs 1), 3), 4) and 5) above, and

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to the following additional conditions: 1) the research has the aim of contributing, through significant improvement in the scientific understanding of the individual's condition, disease or disorder, to the ultimate attainment of results capable of conferring benefit to the person concerned or to other persons in the same age category or afflicted with the same disease or disorder or having the same condition; 2) the research entails only minimal risk and minimal burden for the individual concerned. The issue of clinical and biomedical experiments regulate in detail the provisions of Additional Protocol to the Convention on Human Rights and Biomedicine, concerning Biomedical Research (2005).

Many controversies surround the issue of organ transplant patients and obtaining any gratification for the donation. In this regard *the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine* in Article 19 paragraph 1 provides that removal of organs or tissue from a living person for transplantation purposes may be carried out solely for the therapeutic benefit of the recipient and where there is no suitable organ or tissue available from a deceased person and no other alternative therapeutic method of comparable effectiveness. It is added in Article 19 paragraph 2, the necessary consent as provided for under Article 5 must have been given expressly and specifically either in written form or before an official body. According to the Article 20 no organ or tissue removal may be carried out on a person who does not have the capacity to consent under Article 5. Exceptionally and under the protective conditions prescribed by law, the removal of regenerative tissue from a person who does not have the capacity to consent may be authorised provided the following conditions are met: I) there is no compatible donor available who has the capacity to consent; II) the recipient is a brother or sister of the donor; III) the donation must have the potential to be life-saving for the recipient; IV) the authorisation provided for under paragraphs 2 and 3 of Article 6 has been given specifically and in writing, in accordance with the law and with the approval of the competent body; V) the potential donor concerned does not object. An important provision is also Article 21, according to which the human body and its parts shall not, as such, give rise to financial gain. The issue of transplantation of organs regulate in detail the provisions of Additional Protocol to the Convention on Human Rights and Biomedicine concerning Transplantation of Organs and Tissues of Human Origin (2002).

The obligation to treat the patient with due respect to him also applies to condition *post-mortem*. In the period between death and finding transport to the hospital dissecting corpses of the deceased should be stored in a single room unit, preserving the dignity of the deceased owed. In case of death of the patient in the operating room, corpse of the deceased can be stored in a designated place in the operating room, also with ensuring dignity owed to the deceased. Appointed members of the medical staff (e.g. nurses) should be removed from the patient's linen and perform post-mortem toilet - washing the body, remove the tubing and connectors, protection of the swabs's injection, closing the eyelids by applying a moistened swabs, ligation of the mandible in case of fall, remove all decorations and their protection. The body should be placed in a supine position, with his hands folded on the body. Delay protects the sheet and assumes wrist or foot of the deceased identifier made of ribbons, cloth or plastic, with patient data. The transport of the deceased should be carried out in a discreet way of preserving the dignity of the deceased.

Prohibition of degrading treatment extends to the patient's rules of conduct with the remains and tissues of the human body, i.e. the parts of the human body separated from the whole which no to be corpse under applicable law. They can be, for example submitted to histopathological examination by the doctor. Before passing tissue for histopathological examination should be secured in a liquid preservative. The remains, however, unless they require histopathological examination immediately after their removal

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are marked and properly secured. Then should be stored in a dedicated freezer and immediately given to the employee dissecting. It is not permissible utilization remains together with domestic waste, their use without the consent of the patient or his family to research, and the use of these substances recovered (e.g. blood) in industrial production.

THE RIGHT TO RESPECT FOR PRIVATE AND FAMILY LIFE, HOME AND CORRESPONDENCE

According to Article 17 ICCPR no one shall be subjected to arbitrary or unlawful interference with his privacy, family, home or correspondence, nor to unlawful attacks on his honour and reputation (paragraph 1). Everyone has the right to the protection of the law against such interference or attacks (paragraph 2).

In the first place it should to be noted that family life is wider than blood or formal relationships. Private life covers things like privacy, personal choices, relationships and participation in community life. Home means respect for the home someone has, not a right to housing. Correspondence means all communication for example like phone calls, letters, email. As examples of conduct that would violate these standards should be indicated completely separation of families and other relationships due to hospital and controlling mail, phone calls etc without authority (see *Draft Charter of rights for people with dementia and their carers. A consultation document* - Appendix 2: *Examples of human rights in health and social care,* Alzheimer Scotland. Action on Dementia).

If the hospitalized patient requests to exercise person care over him during the next treatment, the possibility of such shall be provided with. It is in fact the realization of the right to family life. Caretaker should, however, adhere to the accepted rules of behavior in the hospital, and if the patient lies on a dormitory room, the presence in the room caretaker must agree to the remaining patients in this room. In particular patient should be kept only one caretaker, who must strictly comply with all directions and instructions of medical personnel. In particular, without consultation with a nurse or doctor is not allowed to self-administer to the patient any foods and medicines. In addition, this person should wear protective clothing. If necessary caretaker should maintain peace and quiet in the room and on the ward, take care to respect the dignity of the ward and the other patients and not to stray from the patient outside the branch without the knowledge of the medical staff. It is forbidden to manipulate medical devices, appliances, electrical installations, ventilation etc.

THE RIGHT TO FREEDOM OR LIBERTY

According to the Article 9 paragraph 1 ICCPR everyone has the right to liberty and security of person.

This is not a right of individuals to do whatever they want but a right not to be deprived of liberty in an arbitrary way. Examples of violations of these standards are: a) informal detention in hospital of people who lack capacity to consent to admission, b) delays in discharging people detained under mental health legislation, c) excessive, arbitrary and inappropriate use of restraint in health and social care settings (see *Draft Charter of rights for people with dementia and their carers. A consultation document* - Appendix 2: *Examples of human rights in health and social care,* Alzheimer Scotland. Action on Dementia).

Controversial issue is the problem of monitoring in hospitals due to the need to ensure the strengthening of the security or medical personnel and patients. Indisputably the installation of monitoring is prohibited

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in the halls, in which patients are hospitalized, in doctors' offices, in the studios of ultrasonography, RTG etc., as well as treatment rooms. However, you can consider installing monitoring waiting in emergency rooms, corridors hospital, as well as at the entrances to individual departments or hospital facilities. In this situation, it seems that security considerations outweigh the right to privacy of patients and their families who would like to be discreet on the visit to the hospital.

THE RIGHT TO A FAIR TRIAL

In accordance with Article 14 paragraph 1 ICCPR all persons shall be equal before the courts and tribunals. In the determination of any criminal charge against him, or of his rights and obligations in a suit at law, everyone shall be entitled to a fair and public hearing by a competent, independent and impartial tribunal established by law. The press and the public may be excluded from all or part of a trial for reasons of morals, public order or national security in a democratic society, or when the interest of the private lives of the parties so requires, or to the extent strictly necessary in the opinion of the court in special circumstances where publicity would prejudice the interests of justice; but any judgement rendered in a criminal case or in a suit at law shall be made public except where the interest of juvenile persons otherwise requires or the proceedings concern matrimonial disputes or the guardianship of children.

This does not just apply to criminal proceedings but to a broad range of areas where an individuals civil rights or responsibilities are decided upon. It includes an individual's right to a chance to present a case before decision is made, reasons for the decision an independent and impartial tribunal or hearing. This standard is addressed more to the state than to hospitals and includes the need to establish procedures to submit complaints against public authorities, as well as the start of proceedings on damages and compensation for any damage caused by the treatment.

Regardless of the possibility of bringing legal action for compensation or damages for medical malpractice, legal instrument - functioning internally in every hospital - it should be an action for specific medical staff negligence. Hospitalized patients should be able to bring an action in any form: orally or in writing, both in paper and electronic. In addition, the complaint should be possible to submit in every cell of every organization and email address hospital. In order to make it easier for complainants, the hospital should keep a book of complaints and applications, including in electronic form e.g. on the official website of the hospital. Any complaint must, however, be the basis for the fair conduct of the investigation, including obtaining and collecting information, positions and statements of the persons concerned or which may help to clarify the matter.

THE RIGHT NOT TO BE DISCRIMINATED AGAINST

In accordance with Article 26 ICCPR all persons are equal before the law and are entitled without any discrimination to the equal protection of the law. In this respect, the law shall prohibit any discrimination and guarantee to all persons equal and effective protection against discrimination on any ground such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status.

Discrimination can be direct or indirect. The right not to be discriminated may have been breached under other legislation such as the Disability Discrimination Act 1995. Examples of violations of these

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standards are: a) access to medical treatment or community care services, based on age, disability, gender or ethnic origin etc., b) information or options presented in inaccessible ways, c) failing to offer food to take account of cultural differences such as kosher or halal foods (see *Draft Charter of rights for people with dementia and their carers. A consultation document* - Appendix 2: *Examples of human rights in health and social care,* Alzheimer Scotland. Action on Dementia).

THE RIGHT TO LIFE

In accordance with Article 6 paragraph 1 ICCPR every human being has the inherent right to life. This right shall be protected by law. No one shall be arbitrarily deprived of his life.

The right to life is listed next to the right to health, or instead of this law as the law objectively broader, in that part of the right to health. Apart from this it is emphasized that public authorities must take steps to protect an individual's life, in almost all circumstances, and must not take away a person's life except in very limited circumstances. This protection requires that there should be an official investigation into deaths resulting from the states failure to protect life or use of force. An important finding is that the right to life is a fundamental right but this does not mean that there is a right to medical treatment in all circumstances. Examples of violations of these standards are: a) do not resuscitate orders placed by medical staff because they consider the patient's life to be of low quality, b) refusal of life saving treatment, c) deaths caused by negligence (see *Draft Charter of rights for people with dementia and their carers. A consultation document* - Appendix 2: *Examples of human rights in health and social care,* Alzheimer Scotland. Action on Dementia).

POLITICAL RIGHTS AND FREEDOMS

According to the Article 25 ICCPR every citizen shall have the right and the opportunity, without any of the distinctions mentioned in article 2 and without unreasonable restrictions: a) to take part in the conduct of public affairs, directly or through freely chosen representatives; b) to vote and to be elected at genuine periodic elections which shall be by universal and equal suffrage and shall be held by secret ballot, guaranteeing the free expression of the will of the electors; c) to have access, on general terms of equality, to public service in his country.

It is the duty of public authorities and hospital management is to enable patient's participation in elections by voting: traditional at a polling station set up in the hospital, voting by mail or e-voting. Law of patients is also participating in the campaign by becoming familiar with the electoral slogans and programs of the various political parties and candidates. This last point raises some ethical concerns, especially among health professionals, according to which, for example. Putting up election posters in hospitals is highly immoral, for political views should not be exposed in the hospital, where the key is to be patient, not a politician. According to opponents of campaigning in public health essential task of the hospital, which is to provide health care services to patients - often in danger of life and health - should not be linked in any way with those candidates in the elections, electoral programs, whether political parties. Public health, as well as military and uniformed services, absolutely should remain apolitical. However, we must remember that the patient's universal rights include the right to personal contact,

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telephone or correspondence with others, from what it is possible to interpret the right to receive content targeted electoral candidates in the election. Patients' rights are undoubtedly part of the wider system of human and civil rights, which include political rights. Therefore, the election agitation conducted in public health care is not ipso facto contrary to the idea of patient rights. Note, however, that there will be critical patient being addressed to the content of election, and the question of the ethics of the election campaign carried out in hospitals appears only when the patient lacks approval for the transfer of his political messages during hospitalization.

PROTECTION OF HEALTH AS A PREMISE OF HUMAN RIGHTS RESTRICTIONS

According to the Article 12 paragraph 1 ICCPR everyone lawfully within the territory of a State shall, within that territory, have the right to liberty of movement and freedom to choose his residence. Sometimes, however, the right to health is a premise of limiting human rights. This occurs when the right to health is a component of public health and are limiting the rights of the specific unit. Such a person despite the fact that she is suffering from certain health problems and has the status of a patient is considered as posing a threat to the rest of society. The thing applies in particular to patients suffering from mental illness, patients treated in connection with addiction to alcohol or drugs, as well as infectious diseases patients. Treatment of these patients is done either in a specialized health care facilities or in a specially separate wards.

The Article 3 imposes an obligation on the States to ensure that the health and well-being of detainees are adequately secured by, among other things, providing them with the requisite medical assistance (see Kudła v. Poland [GC], no. 30210/96, § 94, ECHR 2000-XI). The mere fact that a detainee was seen by a doctor and prescribed a certain form of treatment cannot automatically lead to the conclusion that the medical assistance was adequate. The authorities must also ensure that a comprehensive record is kept concerning the detainee's state of health and the treatment he underwent while in detention, that the diagnoses and care are prompt and accurate, and that where necessitated by the nature of a medical condition, supervision is regular and systematic and involves a comprehensive therapeutic strategy aimed at curing the detainee's diseases or preventing their aggravation, rather than addressing them on a symptomatic basis (see Visloguzov v. Ukraine, no. 32362/02, § 69, 20 May 2010 and the case-law cited therein).

The jurisprudence of the European Court of Human Rights emphasizes that an individual cannot be considered to be of "unsound mind" and deprived of his liberty unless the following three minimum conditions are satisfied: firstly, he must reliably be shown by objective medical expertise to be of unsound mind; secondly, the mental disorder must be of a kind or degree warranting compulsory confinement; thirdly, the validity of continued confinement depends on the persistence of such a disorder (see, for example, Winterwerp, cited above, § 39; Johnson v. the United Kingdom, 24 October 1997, § 60, Reports 1997-VII; X v. Finland, no. 34806/04, § 149, ECHR 2012 (extracts); Stanev v. Bulgaria [GC], no. 36760/06, § 145, ECHR 2012; and Ruiz Rivera v. Switzerland, no. 8300/06, § 59, 18 February 2014). However, the detention of an individual is such a serious measure that it is only justified where other, less severe measures have been considered and found to be insufficient to safeguard the individual or public interest which might require that the person concerned be detained. That means that it does not suffice that the deprivation of liberty is in conformity with national law; it must also be necessary in the

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particular circumstances (see Witold Litwa v. Poland, no. 26629/95, § 78, ECHR 2000 III; Varbanov v. Bulgaria, no. 31365/96, § 46, ECHR 2000-X; Karamanof v. Greece, no. 46372/09, § 42, 26 July 2011; Stanev, cited above, § 143; M. v. Ukraine, no. 2452/04, § 57, 19 April 2012).

The hospital human rights are limited in such aspects as freedom of contact with other people, freedom of movement, exercise of the right of ownership of some items, or the right to physical integrity.

Patients with a finding of serious infectious disease most often undergo immediate procedures of hygiene and disinfection, and then are isolated in individual hospital rooms. Contact with family is significantly reduced or even turned off. Freedom to move around the site hospital is unacceptable, and the patient is required to submit to any diagnostic tests, with the collection of clinical specimens for testing. Limited is also a the secret concerning the health of the patient, because of possible contamination should learn immediately all persons who have direct contact with the patient in conditions involving high probability of infection.

Controversial action, but sometimes required in terms of hospital treatment of people with mental health problems is the use of direct coercion. It consists mostly in holding down, forced use of drugs, immobilization and isolation. By holding means the immediate, short-term immobilization of people with physical force. Forced use of drugs is ad hoc and provided for in the plan of treatment the introduction of drugs into the body without his consent. Immobilization is longer lasting restrain a person with straps, handles, sheets or straitjacket. In contrast, the insulation consists of placing the person alone in a closed room. Before using coercion involving immobilization or isolation of the patient receiving items, which can be dangerous to the life or health, or other persons, in particular: sharps, glasses, dentures, belt, suspenders, laces, matches. It is worth noting that the room should be designed to protect the insulation from damage a person's body, and also correspond in terms of living and sanitary conditions other rooms a psychiatric hospital or a social welfare home.

The line of the European Court of Human Rights case-law shows that to fall under Article 3 the European Convention on the Protection of Human Rights and Fundamental Freedoms ill-treatment must attain a minimum level of severity. The assessment of this minimum level of severity is relative; it depends on all the circumstances of the case, such as the duration of the treatment, its physical and mental effects and, in some cases, the gender, age and state of health of the victim. Further factors include the purpose for which the treatment was inflicted, together with the intention or motivation behind it, as well as its context, such as an atmosphere of heightened tension and emotions (see Gäfgen v. Germany [GC], no. 22978/05, § 88, ECHR 2010). There is the special vulnerability of mentally ill persons in its case-law and the assessment of whether the treatment or punishment concerned is incompatible with the standards of Article 3 of the European Convention on the Protection of Human Rights and Fundamental Freedoms, in particular, to take into consideration this vulnerability (see Keenan v. the United Kingdom, no. 27229/95, § 111, ECHR 2001-III; Rohde v. Denmark, no. 69332/01, § 99, 21 July 2005; Renolde v. France, no. 5608/05, § 120, ECHR 2008 (extracts). In respect of persons deprived of their liberty, recourse to physical force which has not been made strictly necessary by their own conduct diminishes human dignity and is in principle an infringement of the right set forth in Article 3 of the Convention (see Krastanov v. Bulgaria, no. 50222/99, § 53, 30 September 2004). Nevertheless, it is for the medical authorities to decide, on the basis of the recognised rules of medical science, on the therapeutic methods to be used, if necessary by force, to preserve the physical and mental health of patients who are entirely incapable of deciding for themselves and for whom they are therefore responsible. The established principles of medicine are admittedly, in principle, decisive in such cases; as a general rule, a measure

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which is a therapeutic necessity cannot be regarded as inhuman or degrading. The European Court of Human Rights has already held that the assessment of whether involuntary treatment of patients with mental disabilities in the hospital setting was justified needed to be examined against the question of medical necessity, which must convincingly be shown to exist, taking into account the current legal and medical standards on the issue. It notes, however, that the developments in contemporary legal standards on seclusion and other forms of coercive and non-consensual measures against patients with psychological or intellectual disabilities in hospitals and all other places of deprivation of liberty require that such measures be employed as a matter of last resort and when their application is the only means available to prevent immediate or imminent harm to the patient or others. Furthermore, the use of such measures must be commensurate with adequate safeguards from any abuse, providing sufficient procedural protection, and capable of demonstrating sufficient justification that the requirements of ultimate necessity and proportionality have been complied with and that all other reasonable options failed to satisfactorily contain the risk of harm to the patient or others.

On the basis of the European Court of Human Rights case law can be concluded that use of direct coercion from the patient, if necessary, must take into account the principle of proportionality, meaning that direct coercion may only last until the cessation of reasons for its use. In general, the use of direct coercion in the form of immobilisation or isolation should be prescribed by a doctor examining a patient for a period not exceeding four hours. However, if necessary, doctor, after re-examination of the patient's personal, may extend the periods of immobilization for the next 6 hours. In order to ensure transparency of the activities of medical personnel is required to be recorded in the patient's medical record any use of a particular type of direct coercion. Entries should include in particular the reasons for the use of coercion, its type and duration of immobilization or isolation.

The patient isolated or subjected to any other form of direct coercion cannot be left alone. Therefore, nurses are required to control the physical condition of the person immobilized or isolated at least once every 15 minutes, even during sleep that person. Annotations on the status of the person shall, without delay, to the patient. These should include, among others, assessment of the soundness of immobilization, in particular verify that the straps, handles, bed sheets and straitjacket are in place too loose or too tight. In addition, the patient has the right to freedom from short-term immobilization in order to change its position or to meet the needs of physiological and hygienic, not less frequently than every 4 hours.

The interruption of treatment and end of hospitalization of patients suffering from mental illness should be noted that the temporary relief of the patient may be under controlled conditions, i.e. on the basis of passes issued by the hospital staff. Patients cannot interned but leave the hospital grounds cannot be on leave or use the free exit into the hospital and the town in which the hospital is located. In certain cases, such persons, with the consent of doctor, can benefit from the outputs into the hospital under the care of the staff.

Relative to patients treated in connection with addiction to alcohol or drugs are implemented particularly restrictive guidelines for search. It should be remembered that the lodging, possession, consumption of alcohol in a hospital ward, drugs, medication not prescribed by a medical branch is prohibited. Similarly, all the beauty in the form of cologne, aftershave, deodorant, stored in a designated room, and the patient can use them in the presence of personnel. Sometimes the use by patients of mobile phones is permitted only in urgent cases and in a designated place (department store) in the presence of personnel. Smoking can take place only in designated areas. All sharp and dangerous objects including shaving devices are stored in a designated area.

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CONCLUSION

1. The right to health is one of the most important human rights, which is reflected in the many sources of international law. The right to health is an inalienable and universal attribute, enjoyed the same basis to all individuals. The right to health can not be equated with the right of unrestricted access to health care services. This depends on the health policy because of the particular country and in line with the applicable state health services.
2. A characteristic feature of access to health care is its diversity. This is the first manifests itself in the fact that to get medical help as a rule can not be dependent on the financial situation of the patient, but in practice in many countries, the provision of health care are provided for a fee or for partial payment, are introduced queuing systems. Subjective differentiation in access to health care may, however, rely on the priority use a specific group of patients, for example. oncological treatment or patients with infectious diseases. As a rule, the right to health is definitely secured for all the same extent only in relation to the life-saving benefits awarded in emergencies.
3. Hospitalization of patients is a matter which involves some disadvantages and the necessity for patients to undergo the rigors of a specific hospital stay. And in such conditions, the organization of hospital care, however, should take into account the specific standards resulting from the idea of human rights: availability, accessibility, and quality acceptability.
4. Human rights should be respected at every stage of hospitalization: from his admission to the hospital, through the provision of appropriate conditions of stay and treatment, to unsubscribe the patient from the hospital. It should be noted that human rights are at the organization and conduct of clinical trials, and transplantation. It is not without significance for human dignity is the treatment of the body and the patient remains with respect. An expression of concern for the implementation of human rights in hospitals is to implement the quality policy, security policy and medical equipment management system.
5. Not all human rights are directly related to the right to health but it does not change the fact that they should be respected during hospital treatment. Hospital management should make every effort to hospitalization was the least troublesome for the patient and does not cause damage to family life, professional or social patient. This is to serve as a contact with the family, the right to correspondence, or the right to participate in elections. The injured patient should be able to claim compensation before an impartial body to hospital staff or hospital for medical malpractice.
6. Limitation of human rights in hospital treatment may be caused exclusively to protect the public interest, public health and public safety. Isolation and involuntary treatment of mentally ill patients or addicted to alcohol or drugs is to ensure the safety of other members of society and to prevent the commission of offenses by them both during treatment and after its completion. Isolation of infectious patients, while patients is to prevent the uncontrolled spread of diseases and epidemics. It is clear also that the specific conditions of this type of hospitalization will involve the necessity of human rights violations identified, such as the right to freedom and personal inviolability, e.g. as a result of direct coercion. However in these situations, when principle of proportionality in the use of these measures is respected, the effect should be considered legalizing his state of need.

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Chapter 54
What Drives the Adoption of Social Media Applications by the Public Sector?
Evidence from Local Health Departments

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ABSTRACT

Social media applications (SMAs) have been increasingly used by the public sector to interactively communicate with citizens, businesses, and other stakeholders, but we know little about what drives their adoption and usage. In this paper the author hypothesizes that SMA adoption is jointly shaped by top management characteristics, organizational attributes, and interorganizational and environmental factors. Drawing on a national survey of the U.S. local health departments (LHDs), his empirical findings suggest that the age and career background of top executives, organizational size, jurisdictional coverage, quality improvement initiatives, contracting-out experience, and emergency presence are key predictors of SMA adoption. The author also finds that the adoption and number of SMAs are affected by two different groups of antecedents. The results contribute to our understanding of SMA adoption and generate meaningful policy implications for LHDs and other public sectors.

INTRODUCTION

As the most recent information and communication technology (ICT) revolution, social media applications (SMAs) and Web 2.0 technologies (e.g., Facebook, Twitter, and YouTube) have unprecedentedly transformed the virtual world and real lives. Due to its salience in immediateness, interactivity, and engagement, SMAs outperform traditional ICTs in attracting users and adding value (McAfee, 2009). Billions of users frequently visit and spend roughly half of their time in SMAs (Nielsen, 2012). Citizens also apply SMAs extensively in civil and political engagement, which steadily drives the public sector to adopt SMAs (Rainie, Smith, Schlozman, Brady, & Verba, 2012).

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A double-edged sword, SMAs generates both opportunities and threats to the public sector (Cromer, 2010). Some sectors pioneer in adopting them, whereas others largely lag behind. The variations of public sectors in using SMAs invoke our interest to uncover its antecedents (Bertot, Jaeger, & Hansen, 2012). As one type of cutting-edged organizational innovations, we still know little about its determinants and conditions. The adoption of SMAs was theorized by three stages including informal experiment, norm emerging, and formalization (Mergel & Bretschneider, 2013), but it has not been empirically verified. The strategies of SMA use by police departments were compared (Meijer & Thaens, 2013), but no formal theories generate. Despite the adoption of SMAs by state governments (Ahn & Berardino, 2014) and municipal governments {Bonsón, 2012 #12985} has been examined, the models are partially elaborated and tested. Although the literature has examined the extensive use of SMAs by public organizations, what drives their adoption has not yet been systematically investigated. It is vital to understanding the antecedents and mechanisms of SMA adoption, which help public sectors to promote their extensive usage and generate positive consequences.

This paper draws on the 2010 national survey of over 500 local health departments (LHDs) in the U.S. to empirically examine the key antecedents of SMA adoption. LHDs are local public agencies responsible for community health service delivery and policy implementation. They have intensive communications with local residents and other external stakeholders, e.g., local government agencies, health care service providers, policy advocators, and media. There are roughly 2,700 local health departments (LHDs) across the U.S, and the National Association of County and City Health Officials (NACCHO, 2011) defines a LHD as "an administrative or service unit of local or state government, concerned with health, and carrying some responsibility for the health of a jurisdiction smaller than the state." (p.2) Extensive communication with and intensive involvement by other stakeholders usually require LHDs to adopt more efficient and friendly ICTs to promote their mission and target their clients (Keane, Marx, & Ricci, 2001). Thus, it is imperative for LHDs to adopt SMAs to improve communication quality (McCaughey et al., 2014), and it is appropriate to empirically examine SMA adoption by LHDs.

The ubiquitous use of SMAs by ordinary citizens encourages public health organizations to harness SMAs to strengthen communication and promotion (Chou, Hunt, Beckjord, Moser, & Hesse, 2009; Thackeray, Neiger, Hanson, & McKenzie, 2008). Public health organizations and practitioners have been increasingly using SMAs (Avery et al., 2010; Park, Rodgers, & Stemmle, 2011). A recent investigation reveals that approximately 60 percent of reported state health departments (SHDs) in the U.S. have adopted at least one type of SMAs, and the most used tools are Twitter, Facebook, and YouTube (Thackeray, Neiger, Smith, & Van Wagenen, 2012). A network analysis finds that SHDs are densely connected with each other on Facebook and Twitter to facilitate bidirectional communication and information dissemination (Harris, 2013). SMA adoption by LHDs, however, has not yet been empirically examined and we want to fill this research gap in this paper.

In the remainder of this paper, we first briefly review the literature on innovation adoption and propose multiple hypotheses to explain SMA adoption. We then introduce the data and methods used in this study, followed by the key empirical findings. We finally discuss the contributions and implications of the results, and conclude with limitations and future research directions.

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CONCEPTUAL FRAMEWORK AND THEORETICAL HYPOTHESES

In this section, we first review the literature on innovation adoption and identify key variables that may affect SMA adoption. The antecedents are grouped into three categories, including top management characteristics, organizational attributes, and interorganizational and environmental factors.

The Determinants of Organizational ICT Innovation Adoption

Organizational innovation is the adoption of something new or unique to the adopting organization (e.g., new ideas, technologies, or practices), no matter how many organizations have already adopted it (Rogers, 2003; Walker, 2006). Newness and uniqueness are not sufficient to be counted as innovation for public sectors, which usually requires transforming bureaucracy and creating public value (Borins, 1998; Moore, 1997). Identify what matters for organizational innovation is one of the core research questions in the field, as it is the first step to propose proper policies encouraging its burgeoning and development. SMAs and other ICT innovations are technological innovations adopted by organizations, and they are very different from administrative innovations such as restructuring. We can draw on the abundant literature on organizational innovation to explore what matters for SMA adoption by public sectors.

The adoption of organizational innovations can be influenced by numerous factors, internal or external, positive or negative (Crossan & Apaydin, 2010; Rogers, 2003; Wolfe, 1994). We group the determinants of ICT innovation adoption into three categories, namely top management attributes, organizational characteristics, and interorganizational and environmental characteristics. The variables and hypotheses are summarized in Table 1.

First, the attributes, cognitions, and attitudes of top management, highlighted by the strategic leadership theory (Finkelstein, Hambrick, & Cannella, 2009), are key determinants of organizational innovation (Damanpour & Schneider, 2009; Hsu, Chen, & Lin, 2008; Jaskyte, 2004). The championship of top executives is the fundamental source of organizational creativity and innovation (Kimberly & Evanisko, 1981), and we primarily analyze their demographics and career characteristics.

As of organizational attributes, several antecedents have been documented by most of prior studies and we believe they still work in the era of SMAs. Organizational attributes examined in the study include organizational size, fiscal resource, governance type, services delivered, management practices, and ICT preparedness.

Apart from intraorganizational factors, interorganizational and environmental variables are also key sources of innovation variations (Greenhalgh, Robert, MacFarlane, Bate, & Kyriakidou, 2004; Rogers, 2003). Interorganizational competition, learning, imitating, and information and resource sharing are found to be crucial antecedents of innovation adoption (Berry & Berry, 2007). We investigate several outreach activities and external factors that may trigger or hinder SMA adoption by LHDs, including contracting-out, interorganizational resource sharing, and emergency presence.

Top Management Attributes

Organization to a large extent is a reflection of its upper echelons, and the attributes, cognitions, and attitudes of top management matter significantly for organizational variations in the adoption and implementation of innovative practices (Finkelstein et al., 2009). A recent literature review suggests that top management characteristics explain a large extent of the variance of organizational innovation (Hsu et

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Table 1.The hypotheses and test results

Hypothesis	Variable	Sign	SMA Adoption	SMA Count	Test
Top Management Attributes					
H1	Education	+	n.s.	n.s.	N
H2	Age	-	-	n.s.	P
H3	Tenure	-	n.s.	n.s.	N
H4	External	+	+	n.s.	P
Organizational Characteristics					
H5	Organizational size	+	+	+	Y
H6	State government	-	n.s.	n.s.	N
H6	Local government	+	+	+	Y
H7	Region office	-	n.s.	n.s.	N
H7	County office	+	+	+	Y
H8	Board	+	+	+	Y
H9	Fiscal health	+	n.s.	n.s.	N
H10	Complexity	+	n.s.	n.s.	N
H11	Administrative sophistication: Quality improvement	+	n.s.	n.s.	N
H11	Administrative sophistication: Accreditation	+	+	+	N
H12	ICT preparedness: ICT systems	+	n.s.	n.s.	N
H12	ICT preparedness: Information officer	+	n.s.	n.s.	N
Interorganizational and Environmental Characteristics					
H13	Contracting-out	+	n.s.	+	P
H14	Resource sharing	+	n.s.	n.s.	N
H15	Emergency presence	+	+	n.s.	P

Notes: The signs + and - refer to the hypothesized positive and negative associations between the independent and dependent variables respectively. The signs +, -, and n.s. refer to positive, negative and nonsignificant effects respectively. The signs Y, P, and N mean that the hypothesis is fully supported, partially supported, and unsupported by the analytic results respectively.

al., 2008). Top management support is also found to play a key role in ICT innovation (Jeyaraj, Rottman, & Lacity, 2006). Recent evidences also confirm the notable correlations between top management attributes and public organizational innovation (Borins, 1998; Damanpour & Schneider, 2009; Jaskyte, 2004; Moore, 1997).

A recent study reveals that if SMAs are favored by the incumbent governors, state governments are more likely to adopt them on state web portals (Ahn & Berardino, 2014). Leadership style of LHDs is also found to matter for local public health system performance, partially due to their commitment to organizational change (Bekemeier, Grembowski, Yang, & Herting, 2012). In line with the literature, we examine the influences of four top management attributes on SMA adoption.

Education of top executive. highly educated executives are more open to new ideas and have more channels to search and deploy new knowledge, which is the core element of organizational innovation (Finkelstein et al., 2009). Prior studies found a positive correlation between executive education and innovation adoption (Kimberly & Evanisko, 1981). Public managers with higher qualifications (e.g.,

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education and experience) are also revealed to be capable in tax collection and social spending (Avellaneda, 2009). We expect organizations with highly educated top executives are more likely to adopt SMAs.

H1: Formal education of top executive is positively associated with SMA adoption.

Age of top executive. Executive age is usually argued by scholars to be negatively related to organizational innovation, although age often goes hand in hand with experiences and visions (Finkelstein et al., 2009). Younger executives are by and large more risk-taking and open to promising and innovative practices demanding further verification. SMAs are more likely to be used by younger adults (Rainie et al., 2012), which is also one key source of digital divide (Norris, 2001). We expect younger top executives are more likely to adopt SMAs than their elder peers.

H2: Age of top executive is negatively associated with SMA adoption.

Tenure of top executive. Upper echelons are persons in charge of organizational rudder, and they are more likely to embrace organizational experimentation and innovation in their earlier stage of career season (Hambrick & Fukutomi, 1991). Tenure in office of public managers is argued to be negatively associated with organizational innovation (Damanpour & Schneider, 2009), and we predict it will also have negative effect on SMA adoption (Ahn & Berardino, 2014).

H3: Tenure in office of top executive is negatively associated with SMA adoption.

Career background of top executive. The motivation of organizational innovation to a large extent lies in the cognitions and attitudes of top management (Mohr, 1969), which are rooted in their career incentives (Potts, 2009). Compared with internally promoted executives, those from other organizations are more likely to introduce new ideas and practices. A recent study confirms that internally promoted executives are less likely to adopt innovations than diagonally mobile (or externally transferred) ones (Teodoro, 2010). We predict diagonally mobile executives outperform their internally promoted counterparts in introducing SMAs.

H4: Externally transferred top executives are more likely to adopt SMAs than internally promoted ones.

Organizational Characteristics

Organizational innovation is strongly related to organizational attributes. A systematic literature review suggests that organizational innovation is primarily driven by organizational characteristics, e.g., organizational structural attributes and resources (Damanpour, 1991). A recent review reveals that characteristics of innovation and organization are the best predictors of ICT innovation adoption (Hameed, Counsell, & Swift, 2012). Evidences from public organizations generate similar results, though different factors work in slightly distinct ways (Walker, 2006). In this paper we focus on eight organizational factors in driving SMA adoption.

Organizational size. The effects of organizational size on innovation adoption have been documented by the literature, although the results are still mixed (Camison-Zornoza, Lapiedra-Alcami, Segarra-Cipres, & Boronat-Navarro, 2004; Damanpour, 1992). Larger organizations usually are rich in resource and

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structurally complex, which are proved to be favorable conditions for organizational innovation (Shah, Lovelace, & Mays, 2012). A study of SHDs shows that jurisdictional population density is significantly associated with SMA adoption (Thackeray et al., 2012). SMAs require broad network base to engine their influences, and larger organizations adopting ICT innovations also have economy of scale. We expect organizations serving a large user base are more likely to adopt SMAs to facilitate communication and information dissemination.

H5: Organizational size is positively associated with SMA adoption.

Government affiliation. The affiliation, office type, and board involvement of LHDs may influence their propensity to SMA adoption (DeFriese et al., 1981; Mays et al., 2006). LHDs can be affiliated with local government, state government, or both. LHDs governed by local governments are more closely linked with and embedded in the local health community, and they are more likely to adopt SMAs to facilitate communication with local users. LHDs governed by state governments, in contrast, may be less likely to adopt SMAs.

H6: Government affiliation is significantly associated with SMA adoption.

Office type. The type of jurisdiction it serves may affect a LHD's tendency to adopt SMAs. A LHD can be a regional office, a county office, or neither. In the similar vein with government affiliation, we expect that LHDs operating as county offices are more likely to adopt SMAs while regional offices are less likely to do so.

H7: Office type is significantly associated with SMA adoption.

Board involvement. The presence of local health boards may influences LHDs' decision-making and behaviors. We predict that LHDs with local health boards are more concerned about local health needs, and they would be more likely to engage in local activities by using SMAs.

H8: Board involvement is positively associated with SMA adoption.

Organizational resource. Organizational slack provides essential resource and space for organizational members to innovate, and its benefits have been repeatedly confirmed by prior studies (Damanpour, 1991). Available resources are also advocated to be one of the key antecedents of public health organizational innovation (Fleuren, Wiefferink, & Paulussen, 2004). Although SMAs themselves are free tools available for all public sectors, they still require sufficient technological and human resource investment (Bertot et al., 2012; Eggers, 2007). Thus organizational resource, particularly tangible financial resource, is vital for its adoption.

H9: Organizational resource is positively associated with SMA adoption.

Organizational complexity. Organizational complexity, defined as structural and architectural sophistication of organizations, is found to be positively correlated with organizational innovation (Damanpour,

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1996). The diversity of elements within organizations promotes idea exchange and information communication, which further contributes to organizational innovation (Rogers, 2003). For a LHD, organizational complexity refers to the amount and diversity of services and activities it delivers or performs. More complex LHDs are more likely to adopt innovative technologies and practices to efficiently and effectively respond to external service needs.

H10: Organizational complexity is positively associated with SMA adoption.

Administrative sophistication. The complementarity of different types of organizational innovation has been documented (Walker, 2008), and administrative and technological innovations may mutually benefit each other (Daft, 1978). Organizations equipped with more sophisticated administrative practices like strategic planning and quality improvement are more likely to adopt advanced ICT applications to strengthen the capabilities of these management initiatives. The effectiveness of modern administrative practices often depends on the support of complementary ICT tools, and we predict the salience of these administrative practices may increase organizations' probability to adopting SMAs.

H11: Organizational administrative sophistication is positively associated with SMA adoption.

ICT preparedness. SMA adoption is not an isolated organizational effort, and it relies on the equipping and applications of other prerequisite ICT infrastructure and tools (Chuna & Reyes, 2012). If organizations are veteran in Web 1.0 technologies such as web portal, management information system, and other ICT applications, then they are more prepared to adopt SMAs (Bertot et al., 2012). Organizations investing strongly in ICT human resource are more likely to adopt SMAs, which are the extension of existing ICT functions and offer opportunities for them to strengthen their departmental power (Hameed et al., 2012).

H12: Organizational ICT preparedness is positively associated with SMA adoption.

Interorganizational Outreach and Environmental Characteristics

SMAs are smart tools available for organizations to efficiently communicate with their stakeholders, and organizations with more outreach activities and interorganizational exchange are more likely to adopt efficient SMAs to facilitate their work (McAfee, 2009). Evidence from the U.S. local e-government suggests that external influences and citizen demands perceived by public managers accelerates the adoption of communication technologies (Li & Feeney, 2014). Interorganizational communications, particularly contracting-out and interorganizational resource sharing, are positively associated with SMA adoption. SMAs are also used ubiquitously during emergencies, and the presence of emergencies may promote SMA adoption.

Contracting-out. Privatization, contracting-out, and public-private partnership are advocated to be one of the core elements of New Public Management (NPM), and they are also believed to strength the communication and connectivity between public sectors and other organizations (Agranoff, 2012). Organizations having more partnership with other peers are more likely to harness cutting-edged ICT applications to advance their information exchange with other organizations, which could promote SMA adoption.

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H13: The percent of services contracted out is positively associated with SMA adoption.

Interorganizational resource sharing. Networked organizations are mutually connected both in real society and virtual Internet world. The involvement of organizations in information and resource exchange may push them to adopt SMAs to lower their transaction costs and improve communication effectiveness (McAfee, 2009). If public sectors share resources (e.g., funding, staff, or equipment) with their partners on a continuous and recurring basis, they are more likely to introduce SMAs to facilitate their mutual connection.

H14: Interorganizational resource sharing is positively associated with SMA adoption.

Emergency presence. SMAs as efficient information dissemination tools are usually used by public sectors when a crisis or catastrophic disaster occurs, which is definitely the case of Hurricane Katrina (McGuire & Schneck, 2010). SMAs are initiatively employed by police departments and emergency management agencies (Meijer & Thaens, 2013), and they have been successfully applied in disaster response and crisis management across the world (Chuna & Reyes, 2012; Mergel, 2012). We expect that organizations encountering major emergency events challenging their traditional response modes are more likely to adopt SMAs to innovatively buffer environmental threats.

H15: Organizations are more likely to adopt SMAs when environmental threats or emergency are presented.

DATA AND METHODS

In this section, we first introduce the data used in this study and their sources. We then present the measurement approaches of our key variables, followed by the summary of model specifications.

Sample and Data Sources

The data used in this paper are from the 2010 survey of National Profile of Local Health Departments (NPLHD) organized by the NACCHO. All LHDs were the population of the survey and received an E-mail invitation to participate in the survey. Roughly all LHDs are members of the NACCHO and are covered by the regular surveys of NPLHD, guaranteeing its response rate and data quality (Leep & Shah, 2012). The 2010 survey was conducted from September to November by a Web-based questionnaire and top agency executive or designated alternate of every LHD is invited to participate in the survey. Follow-up with non-respondents and technical support were employed to increase response rate, which was 82 percent with 2,107 out of 2,565 sampled LHDs completing the questionnaire (NACCHO, 2011).

Every LHD received the core component of the questionnaire (including basic questions on agency governance, workforce, and activities), while a stratified random sample of LHDs received an extra module including questions on ICT and quality improvement. The strata are the jurisdictional population size served by LHDs and the sampling framework ensures that the distribution of LHDs is consistent with that of the total LHD population. Totally 624 LHDs were sampled to receive the module, and 531 LHDs (or85 percent) responded, accounting for 25.20 percent and 20.70 percent of the respondents and the population respectively (NACCHO, 2011).

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Dependent Variables

The item used to operationalize SMA adoption is: "Does your LHD make use of any of the following Web 2.0 technologies? (Select all that apply)". The seven technologies available for selection include: Blogs, Facebook, LinkedIn, MySpace, Twitter, YouTube, and SlideShare. If LHDs have adopted other applications not mentioned above, they can select "Others" and specify the applications they adopted. Respondents can also select "None" or "Don't know" if they have not yet adopted or don't know any technologies mentioned above.

We use two dependent variables in the study. If a LHD has adopted at least one SMA, it is coded as 1 and otherwise 0. We also calculate the total number of SMAs a LHD has adopted, which theoretically ranges from 0 (non-adoption) and 8 (7 specific plus 1 other SMAs). This measurement strategy enables us not only to examine whether a LHD adopts a SMA, but also to analyze the multiplicity of SMA adoption.

Independent Variables

The tenure and age of top executive are measured by the actual number of years. Formal educational is operationalized by the highest degrees top executives earned, ranging from 1 (associate degree) to 4 (doctoral degree). For career background, if top executive is his/her first position in the current LHD, we code 1 (external transfer) and otherwise 0 (internal promotion).

Organizational size is measured by the total amount of full-time equivalents (FTEs) workforce in each LHD (NACCHO, 2011). For government affiliation, we generate two dummy variables for local and state governments, and use shared form as the reference group. We create two dummies for regional and county offices, treating both as the reference group. We also develop a dummy for board involvement.

Organizational resource is gauged by fiscal health, which is measured by the difference between total revenue and total expenditure as share of total expenditure of LHDs for the most recently completed fiscal year (Berry, 1994). The indicator ranges from -1 to 1 and the higher the value the affluent the fiscal condition.

LHDs were asked to fill in what types of services and activities they deliver among a list of total 87 ones across 10 areas. Organizational complexity is measured by the total number of services and activities delivered by LHDs to their jurisdictional population, either directly performed by LHDs or contracted out.

Quality improvement initiatives are measured by two measures. The first is about the involvement of quality improvement activities, ranging from 0 to 3. The second item asks LHDs whether they would join voluntary national accreditation programs, which ranges from 1 (strongly disagree) to 5 (strongly agree).

Organizational ICT preparedness is operationalized by two indicators. One is the extent to which five public health information systems have been implemented, planned, or investigated, which ranges from 0 to 3. We average these five items to construct a global ICT preparedness index. The second indicator is a dummy variable of ICT human capital, asking whether LHDs employ public information specialists or officers as a part of their workforce. We code 1 for the presence of ICT human capital and 0 otherwise.

We use the percent of services and activities contracted out to measure the extent of contracting-out. The indicator ranges from 0 to 1 and the larger the value the higher extent of contracting-out. Inter-LHD resource sharing is gauged by the number of other LHDs with which the focal LHD shares resources (e.g., funding, staff, and equipment) on a continuous and recurring basis. The presence of emergency or crisis is gauged by a dummy variable. The survey asked whether LHD responded to any all-hazards events (e.g., H1N1 influenza outbreak) last year, and 1 is coded for the presence of emergency and 0 otherwise.

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Analytic Methods

As our two dependent variables are dichotomous and count variables, logit and negative binomial models are employed to test the hypotheses respectively. The ordinary least square (OLS) model is inappropriate to estimate limited dependent variables, binary and count data herein, as their distributions and estimated coefficients violate the assumptions of OLS (e.g., normality and homogeneity) (Long & Freese, 2006). Logit model is adopted in the study to regress on the dichotomous variable and negative binominal model is utilized in regressing on the count variable. Although Poisson model is also eligible for count dependent variables, negative binomial model is more appropriate and efficient in model estimates (Cameron & Trivedi, 1998). Robust standard errors are calculated to mitigate the problem of heterogeneity, and we use marginal effects instead of unstandardized regression coefficients to facilitate the interpretations of our analytic results (Long & Freese, 2006).

EMPIRICAL RESULTS

In this section, we first report the descriptive statistics of the key variables, and then separately present the regression model estimates of the adoption and number of SMAs.

The descriptive statistics reported in Table 2 show that roughly 40 percent of LHDs have adopted at least one type of SMAs, while over 60 percent does not use any SMAs. The most frequently used SMAs are Facebook and Twitter, accounting for 28 and 13 percent respectively. Other applications account for less than 10 percent. Some LHDs launched all above-mentioned SMAs and other tools, whereas others only opened a few. On average LHDs adopted roughly one SMA.

The SMA Adoption Model

The results of logit and negative binominal models are reported in Table 3. The two dependent variables are well explained by our models, as suggested by Wald χ^2 and pseudo R^2. All values of variance inflation factor (VIF) of our independent variables are smaller than 3.00, suggesting there is not severe multicollinearity problem and the model estimates are consistent and reliable.

The logit model (Model 1) shows that two out of four variables on top management attributes (age and career background) are significant and consistent with our hypotheses. In contrast to our hypothesis, education of top executive is negatively but nonsignificantly correlated with SMA adoption. Although top executive tenure is negatively correlated with SMA adoption, it is nonsignificant. The results suggest that LHDs with younger and external top executives are more likely to adopt SMAs. In a nutshell, H1 and H3 are not supported while H2 and H4 are supported by the results.

As of organizational characteristics, we find organizational size and accreditation preparedness are positively and significantly associated with SMA adoption. LHDs governed by local governments are more likely to adopt SMAs than those by state governments or both. LHDs reporting as county offices are relatively more proactive in adopting SMAs. Meanwhile, LHDs with local health board are more likely to open SMA accounts. Other organizational variables are positively and nonsignificantly correlated with SMA adoption, except for quality improvement initiative. In sum, H5, H6, H7, and H8 are supported but H9, H10, H11, and H12 are not supported by the results.

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Table 2. The descriptive statistics of key variables

Variable	*N*	Mean	SD	Min	Max
SMA adoption	511	0.386	0.487	0	1
SMA count	511	0.714	1.210	0	8
Education	531	2.889	0.856	1	4
Age	509	53.257	8.912	26	80
Tenure	516	8.926	7.665	1	36
External	524	0.781	0.414	0	1
Size	497	118.762	486.661	0	6543
State government	531	0.166	0.372	0	1
Local government	531	0.744	0.437	0	1
Region office	531	0.047	0.212	0	1
County office	531	0.060	0.238	0	1
Board	529	0.728	0.446	0	1
Fiscal health	389	0.005	0.171	-0.637	0.808
Complexity	531	41.458	15.675	3	87
Quality improvement	522	1.510	0.924	0	3
Accreditation	454	3.542	1.051	1	5
ICT systems	506	1.382	0.797	0	3
Information officer	463	0.276	0.448	0	1
Contracting-out	531	0.101	0.145	0	1
Resource sharing	531	2.282	3.958	0	21
Emergency	519	0.703	0.457	0	1

The presence of emergency or crisis has positive and significant effect on SMA adoption, whereas the signs of contracting-out and inter-LHD resource sharing are positive but nonsignificant. With regard to interorganizational and environmental factors, H13 and H14 are not supported while H15 are supported by the results.

The SMA Count Model

The SMA count model suggests neither top management attributes have significant effects on the number of SMAs (Model 2). Although top management matters in whether or not LHDs adopt SMAs, it does not affect the number of SMAs.

By organizational characteristics, we again find organizational size and willingness of accreditation are positively and significantly related to the amount of SMAs launched by LHDs. The results of government affiliation, office type, and board involvement turn to be similar to the SMA adoption model, while other organizational attributes are still nonsignificant.

We find positive albeit nonsignificant effects of resource sharing and emergency presence on the number of SMAs. In contrary to the logit model, contracting-out is found to be positively and significantly correlated with the number of SMAs.

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Table 3. The logit and negative binomial models

Dependent Variable	SMA Adoption (Model 1)		SMA Count (Model 2)	
	dy/dx	SE	dy/dx	SE
Education	-0.274	(0.236)	-0.0472	(0.133)
Age	-0.0339*	(0.0201)	0.00133	(0.00929)
Tenure	-0.00515	(0.0211)	-0.0137	(0.0123)
External	0.602*	(0.361)	0.152	(0.211)
Size (log)	0.830***	(0.162)	0.427***	(0.0759)
State government	0.213	(0.933)	-0.199	(0.714)
Local government	2.406***	(0.579)	1.508***	(0.387)
Region office	0.802	(0.901)	0.519	(0.607)
County office	3.253**	(1.375)	2.705***	(0.816)
Board	0.920**	(0.413)	0.388*	(0.222)
Fiscal health	1.192	(1.198)	0.290	(0.529)
Complexity	0.0137	(0.0109)	-0.00485	(0.00547)
Quality improvement	-0.0727	(0.204)	-0.0900	(0.115)
Accreditation	0.301**	(0.148)	0.251***	(0.0747)
ICT systems	0.117	(0.200)	0.0336	(0.0953)
Information officer	0.107	(0.388)	0.298	(0.207)
Contracting-out	2.127	(1.343)	1.777**	(0.741)
Resource sharing	0.0273	(0.0497)	0.0212	(0.0220)
Emergency	0.691*	(0.414)	0.392	(0.252)
Constant	-6.586***	(1.720)	-4.833***	(0.881)
Log pseudo-likelihood	-147.73906		-310.44645	
Wald χ^2	67.24***		166.15***	
Pseudo R^2	0.2244		0.1498	

Notes: N=277. Marginal effects (dy/dx) are reported, and robust standard errors are in parentheses. *** $p<.01$; ** $p<.05$; * $p<.1$.

DISCUSSIONS

In this section, we first discuss the empirical findings of our analyses and the contributions of the results to the literature. We then discuss the policy implications of our findings. We finally acknowledge the limitations and suggest future research directions.

Theoretical Contributions

The availability of new technologies and accountability challenges push public sectors to adopt SMAs to strengthen their communication with and accountability to citizens, and it is crucial to explore what matters for their adoption and diffusion. Drawing on the organization innovation literature, we develop theoretical hypotheses and generate empirical findings to explain SMA adoption (see Table 1).

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The contributions of this study are twofold. First, we theoretically propose and empirically test a battery of hypotheses on the antecedents of SMA adoption by LHDs. Although numerous studies have documented the usage of SMAs by public sectors across diverse contexts, what drives their adoption has not yet been systematically examined. This study reports one of the first results on SMA adoption by LHDs, and contributes to the ongoing research stream on the adoption and usage of SMAs in public sectors.

We find that SMA adoption is to a large extent driven by organizational size and management practices, while top management and environmental characteristics also play important roles. Despite dramatically different from traditional ICTs and other organizational innovations, we do find that the adoption and number of SMAs are determined by similar factors (Crossan & Apaydin, 2010; Damanpour, 1991; Jeyaraj et al., 2006; Rogers, 2003; Wolfe, 1994). The findings highlight the value of comparative research incorporating innovation types and characteristics as important antecedents and moderators of organizational innovation (Damanpour, 1991; Rogers, 2003; Wolfe, 1994).

Second, we find that the adoption and number of SMAs are affected by two different groups of antecedents. Despite sharing some common predictors, the adoption and number of SMAs are driven by two subtly different groups of antecedents. Top management attributes matter for SMA adoption, but they have little effects on the number of SMAs. Interestingly, both the adoption and number of SMAs are driven by organizational size and accreditation preparedness. Emergency presence has significantly positive effect on SMA adoption, whereas contracting-out only significantly affects the number of SMAs adopted by LHDs. These findings are in line with prior studies on the adoption and implementation of organizational innovation, which should be appropriately depicted as a complex multi-stage process influenced by different groups of factors (Damanpour, 1991; Walker, 2006).

Policy Implications

Our findings also generate meaningful implications for public sectors in managing SMAs. We highlight several key antecedents of SMAs, which can be important arenas to promote SMA adoption and diffusion.

First, the crucial roles played by top management in determining whether and how innovative practices can be assimilated in organizations have been documented by the literature, and we also find similar results in SMA adoption. The age and career background of top executives are revealed to be only positively associated with SMA adoption, while their education level and tenure in office have little explanatory power in both models. The findings imply that the sources and attitudes of top executives play key roles in whether or not adopting SMAs, but they matter little in how many SMAs could be adopted. Public sectors can recruit external and younger top executives to manage SMAs, which may help boost their usage and impact.

Second, we find jurisdictional coverage of LHDs have significant effects on the adoption and number of SMAs. Government affiliation, office type, and board involvement are all significantly associated with both the adoption and number of SMAs. LHDs governed by or working at lower levels of government (e.g., county) are more likely to adopt SMAs and usually adopt more SMAs, implying the nature of SMAs in connecting grassroots community and citizens (DeFriese et al., 1981). The consolidation and structural transformation of LHDs are advocated by recent reform efforts (NACCHO, 2011), but whether such initiatives can trigger organizational innovation and performance improvement should be cautiously detected and examined. Local health board usually has authority to appoint top executives,

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approve budget, and allocate other resources, and their involvement may pull LHDs to adopt innovative practices to meet board expectations (Mays et al., 2006).

LHDs operating in larger jurisdictions use SMAs more frequently than their peers serving jurisdictions with smaller populations (NACCHO, 2011). Organizational size and total revenue are highly correlated (α=0.9602, $p<0.01$), and we can also pinpoint the importance of financial resource for SMA adoption, although the effect of fiscal health is nonsignificant. We only find LHDs' willingness to accreditation has significant impact on the adoption and number of SMAs, suggesting LHDs embracing quality improvement and external recognitions are more likely to utilize SMAs to promote themselves. To further advance the innovation and quality improvement of LHDs, more efforts should be put on resource deployment and capability building, which are found to be important antecedents of SMA adoption.

In line with theories and prior studies, we find robust effects of interorganizational and environmental characteristics in SMA adoption. LHDs contracting out more services and activities are more likely to adopt more SMAs, whereas those encountering environmental threats in forms of public health emergencies are more likely to adopt at least one type of SMAs. We do not find significant influences of inter-LHD resource sharing, which may be mostly tunneled by other formal and organized means (e.g., inter-LHD agreements and memorandums). The results suggest that external pressures can be leveraged to promote LHDs and other public sectors to adopt SMAs.

Limitations and Future Research Avenues

The limitations of this study should be acknowledged before proceeding to the conclusion. First, the study is contextualized in the U.S. LHDs, and the findings should not be overgeneralized to other organization types and situations. We encourage scholars to replicate and extend our study in other organization types (e.g., local governments and police bureaus) and in other contexts (e.g., developing countries in other continents), which may contribute to the validity and generalization of the findings.

Second, the adoption of innovation is jointly determined by diverse variables, and we only investigate several most salient factors. Other antecedents affecting SMA adoption (e.g., top management team characteristics, organizational culture, ICT skills, regional diffusion effects, and environmental dynamics) can be examined when fine-tuned data are available. For instance, top management team as a group accounts much more strongly for innovation adoption than sole top managers, and it is promising to study their structural impact (Hsu et al., 2008).

Furthermore, the adoption of innovation may be driven by distinct factors at different stage (Rogers, 2003; Walker, 2006), and more investigations can be done to compare the explanatory power of antecedents across different stages of SMA adoption and post-adoption periods. The data used in this study were collected in 2010, when only 40 percent of LHDs had SMA accounts and the diffusion of SMAs was still in the nascent stage. SMA adoption may be greatly expedited in the later stage of diffusion (e.g., 60-80 percent of adoption), and it will be meaningful to replicate and retest our study then.

Lastly, we only study whether LHDs adopt SMAs and the number of SMAs utilized, and how these applications are used deserves more in-depth studies. Recent studies suggest that public sectors are more likely to use SMAs for unidirectional information distribution, making no difference from traditional e-government applications such as web portals (Kuzma, 2010; Omar, Scheepers, & Stockdale, 2012; Snead, 2013). Evidence from SHDs suggest that SMA usage is still in the nascent stage of information dissemination and distribution, and more in-depth interactivity and engagement are demanded (Thackeray et al., 2012). What is most demanding, both practically and empirically, is the use of SMAs in online

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conversation, interactivity, and engagement with stakeholders (Bonsón et al., 2012; Chuna & Reyes, 2012). One promising research avenue is to examine the "assimilation gap" of SMAs, which denotes the extent to which innovations are really deployment by organizations after adoption (Fichman & Kemerer, 1999). Future studies can go a further step to study what drives public sectors to engage in more in-depth usage of SMAs, which may be helpful to guide them to exploit the core value of SMAs.

CONCLUSION

The ubiquitous usage of SMAs by citizens and corporates pushes public sectors to engage in the bandwagon to actively communicate with stakeholders, disseminate information, and monitor social dynamics. It is crucial to understanding why local public service sectors embrace social media tools, and policy experts and authorities can benefit from the knowledge on the antecedents and mechanisms of SMA adoption and implementation. This paper tries to address the knowledge gap in the study of SMA adoption, and we find several interesting and meaningful results.

We argue that SMA adoption can be jointly explained by top management characteristics, organizational attributes, and interorganizational and environmental factors. Drawing on a national survey of the U.S. LHDs, our results partially confirm the explanatory power of our model. We find that the age and career background of top executives, organizational size and structure, quality improvement initiatives, contracting-out, and emergency presence are key antecedents of the adoption and number of SMAs. We also find that the adoption and number of SMAs are affected by two different groups of antecedents. We report one of the first empirical results on the antecedents of SMA adoption by LHDs. Our findings theoretically and empirically contribute to our understanding of SMA adoption. We also provide meaningful policy implications for practitioners to harness SMAs in LHDs and other public sectors.

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Chapter 55
Are Climate Change Adaptation Policies a Game Changer?
A Case Study of Perspectives from Public Health Officials in Ontario, Canada

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ABSTRACT

The health impacts of climate change have received significant attention in the international scholarly literature. Despite this, there is an absence of research evaluating existing policies aimed at promoting and protecting population health. This chapter provides an implementation analysis of the Ontario Public Health Standards (OPHS), 2008/2014--the provincial policy statement that governs mandatory public health activities in the province which includes taking action on climate change. This chapter responds to two specific questions: First, how are Ontario's 36 regional health units interpreting and implementing this policy statement; and second, how are those interpretations translated into practice. Using a web-scan and in-depth interviews with practitioners from twenty Ontario health units, this paper presents four interpretations of the OPHS, a typology of best practices related to regional adaptation, and policy recommendations to bolster domestic and international adaptive capacity to emerging infectious diseases associated with climate change, and a variety of other health-related climate impacts.

INTRODUCTION

Climate change is rapidly affecting human health around the globe and posing new challenges for public health infrastructure and systems (McMichael, 2013). This paper analyzes the degree to which existing public health policies are successful in bolstering adaptation to climate change in the public health sector, and whether the implementations of those policies create activities capable of responding to the emergence of new infectious diseases and a host of other climate-related health impacts. Specifically, this paper uses Ontario, Canada as a case study for examining how public health policies (i.e. the *Ontario Public Health Standards, 2008/2014*) are interpreted and made actionable by front-line practitioners.

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The paper begins with an overview of climate change and its health impacts across Ontario before describing the methods and presenting a typology of policy interpretations that speak to the strengths and weaknesses of a relatively broad policy mandate. More specifically, the paper seeks to understand how practitioners made climate change actionable in their work before and after the enactment of the *Ontario Public Health Standards,* and to what degree policy elicits adaptive programming and interventions. In doing so, the paper provides guidance for government officials and public health practitioners in other nations attempting to understand whether their policy infrastructure is robust enough to respond to climate-related health impacts.

BACKGROUND: CLIMATE CHANGE IN ONTARIO, CANADA

Canada's climate is rapidly changing, and as a result, so too are the health risks posed to Canadians (Séguin, 2008). While global average temperatures are projected to increase by between two and four degrees Celsius by the end of the twenty-first century, Canada will experience more rapid temperature increases (IPCC, 2013). Between 1948 and 2006, southern Ontario has already experienced a 1.3 degrees Celsius increase, and projections for the province indicate that it will experience a two to four degree Celsius increase by 2050 (Feltmate & Thistlewaite, 2012).

Climate change has been called the greatest public health threat of the twenty-first century (Costello et al., 2009). Accordingly, the Canadian experience of climate change will mirror that occurring in other democratic countries with a well-established public health sector. Primary risks include the direct biological consequences of extreme weather events (i.e., heat, cold, violent weather), temperature-enhanced air pollutants in urban areas, and increased exposure to UV radiation; secondary risks include risks mediated by biophysical or ecological processes including food security/foodborne disease, water scarcity/waterborne disease, and changes in disease vectors as previously inhospitable climates become warmer. For Ontario, Canada, there are significant concerns about emerging vectors contaminating drinking water and recreational water sources and food contamination, with increased risk of *E. coli, Cryptosporidium, Giardia, and S. typhi* all being linked to warmer temperatures (Health Canada, 2008). Changes in the ecology of various disease-carrying insects also pose significant concerns for the spread of mosquito borne vectors including the West Nile Virus (Paz, 2015) and Eastern Equine Encephalitis (Parham et al., 2015). There is also cause for concern surrounding the spread of Lyme disease spread by tick populations (Ostfeld et al., 2015) and the possible emergence of new diseases and those previously eradicated across the country (Cambell-Lendrum et al., 2015). Tertiary risks include a host of mental health issues, displacement and migration, and the exacerbation of existing health inequalities (Friel et al., 2011; McMichael, 2013; Séguin, 2008).

Climate change will also pose significant economic implications, particularly for major urban areas. For example, the cumulative cost of premature mortality risk attributable to heat and air quality impacts from climate change in Toronto between 2010 and 2100 is estimated at between $65 and $96 billion, and the healthcare costs attributable to air quality impacts from climate change alone in the same time period are estimated to be between $72 and $285 million (NRTEE, 2011). These estimates do not factor in the rising cost of extreme weather. Indeed, the July 2013 storm that struck much of southwestern Ontario has proven to be the province's costliest "natural" disaster with estimated damages totalling upwards of $850 million.

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Some research has begun to explore how institutional policies and programs at the national level are fostering the country's capacity to adapt to climate change's health impacts (Lesnikowski et al., 2014; Panic and Ford, 2013). In the United States, empirical work demonstrates that public health staff may lack the appropriate training and skills to engage with climate change programmatically or substantively, and that adaptation and prevention have yet to be made a priority among American health departments as a result (Maibach et al., 2008). To remedy this, the Center for Disease Control developed the Building Resilience Against Climate Effects Framework which has been taken up across levels of government.

In the Canadian context, specific public health adaptation options have yet to be implemented in many regions across the country (Canadian Public Health Association, 2006), with the exception of perhaps Quebec which has been leading the charge in developing advanced climate change and health modelling scenarios with OURANOS. Following this, an investigation into emerging activities and best practices from other parts of Canada is warranted, but particularly those applying evidence informed public health approaches (Hess et al., 2014) which may have transferable lessons for other developed nation contexts. Further, while numerous frameworks and strategies for public health adaptation to climate change exist in the literature, there are fewer empirical examinations of existing policies and their resulting implementation, and how well they are able to address the health implications of climate change.

In the sections that follow, the author uses the public health system in Ontario as a case study for evaluating the programmatic outputs of public health policy specifically related to climate change adaptation. The author uses a web scan and in-depth interviews with key informants from Ontario's environmental public health practitioner community to 1) illustrate the markedly different interpretations of provincial public health policy protocols related to climate change both in the absence and presence of formal policy; and 2) develop a typology of adaptation activities being undertaken at the level of Ontario health units.

Why Study Ontario? The Ontario Public Health Standards (2008) and Climate Change Adaptation

Ontario is Canada's most populated province, yet despite a high degree of urbanization, it still holds a vast rural and northern population. The public health system is regulated at the provincial level by the Ministry of Health and Long-Term Care (MOHLTC), but program and service delivery occurs at the regional level with a cost-sharing mechanism that splits operational costs between the province and regional municipalities (Deber, 2003). The regional nature of Ontario's public health system is arguably well designed to engage with climate change because health units can respond to regionally specific health needs, as well as the regional specificity of climate change. The province has thirty-six regional health units (see Figure 1) which are governed under the *Ontario Public Health Standards* (OPHS).

The OPHS are published:

As the guidelines for the provision of mandatory health programs and services by the Minister of Health and Long-term Care pursuant to Section 7 of the Health Protection and Promotion Act, R.S.O. 1990, C.H.7. (MOHLTC, 2008, 1)

The OPHS are also one of the first pieces of Canadian policy creating a mandate to address the emergent health implications of climate change. The OPHS classifies climate change as an environ-

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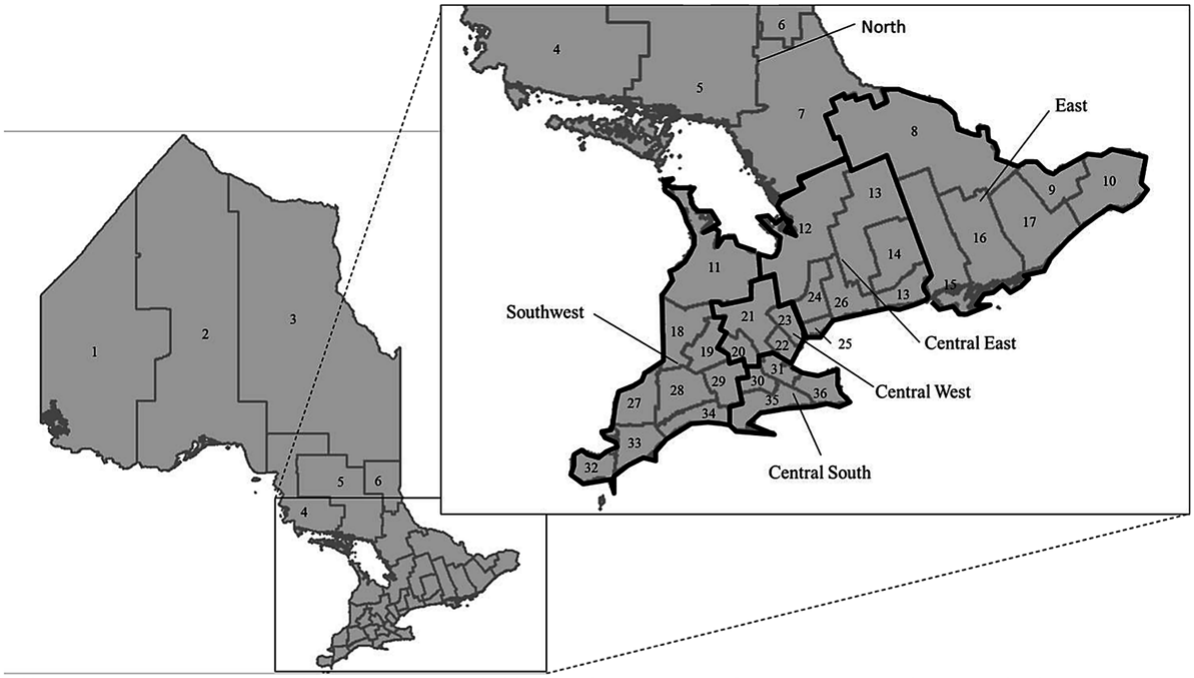
Figure 1. Ontario's 36 regional public health units grouped by census division*



*Health units are as follows: [1] Northwestern; [2] Thunder Bay District; [3] Porcupine; [4] Algoma; [5] Sudbury and District; [6] Timiskaming; [7] North Bay-Parry Sound District; [8] Renfrew County and District; [9] City of Ottawa; [10] Eastern Ontario; [11] Grey-Bruce;; [12] Simcoe Muskoka District; [13] Haliburton, Kawartha, Pine Ridge District; [14] Peterborough County-City; [15] Hastings and Prince Edward Counties; [16] Kingston, Frontenac, Lennox and Addington; [17]Leeds, Grenville and Lanark; [18] Huron County; [19] Perth District; [20] Regional Municipality of Waterloo; [21] Wellington Dufferin-Guelph; [22] Halton Region; [23] Peel Region; [24] York Region; [25] City of Toronto; [26] Durham Region; [27] County of Lambton; [28] Middlesex-London; [29] Oxford County; [30] Brant County; [31] City of Hamilton ; [32] Windsor-Essex County; [33] Chatham-Kent; [34] Elgin-St.Thomas; [35] Haldimand-Norfolk; [36] Niagara Region

mental health hazard, and broadly organizes the protocols for addressing environmental health hazards around preventing or reducing the burden of illness from hazards in the physical environment. Specific protocols include a mandate to:

1. Conduct surveillance of the environmental health status of the community;
2. Conduct epidemiological analysis of surveillance data, including monitoring trends over time, emerging trends, and priority populations;
3. Increase public awareness of health risk factors associated with the following health hazards: indoor air quality, outdoor air quality, extreme weather, climate change, exposure to radiation, and other measures as emerging health issues arise. These efforts shall include adapting or supplementing national and provincial health communication strategies, and/or developing and implementing regional/local communications strategies; and
4. Assist community partners to develop healthy policies to reduce exposure to health hazards (MOHLTC, 2008, 46–47).

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It merits attention that "climate change" appears in the OPHS document under only the third protocol where it is simultaneously identified as an environmental health hazard and sets a requirement to raise public awareness about the health risks associated with a changing climate.

An analysis of all the activities and protocols related to climate change in the OPHS is beyond the scope of this paper. A previous review by Clarke and Berry (2012) compared the OPHS with existing climate change and health adaptation frameworks. Their findings indicate that the OPHS requires many traditional risk-management activities identified in pre-existing climate change adaptation frameworks related to emergency response and surveillance and monitoring.

However, these claims have not been empirically validated by environmental health managers mandated to work in the field of public health in Ontario, and some scholars are critical of whether "traditional" risk management activities are well suited to addressing the complexity of climate change's related health impacts (Morris, 2010). Clarke and Berry's results neither describe existing adaptation initiatives across the province nor how environmental health practitioners see existing protocols as linked with actions required on climate change adaptation. In moving somewhat closer to this end, Paterson and colleagues (2012) conducted interviews with ten health units in Ontario to assess public health adaptation activities. Their findings suggest that public health officials are particularly concerned with temperature, air quality, and extreme-weather-related impacts. Yet, their analysis is limited primarily to health units in the southwest which reduces the provincial generalizability of their results. Their work also does not describe existing adaptation activities that are either ongoing or in development throughout the province.

METHODS AND ANALYSIS

This study's methods are informed by qualitative methods and followed a two-phase data collection and analysis strategy. First, the author conducted a web scan of each of the 36 Ontario public health unit websites between January and April of 2013. For those health units with stand-alone websites, the Boolean search terms "climate change" or "greenhouse gas*" or "global warming" were used, making the documentation and collection of resulting hits straightforward. For health units' websites embedded in municipal or regional web domains, the author employed the same search terms with the additional search term "and health." The publishing dates of key documents were utilized to inform a temporal analysis of practices pre- and post-implementation of the *OPHS* in 2008, and if relevant 'hits' were undated or they were excluded from the temporal comparison, but included in the subsequent content analysis. Content analysis was used to document how health units describe the health impacts of climate change, and what programs each health unit tied directly to climate change.

Next, the author conducted twenty semi-structured interviews with public health professionals from twenty Ontario health units. While all thirty-six health units were contacted for an interview, twenty had a staff member who was willing to participate in the study, thirteen refused to participate on the grounds that they could not contribute anything to it (i.e., there was no climate-change orientation to their work, nor were there plans to incorporate climate change into their work in the near future), and three health units did not respond. The author transcribed interviews following appropriate protocols (Poland, 1995).

The twenty completed interviews have strong regional representational by census division (see Table 1) and capture a wide-ranging spectrum of action on climate change. Interviews sought to uncover personal perspectives from active practitioners working in the field in an attempt to uncover how the then-five-year-old policy mandate was being translated into practice and what that meant for their work on

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Table 1. Interview sample by census division (N=20)

Health Units by Census Division (N)	Number of Health Units Represented in Interviews	% Health Units Reporting from Each Census Division
Central East (6)*	4	66.6%
Central West (4)	2	50.0%
Central South (4)	2	50.0%
East (6)	2	33.3%
Southwest (9)	6	66.6%
North (7)	4	57.1%
Total (36)	20	55.5%

*Includes Toronto for the purpose of analysis and anonymity.

a day-to-day basis (see interview questions in the Appendix). Accordingly, a limitation of this study is that it does not include the perspectives of provincial and federal level decision-makers because they are not necessarily front-line practitioners. Future work could seek to integrate perspectives across levels of government to improve the resolution of our understanding related to climate change policy and practice.

Due to the perceived political nature of climate change, the author protected research participants' anonymity through the use of pseudonyms, and their specific organizations are not identified by name. This study received ethical approval from the University of Toronto Research Ethics Board.

The analysis of interview transcripts followed an iterative strategy involving three distinct phases to organize and iteratively 'unpack' the data. As analytic strategies, each phase included identifying information and the 'uncleaned' data are therefore not presented here, but the three phases (described below) were utilized to enhance rigour and triangulate findings.

First, a cross-case display matrix was produced following Miles and Huberman (1994) that sought to produce a visual display of key variables and themes loosely organized around the interview questions. This method allows the researcher to draw comparisons across cases according to some of the distinctions present within core themes. Second, in an attempt to preserve the contextual nuance of each interview, case summaries (Poland et al., 2009) of each interview were produced that resemble a condensed transcript highlighting key programmatic areas of interests, comments on policy uptake, and other thematic issues that arose during the interview. Third and finally, the author employed "category zooming" — a form of analytic generalization that "zooms in" on a particular aspect of qualitative inquiry with the goal of going into greater interpretive depth about the complexities of a single point in a broader study (Halkier, 2011). This approach loosely resembles a targeted analysis of spoken text (in the form of interview transcripts) with the goal of understanding how discursive features of policy interpretation manifest in distinct and particular forms of policy implementation.

RESULTS

20 of 36 health units had a staff member volunteer to participate in this study, 13 refused to participate on the grounds that they had no climate change orientation to their existing work, and three did not respond (see Table 1). Completed interviews offer a geographically representative sample of Ontario

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health units when aggregated by census division: four of six health units from the central east (including Toronto for the purpose of analysis and anonymity); two of four health units from the central west; two of four from the central south; two of six from the east; six of nine from the southwest; and four of seven from the north.

Four Interpretations of OPHS Protocols Related to Climate Change Adaptation

The majority of interview participants (14 of 20) identified the existing guidelines as their entry point into engaging with climate change from a public health perspective. As one respondent put it: "The whole ministry put out the new ministry standards and I'm sure that you're probably familiar with those as well … the standards and protocols, 2008, right? And in there they outlined climate control as one of our initiatives that needs to be addressed" (Syndra, Environmental Health Manager).

However, interpretations of what the OPHS required resulted in varied responses to program development across Ontario health units. The degree of engagement with climate change at the program level can be conceptualized in terms of four specific interpretations of the OPHS policy, including: inaction, communicating health risks, mainstreaming climate change into existing programs, and championing innovative activities.

Inaction

Inaction was the lowest level of engagement with climate change and it is notable that many of the public health unit staff interviewed for this project indicated that they did not have a comprehensive climate change program (N=8). Vladimir, an environmental program manager said "I'd have to say that if we were really to talk about climate change here as something we are sort of pursuing in a conscious way right now, I would have to say that we're really not" and that "climate change isn't up there as a label on anything that we do." This point is reiterated by other managers:

I have to say right off the bat that we don't directly call it that. We don't have a climate change management program [laughing]. (Riven, Associate Medical Officer of Health)

We haven't done a tonne on climate change really. (Lucian, Environmental Health Manager)

Well I don't know if we do it in a ... way that we conscientiously are doing this because of, you know, we're under the umbrella of climate change adaptation. But I think—but specifically—probably similar to other health units, where we've been involved in a number of ways …I guess easily would be the extreme temperature … types of programming and protocols that we have in place ... have had in place now for a number of years here. (Yorick, Environmental Health Manager)

Actually we have not really done much to address it. We are waiting for the … province to come up with…I think, some province-wide…program or protocol that will apply. (Olaf, Environmental Health Manager)

Barriers to public health adaptation are well documented in the peer-reviewed literature and include perceived uncertainties about future climatic and socioeconomic conditions; the lack of financial, human, and technological resources; limited social capital to engage other sectors; the highly specialized

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nature of public health and other institutions that might limit or make invisible adaptations taking place in other sectors; and cognitive limitations around behaviour change (Huang et al., 2011). Wardekker et al. (2012) add that the multi-causality and complex cause-effect relationships between climate change and associated known and unknown impacts further complicate planning.

Interviews with public health practitioners in Ontario illuminated similar findings, whereby constraints in or lack of resources of time, energy, money, and political leadership to run new programs were identified as a primary reason for inaction (see Table 2). This is relative to health units with significantly more resources who may have greater ability to engage with climate change and its resulting health impacts. However, Ontario public health practitioners further identified that problem denial may be an issue within health units, and that other areas of research and practice are prioritized. A final barrier was the notion of "blame avoidance" (Howlett, 2014), whereby the uncertainty and time lag associated with climate change — while problematic from a programming perspective — were coupled with a question of what business or authority public health had engaging with climate change relative to other sectors.

One respondent claimed that public health's involvement might be conceived of as "the kindergarten kids trying to play with the big boys. I don't know, I suppose again, it's a question of what areas do you have a mandate over?" This respondent went on to clarify this point by adding:

Can we lead the charge on it? I'm not sure that would be the role of public health — to lead the charge on climate change — because the factors causing it are so, I mean they're individual choices, but they're also macro. They're systems, they're factories, they're regulations. You know, it's a whole different set of jurisdictions that deal with the major polluters. We can influence individual behaviour, to the extent that's even possible, but really only through information and education. We don't have a lot of levers to pull that would make a major difference systemically across the board. (Riven, Associate Medical Officer of Health)

Communication of Health Risks

A second interpretation of the OPHS highlights only the communication of health risks associated with climate change as the primary means of policy implementation, but none of the other OPHS-mandated protocols related to environmental health hazards. In this case, practitioners viewed public engagement and raising awareness of climate change's health impacts as their sole programmatic responsibility:

Table 2. Barriers to developing public health programs to adapt to climate change in Ontario

Barrier	Supporting Quote
Lack of Resources	"We don't really have the resources to start any kind of planning and anything in depth as the project goes to climate change" – Jayce, Environmental Health Manager
Problem Denial	"[CC] is hardly ever addressed as far as I hear. I'm not sure why and I think some of it might be personal. People aren't going to change, so maybe a bit of it is denial?" – Quinn, Health Promoter
Prioritization of Other Areas	"I don't think it's really seen as something that is important here." – Syndra, Environmental Health Manager
Blame Avoidance	"I think there's concern that it's just too much. It's just too far in the future. It's uncertain, it's scary, and is it really our business?" – Alistair, Medical Officer of Health

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Under [the OPHS], it was mandated by the Board of Health outcomes … the board of health shall increase public awareness of health risk factors associated with the following health hazards, and one of those health hazards was part of climate change — which was something that we were tasked to do. (Darius, Environmental Health Manager)

Namely [climate change programming] has been with our heat alerts and our cold alerts. Um, and through that mechanism, that's where most of the work has been associated with. (Zac, Environmental Health Manager)

That's what we do. So we make sure people are informed. So we have protocol here when those events happen to make sure that we communicate or issue immediate releases to … the media we have around here. In addition to that, we do work with municipalities to make sure that the information is disseminated door to door. (Olaf, Environmental Health Manager)

So we're not at the stage where the public health standards say you have a role in prevention at the level of the health unit, because even if that word were mentioned, rather than just mitigating the appearance of risk, then there's mitigating risk, then there's preventing. So of the kind of three, we're only at the very beginning … communicating risk. That's the first level. (Riven, Associate Medical Officer of Health)

The emphasis on risk communication was further highlighted through the web scan, where the majority of risk-communication activities were on an event-by-event basis (i.e., communicating the health risks of extreme heat during a heat alert). Some health units also linked to comprehensive climate change impact documents (see, for example, Séguin, 2008), or presented reviews of region-specific climate impacts through independent research or vulnerability assessments.

How climate change is tied to specific health effects is also highly dependent on the region in which a health unit is located. Figure 2 communicates which health impacts of climate change were described on health unit websites by census division. That is, this figure indicates what percentage of health units identify one or more health impact in materials they have made publicly available via their websites. In other words, this figure merely serves to show the health impacts of greatest concern across census divisions, and across the province more generally.

Findings show that health units in the "Golden Horseshoe" area (i.e., Central West and Central South census divisions, which encompass the Greater Toronto Area [GTA] through to Niagara Falls) of the province tend to have more active outreach for identified health impacts. Perhaps because this is the most populous part of the province, these health units tend to be larger and well-resourced. Also, by virtue of the urban areas they occupy, there may be richer opportunities for collaboration with neighbouring health units and environmental not-for-profits. Finally, given the pre-existing concerns of extreme temperature and air quality issues in the Niagara-GTA corridor and the inseparability of these issues from the climate change discourse, the path dependence in program development before and after the development of the OPHS has led those health units to make natural connections to climate change.

Mainstreaming Climate Change into Existing Programs

A third interpretation of the OPHS mandate was to "mainstream," "backfill," or "integrate" climate change into existing programs. This approach primarily involves practitioners viewing existing programs

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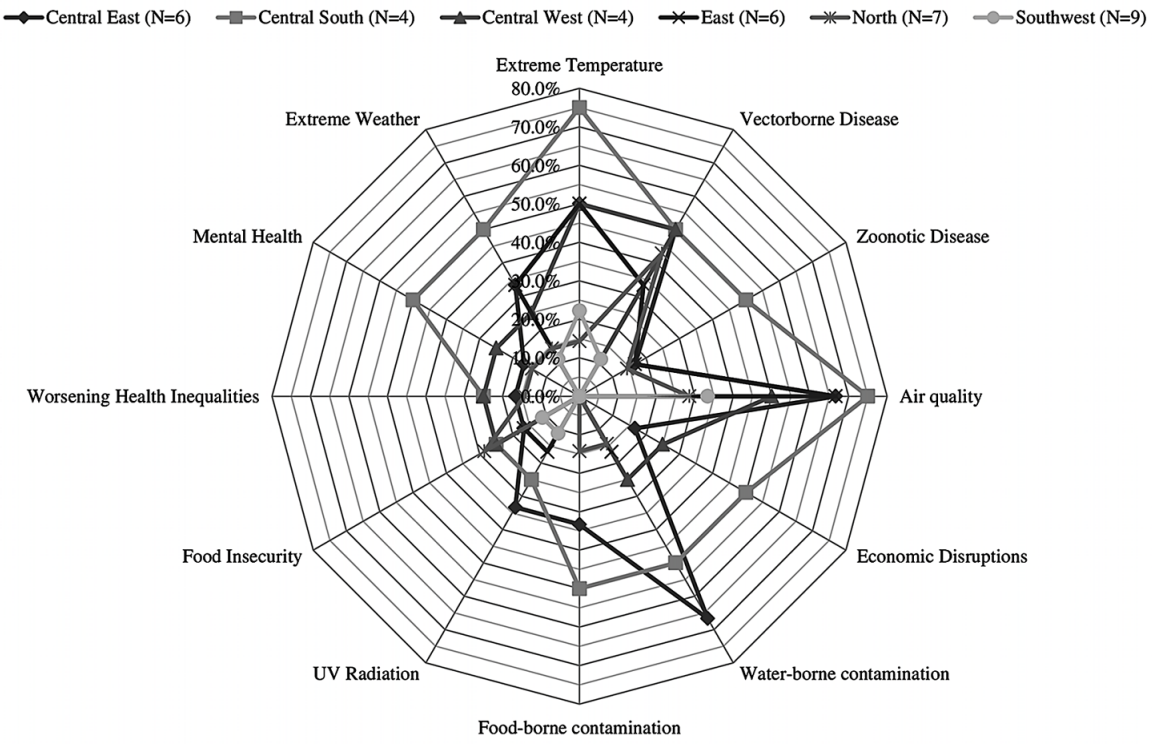
Figure 2. Percentage of climate change impact areas described on Ontario health unit websites according to census division



through the lens of climate change, or "in other words, link[ing] them with an integrated strategy that says if there's an opportunity to promote climate change within the programs, do it at no cost" (Viktor, Environmental Health Manager). The approach of mainstreaming is well documented by Paterson et al. (2012) and therefore does not require additional analysis here.

Championing Climate Change

The final category of interpretation of provincial policy resembled a more active engagement with the issue in a way that is commensurate with the OPHS protocols and beyond.

The organizations that have so far "championed" climate change as a public health issue are actively linking climate change to existing and emerging health concerns in their regions, and are beginning to develop specific partnerships and programs to address climate change's health impacts.

A Typology of Adaptation Strategies among Climate Change "Champions": Pre- and Post-2008

Findings from the web scan and interviews indicate that prior to the implementation of the OPHS in 2008, climate change was rarely taken up by any health units in Ontario. However, climate change does

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factor into three unique streams of programmatic action prior to the 2008 policy mandate. First, instances where climate change, greenhouse gas emissions, or global warming were mentioned included activities around "Clean Air Days" and provincial "Idle free" legislation — particularly around schools, which demonstrates the inseparability of climate change with the broader air quality discourse. This was reiterated by one of the interview participants who said:

We still today support Clean Air Day and as an organization the municipality still offers free bus rides every first week of June. That happens on that Wednesday. So we still do the advertising. That never went away. We still continue to do that piece, but it's a very minor piece now in comparison to what we tried to make of it. (Syndra, Environmental Health Manager)

A second piece of programming prior to 2008 was the monitoring of health-related impacts from poor air quality and extreme heat, often in collaboration with the Ministry of Environment. In this instance, there is some evidence from the web scan that indicates the discourse of climate change was invoked to further communicate the health risks associated with exposure to poor air quality and high temperatures, although the active linking of these issues to climate change was primarily present in health units occupying the GTA-Niagara corridor.

Finally, although occurring to a lesser degree, some public health units began creating advocacy coalitions with research institutions and community organizations, such as the Clean Air Partnership and the GTA Clean Air Council, to begin to develop strategic plans for how best to approach climate change from a public health perspective. Numerous working groups were formed at the provincial level, including the participation by several health units in the development of the 2008 environmental health hazard protocols. Some regional municipalities entered into conversations around the development of regional climate change strategies and emissions inventories, with several health units playing a supporting role.

Following the enactment of the OPHS, however, climate-related practices began to proliferate across the province, largely driven by practitioners reading the protocols as an impetus to "champion" climate change at the regional level. Table 3 provides an overview of six specific areas of climate change adaptation from Ontario public health units broadly classified as: capacity building and knowledge exchange; management and planning; disease surveillance and analysis; communication and outreach; green infrastructure; and localized food production. It is notable to mention that health units have been required to monitor and report outbreaks of infectious disease prior to the implementation of the OPHS. However, it

Table 3. Typology of adaptation strategies pursued by Ontario public health units

Adaptation Strategy	Examples
Capacity building and knowledge exchange	Training workshops; provincial meetings; roundtable exercises; information sharing
(Intersectoral) management and planning	Reviews of official plans; participation in regional climate change strategies; sourcing funding
Surveillance and analysis	Warning or observation systems (heat, air quality, vector-borne disease, water quality); epidemiological surveillance; vulnerability assessments
Communication and outreach	Dissemination of behaviour change messages (e.g., sun safety campaigns)
Green infrastructure	Organizational "greening"; built environment initiatives; urban forestry strategies
Localized food production	Development of local food charters

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was not until after 2008 that we begin to see infectious disease concerns tied directly to climate change, particularly those related to West Nile Virus and Lyme disease, although actions are primarily oriented towards the continued surveillance of these diseases, opting to primarily 'wait and see' what happens prior to designing new public health interventions to address possible increases in incidence and prevalence.

The majority of actions fall under the first four strategy types, with green infrastructure and localized food production emerging in but a few health units as upstream strategies to combat (i.e., mitigate) and adapt to climate change. In the interview data collected, it appears that the emerging "best practices" for climate change adaptation in Ontario currently fall under four programmatic areas. First, conducting vulnerability and adaptation assessments to assess baseline community vulnerability and the adaptive capacity of public health and community infrastructure seems to currently be in vogue among Ontario health units as an "aggressive" strategy to better understand the impacts of climate change across populations:

The health unit wanted to do something like other health units… [Health unit name omitted] has aggressively done the climate change work for their vulnerability assessment, so we wanted to be participants in that, so that we can better protect our community. (Darius, Environmental Health Manager)

At least two health units had completed comprehensive climate change and health vulnerability assessments that looked at health impacts at present and into the future using climate models to project future changes to health. An additional three health units conducted scoping reviews of the literature to broadly identify "vulnerable populations" that may or may not be present in their geographic area, but which are captured in the peer-review and grey literature.

Second, participating in regional climate change strategies is an adaptation option that was undertaken by at least eight health units. While such strategies are largely a capacity-building and collaborative exercise, public health units are active members of regional conversations on this subject and are aggressively considering how their existing competencies and expertise might contribute to an integrated regional strategy.

Third, "organizational greening" has been undertaken by at least two health units, where corporate practices have been analyzed to seek out energy efficiencies and lead by example before developing community interventions. This has proven to be a transformative step in fostering a broader culture of sustainability in the workplace:

It's certainly taking it internal, right, instead of...[absolutely] mitigation vs. adaptation in the community. It's sort of looking internally and saying what could we or should we be doing … to reduce our carbon footprint and other impacts on the environment. Leading by example. So, we've ... gradually implemented many of the recommendations about procurement, about reduced light usage, the temperature settings in our buildings, reflective coatings on windows. Sort of energy-conservation measures. We've really gone after transportation. So we've communicated repeatedly the importance of people carpooling and not travelling at all if they can webcast it instead or teleconference it instead or using public transportation or even active transportation if it fits. (Alistair, Medical Officer of Health)

A final emerging best practice relates to the built environment. Some health units highlighted their participation in urban forestry strategies, active transportation initiatives, and regional infrastructure development. However, several practitioners were critical of the emerging provincial emphasis on built

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environment strategies in relation to climate change (Dimoulas-Graham et al., 2012; OPHA, 2011; Perrotta, 2011), and questioned the degree to which the climate change discourse was actually present in built environment work:

And while, right now, the ministry and the Chief Medical Officer of Health for Ontario is promoting chronic disease prevention and obesity reduction strategies, and health units working with the municipalities on the built environment, like building walkable communities. I think that unfortunately they don't want to get message overload and they think they've got to target one message. That might be the strategy they are using, but I think there's such a unique opportunity right now if you are promoting walkabilty for physical activity, in just your second breath you could say you are reducing GHGs and addressing climate change and air quality. (Janna, Environmental Health Manager)

I think we at some point need to look at how you take it to the centre. There is an Ontario Public Health, public health sector strategic plan that was just launched by the Chief Medical Officer of Health in April, and it has a section on the built environment, and this is actually, environment, environmental health in general, and a specific area of focus on the built environment. It doesn't explicitly speak to climate change, and I think a future iteration of that plan should. It would be a worthy target that a future version of it actually speak to climate change. To actually become sort of a collective area of focus for all of public health. I would hate in a hundred years for people to look back and say "where were you?" (Alistair, Medical Officer of Health)

In both of these examples, practitioners signal that existing practices in public health may not go far enough with respect to the built environment, thereby actively questioning the degree to which co-benefits of climate change adaptation work are being stressed or emphasized. From their perspective, this raises an important question about how the work is focused and framed when climate change is left out of the conversation.

DISCUSSION: PUBLIC HEALTH POLICY AS CONSTRAINING AND ENABLING FOR FIELDS OF PUBLIC HEALTH PRACTICE

Results indicate that fourteen of twenty interview participants referred to the OPHS mandate to engage with climate change from a public health perspective, but participants had different interpretations of what the policy meant and how it should be implemented. The organizations that tended to be furthest ahead in terms of climate change work do not frequently invoke the OPHS, but describe particular programs they have developed and delivered. In this regard, the broad mandate present within the OPHS leaves room for a range of possible interpretations that can either limit or open up new opportunities to take action. For example, one environmental health manager indicated that the standards give practitioners new opportunities to explore climate change in relatively nuanced ways:

The public health standards now provide a little bit more latitude. So there's you know, more opportunities to do more health promotion around exposure. So we, you know, for example, we're responsible for increasing public awareness around health risks associated with a lot of health hazards, and one of

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them being climate change and extreme weather and outdoor air quality. So, that gives us a little more [laughs]. At least I feel like I have a little more latitude or opportunity to explore more than we have in the past and in — you know, there's more of a role on supporting public policy in the standards as well. (Evelyn, Environmental Health Manager)

However, the opposite can also be true, where a broad policy mandate is read in a way that stifles innovation and action is directed to meet only a minimum standard:

So the question's going to be, once the information is out there, how long is it going to take for the broader Ontario public health to start changing its attack on stuff? …I've also said to people that the health standards talk about outreach and communication on climate change and extreme weather and leave it kind of broadly. (Udyr, Research and Policy Analyst)

What is clear from this discussion is that the existing policy mandate in Ontario has created space for practitioners to pursue a variety of strategic options related to climate change adaptation, and that a broad policy mandate can either enhance or inhibit innovation. However, it is probably fair to conclude — especially since thirteen health units declined to participate in this study given they had little to offer — that the OPHS have not translated into equal action on climate change across health units and that policy implementation is not necessarily commensurate with the intentions of the formal policy statement.

In this regard, the intensity of action on climate change adaptation can take the form of positive responses where health units use procedural tools to support existing actions and core functions of public health practice by integrating climate change into pre-existing programming. However, increased innovation can also take form through small-scale positive responses that use substantive programmatic "experiments" to carve out entirely new areas of practice. Such innovation recognizes the limitations of a health-protection focus that reactively responds to health impacts instead of engaging in a proactive agenda to mitigate and adapt to health impacts that are forecasted twenty-five or even fifty years into the future.

Successful pilot projects open the possibility for future policy change, while an alternative interpretation of existing policy protocols might reinforce the status quo of public health practice by re-emphasizing traditional responsibilities. Moreover, some health units may interpret the broad policy mandate as lacking clarity, or worse, as creating new responsibilities with the same amount of resources — which may effectively inhibit innovation and prevent health units from engaging with climate change entirely.

However, there are still significant challenges in advancing the climate change agenda in Ontario, particularly in relation to emerging infectious diseases. Findings above demonstrate that most of the work across the province is focused on disease surveillance and risk communication and more proactive actions in the face of climate change are limited. Indeed, the OPHS has a number of pre-established protocols to deal with infectious diseases that have a long history of affecting population health in Canada. The mandated activities are largely in line with what has been presented above: disease surveillance, health promotion (i.e. risk communication), and health protection (i.e. health inspections of high risk areas of potential transmission). This raises two particularly interesting questions. First, are existing public health activities in Canada adaptive enough to deal with the health impacts of climate change, and second, are the existing provincial policies robust enough (as suggested by some authors—see Clarke & Berry, 2012) to trigger action on emerging infectious diseases that do not have a long standing history of public

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health intervention in Ontario? These questions are perhaps, more relevant than ever as climate-sensitive infectious diseases (e.g. Lyme Disease, the West Nile Virus, Dengue, Malaria, endemic fungal diseases) pose new risks to the health of North American populations (Greer et al., 2008)

POLICY RECOMMENDATIONS TO BOLSTER ADAPTIVE CAPACITY

Several policy recommendations for local public health practitioners and regional/provincial decision-makers follow from these findings. These recommendations include:

1. Making the connections between climate change and health explicit for the practicing public health community;
2. Acquiring the resources and training necessary to conduct prospective disease modeling;
3. Conducting climate change and health vulnerability assessments to understand baseline exposure, sensitivity and adaptive capacity;
4. Utilizing adaptive management principles to help develop new programs, and evaluate their success; and making the political and economic case for programs that have co-benefits which improve community well-being and bolster adaptation to climate change at the community level.

While many existing actions on climate change are oriented toward building capacity to begin to address emergent health implications, there is still a lack of awareness of climate change as a public health issue, and a lack of clarity in the existing provincial protocols. It is therefore clear that policy should enhance the emphasis on the association between environmental issues and health, including the health-enhancing effects or co-benefits of pro-environmental behaviours (Plotkinoff et al., 2004).

The OPHS is a significant piece of legislation that outlines protocols for health surveillance and monitoring. However, there is a need to engage in the *prospective* surveillance of health impacts that are projected to increase under climate change (Ostry et al., 2010) which requires the provision of relevant high-resolution regional climate models to forecast a variety of scenarios into the future and engage in adaptive management based on those projections (e.g. the BRACE framework in the United States). This would require additional resources to be allocated and guidance provided to health units and increased awareness about how to use climate-specific information (Clarke and Berry, 2012). Indeed, Canadian federal support for climate change and health initiatives is currently limited relative to the United States.

Since climate change will strain health services unequally across the province, there is a need to understand existing vulnerabilities in the health sector, as well as broader community vulnerabilities. Some of the identified limitations of existing environmental health assessment methodologies might be overcome by conducting localized vulnerability assessments (Shin and Ha, 2012; WHO/PAHO, 2012). Several health units have embarked on this path. Undertaking a vulnerability and adaptation assessment requires practitioners to apply their in-depth local knowledge of human health in the context of climate change. Since the impacts of climate change will be regionally specific and health units already have regionally specific health needs, assessment methodologies should strive to identify adaptation options that are customizable for local conditions and populations (Ostry, et al., 2010) to better contextualize community vulnerabilities given that these are often intertwined in unique, place-based settings (Yardley, et al., 2010). Numerous frameworks exist to assess local vulnerabilities based on the conduct of a

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scoping review, the assessment of current health vulnerabilities under historical climate conditions, the assessment of future health vulnerabilities under future climate conditions, the prioritization of suitable adaptation options, and the evaluation of those options (Wardeklier, et al., 2012; WHO/PAHO, 2012).

However, undertaking a vulnerability and adaptation assessment requires that program managers are able to continually evaluate programs and policies in real time. Due to the uncertainty of climate change models and regional impacts, managers will be required to update baseline information from assessments and refine programs as patterns in health impacts continue to emerge. Adaptive management protocols have been forwarded as a potentially useful policy tool for engaging in climate change adaptation in the public health sector (Ebi, 2011; Hess, et al. 2012). Adaptive management relies on collaboration between multiple stakeholders that participate in co-defining particular problems and identifying particular solutions with the goal of projecting the possible consequences of pursuing different decisions over time and weighing stakeholder tolerance to outcomes over the longer term. This approach is broadly related to the developmental evaluation (Patton, 2011) of existing programs, and emphasizes the procedural "learning by doing" and evaluating program efficiency and effectiveness under changing climatic and social conditions. Adaptive management is well suited to addressing complex problems, and the OPHS policy statement could go to greater lengths to mandate the evaluation of environmental health hazard programs by the provincial governing body in order to reflect and assess the changing nature of best practices over time, while ensuring that information pertaining to promising practices is communicated back to health units in a timely fashion (Morris, 2010).

Finally, a significant focus in the international literature on public health responses to climate change emphasizes the health co-benefits of adaptations in other sectors through healthy public policy initiatives (Cheng and Berry, 2012; Haines, et al. 2009; Younger, et al. 2008). To that end, the use of health impact assessment methodologies in collaboration with other sectors (Patz, et al. 2008) is a useful mechanism to understand the influence of policy decisions on human health. This is particularly salient given that there is a relative paucity of attempts to incorporate climate-change-related health impacts as an input into existing environmental health impact assessment methodologies due to challenges with data collection, data quality, and persistent issues around stakeholder engagement (Turner, et al. 2013). While "built environment" initiatives are a growing area of focus for Ontario health units (OPHA, 2011; Dimoulas-Graham, 2012), climate change rarely enters into these discussions.

CONCLUSION

The relatively broad policy mandate from which to engage with climate change from a public health perspective leads to differing interpretations and programmatic outputs. First, the broad policy mandate has enabled public health officials to put off acting on the province's changing climate by waiting for more definitive protocols. Second, public health officials from health units that are relatively better resourced (i.e., have more staff and funding) have used the broad mandate to engage in and justify innovative adaptation activities.

Future research and provincial policy development should strive to be mindful of existing disparities between health units to ensure that programs can be adequately delivered across contexts. Governmental support for implementation and evaluation of public health activities both directly and indirectly related to climate change's health impacts should be considered, as modeled by the Building Resilience Against

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Climate Effects (BRACE) model funded by the Centers for Disease Control and Prevention (CDC) in the United States (Eidson et al., 2015). Moreover, it is clear that infectious diseases are a largely neglected topic in the Canadian context of public health adaptation to climate change, and the "wait and see" attitude expressed by some decision-makers is likely to limit the effectiveness of climate change adaptation policies. The belief that existing policies will be robust enough to treat emerging infectious diseases has therefore been called into question in this chapter. Instead, this chapter argues that in order to truly engage with the upstream determinants of health, public health decision makers will need to name climate change as a legitimate threat to public health and engage with the discourse in a way that shows how public health institutions can contribute to solving one of the most complex and challenging issues of the twenty-first century.

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APPENDIX: INTERVIEW QUESTIONS

1. Please tell me about the work that you do with your health unit?

[Probe: organizational structure; personal history with organization; training; education; work; how they became involved with climate change related work (OPHS as entry point?), if at all, and associated personal motivations and trajectory of that work]

2. What are you and your colleagues to address issues of adaptation to climate change?

[Probe: what does this work look like on a day-to-day basis (in terms of practice); focus and rationale of particular initiatives; who else are they working with]

3. What role does health equity play in the climate change work that you and your colleagues are conducting?

[Probe: priority populations; specific activities; specific foci]

4. How is the work you and your colleagues do on climate change positioned relative to other programs or work that your organization conducts on a day-to-day basis?

[Probe: how do other members of your organization think about and navigate climate change as a public health issue; does climate change adaptation require a different approach compared with other environmental health issues; what do you think a public health approach that engages with climate change adaptation should ideally look like?]

5. What has been challenging in climate change adaptation work from a public health perspective?

[Probe: push-back encountered (personal, organizational, external)]

6. What has worked well in your climate change adaptation work?

[Probe: practices, resources or assets that interviewee found useful/important; looking to the future, what resources or assets would be important to further this work?]

7. Based on our conversation today, are there any documents that it would be helpful for me to see and that would help me better understand the work you do?

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Chapter 56
A Systems Approach for Sustainably Reducing Childhood Diarrheal Deaths in Developing Countries

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ABSTRACT

Diarrhea is the second leading cause of death and is the major cause of malnutrition in children under age 5 worldwide. More than 50 percent of the cases occur in developing countries, particularly in sub-Saharan Africa and Southeast Asia. Open defecation, substandard fecal disposal systems, and contaminated water supplies are the typical causes of diarrheal diseases. This public health crisis in low income countries mirrors the experiences of today's industrialized nations two centuries ago. The lessons learned from their sanitary evolution can be instructive in charting a sustainable path towards saving the lives of almost 2 million children annually. In this chapter a case study of Cuba's sanitary reformation is also presented to showcase successes, similar to those of developed countries, within a developing country and economically challenging context.

INTRODUCTION

Diarrhea is the second leading cause of death and the major cause of malnutrition in children under age 5 (World Health Organization (WHO), 2013b). Of the more than 1.5 million childhood deaths due to diarrhea each year, over 50 percent of all cases occur in developing countries, particularly in sub-Saharan Africa and Southeast Asia (Walker et al., 2013). Diarrhea is usually a symptom of an infection of the intestinal tract and presents as the passage of three or more loose or watery stool at least three times per day or more frequently than normal for an individual (WHO, 2013b). The most common etiologic agents, namely bacteria, viruses and protozoa, are primarily transmitted via the fecal-oral route (Tinuade

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et al., 2006). This means that most diarrheal pathogens are transmitted from the feces of an individual to his/her and/or the mouth of another. The underlying assumption is: an individual must be exposed to or come in contact with the causative agent(s) to become infected and thus acquire the disease. This also implies that if the disease agents are removed or prevented from the environment of the at risk population, members will not become exposed and consequently develop the disease. Open defecation, substandard sanitation systems and subsequent pollution of nearby drinking water sources are usually implicated in disease causation (United Nations (UN), 2014). This is because fecal matter and its environmental repositories contain most common diarrheal etiologic agents. Thus, sanitation interventions such as latrines and, providing clean water and washing hands facilities, interrupt the fecal-oral transmission pathways. They are therefore effective in preventing and reducing diarrheal incidence, associated morbidity and mortality as wells as subsequent sequelae such as malnutrition. For example, research has shown that access to improved system of feces disposal may reduce the rate of childhood diarrhea by up to 43 percent (Cumming, 2009; WHO, 2013a).

In general diarrhea is, a very common, easily preventable and treatable disease, considered to be no more than a nuisance in most cases. In fact, there are about 1.7 billion incidence of diarrhea each year in both developed and developing countries (WHO, 2013b). However, developing countries are characterized by more adverse morbidity (persistent and reoccurring episodes) and higher mortality (death) health outcomes. For example, in developed countries the average disease incidence range from 1-3 episodes per person per year compared to 5-18 per person per year in developing countries (Guerrant, Hughes, Lima, & Crane, 1991). Rotavirus, which is a common cause of diarrhea in children under age 5 in the United States (US) causes about 300 deaths annually compared to over 220,000 actual hospitalizations (Pont, Grijalva, Griffin, Scott, & Cooper, 2009). In contrast, Rotavirus-induced diarrhea can be a death sentence for children in poor countries. For example, in 2008, the number of Rotavirus associated diarrheal deaths in some sub-Saharan African countries included, Angola (8,788), Uganda (10,637), Ethiopia (28,218), DR Congo (32, 653) and Nigeria (41,057) (Tate et al., 2012). The implication of this is, sadly, every 20 second a child, particularly in a low income country, dies of this relatively innocuous disease for which vaccine exits, is therefore preventable and for which treatment exists (Onda, Crocker, Kayser, & Bartram, 2014; UN, 2014). The World Health Organization (WHO) reports that children in sub-Saharan Africa are thus 16 times more likely to die before age 5 than children in developed regions and over half of these deaths could have been prevented by simple and affordable water and sanitation interventions (WHO, 2013a).

When one considers these somber numbers, it begs the question, is every life on this planet of equal value? In addition, should a child be condemned to unnecessary morbidity, misery and inevitable death, simply on the basis of a lottery of birth? This flies in the face of environmental justice, which demands that no one group should disproportionately bear the burden of adverse health outcomes from environmental hazards while not being able to enjoy the benefits available to other groups simply on the basis of geography and income. The solutions for sustainably providing and implementing clean water and improved sanitation and, reducing childhood diarrheal deaths exist, they are affordable and history has provided precedence that they work. What is left is the focused economic, social and political will of the international community and the affected countries to employ them. In other words, these large scale community health challenges are best tackled by employing a systems approach.

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BACKGROUND

Why Children under 5?

Child Mortality, also known as Under-5 Mortality, is a population measure that estimates the number of infants and children that will die before reaching age 5 in a particular geographic location. It is measured as a rate per 1,000 live births. For example, the Under-5 Mortality for Cuba is 7 while for Sierra Leone it is 182 (WHO, UN, United Nation Children's Fund (UNICEF), & The World Bank (WB), 2013). Based on these figures, the probability exists that for every 1,000 children born alive, 7 and 182 will die before their fifth birthday in Cuba and Sierra Leone respectively. Similar to Life Expectancy, which measures how long an individual may live if born in a particular country, Under-5 Mortality, highlights the overall health and wellbeing of a society and measures the long-term health trajectory of a country. Children, age 5 years and under represent the segment of the population most sensitive to environmental threats and are thus perceived, as it were, the "canaries-in-the-coalmine" for the entire populace (Meckel, 1998).

Not all persons exposed to fecal infectious organisms get sick and how adverse the episode is depends on the susceptibility of the individual. Children, in general, are particularly susceptible to diarrheal infections for a number of reasons. They have underdeveloped immune systems and are more likely to become sick or have more severe symptoms once exposed to pathogenic organisms. Malnutrition, concurrent infections and co-morbidities (e.g., HIV, malaria), which are often indigenous to developing areas, further overtax already fledgling immune systems, leading to more adverse and fatal outcomes (Avery, Anchang, Tumsweige, Strachan, & Goude, 2014; Checkley et al., 2008). Children tend to play in the dirt more and often put things in their mouths. Therefore, if their environments are unhygienic and contaminated with fecal matter, they are more likely to come in contact with infectious agents than their adult counterparts. Finally, small children commonly do not use latrines because they are typically not designed with them in mind and child-sized potties may not be available in poorer settings (Valerie Curtis et al., 1995; Yeager, Huttly, Bartolini, Rojas, & Lanata, 1999). As a result, they may defecate in areas that they play and/or frequent. This practice may be compounded by cultural ignorance about the infectious nature of stools from children (Brown, Cairncross, & Ensink, 2013). In fact, by virtue of their behaviors, children's stools tend to have higher concentrations of pathogenic organisms than their adult counterparts (WHO & UNICEF, 2009). These conditions operate individually and concomitantly to predispose children to reoccurring infections.

Repeated episodes of severe and/or persistent diarrhea in the early years of life can lead to serious, lifelong health problems and have been estimated to be responsible for about half of diarrheal related deaths (Brown et al., 2013). Diseases from enteric infections can lead to malnutrition, stunted growth, and impaired cognitive development (Checkley et al., 2008). Developing countries like Africa are home to the world's youngest population (Fatusi & Hindin, 2010). The youth cohort, typically ages 10-24 years, is the driver of population growth because they are in the potential and projected childbearing age range. With almost 70 percent of this population group living in developing countries, one can expect population explosions in these regions in the upcoming decades (Fatusi & Hindin, 2010). From a population dynamics perspective, this means diminished opportunities and productivity over a lifetime for potentially large proportions of the world's populations. Therefore, the long-term sustainable health

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and economic trajectory of our planet could potentially be short-circuited by high incidence of an otherwise preventable and curable disease. For example, the UN reports that sub-Saharan Africa loses 5 percent of Gross Domestic Product (GDP) annually due to health problems caused by lack of water and sanitation (Moszynski, 2006).

Traditional Approach to Solving Community Health Challenges

The traditional or reductionist approach to solving community health challenges has been; isolation of each health outcome, determination of the dominant cause and suggestion of vertical intervention programs to address each cause (Buchholz, Volk, & Luzadis, 2007; Novick, Morrow, & Mays, 2008). For example, if a rural community in a developing country is found to have a high incidence of diarrheal deaths, a Non-Governmental Organization (NGO) may determine that the major cause is the lack of proper excreta disposal or poor quality water or personal and domestic hygiene. The affected community then receives discipline-specific programs such as Oral Rehydration Therapy (ORT) (Pignatelli & Musumeci, 2003), or excreta disposal (Corrales, Izurieta, & Moe, 2006; Pruss & Mariotti, 2000), or wells (Caslake et al., 2004; McGuigan, Joyce, Conroy, Gillespie, & Elmore, 1998), or hygiene education (Val Curtis & Cairncross, 2003). This outlook has persisted despite emerging evidence that problems solved in this manner often fail or worse, create new problems (Corrales et al., 2006; Espinosa, Harnden, & Walker, 2008; Stepek, Buttle, Duce, & Behnke, 2006; Sterman, 2006).

Research show several instances of counterintuitive results from vertical interventions. Areas with high diarrheal deaths incidence tend to have high rates of open defecation (Schmidlin et al., 2013). As a result, latrine interventions have been aggressively promoted to interrupt the fecal-oral transmission of diarrheal disease. These relatively low cost infrastructures serve to remove feces from the living environment and in some cases protect the contents from flies which are indeed vectors of diarrhea-causing organisms. However, while well intentioned, latrines can actually increase disease incidence and prevalence in affected communities and may create new problems. Most latrines are simple pits in the ground with a superstructure as shelter. These pits are not typically lined and therefore the liquid content seeps out into the ground water taking along infectious organisms and nutrients (Dzwairo, Hoko, Love, & Guzha, 2006; Knappett et al., 2011; Mkandawire, 2008; Nyenje, Foppen, Kulabako, Muwanga, & Uhlenbrook, 2013; Suthar et al., 2009). Consider also if a water well had been dug within the flow path of the microbial and nutrient rich contaminant plume radiating from the latrine. Consequently, the water supply becomes a continual vector for not only diarrheal infectious organisms but also nutrient-related illnesses such as methemoglobinemia (blue-baby syndrome) (Suthar et al., 2009). Another unexpected finding is, over time, latrines may become transmission loci for increase disease incidence if there is no concurrent change in hygiene behavioral practices. For example, if an earth floor in a latrine is poorly maintained, it can become the focal point for disease transmission (Grimason, Davison, Tembo, Jabu, & Jackson, 2000). In fact, dirty latrines may result in higher disease incidence than would occur if people were practicing widely scattered open defecation (Cairncross, 1983). Finally, without adequate security infrastructure, latrines can become rape target areas where women and girls run the risk of being ambushed and brutally attacked (Amesty International (AI), 2010; WaterAid, 2014).

The preceding discourse is not intended to completely castigate current efforts and deny that they have shown some measure of success. For example, the proportion of the population in sub-Saharan Africa with improved sanitation, increased from 20 to 30 percent between 1990 and 2011, while those practic-

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ing open defecation decreased from 36 to 26 percent over the same period (WHO & UNICEF, 2013). Campaigns such as the UN's Millennium Development Goal (MGD) and the WHO's, "International Year of Sanitation 2008" have brought international attention to this very important cause. However, any optimism must be tempered with the reality that 115 people in Africa die every hour from diseases linked to poor sanitation, poor hygiene and contaminated water and that MGD for sanitation will not be met by 2015 (Onda et al., 2014). Further, only about 37 percent of the population in sub-Saharan Africa use improved sanitation, while globally about 2.5 billion people still do not have access (Letema, van Vliet, & van Lier, 2014; Zawahri, Sowers, & Weinthal, 2011).

Interventions to correct these public health challenges at this scale and magnitude require a systems approach. This framework acknowledges that the current health emergency arose out of centuries of ignorance, inertia and indifference. The systems approach also recognizes the inherent nonlinearity of the synergistic interactions among geo-political, socio-economic and environmental factors that have caucused to hinder solutions or exacerbate diarrheal disease establishment. Therefore, political advocacy by both national and international stakeholders, as well as the simultaneous or scaffolded application of multiple public health interventions, is needed to create solutions that are economically viable, culturally sensitive and ecologically sustainable.

Lessons from the Last Two Centuries

About two hundred years ago, the current public health crisis in developing countries, epitomized the experiences of today's developed countries such as the Great Britain (Chadwick, 1843). During that period, consequently, they too experienced similar morbidity and mortality rates (Burstrom, Macassa, Oberg, Bernhardt, & Smedman, 2005). In retrospect, it was the confluence of geo-political, social-economic and ecological factors which aided and/or hindered the sustainable transfer of solutions to these challenges for developed nations (Konteh, 2009). Today, advances in supplying clean water and safe sanitation systems, adequate nutrition, widespread use of vaccines in conjunction with enforced and progressive legislature, have contributed to a dramatic drop in deaths due to diarrheal diseases, which were at one time entrenched national problems. For example, in 1897, 54 percent of the infants' deaths in in the US city of Chicago were due to diarrheal infection (Wolf, 2001). European countries such as the UK consistently had infant mortality rates above 100 per 1000 live births (Chadwick, 1843; Regidor et al., 2011). Canadian babies fared no better with 145 infants dying per 1000 live births in the 1890s (Mercier & Boone, 2002). As it is today, social and political inertia played a significant role in hindering or aiding technology transfer and adaption. Thus, change did not always happen quickly after scientific discoveries elucidate and confirm disease causation. For instance, while the city of Philadelphia understood the connection between clean water and disease outbreak from as early as 1799 and the germ theory was widely accepted by the 1890s, up to 85 percent of its untreated wastewater continued to be dumped in the Delaware River as late as the 1940s (Philadelphia Water Department (PWD), 2002). Philadelphia was not unique in this practice, but was among many large cities with combined sewers who continued to subscribe to the theory that running water purify itself even after being disproved in both the US and Europe (Tarr, 1979). In the summer of 1832, disease broke out in Baltimore claiming 853 victims, yet the city's leadership delayed building comprehensive sewer systems until 1905, only acting after experiencing two more and similarly devastating epidemics (Rosenberg, 1987; Schultz & McShane, 1978). Contemporary high-income societies also faced unintended consequences during their

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sanitary reformation. For example, in the 1800s, mothers in the US were encouraged to feed their babies milk to help reduce childhood mortality rates, but the milk was contaminated with feces laced water thus increasing infant mortality rates (Ward & Warren, 2007).

Similarly, for developing countries, poor sanitation and high disease burden arise out of and are driven by concomitants of socio-economic underdevelopment and an environment that facilitates the proliferation of pathogens (Santiso, 1997; WHO & UNICEF, 2013). While being cautious not to assume that the sanitary and health dynamics of developed and contemporary developing nations are uniform in their trajectory, it is beneficial to observed commonalities in progression and adaptation of lifesaving public health interventions. This is with the hope of finding evidence of successes that worked over the years and that can be modified and made applicable within contemporary low income contexts.

PUBLIC HEALTH TRAJECTORY IN THE DEVELOPED WORLD

Reoccurring cycles of industrialization, chaotic urbanization and sanitation-related disease outbreaks in 19th century's developed countries served to socialize the connection between public health and the environment among the general populace. As industries grew, great swarms of people flock to urban areas in search of work and a better life (Ausubel, Meyer, & Wernick, 2001). Rawlinson (1853), in the minutes of proceedings of the Institution of Civil Engineers (Great Britain) highlighted these dilemmas. Rawlinson mentioned great population increases, some of over a million people in just a decade; the inability of the infrastructure to support such influx; and the subsequent increases in disease incidence with highest mortality, as much as ten to one, in the "unhealthy parts of town". The disparity in the death rates between rich and poor was so pronounced that the lower class in Paris surmised that the disease outbreaks were a conspiracy by the nobility to wipe them out (Rosenberg, 1987). In the US, the prognosis was no better. In the summer of 1832, disease broke out in Baltimore claiming 853 victims, most of whom were poor (Schultz & McShane, 1978).

These empirical observations helped to establish the connection between disease epidemics, poor sanitation and personal hygiene, and unhealthy environments (Tarr et al., 1984). As acceptance to the germ theory grew, in the 1890s, public health advocates in concert with public outcry, lobbied municipalities to implement many public works projects including comprehensive sewer systems, and water and wastewater treatments systems (Wolf, 2007). At first, gross mortality rates were used to measure the efficacy of these interventions. However, this rate was easily confounded by so many other variables that causality was not easily ascertained. The age-adjusted mortality, more specifically child mortality rate was a more proximate measure and had the added advantage of eliciting empathy from decision makers and the public in general (Rosenberg, 1987; Wolf, 2007). Concurrent to these activities was the promulgation and enforcement of a series of legislatures and policies designed to streamline the decision making processes for activities that affect the health of citizens (Perdue, Stone, & Gostin, 2003). One benefits of these laws was to authorize local and state government to tax and spend, and in turn gave them control over the direction of their development, which up until then was a mélange of private interests and public pressure (Jon, 1979).

Accompanying these large scale public works projects and, changes in legislature and community governance were ubiquitous educational campaigns aimed at socializing scientific discoveries in popular culture and help the ordinary citizen make the connection between their hygiene behaviors and the spread

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of disease (Ogle, 1993; Tomes, 1998). Communities thus armed with socially instrumental knowledge were able to forcefully lobby their local, state and national governments to make public health investments such as water purification and sewerage systems, garbage removal and children immunization.

As the mortality rates decreased as a result of these efforts the discussion moved on from how to achieve universal coverage to how best to engineer the system. For example, there were vigorous arguments on whether to use separate vs combined sewer (Tarr, 1979) or small-pipe vs large culvert (Jon, 1979). Notwithstanding, successful sanitary revolutions in developed countries all seemed to follow similar trajectories. Once the gravity of the public health crisis has been acknowledged by authorized stakeholders, a process was typically implemented to reduce the mortality and morbidity outcomes of those already affected such hydration therapy or increasing the availability of training medical professionals. Once disease outcome rates start to respond to interventions a series of disease disruption and prevention strategies are then employed whether in tandem or as next steps. These typically involve, public health legislature (e.g., Public Health Act of 1875, 1936 & 1984 in the UK), hygiene education campaigns, creating environments that protect whole community such as sewerage system and piped water while providing universal access and, employing prevention efforts such as immunization and chlorination (Ausubel et al., 2001; Center for Disease Control and Prevention (CDC), 1999; Coker & Martin, 2006). The final stage in this evolutionary process is that of protecting the health of the environment in an effort to protect the health of the community. For example, starting around the early 1970s, the US enacted a series of environmental legislature authorizing the US Environmental Protection Agency (EPA), Clean Water Act, the Safe Drinking Water Act and the National Pollutant Discharge Elimination System (NPDES) (Kapp Jr, 2014). The UK also enacted comparable legislature dating back to 1860s but more recently the Environmental Protection Act of 1990 (Holland & Boon Foo, 2003).

Sustainable Access in the Context of a Developing Country: The Case of Cuba

"Lack of resources" is typically invoked by policy and decision makers in developing economies to justify the lack of progress towards realizing sustainable access to water and sanitation for their constituents. This excuse is by no means unique to developing countries and has been historically used to hinder the progress of previous sanitary reforms (Hanley, 2007). Therefore, providing an environmental that supports the health of each citizen is not simply about wealthy and poor countries, though that plays a role, but it is more importantly about societal and political will and focus. For example, Cuba has a lower Under-5 Mortality rate than the US, coming in at 5.5 per 1,000 live births (Cooper, Kennelly, & Orduñez-Garcia, 2006). In the 1960s, Cuba's Under-5 Mortality rate was almost thrice that of the US (29 per 1000), topping out at 91 per 1,000 live births (Kuntz, 1994). Even more remarkable is that the country made these health gains in spite of tremendous economic struggles cause by trade embargos that impacted food and medicine supplies.

Cuba's health status indicators, such as Under-1 or -5 Mortality rates, transitioned from those typical of a contemporary developing country to those synonymous with the developed world. Similar to today's lower income nations' health profile, the main causes of Cuba's historically high childhood mortality were infectious diseases. In the early 1950s to mid-1960s communicable diseases such as diarrhea accounted for 80 percent of the Under-1 infant mortality rate (Valdés, 1971). In response to this colossal human tragedy, hospital administered rehydration therapy programs were instituted and the rate fell to 16 percent in about four years (Drain & Barry, 2010). While mortality rates declined, diarrheal disease

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incidence, however, continued to be high in the general population with almost a million cases in 1984 (Terris, 1989). As it is today among developing countries, this was primarily due to low water and sanitation coverage (McLeod, 2010).

Currently in developing countries, open defecation rates and low access to medical services in rural areas and consequent diarrheal disease incidence are significantly higher than urban regions. A similar urban – rural divide existed in 1960s Cuba. For example, there was only one rural hospital and rural infant mortality was about 100/1000 live birth. Most physicians practiced in urban areas where patients could more likely pay for services. In a 1959 comprehensive health study, the health authorities found that about 70 percent of all Cubans had parasites while the rural incidence was closer to 90 percent (Valdés, 1971). Thus, the areas that needed the most help had the least service. To overcome this socio-economic and subsequent health disparity and inequity, both rural and urban medical services were provided to all for free at the neighborhood level. As disease incidence declined, the strategy changed from providing medical services to as many people as needed to one of prevention and health promotion. This included the implementation of a series of nutrition, vaccination, housing and environment improvement, sewage disposal and improved water supply programs (Kuntz, 1994).

As mortality (less people dying) and morbidity (less people getting sick) rates decline, Cuba undertook a public health path similar to that of developed countries by enacting legislature and made steps to provide sanitation and health access to all Cubans. As part of their 1976 Constitution and 1983 Public Health Law, Cuba created national public health system with the aims of universality and accessibility, vertical integration, and inter-sectoral planning, as seen in the following fundamental principles (Iatridis, 1990; De Vos et al., 2009):

- Health care is a right, available to all equally and free of charge.
- Health care is the responsibility of the state.
- Preventive and curative services are integrated.
- The public participates in the health system's development and functioning.
- Health care activities are integrated with economic and social development.
- Global health cooperation is a fundamental obligation of the health system and its professionals.

The process was not without its own fits and starts. While high level rights were being enshrined in the constitution to provide comprehensive coverage, patients were complaining of long waiting times to see doctors and that the visits were too short to address their needs (Márquez, 2009). In response to these complaints the government created community-based polyclinic system with the mandate to providing comprehensive care in residents' local community (Wong & Wylie, 2010). Policymakers understood that health and illness emerged out of a confluence of people interacting with their environment, therefore all community members from health workers to school students are taught not only the health status of their community, but also the environmental, social, cultural and economic factors that affect it (Spiegel & Yassi, 2004). By the early 1980s Cuba spent about US$ 49 per person on health while providing about 6 beds per 1,000 persons and about 55 health professionals per 10,000 persons. By 2009 Cuba provided physician and nurses at a rate of 63 and 84 per 10, 000 population. To put this in context, the US's rates are 23 and 79 respectively (Márquez, 2009).

Cuba is known for its many skilled doctors and trained health professionals, a comprehensive network of regional and national hospitals and, community clinics, universal literacy, and seamless integration of public health and clinical medicine that emphasize prevention and health promotion. Prevention strate-

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gies include neighborhood environmental cleanup and in home hygiene (Dresang, Brebrick, Murray, Shallue, & Sullivan-Vedder, 2005). The Cuban experience models sustainable solutions to community health challenges, in a developing world context, when decision makers choose to prioritize human capital development in the face of limited resources. For example, in 2006 Cuba spend $355 per capita on health while the US spent $6714 per capita while achieving similar population health outcomes (Drain & Barry, 2010; Márquez, 2009).

WHERE ON THE SANITARY REFORM TRAJECTORY ARE DEVELOPING COUNTRIES?

Based on the preceding case studies, sustainable reduction in childhood diarrheal deaths followed a health trajectory that includes mortality and morbidity control, systemic and universal access to clean water and improved sanitation as well as supporting legislature along the way. Where along this progressive process are contemporary developing countries? Based on the discussion in the "Traditional Approach" section above, developing countries have experienced a hodgepodge of targeted health interventions in each of these phases without any long term plan and coordination.

For example, starting in the mid-1980s, ORT was dubbed "the most efficacious strategy for reducing mortality" (Taylor, Ha, Frank & Whiter, 1990). Studies later found that while ORT was effective against acute diarrheal episodes, it was helpless against persistent and reoccurring cases, which are more likely to have mortality outcomes (Guerrant et al., 1991). That is, while ORT may save a child from one particular bout of diarrheal infection, he/she may later die due to reoccurrence of this disease and/or its sequelae. In addition, programs were implemented over definite periods and then stopped before gains could be institutionalized or reached less well-off members of the communities (Gwatkin, 2003; Miller & Hirschhorn, 1995; Taylor et al., 1990).

Water and sanitation efforts have led to fragmentation and disproportion in coverage. After research in 7 developing countries by WHO between 1960 -1965 found that children under age 6 had a 40 percent monthly diarrheal prevalence rate, the international financial community donated a total of US $9 billion for water supply and $3.4 billion for sanitation improvements between 1970 – 1975 (Yongsi & Dovie, 2007). Today, the world is off track to meet the 2015 Target 10 of Millennium Development Goal 7 for improved sanitation while the goal for water was met 5 years ahead of schedule (UNICEF & WHO, 2012).

LAWS AND LATRINES: HUMAN RIGHT TO WATER AND SANITATION

With regards to legislature, there has also been an assortment of legal instruments and policies that have cropped up over the years. On July 28, 2010, the UN General Assembly, for the first time, explicitly recognized the right to both water and sanitation as a singular human right and acknowledged that access to clean drinking water and adequate sanitation is essential to the realization of all human rights (Luh, Baum, & Bartram, 2013). Resolution 64/292, though non-binding, calls for member States and international organizations to provide financial resources, help capacity-building and technology transfer to help countries, particularly developing countries, to provide safe, clean, accessible and affordable drinking water and sanitation for all. A few months later, the UN Human Rights Council affirms that the right to water and sanitation is indeed part of existing international law and confirms that the right

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is legally binding upon States Parties (Council, 2010). This breakthrough came after decades of arduous and exasperating debates and is welcomed news for the over 700 million and 2.5 billion people without access to safe drinking water and improved sanitation respectively (UNICEF & WHO, 2013).

It would not be good form to understate the gravity of such monumental achievements, however, the undeniable fact remains; too many children are unnecessarily sentenced to this colossal daily tragedy. Indeed, in the years leading up to 2010 several conventions, initiatives, goals and resolutions, alluding to varying degrees of human right to water and sanitation, were proposed with mixed success. For example, in November 2002, the UN General Assembly confirmed the right to water in international law (UN, 2002). Though not legally binding, General Comment No. 15 interpreted the International Convention on Economic, Social and Cultural Rights (ICESCR), explicitly outlined States Parties' obligations to the right and defined what actions would constitute a violation. The majority of States in the world are parties to the Convention with a few exceptions (UN, 1966). Yet during the period 2002 to 2010 these signatories fell short of realizing and protecting the right to safe drinking water for their citizens.

South Africa showed exceptional foresight by including these rights in its constitution. Article 27 of the Constitution of South Africa (1996),

1. Everyone has the right to have access to … (b) sufficient food and water; and … 2. The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realization of each of these rights.

South Africa's Water Services Act and National Water Act further elaborated on this constitutional right in 2001 when it recognized the right to water in its Reconstruction and Development Plan in its Free Basic Water policy. This policy has the aim to ensure adequate access by mandating 25 liters of water per day per person (Curry, 2010). Unfortunately, large discrepancies in coverage exist around the country where on average "wealthy, mostly white South Africans…use 600 liters per person per day… poor and largely black residents… 10" (Bakker, 2003).

A large scale example of poor implementation is the African Charter on the Rights and Welfare of the Child (AfCRC) 1990, which most African States were party to (Khalfan et al., 2007). This regional legal instrument mandated States to "ensure the provision of adequate nutrition and safe drinking water". Yet from 1990 to 2000, Africa is the only region in the world to show a decline in the proportion of the population that has access to water and sanitation (Boschi-Pinto, Lanata, Mendoza, & Habte, 2006). What if anything is now different? Will an explicit, legally binding international instrument change what happens on the ground in rural villages in Southeast Asia or Africa?

Every country in the world is now party to at least one health-related human rights treaty which typically includes provisions of related conditions to facilitate the privileges promulgated by the legal instrument. However, being signatories of international human rights instruments and/or inclusion of access to water and sanitation in countries' constitution do not inevitably lead to implementation and subsequent realization in the lives of the average household. As the international community explicitly acknowledges that access to safe water and improved sanitation is indeed a single human right, what prerogatives does this right afford the average citizen? Member States must in turn adopt legislation identifying the legal duties of national and municipal authorities, and prescribe normative course of action in response to violations to the explicitly stated entitlements of each citizen. As history has shown, this is an important phase in the progressive journey of sustainable sanitary reform.

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CONCLUSION AND RECOMMENDATIONS

Diarrhea is in general, an easily preventable and treatable disease. Yet, it kills so many each year, especially children in developing nations. Diarrheal disease incidences in developing countries are typically as a result of fecal-oral transmission. History has provided case studies indicating the strategies needed in order to sustainably reduce diarrheal morbidity and mortality. A systems approach has been shown to be most effective. This include public health investment, laws, political advocacy as well as the simultaneous or scaffolded application of multiple universal public health interventions such as hygiene education, and water and sanitation systems. Each of these interventions has been deployed in developing countries at one time or the other. However, their implementation has been ad hoc without long term and sustained efforts.

Disease transmission is a complex process and no single intervention is foolproof. In fact, single intervention strategies tend to be unsustainable and in worse cases can create new problems. Contemporary developed countries faced similar challenges in the past and it was only through a series of sustained implementation of several public health programs that they were able to break the cycle of death and disease. While lack of resources is certainly a barrier for developing economies, the case of Cuba points to the need for social and political will to want to increase the human capital of the constituents.

The health and sanitation trajectories of Cuba and developed countries have many things in common. One important factor is that of sovereignty. That is, the countries involved, had the freedom to create long term goals and implement them without the constant pressure of external reporting and auditing. Governments of many developing countries do not have this freedom and tend to align their public health policies and priorities to the interests of advanced nations who provide funding (Konteh, 2009). For example, up until the mid-1970s, the World Bank seemed to only support sanitation projects where industrial demand indicated that it would produce a good economic return on the investment. Much of the capital aid provided was therefore earmarked for industrial output rather than human capacity building under the assumptions of 'trickle down' economics and that wealth creation was a fundamental precondition for improving health to rural areas and the urban poor (Pickford, 1980). Cuba provides a natural experiment – it was able to develop and implement policies without the financial backing and therefore mandates of the international community. Indeed it got support from the Soviet Union, but it saw fit to develop it human, medical and environmental resources to meet health needs of its populace.

As the international community acknowledges the once implicitly mentioned, right to access safe water and adequate sanitation, it is important that developing countries seize this opportunity to exert sovereignty in creating and implementing policies that promote sustainable access to water, sanitation and good health within the context of their own socio-economic, geo-political and ecological reality. With regards to the lack of structural, social and political infrastructure that is typically cited as being a barrier in developing countries for technology transfer and institutionalization of gains, one only has to look back in history to see that such were also the conditions that existed in currently successful developed nations.

Therefore, sustainable and permanent change can only occur when affected countries, governments and citizens treat and expect the provision of improved sanitation systems and the subsequent health benefits, as fundamental rights commensurate with any other fundamental human right, such as the right to life, liberty and security of person. This right to good health and freedom from disease can only be realized when local and national governments acknowledge that providing equitable access to water and sanitation is a crucial component of social and economic development and support intensive efforts to

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educate and raise awareness of all segments of society. Decision makers in developing countries must come to the realization that ensuring environmental justice for all cohorts of their populations benefits everyone and moves the country forward as a whole. President Franklin Delano Roosevelt echoed this sentiment in his second Inaugural Address, "The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have little" – Second Inaugural Address (Jan. 20, 1937), in Great Speeches 61 (John Grafton ed., 1999).

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KEY TERMS AND DEFINITIONS

Diarrhea: Usually a symptom of an infection of the intestinal tract and presents as the passage of three or more loose or watery stool at least three times per day or more frequently than normal for an individual. It is a very common disease and affect individuals in every country and from every socio-economic background. In healthy individuals there is usually little cause for concern as episodes tend to be self-limiting. However, for undernourished and disease weakened patients, especially children, persistently reoccurring episodes are typically life-threatening. The interaction between diarrhea and malnutrition is bidirectional and synergistic. During a diarrheal episode, the increased rate of the passage of food through the intestines reduces the digestion and absorption of macro and micro nutrients. In addition, patients with persistent diarrhea may have poor appetite and thus have a reduction in food intake. With limited nutrients, the immune system becomes impaired and is unable to respond to attacks from enteric pathogens. Therefore both diarrhea and malnutrition work in synergy to predispose affected individuals to reoccurring episodes, more severe symptoms and higher rates of mortality. Children are particularly susceptible because their immune systems are underdeveloped.

Disease Incidence: Incidence is the rate of new (or newly diagnosed) cases of the disease in a defined population (e.g., children under 5 years old) during a specific time period (e.g., a calendar year). It is generally reported as the number of new cases occurring within a period of time (e.g., 20 new cases of HIV infection occurred in village A during 2013. The defined population refers to the population at risk. This means that for the defined population, children under 5 years old, they are all at risk of getting diarrhea but do not have the disease at the beginning of 2013.

Disease Prevalence: Prevalence is the actual number of cases alive, with the disease in a defined population either during a period of time (period prevalence) or at a particular date in time (point prevalence). While incidence deals with entirely new cases, prevalence counts what exists. It is typically reported as a prevalence rate which is the proportion of ad defined population that has specific disease or attribute at a specific time.

Enteric Infections: Infectious disease of the intestines. Typical bacterial enteric infections include E. coli and cholera. These infections are accompanied by diarrhea, nausea and sometimes vomiting.

Environmental Justice: Requires that no one group should disproportionately bear the burden of adverse health outcomes from environmental hazards simply on the basis of ethnic and racial background, geography and income. Each cohort and/or people group must be fairly represented in all environmental related decision-making processes – so as to prevent environmental discrimination. Environmental

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discrimination occurs when certain communities, because of their minority or disadvantage status, bear a higher burden of risk from environmental hazards without enjoying the benefits that are easily accessible to other groups.

Health Outcomes: Simply put, are symptoms or result of health-related activities. They are measured on a continuum from morbidity (illness) to mortality (death).

Infant and Child Mortality Rates: Infant mortality rate is the number of children that die before their first birthday per 1000 live births in a country or geographical location. While child mortality is the number of children that dies under age five per 1000 live births in a country or geographical location.

Life Expectancy: The mean number of years an individual is expected to live if born and/or exposed to specific environmental conditions in a country or geographical location.

Open Defecation: The practice of depositing human stool outside particularly in areas where there is no access to improved feces disposal systems. It is typically a rural activity and about 1 billion persons practice it around the world. It is one of the main cause of diarrhea in developing countries.

Oral Rehydration Therapy (ORT): A mixture of clean water and electrolyte solution typically given in response to a diarrheal episode.

Sanitation: Generally speaking, sanitation encompasses fecal disposal systems, water treatment and delivery systems, personal and environmental hygiene education and practices as well as solid waste (garbage) disposal systems. In this work, sanitation typically refer to fecal disposal systems such as latrines in order to differentiate from water treatment interventions.

Sustainable Development: The conceptual framework for organizing plans and activities to achieve sustainability. Where a community's developmental activities is considered sustainable if it produces resources faster than they used, those resources are mostly renewable and/or infinite and, works in harmony with ecological systems to eliminate its wastes.

Systems Approach: A problem solving approach that views the problem (s) as part of an overall system. The component parts of the overall system are view in context to each other rather than in isolation. Therefore, rather than reducing a problem into the properties of its parts or causative components (as in the case of reductionist approach), this approach focuses on the arrangement of and the relations between the parts which connect them into a whole – based on the principle that the whole is greater than the sum of its parts. Instead of simply looking at problems through a linear cause and effects model, the systems framework recognizes the inherent nonlinearity of the synergistic interactions among systems components that can produce unintended consequences through emergence.

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Chapter 57
A Systematic Approach towards the Typology of Functions of National Health System: Provision of Functional Model of National Health System

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ABSTRACT

As one of the main national systems in any country, the health system has always been considered by governments. What distinguishes health system from other systems is that its purpose is directly related to the public health. Different countries adopt different structural patterns in this field but one can consider relatively common functions for a national health system which includes all functional aspects for this system. In recent years, attempts have been made for offering a comprehensive model in describing the functions. The OECD determined principles needed to offer an appropriate typology that should be independent of the names of health programs in different countries. In this chapter, it's tried to provide an overview of the proposed models for structures and functions of the health system and to propose a comprehensive model for it with an emphasis on theoretical aspects of public policy-making and binding functions in any national development system. This comprehensive model, provides the possibility to evaluate the success of a health system.

INTRODUCTION

The health system has always been considered by governments seriously. It is a priority in major development plans. Different countries adopt different structural patterns in the health field depending on their circumstances and macro-economic, political and social considerations. But aside from structural differences, one can consider relatively common functions for a national health system which includes

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all functional aspects for this key system. In recent years, attempts have been made for offering a systematic and comprehensive model in describing the functions of the national health system by competent communities, enterprises and experts in the field of health policy. These efforts were directed towards appropriate partitioning of the internal relationship in the health system and explaining the expected purpose(s) of these interactions. In addition, the remarkable point is that there are many factors outside the health system that affect people's health such as poverty, education, political and social infrastructure in a country. Since these factors are affected by external factors, health systems are known as open systems. Thus there are important implications for approaches to these systems from the perspective that they must affect health systems to produce better health outputs or more efficient and fair behaviors. The main functional elements of health systems can be defined at the global level. The Organization for Economic Cooperation and Development (OECD) determined principles needed to offer an appropriate typology. This classification should be based on the health system features and independent of the names of health programs in different countries. In this chapter, it's tried to provide an overview of the proposed models for structures and functions of the health systems and to propose a new and comprehensive model for the health system which provides the possibility to evaluate the success of a health system.

BACKGROUND

Various models of the health system can be divided into two sets: structural models and functional models. Next, a brief definition of each of these two types and an overview of the proposed models in each type will be provided.

The Structural Models of the Health System

Using various economic and health indicators, these models classify health systems in different countries. These indices are mainly based on the functions and control knobs raised in conceptual models of the health system. According to the OECD, the method for proposing a new classification for health systems consists of two stages. In the first stage, variables and indicators must be defined to highlight the differences in health systems. In the second stage, these variables must come together to extract meaningful groups based on the above three principles (OECD, 2004). Many attempts have been made in this regard, which will be explained next.

Roemer Model (Roemer, 1956)

Roemer analyzed health systems with a political-institutional approach. Using a historical analysis approach, he grouped health systems at that time. That study examined the relationship between a country's health policies and its economic and institutional status. He offered four groups for health services programs:

1. Free enterprises.
2. Social insurance.
3. Public assistance system.
4. Universal service.

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As can be seen, this type of grouping is related to different methods of financing in countries to offer services to individuals.

Field Model (Field, 1973)

Field divided health systems into five groups. In general, this classification is based on the independence of health system personnel, ownership of medical facilities and financing method. The indicators selected by Field try to measure the health system integration.

Roemer and Axelrod Model (Roemer & Axelrod, 1977)

Roemer altered his previous classification and offered five groups for health systems in the world. These groups are as follows.

1. Free enterprise model.
2. Welfare state model.
3. Health system model in underdeveloped countries.
4. Health system model in developing countries.
5. Community-based model.

These groups are formed based on the key role of political and economic aspects in determining the health system status.

Terris et al. Model (Terris et al., 1977)

Then Terris et al. proposed two models: national health services (NHS) and social health insurance (SHI). In the NHS model, service providers are civil servants, services are offered at public hospitals, and the entire population receives free services. In the SHI model, service providers are independent enterprises which offer services according to contracts with the government. In fact, insurance is the health system foundation in these countries. However, the type of insurance coverage varies by country.

The WHO Model (Kleczkowski et al., 1984)

In the World Health Organization (WHO) report, Kleczkowski et al. introduced economic development level and economic approach as the main factors affecting the health system performance. Due to these two factors, health systems can be divided into nine groups:

- **Economic Development:** Various factors such as industrialization and urban population are effective in determining the development level of different countries. Based on these two factors, countries are divided into two groups: developed and developing. Since the developing countries group is so broad, the GDP index is used and this group is divided into two parts: transitional developing countries and poor ones.

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- **Economic Approach:** It indicates the extent of government responsibility in offering services to people in the community. Based on the organizing method of the health system, three types of economic approach can be defined (table 1).
  - **Permissive:** This approach is based on the distribution of the health system responsibilities, and there is minimum social organization for offering governmental services.
  - **Participatory:** It aims to balance social and individual approaches for service delivery. In this approach, the government role is more organized than the previous one.
  - **Social:** In this approach, health is the people's social right, and it is the most organized approach for offering governmental services.

Frenk and Donabedian Model (Frenk & Donabedian, 1987)

Frenk and Donabedian argued that relatively many indices can be used for classification of state intervention in the health system, including:

- Payment method to service providers.
- The level of administrative centralization.
- Percentage of public sectors in the health system.
- Tools used by the government to control service delivery.
- Scope of the covered population.
- Extent and broadness of the resulting benefits for covered persons.
- Principles for determining the eligibility of individuals to receive services.

Based on the type of government control over the health service production and the eligibility of individuals, Frenk and Donabedian proposed a typology for state interventions. The type of government control on the production of health services reflects the relationship between the government and service providers. Eligibility of individuals reflects the relationship between the government and real and potential consumers.

The OECD Model (OECD, 1987)

The OECD introduced a range of health systems based on three criteria: availability, financing method and the type of service providers. The classification considers two approaches (patient sovereignty and social justice) and proposes three basic models.

Table 1. Typology of WHO

Economic Development	Economic Approach		
	Permissive	Participatory	Social
Developed	Model 1	Model 2	Model 3
Developing (Transitional)	Model 4	Model 5	Model 6
Developing (Poor)	Model 7	Model 8	Model 9

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1. National Health Services (NHS).
2. Social Health Insurance (SHI).
3. Private Health Insurance (PHI).

The social justice approach is very important in countries with the NHS system. In these systems, coverage is universal and financing is done through taxes. They are also known as Beveridge systems. The SHI systems are formed by moving toward the patient sovereignty approach and maintaining the social justice approach. In these systems, coverage is almost universal and financing is through employer-based compulsory insurances. They are also known as Bismarck systems. The PHI systems are formed by focusing on the patient sovereignty approach and ignoring social justice. In these systems, people can be covered either by private insurers either personally or by the employer. They are also known as free-market systems. It is clear that in these systems there are many people who have no insurance coverage.

Navarro Model (Navarro, 1989)

By studying the evolution of health systems in different countries, Navarro introduced the class coalition as an independent variable which affects the health system type. According to this concept, he proposed three models (NHS, SHI, and liberal) for the health system.

Hollingsworth et al. Model (Hollingsworth et al., 1990)

Hollingsworth et al. focused on the degree of state intervention in the financing and production of other resources. Based on two indicators (the degree of concentration and management focus), they classified the British health system in a group with a high degree of concentration controlled by the public sector. The Swedish health system fell in a group with a low degree of concentration controlled by the public sector, and the US the health system fell in a group with a low degree of concentration controlled by the private sector.

Roemer Model (Roemer, 1991)

In his continued research, Roemer compared and classified health system structures in some countries by proposing a conceptual matrix. This classification, on one hand, is based on an estimate of the type of health system policies for social intervention in the health services markets and, on the other hand, on the economic level of countries which is defined by the Gross National Product (GNP). The first dimension of the matrix proposed by Roemer refers to the health system policies. The following four types of policies can be introduced in the health system:

1. Entrepreneurial and permissive.
2. Welfare-oriented.
3. Universal and comprehensive.
4. Socialist and centrally planned.

Economic dimension of this matrix includes: 1) industrialized countries, 2) transitional countries, 3) very poor nations and 4) oil-producing countries.

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The OECD Model (OECD, 1992)

Based on the method of financing and reimbursement of costs to service providers, the OECD classified health systems into eight different groups (Table 2).

Model 1: It is the simplest model commonly used in the private sector. The patient pays the treatment costs out-of-pocket according to Fee-For-Service system.

Model 2: In this model, the patient pays his/her costs to the service providers both through taxes as well as out-of-pocket payment.

Model 3: In this model, the costs for the insured persons (who were insured on own volition by paying the insurance premium) are directly repaid to them by the private insurer. On the other hand, patients pay the remuneration of physicians and medical institutions with the Fee-For-Service system. In fact, there is no relationship between insurers and service providers.

Model 4: In this model, financing rests with public insurances based on taxes which its value is totally dependent on the income of individuals. There is no relationship between insurers and service providers. Patients pay the remuneration of physicians and medical institutions with the Fee-For-Service system.

Model 5: This model is based on contracts between insurers and service providers. Due to such contracts, part or all of the services is provided free of charge to patients. The payment type to service providers is based on Fee-For-Service and capitation.

Model 6: In this model, income tax is compulsory. Public enterprises (whether the government or insurers) make their payments to service providers based on Fee-For-Service or capitation. In this model, people are somewhat obligated for payment and the insurance coverage and services are usually universal.

Model 7: Users of this model argue that it can be helpful to recruit physicians, pay their salaries and acquire healthcare centers in the first and second service levels in a non-government manner. The main difference between this model and previous models is that insurers own healthcare centers at the first and second service levels.

Model 8: In this model, financing is through income tax, and payment to service providers is based on fixed salary and budget. Healthcare centers belong to the local government, the central government or public insurers. In fact, the government is totally responsible for service delivery, financing, planning, management and evaluation.

Table 2. Typology of OECD

Reimbursement	Financing	
	Private/Voluntary	Public/Compulsory
Out-of-pocket payment	Model 1	Model 2
Out-of-pocket payment with insurance reimbursement	Model 3	Model 4
Contract with third party	Model 5	Model 6
Budget and Salary Payment by third party	Model 7	Model 8

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Hsiao Model (Hsiao, 1998)

According to Hsiao, factors affecting the health system performance include:

- System centralization versus decentralization.
- Ownership.
- Financing and service providing.
- Vertical integration of the organization.
- Integration of financing and service delivery.

Hsiao classified the health system in different countries based on different financing and service delivery patterns (table 3).

Hsiao Model (Hsiao, 2003)

Hsiao proposed five models for health systems based on different approaches in financing, organization, payment and legislation in health services.

1. **National Health Services (NHS) Model:** In this model, people are covered based on their residency in the country. No independent fund is established for financing health services, but financing is through taxes and other public resources. Anyone who lives in that country enjoys health services as a citizenship right.
2. **National Health Insurance (NHI) Model:** It focuses on universal coverage and equal access to health services for all people. Thus, here the formation of the national health insurance fund is a basic principle in which the people and the government directly participate. The condition for using health services in these countries is membership in the concentrated health insurance fund. In this system, service providers are paid for services based on the Fee-For-Service system, and the insurer purchases services from public and private providers.
3. **Social Health Insurance (SHI) Model:** It has been adopted by many countries in the world. In this method, there are several funds and people join them arbitrarily or according to their job. Usually the type of services, tariffs and rates of individual participation are controlled by the government. In this model, individuals can choose among service providers. In these countries, civil institutions are deeply rooted, people are aware of their rights, and competitiveness is a condition for survival in the healthcare market.

Table 3. Typology of Hsiao (1998)

Financing	Public Income Direct Funds toward			National Health Insurance	Social Insurance		Private Insurance	Out of Pocket Payment by Patient
	Facilities	Service Group	Poor People		Direct Provision	Indirect Provision		
State Provider	×	×	×	×	×	×	×	×
Non-State Provider			×	×		×	×	×

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4. **Voluntary Health Insurance (VHI) Model:** In this model, the capital needed for the health sector is supplied by individuals and the insurance premium paid by the employer. As a result, unemployed and poor people are not covered by any insurance. The government must attempt to finance the uninsured people.
5. **Medisave with Catastrophic Insurance (MCI) Model:** It is a new model compared to mentioned ones. It is based on personal responsibility of individuals for their health and their families, and the government is responsible for offering services to those in need and refractory patients.

The OECD Model (OECD, 2004)

The OECD altered and simplified its classification by removing combined modes of service delivery and financing. It examined and classified different financing methods based on two criteria (prepayment and risk pooling) and proposed four financing methods (table 4).

In summary, the OECD considered Contribution and taxes as a financing method, and the delivery procedure of dominant services as the representative of financing method. This way, it divided health systems into three groups (table 5).

Based on this classification, in the public integrated model, financing is made by the government, and services are offered in public health facilities.

Lee et al. Model (Lee et al., 2008)

Lee et al. studied classifications in the context of health systems and concluded that determinant factors in the characteristics of a country's health system can be summarized as follows:

- Level of social integration.
- Level of state intervention.
- Financing method.
- Service delivery procedure.

Table 4. Financing method according to OECD

		Prepayment	
		Exist	**Not Exist**
Risk Pooling	Exist	Out of Pocket payment	Medical savings accounts
	Not Exist	Spontaneous charity	Health Insurance

Table 5. Typology of the OECD

		Provision of Services	
		Public	**Private**
Financing	Public	Public integrated model	Public contract model
	Private		Private insurance-provider model

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Using the above criteria, Lee et al. classified health systems into four groups. The definitions proposed for models are similar to those by Navarro (1989) and Xiao et al. (2003) (table 6).

Tanner Model (Tanner, 2008)

Tanner argued that there is no general model for the health system for all countries. He divided health systems into the following three groups, based on the unique historical, political, and national conditions.

1. **Single-Payer Health Systems:** The government pays the costs of health services for all citizens.
2. **Employment-Based Health Systems:** The employer is required to provide health insurance for its employees.
3. **Managed Competition-Based Health Systems:** The private sector offers health services. But the government manages the desired market by extensive control and regulation.

Table 6. Model of Lee et al. (2008)

	NHS Model	SHI Model	NHI Model	PHI Model
1- Social Value of Health System Constitution				
1-1- Basic Principle	Universalism	Corporatism	Universalism	Liberalism
1-2- population Coverage Principle	Citizens	Insured people	Citizens	Volunteers
1-3- Boundary of social solidarity	Nation	Groups of insured people	Nation	Volunteers and others
2- Main Structure of Service Provision				
2-1- Existence of private service providers	Limited: England: 96.0%* (1998)	Germany: Relatively Limited (2003) 53.1% Japan: Extensive (1998) 35.8%	Extensive, South Korea: 17.5% (2004) Taiwan: 33%	Extensive, USA: 33.7% (1995)
2-2- Strength of state regulation on private sector	Extensive, Strong, Detailed	Germany: Limited-Medium- General Japan: Extensive- Strong-Detailed	Extensive, Strong, Detailed	Limited
2-3- Availability of citizen to providers	Limited	Limited	Unlimited	Unlimited
3- State Intervention into Health System				
3-1- Proportion of public financing in total health system expenditure	England: 83% (2001)	Germany: 78.6% (2001) England: 81.7% (2001)	South Korea: 54.4% (2001) Taiwan: 64.4% (2001)	USA: 44.9% (2001)
3-2- Source of Financing	Tax	Germany: Social insurance contribution Japan: Tax and Social insurance contribution	Tax and Social insurance contribution	Tax and Premium
3-3- State administration of financing	Individual	Multiple	Individual	Multiple
4- Type of state intervention	Service Provider	Regulator	Conductor	Regulator at low level

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Next, the following table summarizes aforementioned structural systems, and lists and evaluates countries that use each type (table 7).

The following list includes all the used structural indicators. Each structural system can be explained based on these indicators.

1. **Financing Method:** In the financing process, proceeds received from primary and secondary sources are collected and accumulated in the common financial reserve fund and then allocated to the activities of service providers.
2. **Type of Service Delivery:** Service delivery can be considered as the most visible product of the health system and even some people confuse the service delivery system with the health system. Service delivery includes a wide range of activities. These activities can be classified with two different approaches: the first approach is based on the type of service providers and the second approach is based on the type of health services.

Table 7. Summary of structural health systems

	Providers	Criteria of Classification	Classification	Examples
1	Roemer (1956)	Financing Method	Free Enterprises	
			Social Insurance	
			Public assistance system	
			Public Services	
2	Field (1973)	- Independence of personnel in health system - Ownership of health facilities - The Role of professional associations - Financing Method	Private	USA- Western Europe - Russia in 19th Century
			Pluralistic	USA in 20th Century
			National Health Insurance	Sweden- France- Canada- Japan in 20th Century
			National Health Services	England in 20th Century
			Social Health Services	Soviet Union in 20th Century
3	Romer (1977)	Political aspects Economic levels	Free enterprise model	
			Welfare State model	
			Health system model in underdeveloped countries	
			Health system model in developing countries	
			Community-based model	
4	Terris et al (1977)	Type of services delivery	National Health Services	Sweden- England
			Social Health Insurance	Canada- Denmark- Finland- Norway- France- Italy- New Zealand- Ireland- Israel
5	Terris (1978)	Type of services delivery	National Health Services	Sweden- England
			Social Health Insurance	Canada- Denmark- Finland- Norway- France- Italy- New Zealand- Ireland- Israel
			Public Assistance system	Most of Asian, African and Latin American countries

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Table 7. Continued

	Providers	Criteria of Classification	Classification	Examples
6	WHO (1984)	Level of economic development Economic Approach	Developed- Permissive	USA- Australia
			Developed- Participatory-	England- Norway
			Developed- Social	Russia- Hungry
			Developing (Transitional)- Permissive	Columbia- South Korea
			Developing (Transitional)- Participatory	Nigeria- Mexico
			Developing (Transitional)- Social	Cuba- China
			Developing (Poor)- Permissive	Philippine- Thailand
			Developing (Poor)- Participatory	Bangladesh- India
			Developing (Poor)- Social	Ethiopia- North Korea
7	Frenk and Donabedin (1987)	The form of state control over the production of medical services eligibility of the population	Concentrated ownership- Citizenship	Sweden- England- New Zealand
			Concentrated ownership- Contribution/ Privilege	Spain- Venezuela and India
			Concentrated ownership- Poverty	Non-Socialistic and developing countries
			Dispersed ownership- Contribution/ Privilege	Mexico
			Dispersed ownership- Poverty	USA- Non-Socialistic and developing countries
			Concentrated financing- Citizenship	Canada- France- New Zealand- England
			Concentrated financing- Contribution/ Privilege	Brazil- Lebanon
			Concentrated financing- Poverty	USA
			Dispersed financing- Citizenship	Germany- Austria- Swiss- Belgium- Japan- Netherland
			Dispersed financing- Contribution/ Privilege	Argentina- Netherland- USA
8	OECD (1987)	Accessibility (Coverage) Financing method Delivery of Services	National Health Services	England- Denmark
			Social Health Insurance	Germany- Austria
			Private Health Insurance	USA
9	Navarro (1989)	Class Coalition	National Health Services	
			Social Health Insurance	
			Liberal Model	
10	Hollingsworth et al (1990)	Degree of concentration Management focus	High degree of concentration and control by public sector	England
			Low degree of concentration and control by public sector	Sweden
			Low degree of concentration and control by private sector	USA

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Table 7. Continued

	Providers	Criteria of Classification	Classification	Examples
11	Roemer (1991)	Economic level Health system policies	Industrialized countries- Permissive	USA
			Industrialized countries- Welfare oriented	West Germany- Canada- Japan
			Industrialized countries- Universal	England- New Zealand- Norway
			Industrialized countries- Socialist	Soviet Union- Czechoslovakia
			Industrializing countries- Socialist	Thailand- Philippine- South Africa
			Industrializing countries- Welfare oriented	Brazil- Egypt- Malaysia
			Industrializing countries- Universal	Israel- Nicaragua
			Industrializing countries- Socialist	Cuba- North Korea
			Very poor countries- Permissive	Ghana- Bangladesh- Nepal
			Very poor countries- Welfare oriented	India- Burma
			Very poor countries- Universal	Sri lanka- Tanzania
			Very poor countries- Socialist	China- Vietnam
			Oil-producing countries- Welfare oriented	Libya- Gabon
			Oil-producing countries- Universal	Kuwait- Saudi Arabia
12	OECD (1992)	Reimbursement Financing method	Out of pocket payment- private	USA
			Out of pocket payment- public	
			Out of pocket payment with insurance reimbursement- Private	France- USA
			Out of pocket payment with insurance reimbursement- public	
			Contract with third party- private	France- Germany
			Contract with third party- public	Belgium- Canada- Germany- USA
			Budget and salary payment by third party- private	England- Italy- Germany
			Budget and salary payment by third party- public	Belgium- Canada- France
13	OECD (1994)	Financing method Type of service delivery	Contribution- Mixed	Belgium- France- Germany- Austria- Luxemburg - Japan
			Taxation- Public	Ireland- Spain- Denmark- Finland- Greece- Portugal- Norway- Sweden- Italy- England
			Taxation- Mixed	Australia- New Zealand
			Taxation- Private	Canada
			Mixed- Mixed	Turkey- South Korea
			Mixed- Private	Netherland- Mexico
			Private- Private	USA- Swiss
14	Hsiao (1998)	Financing method Type of service delivery		

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Table 7. Continued

	Providers	Criteria of Classification	Classification	Examples
15	Hsiao et al (2003)	Financing method Organization Payment Regulation	National Health Services model	England- Denmark- Greece- Italy- Poland- Hungry- Czech Republic
			National Health Insurance model	Canada- Finland- Norway- Spain- Souh Korea- Taiwan- Sweden
			Social Health Insurance model	Germany- Japan- Austria- Belgium- France- Netherland- Swiss
			Voluntary Health Insurance model	USA
			Medisave with catastrophic insurance model	Singapore
16	OECD (2004)	Financing method Type of service delivery	Public integrated model	Northern Europe Countries
			Public contract model	Japan- South Korea- European countries which are not in the Public integrated model
			Private insurance-provider model	Swiss- USA
17	Lee et al (2008)	Extent of social integration Level of state intervention Financing method Type of Service delivery	National Health Services model	England- Denmark- Greece- Italy- Poland- Hungry- Czech Republic
			Social Health Insurance model	Germany- Japan- Austria- Belgium- France- Netherland
			National Health Insurance model	Canada- Finland- Norway- Spain- South Korea- Taiwan- Sweden
			Private Health Insurance model	USA
18	Tanner (2008)	Financing method	Single-payer health systems	England
			Employment-based health systems	Germany
			Managed competition-based health systems	Swiss
19	Encyclopedia of Public Health	Financing method	Social Health Insurance system	Germany- France- Austria- Netherland- Japan
			Tax-based health system	Canada- Norway- Sweden- Finland- Australia- Italy- Spain- England
			Mixed health systems	

3. **The Basis for Political Philosophy:** Different countries have different political philosophies which are the basis for judgments on the performance of the health sector and other sectors. There are three approaches which determine political philosophy of countries in various fields: utilitarianism, liberalism, socialization.
4. **Type of State Intervention:** According to some experts in the health field, many health systems fail because states adopt wrong intervention methods and related tools. As a result, state intervention in the health system can be considered from two perspectives: type of intervention and level of intervention.

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5. **Range of Covered Individuals:** The range of people covered by different services - which are offered by various service providers - can be divided into three groups: citizens, Contributors/ Owners of privilege and the poor people.
6. **Economic Level:** Economic development is defined as grow along with increased manufacturing capacities including physical, human and social. In economic development, quantitative production growth will be achieved but besides that, social institutions will transform, people's attitudes will change, the utilization capacity of existing resources will increase continuously and dynamically, and a new innovation will be made every day.
7. **Integration Level of the Health System:** Currently, many governments are changing to improve the quality and quantity of service delivery and reduce cost. In this respect, decentralization is one of the basic approaches to achieve this important goal. From the perspective of centralization level, governments can be divided into two categories: centralized and decentralized.

The Functional Models of the Health System

As shown in Figure 1, each functional model describes this meta-system by describing the functions, intermediate goals and ultimate goals. In other words, according to these models, a health system should fulfill the ultimate goal by realizing some functions of the intermediate goals path (figure 1).

Next, the main functional models in health systems are explained.

Londonio and Frenk Model (Londoño & Frenk, 1997)

According to this model, health systems must perform four basic roles to meet the population's needs. Two roles, i.e. financing and provision of services, are conventional functions performed by any health system. The other two roles are often implicitly satisfied or are not met at all. These neglected functions are modulation (a wider concept of regulation, including laying down fair rules and transparency) and articulation. Articulation refers to organization and management of a series of exchanges between the population's members and financing service providers so that resources can flow in the production and consumption of services. Table 8 shows the functions and sub-functions of the health system in this model (table 8).

Figure 1. Functional model of the health system

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Table 8. Functions and sub-functions of the health system in the Londonio and Frenk model

Function	Sub-Function
Modulation	- Health System Development - Coordination - Financing Design - Regulatory - Customer Support
Financing	- Revenue Collection - Fund Pooling - Service Purchasing
Provision of Health Services	- Personal health services - Public health services
Articulation	- Articulating the relationships between people and service providers - Articulating the relationships between financing agencies and service providers

Commonwealth Fund Model (Davis et al., 2007)

The Commonwealth Fund was established in July 2005 in order to determine the characteristics of a health system with optimal performance. The output of this fund is supposed to be used as the base model in reforming the American health system. The studies conducted by this fund can be considered as an independent model in health system. According to this model, the ultimate goal of health system is to achieve healthy, productive and long lives. A high-performance health system is designed to achieve the following four intermediate goals:

1. Safe and high-quality care.
2. Access to care for all people.
3. Efficient and high-valued care.
4. Enhancement of system capacity.

These intermediate goals support achieving the mentioned ultimate goals.
Table 9 shows the functions and sub-functions of the health system according to this model.

Table 9. Functions and sub-functions of the health system in the Commonwealth Fund model

Function	Sub-Function
Modulation	- Capacity building for evaluation/ Information - Policymaking and Planning - Control of social participation and system responsiveness - Creating the ability of accountability - Regulatory
Financing	- Revenue Collection - Aggregation and allocation of financial resources - Purchasing and Payment by provider
Provision of Health Services	---
Resource Generation	- Human resource management - Pharmaceutical material management

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Mills and Ranson Model (Mills & Ranson, 2001)

Mills and Ranson used Roemer's definition (1991) for modeling the health system. Accordingly, the health system is defined as the combination of resources, organization, financing and management which cooperate in offering healthcare services.

In this model, the health system elements are: management, provision of services, organization, plans, resource generation and economic support.

Table 10 shows the functions and sub-functions of the health system according to this model.

The World Health Organization Model (WHO, 2000)

The WHO (established on April 7, 1948) is a UN specialized agency which operates as a coordinating authority in the field of international public health. Its mission is to improve the situation of all the people in the world. The WHO explores the challenges and problems of the health sector in an annual report. These reports are published by subject and include important theoretical headings and practical challenges relevant to that subject. The 2000 WHO Report dedicated to the health system. It has been the reference for many projects and researchers in this field. The report first defines the health system and determines its boundaries, and then examines its ultimate goals, intermediate outputs and functions. The following figure gives an overview of the ultimate goals and functions of the health system in this model (figure 2).

Table 11 shows the functions and sub-functions of the health system according to this model.

The World Bank Model (World Bank, 2007)

In 2007, the World Bank published a report and in its first volume, very briefly described the theoretical framework of the health system used in this project. Based on this report and search in other available documents in the World Bank, a health system model was extracted. Next, this model will be explained. The following figure shows an overview of the health system in this model (figure 3).

Table 12 shows the functions and sub-functions of the health system according to this model.

Table 10. Functions and sub-functions of the health system in Mills and Ranson model

Functions	Sub-Functions
Regulation	- Regulation of market entry and exit - Paying the remuneration of service providers - Quality control and service distribution - Control of standards
Financing	- Tax - Premium - Out of pocket payment
Provision of Services	---
Resource allocation	---

Table 11. Functions and sub-functions of the health system in the WHO model (2000)

Functions	Sub-Functions
Modulation/ Forward looking	Presented above
Financing	- Revenue Collection - Fund pooling - Strategic purchasing
Provision of Services	- Personal health services - Public health services

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Figure 2. Functional model of the WHO for the health system

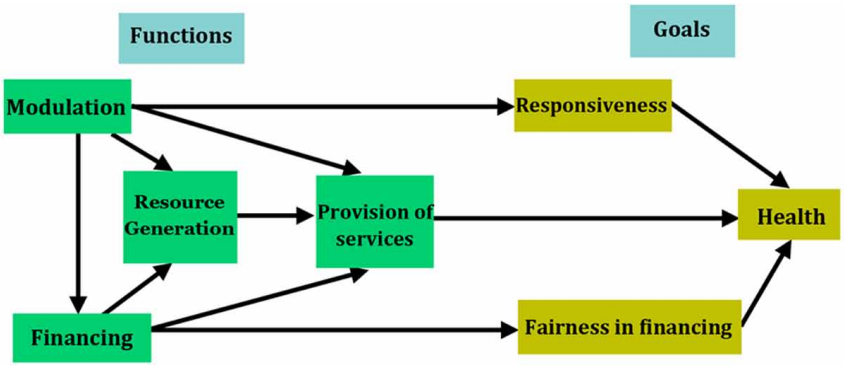

Figure 3. The World Bank model for the health system

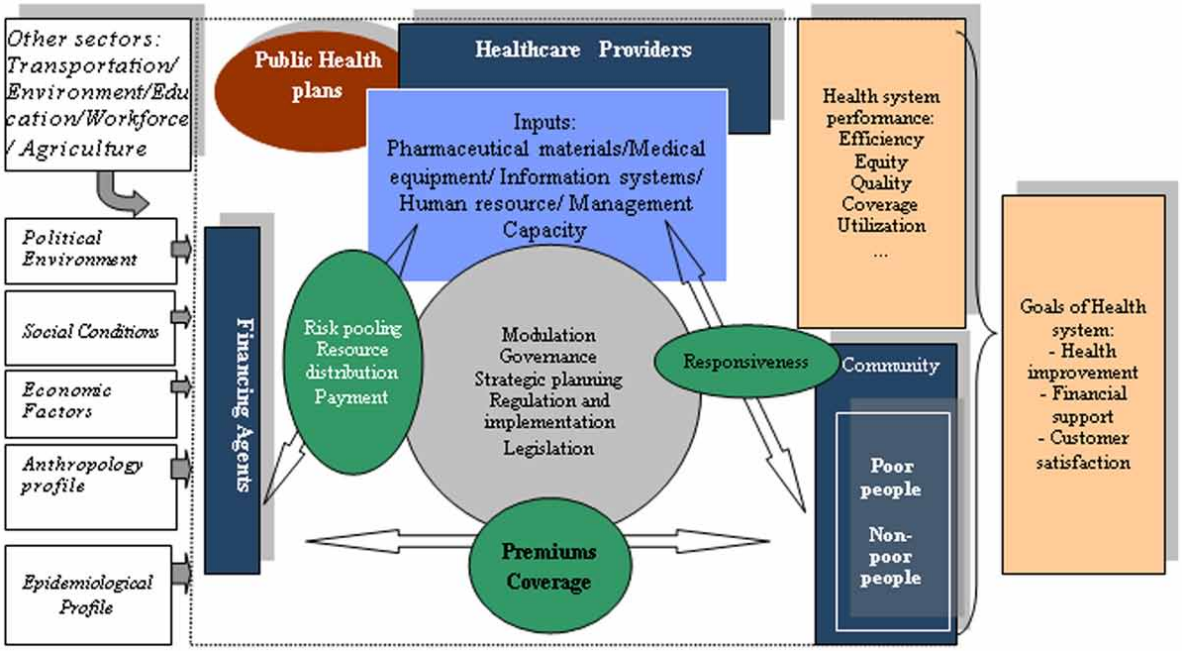

Table 12. Functions and sub-functions of the health system in the World Bank model

Functions	Sub-Functions
Modulation/ Forward looking	- Governance - Strategic Planning - Regulation and Implementation - Legislation
Financing	- Financial resources collection - Risk redistribution - Strategic Purchasing
Provision of services	---
Resource management	---

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The USAID Model (USAID, 2009)

The United States Agency for International Development (USAID) is the United States federal government agency which claims to help develop the world, especially low-income countries (mostly African countries). It conducts theoretical analyses and implements projects in different areas of these countries.

This model adopted the WHO (2000) definition of the health system, that is, the health system consists of "all enterprises, institutions and resources allocated to producing health actions."

Like the WHO model, functions of this model include (table 13):

The WHO Model (WHO, 2007)

The WHO (2007) published an article entitled "Strengthening the Health Systems to Improve Health Outputs, the WHO Framework for Action" and proposed a conceptual model for the health system. According to this report, the health system consists of all enterprises, people and actions and its primary goal is to develop, restore or maintain health.

To achieve their goals, all health systems must perform some basic functions, regardless of how they are organized.

Table 14 shows the functions and sub-functions of the health system in this model.

The Proposed Functional Model

After analyzing various functional models for the health system, it is time to propose an integrated model which contains the strengths of those models and covers their shortcomings. This model is shown in Figure 5. Its important elements are as follows:

Table 13. Functions and sub-functions of the health system in the USAID model

Functions	Sub-Functions
Modulation	- Capacity building for evaluation/ Information - Policymaking and Planning - Control of social participation and system responsiveness - Creating the ability of accountability - Regulatory
Financing	- Revenue Collection - Aggregation and allocation of financial resources - Purchasing and Payment by provider
Provision of Services	---
Resource management	- Human resource management - Pharmaceutical materials management

Table 14. Functions and sub-functions of the health system in the WHO model (2007)

Functions	Sub-Functions
Leadership/ Governance	- Governance - Strategic Planning - Regulation and implementation - legislation
Financing	- Financial resources collection - Risk redistribution - Strategic Purchasing
Provision of Services	---
Healthcare Workforce	---
Information systems management	---
Medical equipment, Vaccines and technologies management	---

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Inputs of the Health System

- **Effects of Non-Health Sectors:** A problem facing any health system is how to interact with other sectors such as transportation, environment, education, and energy. These are known as intersectoral issues in the literature.
- **Political Environment:** The political environment is another input for the health system. It affects the health system performance with tools such as legislation and budgeting. Moreover, some characteristics of the health system such as responsiveness, efficiency, and transparency are partly influenced by the macro-political environment.
- **Social Conditions:** This component affects the health system by affecting factors such as people's participation, demands, and life style.
- **Economic Conditions:** Economic conditions of each country provide the health system with important limitations and opportunities. For example, in countries with high per capita income, the possibility for universal coverage of individuals and reducing financial risks for health is much higher than low-income countries.
- **Geographical Conditions:** Another input to the health system is geographical conditions which affects its priorities and performance. Access to the full basket of food, common diseases, essential vaccines for prevention, and so on are largely dependent on the geographical conditions of countries.
- **Epidemiological Conditions:** By influencing the pattern of disease spread and priorities in the prevention of communicable diseases, epidemiological conditions are an important input for the health system.

Ultimate Goals

Hsiao suggests that we must clarify, at the systematic level, that what final outputs are important to the community and distinguish them from intermediate outputs. It is true that intermediate outputs are important and affect the ultimate output but they are just temporary results.

According to the functional model of the health system, the following ultimate goals can be considered for the health system.

- **Health Level Improvement:** Good health has an intrinsic value to people. Moreover, a certain level of health services is necessary for the protection of life and treatment of severe morbidities. Thus, the maximization of health level can be considered as one of the most important goals for the health system.
- **Health Distribution Improvement:** Not only the improvement of health level is considered as one of the main goals but also equality in its distribution is an important goal for the health system.
- **Protection against Financial and Social Risks:** In some references, "affordability" is considered as a policy objective of the health system. One of the characteristics of healthcare is the uncertainty of high treatment costs. Therefore, the affordability goal in some countries has been set as the ultimate goal of achieving adequate coverage of financial risks for citizens.
- **Public Satisfaction:** It is clear that public satisfaction is the ultimate goal for political leaders and policy makers in democratic societies. Even the leaders of authoritarian governments must satisfy

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the public in the long term. Blendon et al. (1990) concluded that public dissatisfaction with the health system performance contributes to political pressures for the health system reform: dissatisfaction with the status quo is largely related to the common belief that the healthcare system needs fundamental change and restructuring.

Intermediate Goals

Often, intermediate outputs are confused with ultimate goals. Targeting improved access, quality and/or performance is important in health policies but it has derivative importance versus the ultimate goal of the health system. We would like to achieve higher technical quality in health services because it has a positive effect on health status. Improved service quality in health services is desirable as long as it has a positive impact on patient satisfaction and health outputs. The maximization of efficiency allocation allows improving health status and risk coverage under budget constraints. Finally, the success of a nation in achieving these intermediate outputs should be evaluated based on their contribution to ultimate outputs.

According to this model, the intermediate goals are inherently among intermediate/process outputs of the health system. These goals are:

- **Efficiency:** A system is efficient when it produces and offers appropriate services (considering goals) in an appropriate manner. Such a definition leads to two specific concepts for efficiency: technical efficiency and allocative efficiency.
- **Safety:** The provided care is safe when it is delivered in a way that leads to greater reliability for the cared processes and minimal medical errors.
- **Access:** In some cases, access simply means whether services are offered in a particular area or not. Here, the point is the physical availability which can be measured by the distribution of available inputs (beds, physicians or patients) compared with the general population. The second concept is a definition which better reflects the meaning of this word: effective availability means that how easy people can receive care services? The difference between physical availability and effective availability is due to the fact that several barriers (such as cost, travel time, poor and low quality services) may limit individuals to use facilities that are physically available.
- **Quality:** "Quality" can be meaningful only in the quantity of provided care for a patient. The second basic meaning of "quality" which is used by health professionals refers to clinical quality. This sense includes both the skills of care providers (e.g. surgical skills) and the accuracy of diagnostic and therapeutic decisions.
- **Coverage:** Countries always struggle to increase the range of benefits whose citizens deserve (programs, interventions, goods and services). For this purpose, they provide access to goods and services for broader population groups and finally, for all citizens. Ultimately, they attempt to protect their citizens against inappropriate financial and social consequences of using healthcare.

Functions of the Health System

The health system functions in this model include modulation, provision of service, financing, human resource management, medical equipment and drugs management, and information and knowledge management. Each of these functions and their lower levels sub-functions are as follows:

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- **Modulation:** After reviewing the modulation in different models in previous sections, one can mention the following sub-functions to cover all aspects of the health sector and avoid parallelism and overlap in different sub-sections as much as possible. Since modulation is an input for other functions of the health system, there may be overlap between some sub-functions in some areas and other sub-functions in the health system. This is due to the management- and policy-based nature of modulation. These sub-functions are as follows:
  - **Policy Making:** Based on the systemic view to health and the system definition (as a set of various elements and their interrelations to achieve a single goal), all elements and their relationships should pursue a single goal so that the activities within the system are directed towards general goals. Thus, the first sub-function in modulation is policy-making so that the position of elements and activities within the system are clarified, and they can go towards the specified goals with greater strength. Perhaps this sub-function is the most important and crucial element in modulation. Weakness and inefficiency in policy-making has high impacts on the whole system which cannot be compensated with considerable spending and it is just a waste of resources. On the other hand, the strength and intelligence of this element is very effective in the system effectiveness and efficiency and accelerating the achievement of the system goals.
  - **Intelligence:** According to the literature of Intelligent systems (Graham Mann; and Luoma and Leppänen, 2007), it can be said that these systems have the following characteristics:
    - Ability to extract and store knowledge.
    - The human-like logical process.
    - Learning from experience.
    - Access to solutions in a way similar to natural evolution processes.
    - Ability to monitor the status of the entire system.
    - Getting feedback from the system performance and inputs.
    - Ability to modify the system.
    - Ability to monitor and adapt to the changing environment.
  - **Creating Cooperation and Solidarity:** Creating cooperation and solidarity can be performed at two levels:
- Management of inter-sectoral collaboration (the health system and other sectors).
- Management of intra-sectoral collaboration (elements of the health system).
  - **Regulation:** In a clear understanding, regulation refers to the use of coercive power by the government for imposing limitations on organizations and individuals. Regulation tools may include laws, decrees, orders, instructions, administrative rules and guidelines issued by governments and non-government bodies such as the self-regulated organizations, to which the regulation power is delegated by governments. Regulation is not the use of incentives or encouragement (i.e., indoctrination) for affecting individual and organizational behavior. An effective regulation requires good design along with governmental ability in the application and implementation of regulation. Many failures may occur in the setting up and operation of regulations. If there is no regulation in the first place, serious regulation failures may worsen the situation. A key regulation failure occurs when a regulatory agency is captured by the regulated organizations (i.e., organizations that are supposed to be regulated by the agency) and it advocates the interests of capturing groups instead of developing public interests. The

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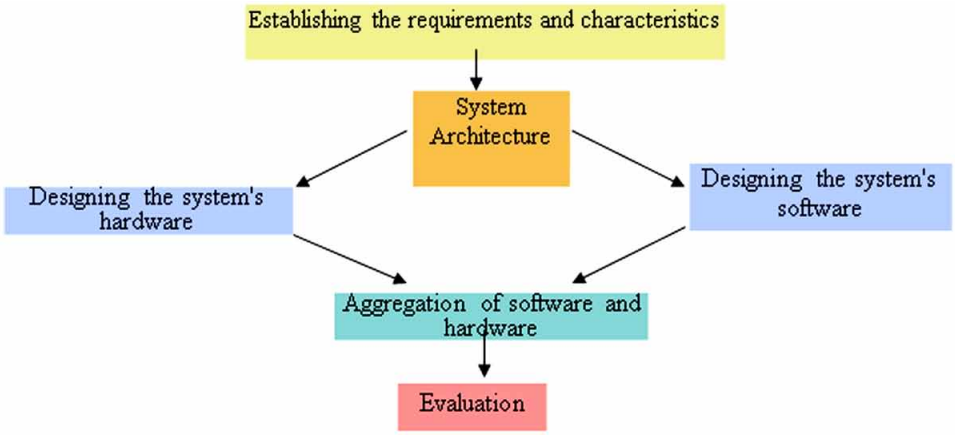
study of L. J. White (2000) was used to explain the regulation. He divided the regulation into three types: economic regulation, information regulation and health/safety/environmental (HSE) regulation.

- **Accountability:** Accountability is often defined as the obligation of an individual or organization to account for its responsibilities (Audit Bureau of Trinidad and Tobago, 2003). At the organizational level, accountability refers to a process in which an organization is committed to balance between the needs of its stakeholders and decision processes and activities, and match its outputs with its commitments (Global Accountability Report, 2003). Edwards and Holmes interpreted accountability as "means by which individuals and organizations report to their superior authorities" (Edwards and Holmes). They believe that effective accountability needs clear expression of goals (whether based on special rules or the realization of preset performance levels), transparency of decisions and relationships, honest reporting on the use of resources and achievements, an inspection process by regulatory authorities in order to determine the satisfaction level of results and mechanisms to encourage and punish those in charge. Accountability comes in two basic types: accountability of officials to superiors in the hierarchical organizational structure (horizontal accountability), and public accountability of officials to the people (vertical accountability). One important result of accountability is "responsible leadership." Responsible leadership along with accountability to the people increases public trust which is the essence of survival and prosperity of any nation (Audit Bureau of Trinidad and Tobago, 2003). Accountability can also be divided into two other types: functional (or short-term) and strategic (or long-term). Functional accountability is measured simpler and is related to the efficient and effective use of resources and the immediate effects of their usage. Strategic accountability is related to the long-term effects and considers the organization's success in achieving long-term goals (Conradi, 1998).
- **System Design:** Based on the organizational architecture studies (Kaufmann, 200), the following cycle can be considered for system design (Figure 4).

Figure 4. Organizational architecture cycle (Kaufmann, 2000)



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  - **Performance Evaluation:** The purpose of performance evaluation is the assessment, evaluation and judgment on the performance of various elements of the health sector according to rules and regulations, and effectiveness, efficiency, economical and ethical criteria in order to improve the quality of services.
- **Provision of Services:** This is the most visible function of the health system which includes demand management, determining the service package, supply management, provision of service, infrastructure and support.
- **Financing:** As mentioned earlier, financing is one of the most important determinants of the health system performance in terms of equity, efficiency and quality. It includes resource mobilization, allocation and distribution at all levels (national and local) and the payment method to service providers. This function refers to "methods used to mobilize resources that support public health plans, provide access to basic health services and form the health service delivery systems" (Shiber and Akiko, 1997). The details of each sub-function are as follows:
  - **Revenue Collection:** Revenue collection refers to mobilize funds from primary (households and firms) and secondary sources (the government and charity institutions). Financial resources can be collected through eight basic mechanisms: out-of-pocket, optional insurance rated based on income, optional insurance rated based on risk, compulsory insurance, general taxes, allocated tax, financial assistance of non-governmental enterprises and agencies, and the sale of public assets.
  - **Risk Pooling:** The second important aspect of financing is to accumulate capital from individuals or households (the pool members) and manage it in such a way that all participants are protected against the risk of paying cost diseases out-of-pocket. Financing based on both taxes and health insurance includes integration. Note that customers' fee-for-service does not include resource integration.
  - **Purchasing Health Services:** Health services are purchased by public or private agencies which spend money directly for providing or purchasing services for their stakeholders. In many cases, the buyers of health services are the agency that integrates financial resources such as the Ministry of Health, social security agencies, regional health boards, insurers, individuals or households (who pay out of pocket when consuming services). For good performance of the health system, financing agencies should produce good amount of revenue, efficiently integrate the risk, provide appropriate incentives for providers, and allocate resources to efficient, effective and fair interventions and services. Figure 5 shows how financing works (figure 5).
- **Human Resource Management (HRM):** Given the importance of human development and the introduction of human as the development axe, which is obvious in the UN Millennium Development Program, HRM is very important in developing economic and social systems. Of course, HR is not equally important in different sectors. Considering the importance of the human dimension of development in recent years, many countries put emphasis on human capital in their development plans. Clearly, the human capital aspects have a special place in the health system. HRM has serious structural and performance weaknesses in the health sector of many developing countries, and structural decentralization is one of the main problems of their health systems. HR is one of the most important resources in the health service delivery system because it is responsible for using health technologies in the management and provision of services in order to promote health. On the other hand, personnel expenses usually account for 60 to 80 percent

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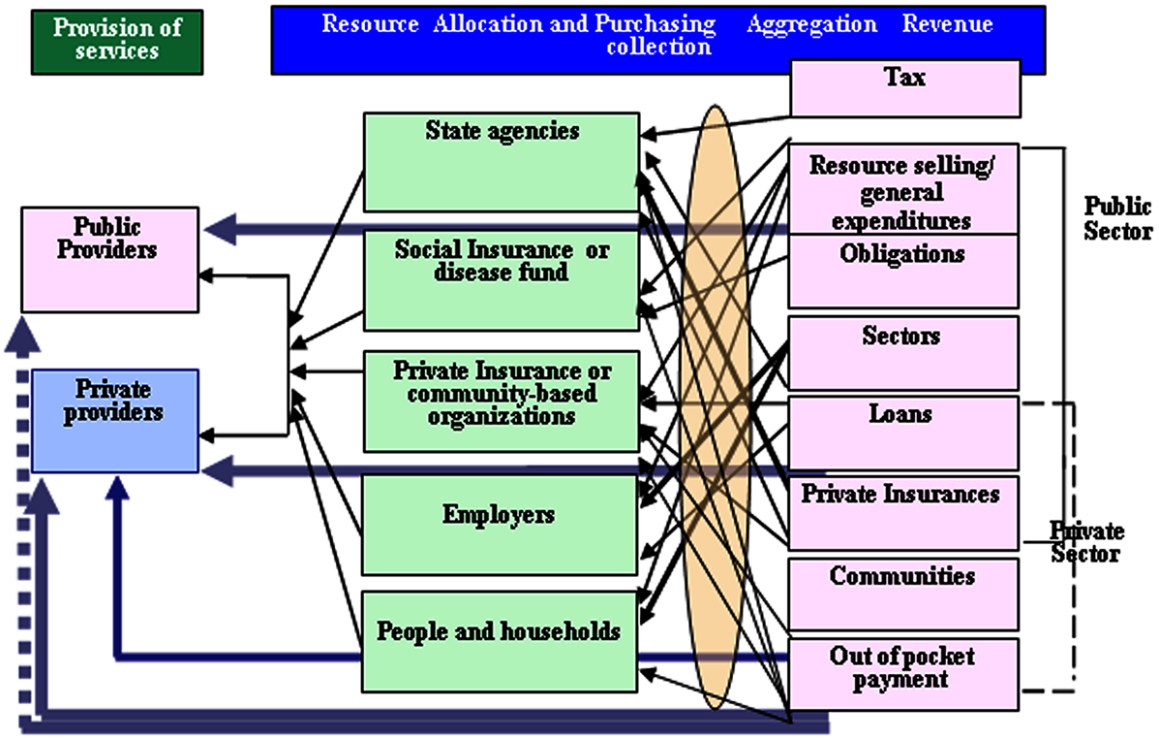
Figure 5. Financing process



of total current expenditures in the health sector. Thus, emphasis on qualitative and quantitative development of human resources will improve efficiency, prevent waste of national resources and, ultimately, enhance social capital. According to HRM definitions, general functions include supply management, organization management and maintenance management.

- **Medical Equipment and Drugs Management:** A health system should guarantee access to medical equipment and drugs through high-quality, safe, efficient and economical technologies.
- **Information and Knowledge Management:** This function is initially divided into two sub-functions: knowledge management and information management. Each one can contain lower level sub-functions.

The necessity of knowledge management in the health system refers to the important role of knowledge in the fulfillment of its goals. It can be argued that almost all the health, education, research, monitoring, and managerial activities in the health system rely heavily on complex knowledge and information. According to global statistics, a physician typically allocates one third of his/her time to information analysis and knowledge promotion. However, the realization of expected outcomes of a national health system (such as lower costs, reduced medical errors, increased quality of care, and increased collaboration and innovation in the health sector) is largely dependent on the use of knowledge management systems in the healthcare sector.

That is why today transition from data-driven decisions to knowledge-based decisions in the form of evidence-based public health (EBPH) is considered in the health systems of developing and developed countries (table 15 and figure 6).

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Table 15. Functions and sub-functions of the proposed model

Functions	Level 1 Sub-Function	Level 2 Sub-Function
Modulation	Policymaking	- Strategy Formulation - Establishing the goals, directions and service prioritizing - Defining the role of health system players
	Intelligence	- Forward looking and monitoring the overall system status - Understanding the environment and its changes - Learning and experience accumulation - Obtain new suggestions and ideas - Modifying the plans, policies, mechanisms and structure of health system
	Collaboration and alliance	- Intersectoral collaboration (health system and other sectors) - Coalition building (elements of health system)
	Regulation	- Economic regulation - Information regulation - Health/ Safety/ Environmental regulation
	Responsiveness	- Creating transparency - Contribution - Addressing litigations
	System Design	- Establishing the requirements and characteristics of health system - Designing the health system hardware (Structures) - Designing the health system software (processes, plans, job description and so on) - Aggregation of hardware and software
	Performance Evaluation	- Determining the evaluation criteria - Data and evidence collection - Documentation and analysis of data and evidences - Recognizing the pros and cons of health system - Determining the prioritized changes and interventions - Propose making evidence-based changes
Financing	Revenue collection	- Determining the sources of revenue - Determining the sourcing mechanisms - Determining the agents - Determining the collection mechanisms of financial sources
Provision of services	Risk pooling	- Fund Pooling - Appropriate redistribution of financial sources
	Health service purchasing	- Strategic purchasing - Passive purchasing
	Demand management	- Demand planning - Legitimizing the plan in the supply side - Demand market planning - Demand prioritizing
	Determining the package of services	- Package of integrated services - Package of essential services - Package of basic services
	Supply management	- Organizing the network of providers - Qualitative and Quantitative management of services - Designing the models of service delivery (referral systems and so on) - Establishing the user groups
	Provision of Service	- Health promotion - Prevention - Screening - Cure - rehabilitation
	Infrastructure building and support	- Facilities management - Equipment and device management - Utilities guarantee - Medical waste management - Communication management - Transportation management

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Table 15. Continued

Functions	Level 1 Sub-Function	Level 2 Sub-Function
Resource management	Sourcing management	- Estimation of required skills - Planning the required human resource - Standardization of education system - Immigration
	Organization management	- Recruitment - Distribution management
	Retain management	- Performance Evaluation - Welfare and compensation system - On the job training - Retirement
Knowledge and information management	Understanding the needs	- Addressing the current problems - Policymaking requirement - Productivity improvement - Fulfilling the stakeholders' expectations
	Knowledge generation	- Knowledge capture - Knowledge creation - Knowledge validation
	Knowledge organizing	- Knowledge standardization - Knowledge archiving - Knowledge sharing
	Knowledge utilization	- Creating the innovation - Responsiveness enhancement - Competency acquisition - Productivity improvement
	Understanding the needs	- Patient's needs - Performance evaluation needs - Provider's needs - Regulator's needs
	Information generation	- collect available information - Information matching - New information creation - Information audit
	Information Organizing	- Information categorizing - Information Archiving - Information dissemination - Information obliteration
	Information Utilization	- Decision making on provision of service - Decision making on organizational issues - Research - Performance improvement - Learning
Medical equipment and drugs management	Medical equipment management	- Planning and Evaluation - Financing and budget allocation - Technology evaluation and selection - Design process - Sourcing and purchasing - Install and setup - Training and skill development - Utilization and safety - Maintenance and repair - Scrapping
	Drugs management	- Selection - Provision - Distribution - Consumption

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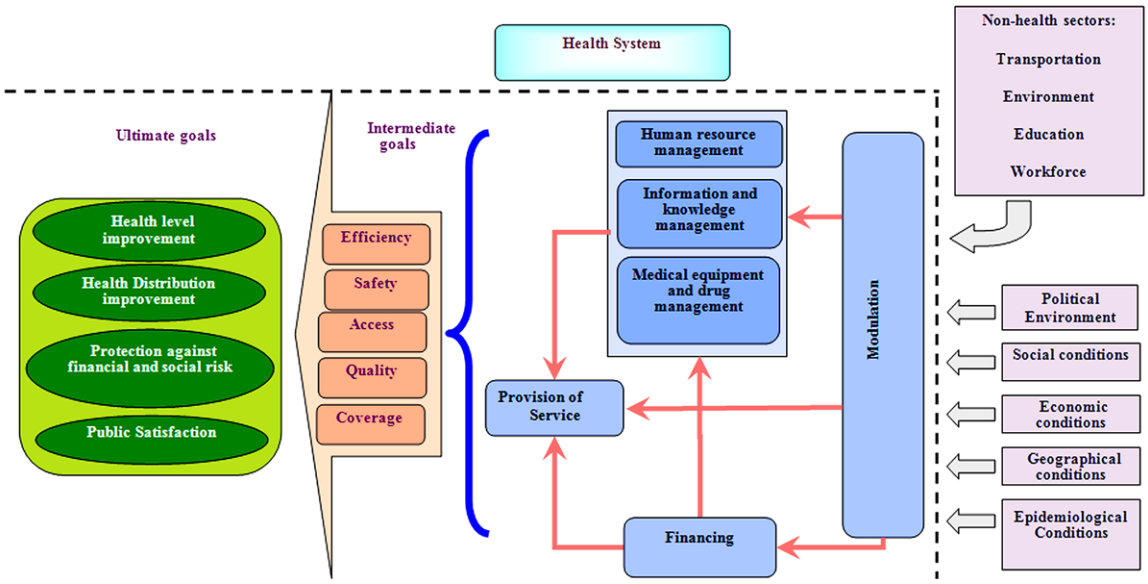
Figure 6. An overview of the proposed model of health system



FUTURE RESEARCH DIRECTIONS

As presented, the model tries to provide a comprehensive view on the performance of the health system, independent of the type of the structural model. Hence, it can be invoked as a basis model in the evaluation of health systems. In other words, in addition to conventional patterns in the evaluation of health systems which are currently used and focused primarily on indicators of health in the community, the above model can be used to evaluate the national and regional health management system analytically. Obviously, based on the functional classification proposed in this model, the strengths and weaknesses of different patterns of health system can be assessed. The causal analysis of functions and sub-functions of the proposed model would be useful in providing health system reform policy.

CONCLUSION

The comprehensive deployment of the health system requires different tools. Each tool is a ring in the intertwined chain of this system. At the end, a coherent and targeted network is formed which in its entirety realizes its main mission: providing and ensuring the public health.

This chapter presented a comprehensive overview of structural models in the national health systems in the world. Then, the national health system was reviewed and analyzed functionally from different perspectives. Finally, a comprehensive functional model was proposed.

With a holistic view to the health system, the proposed model fills the gaps in the previous models and improves the literature on the functional field of health system. This model also breaks different functions into sub-functions and provides a more accurate picture of the functional scope of health system. Thus, the model can be used in order to evaluate the performance of a health system.

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KEY TERMS AND DEFINITIONS

Health: Complete physical, mental and social relaxation, not merely the absence of disease and disability (WHO, 2000).

Health System: The health system includes all activities whose main goal is to preserve, enhance or restore the health (WHO, 2000).

Healthcare: Healthcare includes providing services and implementing prevention, treatment, and rehabilitation plans in various aspects of health (Encyclopedia of Public Health).

Public Health: Public health is the science and art of preventing diseases, increasing life expectancy and raising the general level of human health through applying individual, collective and institutional methods and strategies in society (Winslow, 1920).

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Chapter 58
Rough Fuzzy Set Theory and Neighbourhood Approximation Based Modelling for Spatial Epidemiology

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ABSTRACT

Modern epidemiological studies involve understanding individual and social level inferences and their role in the transmission and distribution of disease instances. The geographic relevance in epidemiology has been analysed in concurrence with these inferences. The substantial amount of data involved in an epidemiological study is usually very large and intuitively involves missing values and uncertainty. Rough Set Theory (RST) has been used in medical informatics for 'outcome prediction' and 'feature selection'. It can be used to construct the decision system involving spatial, medical and demographic data effectively. This chapter proposes the use of rough sets in conjunction with parallel techniques like Fuzzy sets, Intuitionistic systems and Granular (Neighborhood Approximation) computing for the classic problem of data representation, dimensionality reduction, generation and harvest of minimal rules. RST handles missing values and uncertainty more specific to spatial and medical features of data.

BACKGROUND

Recent and past literatures have documented the relationship between locations, individuals and diseases. Geographic Information Systems (GIS) have been widely used to study problems involving public health. Spatial analysis with respect to epidemiology has been addressed in recent researches. Transmission and distribution of SARS - severe acute respiratory syndrome was studied and analysed by Meng et al. (2002), Wang (2006) documented risk exposure pattern, Ulegtekin et al. (2007) analysed distribution

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of measles in Turkey, Slowinski et al. (1996) predicted *pancreatitis* using Rough Set Theory, Rowland et al. (1998) predicted ambulation after spinal cord injuries, Vinterbo and Øhrn (1999) built a rough set based predictor for myocardial infarction, Bai et al. (2010) used RST to uncover spatial decision rules in neural-tube birth defect. Spatial analysis employing statistical models and spatial regression methods to study population dynamics is reported in Chi and Zhu (2008) and the use of weighted centroid method to predict outbreak of *Escherichia Coli* in Buscema et al (2013). The results have depended on specific features of dataset like configuration, distribution, spatial heterogeneity and autocorrelation. Bai et al. (2010) substantiate that being discernibility based, ability to handle inconsistent data, applicability to any number of outcomes, dimensionality reduction, suitability for spatial data are some of the features that make Rough Sets very conducive to epidemiological study.

To better express the multifaceted nature of the real world and address the limitation of knowledge and uncertainty of factual data, *fuzziness* can be used to represent some attributes of data. It has been used to represent the classification of land-cover types in Shi (2005) and effect of environmental factors on birth defects in Bai et al. (2010). A geographic phenomenon may tend to be closely related and distant related entities based on the distance. This is spatial auto correlation and upheld by Tobler's *law of geography* as in Miller (2004). In RST, an object tends to have *roughness* where the object is a subset of universe with some property states Pawlak (1984). Lower and Upper approximations are used to define an object. The roughness of an object can be précised upon collecting more attributes about the object. Bai et al. (2014) affirm that *roughness* is not a *fuzzy* concept by nature and so fuzzy sets cannot be used to represent roughness *Rough Fuzzy Sets* which is an extension of rough sets can be used to construct the decision system for spatial analytics. Combining *Intuitionistic* approach along with rough fuzzy sets will tend to better accuracy of results leading to crisp conditions and probability based fuzzy decisions.

Dimensionality reduction which is also addressed by RST needs an extra step on dealing with spatial and non-spatial attributes of the decision system. Spatial attributes which are *continuous* in nature will have to be discretised for RST to construct equivalence classes. Jensen and Shen (2004) approve that the discretization may sometimes lead to loss of information. Liao (2012) substantiated the use of *Neighborhood Rough Set approximation* to work with continuous attributes without discretising them.

Neighbourhoods are defined using nearest neighbour methods or by distance from central point to boundary. Using the this method, for a given set of continuous attributes in space, a neighbourhood is defined for every object in *U,* as $\delta\left(x\right) = \{x \mid x \in U, d(x, x1 \leq \delta)$ where $\delta > 0$ and $\delta(x)$ is δ neighbourhood information granule of x. Neighborhood approximation is applied to identify the positive and boundary region. The set of objects in the positive region are identified into decision classes without ambiguity. Non-spatial attributes can be reduced using RST reducts. The minimal reduct induced can be combined with the attributes determined using Neighbourhood Rough Sets from which the rules can be inferred. Treating the spatial and non-spatial attributes separately and integrating them later will uphold the inherent spatial features critical to the semantics of rules.

This chapter will discuss Rough Fuzzy Intuitionistic Decision System for identifying the Spatial Distribution of Disease Instances involving demographic, medical, continuous and auto correlated spatial attributes for spatial data based on Neighborhood Rough Sets. However, the temporal nature of medical data is to be accounted for. Any errors due to missing or inconsistent data should be addressed with the construction of error matrix. The rules generated should be verified for being minimal, correctness and accuracy.

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EPIDEMIOLOGY

Epidemiological studies have been instrumental in analysing public health. The forerunners of this field, Hippocrates, Caprasto, Sir Edwin, John Snow and others have laid out the principles on which modern epidemiology is built. They used statistics, demographics and maps to understand the relationship between diseases, people and environment. Understanding prevalent and incident diseases, their root causes, potential treatment and medical prescription for the same are the directions along which diseases are studied. Elaborate studies on transmission models and intervention methods have been carried out. With the advent of GIS (Geographical Information Systems) where data are referred geographically, studying environment has become more sophisticated.

As an important science of public health, ecological studies of epidemiology are persuaded by scientists and administrators. This is relevant as climatic conditions, exposure to natural and man-induced environmental factors and prevalence of social imbalance are posing serious challenges to public health. A strategic way of comprehending public health issues is the need of the hour in developing countries and exploiting geographic feature of data is just striking the right chord. Epidemics and endemics have wiped out millions of lives in the past centuries. And exhaustive studies on transmission models, distribution of disease clusters and impact of globalization have helped scientists to come up with effective interventions and authorities to make informed decisions.

Boulos (2004) emphasizes that including geographical information leads to evidence based spatio-temporal approach in analysing public health. This work recalls the need for exploring spatial patterns in disease outcomes. Song and Kulldorff (2003) discusses the indices used to identify spatial distribution of disease clusters. Moran's Index, Spatial scan statistic, k-nearest neighbour etc., are discussed. Spatial auto correlation is also measured using these statistics.

Dunn (1995) studied the effects of environmental pollutants and its association with asthma incidences in North East England. Briggs (2000) discusses environmental threats to human health and classifies them as risk, health and hazard indicators. The effect of pollutants from industries on public health can be a decisive study contributing to the welfare of people at large and social cause. Cities that have capitalized from Industries are marked by humongous outlet of effluents and air pollutants. Eventually people living in the affected area are prone to a spectrum of infections and diseases. Data Mining based on soft computing techniques like Rough Set Theory can be used to explore spatial conclusive rules on predominant diseases caused by pollution and look for spatial associations related to the diseases.

Conventionally, scientists have used maps to study relationships between places, surroundings and diseases. Later researchers focused on GIS based spatial analysis combined with visual capabilities. Epidemiologists are also working at the spatial analysis based spread of infectious diseases like the transmission of SARS in Beijing Meng et al. (2002). Studies to find the next most likely to be affected areas based on pollution characteristics are thus possible. Spatial data inherits the core and peripheral nature which can be potentially captured using Rough Set theory. The explicit location and extension of spatial instances define implicit relations of spatial neighborhood (such as topological, distance, and direction relations), which can be used by the rough set based clustering algorithm. New techniques are required for effective and efficient data mining with spatial patterns.

In most of the research efforts where the associations between location, environment and disease are analyzed in epidemiology, researchers have traditionally used maps. The Geographic Information system is well fit for studying these associations because of its spatial analysis and display capacity. Rough set theory has been used to identify the NTD birth defect spatial pattern with respect to geographic locations

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in China and to explore the spatial rules Bai et al. (2010). Determining the spatial characteristics of the disease distribution will help in identifying the worst affected population and respective demographics. It can further help to build and test theories, plan and evaluate epidemiological surveys, forecast trends and test control measures. The proposed approach is first of its kind and would serve as an important tool for public health researchers and practitioners.

Rough set theory is an extension of standard set theory. The central objective of Rough Set Analysis is to synthesize an approximation of concepts and has been successfully applied in pattern recognition, machine learning and automated knowledge acquisition. As such problems involve identifying spatial correlations, it would be augmentative to quote that Rough interpretations can be simplified and standardized.

Data mining models will generate conclusive information on how to identify the potential infected areas and associated statistics. Additionally, spatial relevance will enable the authorities to have an insight into the situation of proposal looks at how data mining can be applied for early detection and management of pandemics. Techniques combining data modeling and spatial data mining to find interesting characteristics of disease spread are used. This will help the authorities in taking informed decisions and thus make provision for healthier living of our citizens. This model can be used to carry out evaluations (impact estimate on the health of population in the specific space) in a given location before setting up any industry based on expected the pollutant output. The model can also be extended to predict the increase in the level of pollutants over a period of time and its impact on the population in that space. Such studies will empower the authorities with a broader understanding of geographic locations and its impeding relationship with the cause and spread of diseases caused by pollution. The results can be validated on test data based on training data like any other data mining validation. The studies will not only enlighten the authorities but also support them to make informed decisions at the time of crisis.

Carrying out ecological studies to analyse population demographics and health outcomes may incur *ecological fallacy* where a population level inference may be assumed to be individual level inference. Time variance may reflect myriad changes in studies conducted. Hence modeling for the study should consider this *demographic shift.*

The *health outcome* oriented data will include sensitive information of individuals. Ensuring privacy to sensitive data is becoming an important criterion in the data access policies of governments and corporations. Providing security to data using non-cryptographic based techniques has been in use for a long time. They are used to provide security to Health data, finance data and the like. Data are distorted using various approaches to hide sensitive information and provide privacy. A whole line of methods from statistical disclosure control to distortion based techniques are in use. The scale of geographic area studied for disease instances bears significance on the quality of results obtained. Pixel dimensions are carefully based on the type of problems studied like predicting bird nesting on coastal regions, colocation pattern mining, urban, resource planning etc.,

SPATIAL RELATIONSHIPS

According to Tobler's Law of Geography, spatial attributes tend to have spatial correlation and instinctively exhibit spatial neighbourhoods. Spatial relationships like distances, directions and topology are studied extensively only in novel applications. Addressing topological relationships like intersections, adjacency and overlaps are discussed in Randell and Cohn (1992) using Region connected Calculus. Spatial data is a real world representation model and therefore encompasses uncertainty. Murgante

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(2007) used rough sets for identifying periurban fringes in a province. This work recalls Burrough and Frank (1996) where periurban fringes are said to be the spatial regions with uncertain boundaries. On comparison with Map Algebra, Rough Sets based approach was found to better classify the regions. Beaubouef and Petry (2002) profoundly discuss uncertain nature of spatial data with respect to topology. They have proposed a rough set based approach to the RCC-8 algorithm put forth by Randall & Cohn (1992). The work discusses eight possible relations that hold between vague regions – *partially overlapping, tangential proper par and its inverse, non-tangential proper part and its inverse, equal, externally connected and disconnected.* Further, they have discussed representation of these relations in rough sets by giving a mathematical model for uncertain regions.

DECISION SYSTEMS

The rough set method has been used to find out land control knowledge, with a case study indicating its feasibility in Wang et al. (2001). And, the rough set method has been applied for spatial classification and uncertainty analysis in Ahlqvist et al. (2003). Rough set theory was used in preprocessing and the classification of remotely sensed imagery and attributes analysis in GIS by Li D R et al. (2006). But it did not explicitly study the mining of rules for the classification of spatial data as said in Leung et al. (2007). So they proposed a novel rough set approach for discovering classification rules in spatial data was proposed. The Spatial patterns of risk exposure were identified and mapped using geographical techniques and mathematical modeling to represent the spatio-temporal spread of SARS by Wang J F et al. (2006).

The advantages of discernibility-based methods for data mining are highlighted in the health sciences, and demonstrated that these ideas are applicable by formulating pertinent and innovative medical applications. Rough set theory has been used to extract most relevant clinical attributes and generate rules for arriving at decisions using the concept of 'Core' and 'reduct'. Rough Set theory has been used to select relevant attributes from data set for predicting Diabetes in Su C.T et al. (2006). And several other work show that a number of medical reasoning models observe the core (reduct) ideas of Rough Set theory in diagnostic models. Bai et al (2010) used Rough set approaches are exclusively applied for identifying birth defects in China involving spatial reference and correlations.

A decision system with a set of objects, conditional and decision attributes is constructed. It is defined as (U, CA∩DA) where U is the universe of non-empty objects, CA are the conditional attributes and DA the decision attributes. Construction of the decision requires understanding of the nature of objects we deal which involve spatial, demographical and medical data. The attributes may involve fuzzy nature. When we construct decision system based on rough sets, equivalence classes based on equivalence relation are found and an associated indiscernibility is defined. The objects that belong in an indiscernibility relation are similar to each other with respect to the attributes based on which equivalence relation is defined. For any subset $X \subseteq U$ and any $F \subseteq CA$, is an associated equivalence relation $INDs = \{(x, x') \subseteq U^2 \mid \forall a \in Fa(x) = a(x')\}$ called F-indiscernibility relation. The equivalence class of this is specified as $[x]_F$. Lower and upper approximations of X with respect to F are defined as $\underline{FX}$ and $\overline{FX}$ where $\underline{FX} = \left\{x \mid [x]_F \subseteq X\right\}$ and $\overline{FX} = \left\{x \mid [x]_F \bigcap X \neq \varnothing\right\}$. The difference of these two sets is the boundary set. A set is rough if the boundary region is not empty.

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The number of attributes to be considered for an ecological study may include temperature, rainfall, humidity, wind pattern, soil type, slope, rock types, rivers, road connectivity, proximity to basic services; demographic data – male-female population, educational background, work nature, per capita income, GDP to represent industrialization, density – distribution -type of industries; medical data-disease instances, anonymised patient details etc., The attributes that preserve indiscernibility relation are retained. This is achieved by identifying reduct and core in RST. Thangavel and Pethalakshmi (2006) proposed Reduct algorithm for feature selection, also other variants, genetic algorithm based reducts etc., are available to identify reducts. This ensures that classificatory performance of reduced set of attributes is same as the original set. After identifying the reducts, decision rules are extracted. Decision rules generated should be minimal and complete. Error analysis should be conducted by constructing error matrix and other methods to conclude the work. The rules generated should be verified with data and domain experts for validation.

Neighborhood Rough Sets and Spatial Data

Spatial data involves attributes like temperature, rainfall, slope, humidity and generally are continuous and involve real numbers. Discretising them may lead to loss of information. In the context of Spatial Decision System, the continuous values of attributes are to be preserved. Neighborhood systems use similarity metric to relate data and reduce the chances of information loss. Lin .T. Y (1989) used neighborhood system for approximation in numerical analysis for which a neighborhood of tolerance has to be identified even before the approximation commences. Neighborhood Rough Sets can be used for continuous attributes represented in the decision system. It involves distance measures can be used for handling continuous spatial data.

Neighborhood Granulation

Definition 1: Given a N dimension real number space U, two objects x_i, $x_j \in U$, the distance metric δ between the two data objects, then following properties are satisfied in the neighborhood model.

$$\delta\left(x_i, x_j\right) \geq 0, iff\, i = j, \delta\left(x_i, x_j\right) = 0 \tag{1}$$

$$\delta\left(x_i, x_j\right) = \delta\left(x_j, x_i\right) \tag{2}$$

$$\delta\left(x_i, x_j\right) + \delta\left(x_j, x_k\right) \geq \delta\left(x_i, x_k\right) \tag{3}$$

Then we called (U,δ) is a real number space. The above three properties are reflexivity, symmetry and non-transitive properties of neighborhood relation.

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Definition 2: Given a finite set of objects $U\{x_1,x_2,x_3,\ldots,x_n\}$ in real number space, for every object x_i in U, then the δ-neighborhood definition is as follows:

$$\delta\left(x_i\right)=\left\{x \mid x \in U, d\left(x, x_i\right) \leq \delta\right\} \tag{4}$$

where $\delta>0$, $\delta(x_i)$ is δ neighborhood information granulation from x_i and called as x_i neighborhood granulation.

Neighborhood relations are a kind of similarity relations, which satisfy reflexivity and symmetry properties. The data objects are drawn together for similarity in terms of distances and the samples in the same neighborhood granule are close to each other. Considering two x_i,x_j objects in a M-dimensional space with attribute set $A=\{A_1,A_2,\ldots,A_M\}$, $f(x,A_i)$ represents the value of object x in attribute A_i, a Minkowsky distance defined by

$$\delta_p\left(x_i, x_j\right)=\left(\sum_{i=1}^{M}\left|f\left(x_i, A_i\right)-f\left(x_j, A_j\right)\right|^p\right)^{1/p} \tag{5}$$

$\delta_P(x_i,x_j)$ is Manhattan distance if $p=1$, Euclidean distance if $p=2$ and Chebychev distance if $p=\infty$. Distance functions are discussed by Wilson & Martinez (1997) in detail. $\delta_A(x_i)$ is the neighborhood of data object x_i and its size is based on the threshold δ.

Q. Hu et al. (2008) discuss neighbourhoods involving numerical and categorical attributes.

Definition 3: Let $N\subseteq A$ and $C\subseteq A$ be numerical and categorical attributes respectively. The neighborhood for a for a subset x, effected by N and C and $N \cup C$ are defined by Q. Hu et al. (2008) as

$$\delta_N\left(x\right)=\left\{x_i \mid \Delta_N\left(x, x_i\right) \leq \delta, x_i \int U\right\}; \tag{6}$$

$$\delta_C\left(x\right)=\left\{x_i|\Delta_C\left(x, x_i\right)=0, x_i \epsilon U\right\}; \tag{7}$$

$$\delta_{N \bigcup C}\left(x\right)=\left\{x_i \mid \Delta_N\left(x, x_i\right) \leq \delta \Delta_C\left(x, x_i\right)=0, x_i \int U\right\}; \tag{8}$$

where $\wedge$ is the *AND* operator. Other distance measures for attributes involving numerical and categorical attributes are *heterogeneous overlap metric function, value difference metric, heterogeneous value difference metric and interpolated value difference metric* proposed by Randall and Tony (2007) and Wang (2006).

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Neighborhood Approximation

Considering a set of objects $U=\{x_1,x_2,\ldots,x_n\}$ a neighborhood relation R, then the neighborhood approximation space $S=\{U,R\}$ and for any $X\subseteq U$, lower and upper approximations are defined as follows and *opr* is the approximation operator:

$$\begin{cases} \underline{R}_{opr}(X)=\left\{x_i \in U \mid \delta\left(x_i\right)X, x_i \in U\right\} \\ \overline{R}_{opr}(X)=\left\{x_i \in U \mid \delta\left(x_i\right)\bigcap X, x_i \in U\right\} \end{cases}$$

The positive, negative and boundary region are as follows:

$$\begin{cases} POS\left(X\right)=\underline{R}_{opr}\ (X) \\ NEG\left(X\right)=\sim \overline{R}_{opr}\ (X) \\ BND\left(X\right)=\overline{R}_{n}\ (X)-\underline{R}_{opr}(X) \end{cases}$$

A data object will fall in positive or boundary region. Also, roughness of subset X in the approximation space is inferred from the size of boundary region. The set of objects in positive region can be classified with certainty while the objects in boundary region will have indeterminate classification. Yao (1998) has defined the properties of neighborhood operators and has established a framework for it. Approximations are based on the neighborhood operator *opr*. It is based on the rough set algebra defined by $\left(2^U,\bigcap,\bigcup,\sim,\underline{R}_{opr},\overline{R}_{opr}\right)$. Further Yao (1998) has defined the pair approximations for a random neighborhood operator.

1. $\underline{R}_{opr}\left(X\right)=\sim\ \overline{R}_{opr}\left(\sim X\right))$
2. $\overline{R}_{opr}\left(X\right)=\sim\ (\underline{R}_{opr}\ (\sim X))$
3. $\underline{R}_{opr}\left(U\right)=U$
4. $\overline{R}_{opr}\left(\varnothing\right)=\varnothing$
5. $\underline{R}_{opr}\left(X\bigcap Y\right)=\underline{R}_{opr}\left(X\right)\bigcap\underline{R}_{opr}\left(Y\right)$

6. $\overline{R}_{opr}\left(X\bigcup Y\right)=\overline{R}_{opr}\left(X\right)\bigcup\overline{R}_{opr}\left(Y\right)$.

Yao (1998) states more properties derived from the above set.

Q.Hu et al. (2008) has documented that the lower and upper approximations defined require further adequacy. His work has recalled Variable Precision Rough Sets by Ziarko (1993) which uses an inclusion degree. Considering two sets X and Y from a universal set of objects U, inclusion of X in Y is represented as,

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$$Inc\left(X\right)=\frac{cardinality\left(X\bigcap Y\right)}{cardinality\left(X\right)}$$

assuming X is a not-null set.

Definition 4: The lower and upper approximation from approximation space (U, X, R) as in definition 3, only for a variable precision rough set which considers partial inclusion is defined by

$$\begin{cases}\underline{R^k}\,X=\left\{x_i\in U\mid Inc\left(\delta\left(x_i\right),X\right)\geq k,x_i\in U\right\}\\ \overline{R^k}\,X=\left\{x_i\in U\mid Inc\left(\delta\left(x_i\right),X\right)\geq 1-k,x_i\in U\right\}\end{cases}$$

and *k* falls between 0.5 and 1.

FUZZY FLAIR TO DECISION SYSTEMS

Decision systems may involve decision attributes of fuzzy nature. If d_1, d_2,..d_n the decision values are a fuzzy set of the Universe, they will result in fuzzy decision system. The membership of a decision value v, is $\mu_v = U \rightarrow [0,1]$. Dubois and Prade (1990) introduced rough fuzzy theory and defined lower and upper approximations as

$$\mu_{\bar{B}(S)}\left(x\right)=\max\left\{\mu_S\left(y\right),y\in\left[x\right]_B\right\}$$

$$\mu_{\underline{B}(S)}\left(x\right)=\min\left\{\mu_S\left(y\right),y\in\left[x\right]_B\right\}$$

respectively where U, $AT \cup D$ is an information system $B \subseteq AT$ (conditional attributes) and $S \in D$ (Decision attribute of fuzzy nature). This kind of decision system will be useful in representing spatial data and has to deal with its uncertainty, spatial correlation, roughness and fuzziness. Approximations of such systems were initiated by Xu et al. (2003), Li et al. (2008) and others. Bai et al. (2014) have used fuzzy decision information system to deal with decision attributes which are fuzzy and mined spatial rules. Dimensionality reduction and rule generation for fuzzy based decision systems were put forth by Xu et al. (2003). Spatial layers of data may be represented as attributes and hybrid soft computing techniques can be used to represent and model them.

CONCLUSION AND FUTURE DIRECTIONS

Epidemiology involves studies whose solutions have a greater societal impact. It involves number difficult parameters that require exclusive considerations and hence pose a challenging area. The interdis-

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ciplinary work among Medicine and Computer Science has created remarkable development in the last few decades and has affected the practice of Medicine and Health Care services, but it still needs major collaborative efforts, exploring of new dimensions and enhancements.

Spatio-temporal patterns in disease occurrence and spread in a population is deemed as evidence-based and calls for a lot of studies in this area. Exploiting soft computing techniques that call for hybrid approaches and working with domain experts, statisticians, computer science engineers and administrators is the need of the hour. For further work, construction of robust Decision Systems based on granulation and approximation strategies with different similarity measures and topological properties can be carried out.

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KEY TERMS AND DEFINITIONS

Granulation: It is using groups or clusters of data objects formed on the basis of similarity in an incomplete information system.

Neighborhood Systems: They provide granulation structure for each element of a universe.

Spatial Correlation: The values of a spatial attribute tend to be close to each other and vary gradually from core to periphery of a geographic region.

Spatial Data Mining: Mining patterns or rules from spatial data with respect to a geographic reference.

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Chapter 59
Toward an Informed-Patient Approach to E-Health Services

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ABSTRACT

With the expanding utilization of digital and technological media by public health providers and healthcare consumers, there is a need to evaluate the patients' role. There is good evidence of the growing acceptability of the Internet in seeking health information. This paper aims to evaluate the patients' role as an informed-patient. This role, albeit, with its limitations, affects the ways by which people consume health, consult their doctors and also influence health policy. This paper is a sociological and anthropological analysis of the effect of e-health services on the informed-patients' role and their ability to bring about social change through the Internet and their use of e-healthcare services. Through analyzing current literature and examples of health-related websites, this analysis focuses on informed-patients and how they are able to demand better health services for themselves and for their communities.

INTRODUCTION

This conceptual paper is a sociological and anthropological analysis of the effect of e-health services on the informed-patients' role and their ability to bring about social change through the Internet and their use of e-healthcare services through online community-growth dynamics. In this paper, the term e-health services refers to all new electronic means (the Internet and telecommunications) providing health resources, information and a platform for interaction between institutions, health professionals, health providers, health consumers and the public. Through examples of health-related websites, this analysis focuses on informed-patients and how they are able to seek health information and to demand

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better health services and standards for themselves and for their communities. This article focuses on the empowering role of the Internet for informed-patients to become active agents.

In the following sections, this paper provides examples from different websites to illustrate the use of e-health services, the social implications of this usage upon the physician-patient interactions and the limitations of the e-health services. The paper focuses on the basic interaction between physician and patient, in spite of the fact that *their* physicians are not necessarily the primary providers of information of health-services accessed from these online resources.

With the expanding utilization of digital and technological media by public health providers and healthcare consumers, there is a need to evaluate the patients' role. There is good evidence of the growing acceptability of the Internet in seeking health information (Ahmann, 2000; Diaz et al., 2002; Hardey, 1999; Nettleton & Burrows, 2003; Pemberton & Goldblatt, 1998). Murray et al (2003) argued that in the USA nearly one third of the population search for health information online. According to Schwartz et al (2005), it was estimated by the Pew Internet and American Life Project that on a typical day in 2004, 70 million Americans went online and seven million searched for health or medical information. The Pew survey also estimated that 75% of online men and 85% of online women had searched for health information at least once in the past. Consequently, Schwartz argues that as long as more people gain access to the Internet, the numbers seeking healthcare information are likely to increase. This rapid rise in health information technology (HIT) is reflected, for example, in American expenditure on the growth in health information technology- from $19 to $31 billion between 2000 and 2006 (Miller and West, 2009).

The question is: what makes the Internet more attractive than other media channels? Its attractiveness is intrinsic to its unique infrastructure. In their review, Azy and Fisher (2001), suggest that the Internet possesses a "Triple A Engine": affordability, availability, and anonymity: "*Affordability* refers to the Internet's low cost, which has permitted it to penetrate many segments of society. *Availability* refers to the Internet's ease of use at any time and in many locations. *Anonymity* refers to the apparent obscurity of the Internet's users" (2001:325). Azy and Fisher (2001) added a fourth factor used by King (1999), *Acceptability* which refers to the Internet's legitimacy; and, a fifth factor *aloneness,* which refers to the fact that the Internet is typically used privately "in unobserved human-computer transactions." (2001:325). These factors are most useful for healthcare information seekers.

Recent research has explored the effect of the availability of Internet-based health information on patients' healthcare education and knowledge. Studies found that a significant proportion of people rely on the Internet to make critical health decisions and often bring information retrieved from the Internet into medical consultations (Anderson, Rainey, & Eysenbach 2003; Friedewald, 2000). Fox and Rainie's (2002) study found that 61% of the American public said the Internet had improved the way in which they take care of their health: 93% of health seekers have gone online to look for information about a particular illness or condition and 65% of health seekers have looked for information about nutrition, exercise, or weight control. Azy and Fisher (2001) conclude that the advantages of Internet-driven educational technology are applicable to any area of instruction, but emphasise the benefits of its usefulness for sex education. It appears that the process of seeking health information takes the searcher through interactive and hyper-connective processes that address specific questions and motives, and engage behavioral-skills associated with particular concerns about well-being. In other words, we can, with confidence, and in complete privacy, look up readily accessible material in a comprehensible language about our deepest fears, most embarrassing illnesses and most personal of habits, for only a fraction of the cost our monthly telephone lines or electricity supply.

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In addition to the Internet's information function, people also use the Internet to share illness experiences and to support each other through online chats and forums. The illness experience, according to Kleinman (1998), is the patient narrative which comprises locally shared illness idioms that create a common ground for patient and practitioners to understand each other. One such website is *Treato - the voice of the patient* (http://corp.treato.com/). The website opens with the global patient voice map in real time describing patients' conversations worldwide. Treato provides, in real-time, the patient's voice, narrative and insights based on analysis of thousands of personal health experiences that are being posted online and shared every day. Treato aims to assist pharmaceutical and health marketers to access patient experiences and to understand what patients think about medication, treatment and illness. This website bridges the micro-illness (personal) experience with macro-health systems as a basis for improvement in health provision:

As patients turn to social media networks for information and support, companies have the opportunity to turn the millions of posts they generate on forums, discussion groups and blogs into valuable insights about their quest for guidance and support. With Treato IQ, companies gain immediate, first-hand knowledge of patients' fears, perceptions and attitudes as they make their way from coping with symptoms, understanding their diagnosis and considering and complying with treatment. (Retrieved from http://corp.treato.com/ in December 4th, 2014)

At the same time, Treato offers patients an online portal to post, share and read other patients' stories. According to the website between 2 and 3 million patients and caregivers around the world access the website every month to discover what other patients are saying about symptoms, conditions and types of treatment. In the website, patients can type in any keyword and see what millions of patients are saying about this. At the bottom of the homepage there are details about the numbers of patients, medications, conditions and posts that have already been viewed, and these numbers keep rising in real time. So, perhaps in a rather comforting irony, a patient is not completely alone in their search in the online community. Online searching may, therefore, provide privacy without isolation.

All of the "five A-engines" described above apply in this example of a patient information website: access to the online portal is free; it is available any time and from any place, searches are anonymous (patients do not have to disclose their personal details), and, from the number of users, patients have clearly found it acceptable, and it provides both privacy and a sense of community.

The website, which was established in Israel, states its vision to be:

Healthcare is one of the most complex and sensitive fields discussed online. Patients have their own way of expressing their feelings and experiences using their own words. Our patented algorithms go far beyond analyzing sentiment trends to provide a true understanding of what patients are saying as they or their loved ones cope with disease or make their way through treatment. Patients are increasingly taking an active role in their healthcare. The Internet has not only given consumers and patients a place to get information and conduct research. It's given them a place to tell their story. Treato automatically collects, indexes and analyzes the massive amount of content patients and caregivers generate online to extract relevant information, connect the dots and create the big picture of what they are saying about their personal treatment- and condition-related experiences. The result is the world's largest source of patient insights gathered from billions of online conversations across the social web. We call it the patient voice. (Retrieved from http://corp.treato.com/ in December 4th, 2014)

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This website celebrates the shift in paradigm that has seen patients play an active role as experts in their own health and healthcare decisions. How, therefore, has the Internet impacted patients in their interactions with their physicians? Should, with this expertise, come greater responsibility for looking after one's own health? Is there potential for patients to assume greater power and influence (even financial influence) over health providers or even pharmaceutical companies? Might patients also be able to influence health policy at the level of local or national government? As described above, this paper analyzes the published literature related to the effects of Internet-based health information on the patient's role, and in relation to interactions with physicians and healthcare policy makers.

THE INFORMED-PATIENT ROLE

The availability of Internet-based health information has impacted the patient's role by bringing new dynamics to self-management of health. Studies have described, in particular, the emergence of *the informed-patient role*. This role refers to a patient's competence as a responsible, knowledgeable and self-aware individual, capable of making healthcare decisions based on search, analysis and appraisal of online information (Nettleton et al. 2004; Song et al., 2012). Henwood et al (2003) critically argue that this role encourages a consumer orientation, so, in adopting it, healthcare information is framed as a commodity to be acquired over the Internet. Furthermore, when there are more personal narratives of recovery from illness online, advertisements for health products begin to prosper encouraging new consumerist orientations towards health (Hardey 2001). The informed-patient role illuminates the contemporary developments in the consumption of health and the growth of 'information rich' consumers of health (Shilling, 2002). A wide range of online services and commodities exist that users may access for information (whether primarily written by patients for patients or by health providers for patients). As these online resources grow, more choice will become available to health consumers, but disparities in access to e-healthcare (Biswas, et al, 2014) may become the final determinants of which online health resources are readily available to patients.

Broom (2005) discusses the Internet as a source of empowerment for patients. One aspect of empowerment is exemplified in the patient's sense of control over their illness and disease due to the acquisition of knowledge and, perhaps, greater understanding, or at least, the availability of explanations of medical conditions at the touch of a button. The Internet is also a source of empowerment for ethnic minority patients. Burke-Garcia and Scaly (2014), in the Final Report of the Commission on Social Determinants of Health, describe the potential importance of social media among ethnic minority groups to improve their, often, relatively poor health experiences. Another aspect of empowerment refers to the patient as an active agent who challenges the biomedical hierarchical models that had the physician as the exclusive source of information while the patient was in passive reception. Light (2001) added that the Internet will unleash the "Democratic Imperative of the Internet" (2001: 1179). Meaning that involvement, indeed, participation of individuals in decision making about healthcare funding, rationing and trade-offs will increase, ensuring that "the next decade may bring more devolved decision-making than either the state or the medical profession is ready to concede" (2001: 1179).

The Internet as an information source and a social sharing medium has, therefore, given patients knowledge which has facilitated their participation in the healthcare process. In turn, the active participation of the public in digital media has a valuable role in the dissemination of public health and illness

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prevention messages using 'trusted voices' especially for hard-to-reach audiences (Burke-Garcia and Scaly, 2014). Additionally, the Internet provides an anonymous space in which people can advise each other and share illness experience without stigmatizing health problems (Burrows et al., 2000). This may facilitate open discussions about illness experiences within online groups that usually, in face-to-face interactions, are muted and excluded due to their illness's stigma. In addition, the sharing of illness experience has become, in a number of instances, a credible information resource with patients empowered as 'experts'.

Inequalities remain, however, a barrier in access to the Internet for people across different social class categories and across the world. The digital divide is a major barrier to the consumption of Internet-based health information (Biswas et al., 2014). A key premise to the commodification of healthcare is that patients must possess sufficient capital in the form of economic resource, literacy, IT literacy, social networks, and cultural capital in order to gain access to and act on the wide array of health choices available online; i.e. a patients' desire and ability to capably fulfill the informed patient ideal is strongly connected to their social, cultural and economic location.

In their research among patients in medically underserved populations, Zach et al (2011), suggested that the lack of access to the Internet in itself is not a primary determining barrier to seeking health information and that the digital divide exists not at the level of information access but rather at the level of information use. They concluded that using cell phones as a method of providing targeted health information may facilitate better communication between healthcare providers and their patient populations.

The possession of sufficient capital does not refer simply to the patient's ability to choose and make a correct decision about their health, but also refers to the ability to criticize new health standards, competence, and the information yield from online patient groups. For example, Song et al (2012) in their study of pregnant women seeking healthcare information, argue that, as the Internet allows women to educate themselves about their own and their family's health, it also works to institutionalize a new set of expectations and standards of competence to which women must adhere, in order to be considered savvy informed patients and, at the same time, capable mothers. This study concluded that the majority of women who turned to the Internet seeking reassurance and control in uncertain circumstances relied on resources that affirm advice from mainstream medical authorities while casting normative childbearing in terms of making the right consumer choices:

Rather than embodying technological empowerment, we argue that these pregnant women's Internet use better represents a fully reflexive performance of the informed patient role employed to demonstrate their competence as mothers. We also suggest that a key component to the successful assimilation of those identities is class privilege and that the performance of these identities function as a technology of the self, which works to internalize and maintain the class structure out of which the informed patient and ideal mother ideologies emerge. (2012:793)

THE PHYSICIAN-PATIENT RELATIONSHIP

Use of the Internet in order to seek medical information has the potential to alter the balance of power and expertise within the physician-patient relationship (Jadad 1999; Hardey 1999, 2001). Being an informed-patient increases the potential for people to seek information and second opinions without

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the mediation of their physicians. The physician's role might also change to become that of a secondary source of health advice and treatment so that "individuals may consult them not as a consequence of assuming obligations contained in the sick role, but as a means of assisting their own health-related concerns" (Shilling, 2002:630).

Additionally, users of the Internet may challenge the medical opinion of conventional health professionals, and seek aid from non-orthodox practitioners (Eysenbach and Diepgen 1999; Jadad 1999). This goes in tandem with another social trend of consuming over-the-counter preparations. In both cases, consumers are enabled in the investment in 'health' outside of the traditional places and interactions with health professionals. Thus, people may skip a consultation with their own physician and seek advice on the Internet without going to the hospital or waiting in clinic to see the physician. This Internet advice is easy enough to obtain through Smartphones or computers in spite of the risk that the information may not be correct and may not be from a credible medical source.

Fox and Rainie (2002) have divided health seekers into three groups: About one quarter are vigilant about verifying information on the website, another quarter are concerned about the quality of the information they find, and half rely on their own common sense, rarely checking the source of the information, the date when the information was posted, or the site's privacy policy. The authors explain that one of the reasons that health seekers are generally casual in their approach to verifying online information is that they trust the online environment. Altogether, 72% of health seekers claim that all or most of the health information online may be believed.

In spite of these new dynamics in physician-patient interaction there remains one main limitation: patients might find it difficult to interpret health-related Internet information. The ways by which people filter, translate and interpret the information found on the Internet are negotiable and are dependent on the cultural context. The diversity of information seemingly related to health is, however, a reason for caution. Because of its unregulated, fairly unrestricted and global reach, the Internet presents a challenge to users who have to contextualize information within their individual cultural understanding and beliefs, and within the backdrop of their local healthcare system and national health policy. Patients, therefore, seek help in interpreting the information that they find online from their physicians. Therefore, they bring the information to clinics to discuss with their physicians, and rely on their physicians' interpretation and contextualization of this information (Anderson et al., 2003; Berland et al., 2001; Pemberton & Goldblatt, 1998; Sommerhalder, Andrea, Zufferey, Jürgen, & Thomas, 2009). This potentially poses another challenge for the physicians who may view knowledgeable patients as troublesome (Broom, 2005; Helft, Hlubocky, & Daugherty, 2003; Malone et al., 2004). According to recent studies (Diaz et al., 2002; Hay et al., 2008) some patients do not discuss information found on the Internet with their physicians because they are afraid that their physicians will regard them as a threat.

Yu-Chan (2011), in a study in Taiwan, found that patients' knowledge of their own disease might be considerably increased by searching for information over the Internet. However, within the culture of hierarchical physician–patient relationships, these patients, in terms of medical knowledge, still viewed themselves as being in a position inferior to their physicians. Also, the participants in the study expressed fear that talking about or asking too many questions would offend their physicians, especially if the questions were based on information retrieved from the Internet. Thus, Yu-Chan (2011) conclude that the patients revere physicians and are not used to asking questions, even, sadly, when they did not understand the physician's words.

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THE PATIENT ROLE AND HEALTH POLICY

As discussed above, computers and the Internet have contributed to an emerging revolution in technology-assisted healthcare. The new technologies provide an optimal means for storing, searching, and retrieving healthcare information, and for sharing illness experiences. The Internet also permits self-education and self-management for individuals who become *informed-patients*. This role, albeit, with its limitations, affects the ways by which people consume health, consult their physicians and also influence health policy.

One recent and exciting example is the website *"Health letters"* (https://healthletters.wordpress.com/about/) established in Israel. It is a new endeavor initiated by worried citizens. It aims to promote an open discourse about the Israeli public health system and bring about change. On the website, citizens are asked to write and post online a letter describing their personal experiences within the public health system focusing on the system's conditions and problems. The website was built by a young woman after she had a poor experience in the Intensive Care Unit of one of the public hospitals in Israel. The website, which is also connected to a Facebook page, displays numerous letters signed by patients from around the country who describe in detail their own ordeal in different clinics and hospitals.

According to the designers of the website, the rationale behind this project is:

Along the course of generations, the Israeli government has neglected the Ministry of Health and thus the public health system is on the edge of collapse, it is actually collapsing. Now the responsibility is in your hands. We, the women and men Israeli citizens, suffer each day from the ongoing neglect and demand to locate the public health interests high on the national agenda and to treat it with the same sincere attitude as treating the defense system. Securing the life of Israeli citizens includes not just a military actions but also securing the systems that aid and support the quality of life. Each day we will remind you how bad is the health system condition until we will see a change. (Translated from Hebrew by the author, retrieved from https://healthletters.wordpress.com/about/ in December 4th, 2014)

This website demonstrates the active role of the informed-patient who is able to use information not merely to share their own illness and healthcare experience or to learn about the experience of other patients, but also to promote change in health provision and health policy. In that matter, the interactive nature of the Internet provides the patients the tools to assert their opinions in a manner that other media tools may not (the five A's), perhaps most important of which is to challenge prevailing policy with a level of protection afforded by anonymity and privacy. In this example, the Internet platform provides interactivity so that everyone from all over the country is able to participate and contribute their personal story.

On this website, every story counts, a democratic forum, one might argue. The website enables the patients to communicate with each other in dynamic, active and reciprocal ways – their individual voices are heard. Collectively, the effect is a powerful one: an ongoing public, albeit, online, call for the improvement of healthcare services that gathers pace over time, creates a galvanized body of protest and coalitions of diverse people who are unlikely to acknowledge each other under normal circumstances as they wait together in the physician's waiting room. Social media creates an environment to communicate that face-to-face interaction potentially precludes. By expending their social networks this website builds social capital for the patients and their communities - "bridging social capital" (Putnam, 2000). Bridging

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social capital refers to networks of association between participants who are typically drawn from wide range of backgrounds. Their proximate reason for interaction is to engage together in a collective and shared activity which each individual values and benefits from, which cannot be achieved alone, and which is not available through the bonded and familiar networks that they already have.

The Internet permits the easy exchange of information amongst users. People post online of their own volition and have the confidence to criticize. In turn, as they post, and others post, an online community builds (with a very real sense of community) that inspires commitment and group support. The online publication of the health letters increases their potency in promoting health issues for the sake of the collective. In its effects of empowerment and the publication of human experiences, the Internet presents an exceptional mechanism for instantaneously creating an intervention that serves both an individual's and group's needs, in this example, in terms of sharing healthcare experiences towards improving healthcare provision. In effect, the website enables the public to assert their rights: to protest against the current state of services; to demand improvement; to share their experiences; and, to make themselves heard to policy makers. Here, the Internet provides an equalizing platform for the public to make clear their concerns and entitlements.

Further examples from the UK highlight Internet-based health information services for patients. The first is patient.co.uk (http://www.patient.co.uk/) which provides free information about medical conditions, accessing healthcare, scientific articles and UK clinical guidelines. There are active patient discussion forums, support platforms and links to pharmacies, physician's surgeries and dentists. Launched by General Practitioners, it is accredited by National Health Service England's quality mark. As an example of an online service that brings physicians and patients together, there are sections on the website for patients and for health professionals. It is an interesting bridge between physicians and patients: one may perceive physicians looking up information about their own health. There is a section for medical students. Everyone is potentially interested in the wellbeing pages and patients can even apply to participate in a clinical trial in their own area. The Shared Decision Aids section possibly brings physicians and patients together as co-owners and interpreters of information towards partnership in decision making that can only be achieved when patients have the opportunity to look at reliable information, appraise this in their own time and in the privacy and comfort of their home environment but in an online environment that is communal rather than isolated.

The second example from the UK is Diabetes UK (http://www.diabetes.org.uk). This is a website run by a UK charity for people with diabetes or at risk of diabetes. The website offers information and support with a care line and advocacy service towards patients with diabetes asserting their needs and rights. Priorities include the vulnerable, people with disabilities, mental illness or with poor English language skills, for example. Help comes in the form of letter writing, sending emails or making phone calls on behalf of patients with diabetes. The charity, that includes a Council of People Living with Diabetes and a Council of Health Professionals, campaigns for people affected by diabetes.

The third example is online advocacy which is a potentially powerful use of the Internet. Onside (http://www.onside-advocacy.org.uk) describes this as the process of support for "people to have their voice heard and their views taken into account in decision making processes". They provide a range of advocacy services from generic services in the local area for people with disabilities, suffering illness or domestic violence, for example, to non-instructed advocacy for people with cognitive or communication impairment to ensure fair treatment and representation of their perspective in decision making. They also

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offer mental health advocacy for adults subject to detention under the UK Mental Health Act, making decisions about changing accommodation or undergoing medical treatment.

The power of information technology in influencing policy is not to be underestimated. People with ideas and stories to share come together online and collectively have a powerful voice and exert social capital. In terms of healthcare, Age UK (http://www.ageuk.org.uk), a fourth example, actively campaign and lobby the UK government for health and the social determinants of health. The Nominet Trust have supported a number of health related online projects that have tackled alcohol related liver disease and dementia, for example. The 99% Campaign E-Project was a youth-led project that challenged government policy on issues related to young people's health.

Thus, as seen in the examples of these websites, the Internet may potentially be exploited as a revolutionary tool with unprecedented opportunities to voice the patients' views and demands. How far would this really influence health policy, though? This remains to be seen, but online campaigns have had powerful effects in the past. Enhancing social capital through bridging social networks that comprise overlapping networks of large members of individuals with no prior personal or bonding acquaintance with each other may increase norms of social reciprocity and trustworthiness that plays an essential role in public struggles against established authorities.

MANAGERIAL AND PRACTICAL IMPLICATIONS

Miller and West (2009) asked in the title of their article "Where's the revolution"? Given the rise in concerns over healthcare quality, affordability, and accessibility, the authors' view that national leaders see the use of health information technology (HIT) as "valuable tools for improving the efficiency and effectiveness in the health care system" (2009:262) is represented in, for example, the American appointment of a national health information technology co-ordinator in 2004. This role entails the responsibility for awarding funds for technology standards that enable data-sharing strategies between national and regional organizations. The authors point out that "this is an important policy change: US government investment in HIT, at $125 million so far, has lagged far behind that of nations such as the United Kingdom ($11.5 billion), Germany ($1.8 billion), and Canada ($1.0 billion)" (2009: 262).

Despite the long term potential, Miller and West (2009) discuss the barriers to full and successful implementation. Barriers persist, such as the digital divide, which prevent specific populations from using digital media, technical barriers exist for those who are able to access the Internet but lack information technology skills to use the Internet effectively, financial barriers and non-financial costs (workload, time or staff resources devoted to learn a new technology). Another barrier is concern over privacy and the security of personal and medical data. In their study, the authors found a much higher percentage of respondents reporting conventional face-to-face interactions and telephone contact with healthcare personnel rather than e-mail contact, website visits, or online purchases related to health services. They also found significant inequities in digital communication usage: less well-educated, rural-dwelling respondents with lower incomes were less likely to report visiting health Web sites or making online purchases.

The fact that well-educated individuals are more likely to search for health information online is perhaps the most consistent finding across multivariate studies (Baker et al. 2003; Diaz et al. 2002).

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Technology utilization is highly correlated with education, infrastructure and computer literacy. These factors are critical to improvements in access to technology and the use of digital medical resources. Thus, the Internet may be a revolutionary tool but there is some evidence that not everyone is able to join the revolution.

In affecting health policy and services, there is a need for a coalition of public, private, government and citizen stakeholders that works in synergy to promote the role of the informed-patient as a mutual interest. In promoting digital communication, Miller and West's (2009) recommendations are:

- To focus on targeted populations. Women, for example, are inclined to manage health services for themselves and their families. Thus, there is a positive relationship between gender, health and engagement with both conventional and digital health-seeking behavior;
- To set standardization criteria for the evaluation of the quality of health information posted, its accuracy and consistency;
- To improve education and technological literacy - there are clear links between poor health, literacy and inadequate understanding of health and medical treatment;
- To build digital infrastructure with other stakeholders - building telecommunications and legislative infrastructure for underserved populations towards affordable Internet access.

Miller and West (2009) concluded that:

If public officials want electronic health to flourish, they must provide the budget and build the political coalitions necessary for technology investment. More widespread use of the health care Internet will require high-speed communications networks, and governments play a crucial role in building this technology infrastructure. Without government leadership, digital medicine will generate neither desired service improvements nor anticipated cost savings. Policy makers are beginning to target health care as an area where information technology can improve service delivery, promote efficiency, educate consumers, and increase satisfaction with medical care. However, the relatively low utilization levels identified, along with inequities based on age, gender, education, income, and residence, suggest the need for further reform. (2009: 280)

CONCLUSION

The benefits of Internet-based health information are numerous with regard to the information and empowerment roles of patients and in influencing health policy. In crafting Internet-based health information, significant resources may be efficiently invested in creating websites and programs that provide expert information to a very large audience in a cost-effective fashion. Such information may also be regularly updated. Internet-mediated health information also enables those who reside in remote locations or who are physically confined to access health information and services from their own homes. Moreover, because Internet-based health websites connect with many additional sources of information, health consumers may access a wide range of linked-content that suit their needs and interests. Internet-based technology, as part of the World Wide Web, can also access multiple types of media, allow rapid communication between health consumers and providers, and enable discussions and critique.

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The websites described in this paper demonstrate the extent to which people are surfing the Internet for health-related information and how the Internet has become an increasingly important factor in voicing the patients' health experience as tools for self-health education and managing health. The websites are examples of patients' voices and experiences within the health system. They use the digital platform to collect, share and effect change. They are based on the idea of sharing information and medical knowledge in order to assist others within the general public. The opportunities to share and read personal stories enable people to benefit from social capital, to make critical health decisions and to negotiate better treatment with their physician during medical consultations. The assumption is that sharing information from first-person stories empowers the patients by providing the opportunity to voice their concerns, attribute meanings to their concerns and compare their own with other patient ordeals. In addition to the information role of the Internet for individuals, this plays a significant role in connecting individuals to an online community capable of taking on government policy.

As a result, the patients' personal experiences become a collective, shared experience, one that may be shared with the physician as part of a mutual ongoing evidence–base process. The patient also has ownership of expert medical knowledge and may reasonably discuss their health concerns at greater depth with their physicians.

The illness narrative appears in the websites and forms a new genre where individuals publish their stories without the mediation of health professions. The patient stories are self-evident first-level meaning narratives that contribute to the shared appreciation of what illness and sickness are, how to express this and what is meant when a person expresses the sickness experience. The story of an illness experience may even function as a potential political commentary pointing a finger of condemnation at perceived inequalities in healthcare services, access to these or unacceptable treatment by health service personnel.

To further research this topic, research should address the following questions: how the informed-patients translate their role into policy changers? What are the specific factors, methods and electronic-social determinants of health by which policy is influenced?

Ultimately, and in spite of the limitations and barriers mentioned here, the direct and immediate availability of rich online information resources has changed human culture and experience with regard to healthcare.

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Section 6
Emerging Trends

This section highlights research potential within the field of Public Health and Welfare while exploring uncharted areas of study for the advancement of the discipline. Introducing this section are chapters that set the stage for future research directions and topical suggestions for continued debate, centering on the new venues and forums for discussion. A pair of chapters on space-time makes up the middle of the section of the final 12 chapters, and the book concludes with a look ahead into the future of the Public Health and Welfare field. In all, this text will serve as a vital resource to practitioners and academics interested in the best practices and applications of the burgeoning field of Public Health and Welfare.

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Chapter 60
Health Policy Implementation:
Moving Beyond Its Barriers in United States

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ABSTRACT

This research describes policy implementation components of a health system and explains how they affect outcomes. It argues that implemented policies affect various components of a health system in terms of service delivery, workforce, information, financing, medical products, technologies, leadership and governance. Using health system as framework of analysis, the paper explains that the outcome of health policy implementation determines the availability, quality and equitability of program service delivery. The paper goes on to argue that policy implementation barriers, such as demand-and supply-side barriers, market, insufficient resources, cultural barriers, imperfect communication, information, education, coordination, leadership and governance affect the poor and vulnerable groups in developed and developing countries from benefitting from public spending on public health policies and programs.

INTRODUCTION

An important factor in socio-economic development of any nation is the extent to which that country in involved in healthcare delivery system. Good health is a vital factor of quality of life as well as a pre-requisite for achieving socially and economically productive lives of a nation. No government can function effectively without an appropriate health care system (Gholipour & Rouzbehani, 2016). Health care system is one of the basic institutions that are universal in nature and without which a society cannot survive. The World Health Organization Report (2000) defines health system as comprising all the organizations, institutions and resources that are devoted to producing health actions. Health action in this context entails any effort, whether in personal healthcare, public health services or through intersectional initiatives (Weimer, 2011), whose primary purpose is to improve health. Healthcare institutions consist of formal and informal organizations where preventive, social and clinical services are rendered to the members of the society. Each of the institutions has specific aims and objectives even though

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they all exist to promote health, to prevent the occurrence of diseases, to bring about a peaceful end for those suffering from terminal disease, and to treat human illness. Most health care institutions form an arm of the government. Their social structure, therefore, follows the same pattern as other government institutions.

The purpose of this paper, therefore, is to examine policy implementation by institutions of health care delivery and barriers to effective outcomes. Specifically, the paper attempts to investigate how health polices support program activities of health institutions, such as; elimination of healthcare inequities; access to healthcare facilities, products and services; availability of finance infrastructures and other resources; provision of information and education to individuals and communities to medical products, facilities and services.

Consequent upon this, the paper is structured into five parts. Part one examines the introduction, purpose, clarification of concepts and underpinning theories of health policy implementation. Part two examines the inputs required in a healthcare system, such as; finance, structures and power relationships equipment, personal and clients. Part three discusses the processes or series of activities that transform resources (inputs) into a desired product, service or output. Part four examines the outputs – direct result of the interaction between inputs and processes in the system, the types and quantities of goods and services produced by an activity, program or project. Finally, part five identifies the barriers to effective health policy implementation and its implications.

CONCEPTUAL CLARIFICATIONS

Health System

Health system comprises all organizations, institutions and resources that are devoted to producing health actions. Health actions in this context refers to any efforts, whether in personal healthcare, public health services or through intersectional initiatives whose primary purpose is to improve health. It is an open system with three components of input, processes and outputs. Inputs required in a healthcare system include; finance, physical structure, equipment personnel and clients. The process refers to a series of activities that transform inputs (resources) into a desired product, service or output. The term output is used to describe the direct result of the interaction of inputs and processes in the system, the types of and quantities of goods and services produced by any activity, program or project. On the other hand, the term outcome refers to the result of the outputs, the effects or impacts.

Health Policy

Health policy means more than a national law or intervention. Operational policies are the rules regulations, guidelines and administrative norms that governments use to translate national laws and police into programs and services. Health policy can be defined as the decisions plans and actions that are undertaken to achieve specific healthcare goals in a society. Health policy can also support program activities, such as elimination of inequities in healthcare delivery services or mobilization of community health workers.

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Policy Implementation

Implementation refers to the stage of the policy process immediately after the passage of a law. Implementation, viewed broadly, means administration of law in which various actors, organization, states, local authorities, procedures and techniques work together to put adopted polices into effect in an effort to attain policy or program goals(Dunn,2012). For our purpose, implementation can be conceptualized as a process, outputs (series of activities) and outcome. As a process, it is viewed as a series of decisions and actions directed toward putting a prior authoritative federal legislative decision into effect by the state or local authorities or organizations. As an output, implementation can be defined in terms of the extent to which programmatic goals are supported, such as the level of expenditures committed to a program or the number of violations issued for failure to comply with the implementation directive. Policy implementation can be conceptualized as some measureable change in the large problem that was addressed by the program, public law, or judicial decisions (outcomes).

THEORETICAL UNDERPINNINGS

There are three major theoretical models of policy implementation, namely top-down approach, bottom-up approach and Principal Agent theory.

Top-Down Approach

This approach sees policy as formation and policy execution as distinct activities. Polices are set at higher levels in a political process and are then communicated to subordinate levels which are then to subordinate levels which are then to subordinate levels which are then charged with the technical, managerial and administrative tasks of putting policy into practice. In this approach, certain conditions are necessary for policy implementation to be effective:

- Clear and logically consistent objectives,
- An implementation process structured to enhance compliance by implementers,
- Committed, skilful implementing officials,
- Support from interest groups and legislature,
- No changes in socio-economic conditions that undermine political support,
- Adequate time and sufficient resources available,
- Good coordination and communication.

BOTTOM-UP APPROACH

This approach recognizes that individuals at subordinate levels are likely to play an active part in implementation and may have some discretion to reshape objectives of the policy and charge the way it is implemented. The bottom-up approach sees policy implementation as an interactive process involving policy makers, implementers from various levels of government and other actors.

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PRINCIPAL-AGENCY THEORY

In each situation, there will be a relationship between principals (those who define policy) and agents (those who implement policy), which may include contacts or agreements that enable the principal to specify what is provided and check that this has been accomplished. The amount of discretion given to the agents and the complexity of the principal – agents relationship is affected by the nature of the policy problem – including scale of change required, size of affected group; circumstances surrounding the problem (political, economic climate, technological change); and the organization of the machinery required to implement the policy (number of formal and informal agencies, amount of skills and resources required) the three theories. Whether policies are implemented from the top-down, bottom –up or according to the principal agent theory, policy implementation involves three activities (Anderson and Sotir, 2006):

- **Interpretation:** Translation of the policy into administrative directives.
- **Organization:** Establishment of administrative units and methods necessary to put a program into effect.
- **Application:** Routine administering of the service.

Interpretation of policy directives requires the translation of knowledge on interventions into the particular local context. According to Jenkin et al (2006), factors to take account when interpreting health policy include:

- Local resources, including human resources and infrastructure;
- Specific characteristics of the population;
- Baseline incidence of the health problem;
- The latency period before an effect of the intervention will be observed;
- A balance between achieving targets that reflect process change and those that reflect risk factor change;
- Local variations in the likely effectiveness of particular interventions.

Implementing health policy, therefore involves the rearrangement and restructuring of institutions at the national and subnational levels. It entails determining the power structure and inter-institutional dynamics. Some operational policies may pertain to subnational levels, thus resulting in a more decentralized system.

CONCEPTUAL FRAMEWORK

This paper adopts health system as our conceptual framework of analysis. WHO (2000) defines health system as comprising all organizations, institutions and resources that are devoted to producing health actions. Health actions in this context refers to any efforts, whether in personal healthcare, public health services or through intersectional initiatives whose primary purpose is to improve health. Health system is an open system with three components of input, processes and outputs.

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Inputs required in a healthcare system include; finance, physical structure, equipment, health information, technology, material resources, personnel, health policies and clients. The process refers to a series of actions or activities that transform inputs or resources into a desired product, service or outcome. The series of activities in the process include treatment, client education, community empowerment, official meetings and other health interventions. The term output is used to describe the direct result of the interaction of inputs and processes in the system, the types of and quantities of goods and services produced by an activity, program or project. It includes treated patient, efficient services, improved health status, community empowerment, trained staff, good quality of life and sanitation. On the other hand, the term outcome refers to the result of a process, including output, effects or impacts (Quality Assurance Project, TASC 2 Eritrea, 2003). All this depends on how efficiently the system is administered and how the resources within the operating environment. The enabling environment comprises the government, State, Local authorities, health institutions, socio-cultural and economic factors, regulatory quality control by government, rule of law, civil society, community, individuals, political stability and support, accountability and so on.

This conceptual framework is adopted because the analysis is not intended to identify causal pathway. The health system, which is an open system, is one of the basic institutions that are universal in nature and without which a society cannot survive. According to the WHO (2000), all health systems carry out the functions of providing or delivering personal and non-personal health services; generating the necessary human and physical resources to the that possible; raising and pooling the revenue used to purchase services and acting as the overall steward of the resources, powers and expectations entrusted to them. The health system is, therefore, justified as our conceptual framework of analysis for this paper since large number of people and institutions are involved at different levels.

METHOD OF ANALYSIS

The paper adopts qualitative research technique. The purpose is to select information that would help us describe and explain health policy implementation and barriers to its effectiveness. Data were collected from secondary sources. They include textbooks, journals, newspapers, internet and records. Data from these sources were analyzed using documentary data analysis, thematic analysis and content analysis techniques to elicit key concepts or themes. The concepts were coded and categorized into units of analyses: policy implementation of resources or inputs; policy implementation intervention process or series of activities; and policy implementation of outputs/outcomes (efficient services or improved health status).

HEALTH POLICY IMPLEMENTATION (RESOURCES)

Formal organizations such as health institutions are made up of people and they are set up to achieve specific goals and objectives. The attainment of these goals depends on the availability of resources in the right kind, quantity and mix. Ultimately, the attainment of the goals depends on proper utilization of resources. Resources are those inputs that help, support and/or have positive impact upon the achievement of organizational goals (Peretomode and Peretomode, 2005). According to them, resources can be categorized into human and non-human resources. Non-human resources can be further categorized into

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financial and non-financial resources. Non-financial resources include: facilities, structures, equipment, time, technology, land, transportation, organizational climate, geography, information, policies and so on. The provision of health care services, consequently, involves putting together a considerable number of resource inputs to deliver an extraordinary array of different service outputs. Finance is an important asset in healthcare delivery services. The performance of the health system depends ultimately on the knowledge, skills, and motivation of the people responsible for delivering services.

GOVERNMENT INTERVENTIONS IN HEALTH POLICY IMPLEMENTATION PROCESS

Perhaps the most pervasive impact of government on the delivery of healthcare services in most nations is through regulation. There are many kinds of health-care regulations, namely: facilities, costs, quality and pharmaceuticals. Governments attempt to influence health-care delivery indirectly by providing financial support for certain activities, and directly attempt to move resources around in the health industry. One such attempt is through the regulation of "healthcare facilities and more comprehensive planning for the health needs of communities" (Peter, 1988:258). Another regulatory device is the control of costs in terms of making majority of expenses paid by a third party, such as "Blue Cross or Medicare or Medicaid" in America health care system (Peter, 1988: 258). For example, the regulation of health-care quality is another area of intervention by USA government in health policy implementation. The major public instruments used for regulating the quality of medical care are the Professional Standards Review Organizations (PSROs). These organizations are designed in part to monitor costs of services provided to Medicare Patients but they necessarily become involved in the issue of appropriate some PSROs have gone as far as to establish standard profiles of treatment for certain rather common conditions and then to question physicians whose treatment differs significantly from those patterns.

Furthermore, the US government and other nations are deeply involved in the regulation of pharmaceutical industry and in the control of substances in food and water that are potentially harmful to health. The Food and Drug Administration (FDA) in USA and National Agency for Food and Drug Administration and Control (NAFDAC) in Nigeria are responsible for most of the drug regulation. The safety and effectiveness of a drug must be demonstrated by clinical trials. Associated with drug regulation in the Food and Drug Administration (FDA) has been food regulation, especially the prohibition of carcinogenic substances in food, especially the substances that induce cancer in human beings or animals.

Another issues related to the regulation of pharmaceuticals is the regulation of tobacco, especially cigarettes. It has been observed that smoking cigarettes is harmful to health. It requires warning labels on to be placed on packages and forbid advertising on electronic media. Cigarettes and their regulations figure prominently in financing of health care, especially increased tax on cigarettes. Moreover, competitive mechanisms using market forces to produce desired changes in the health-service industry have been on the increase in recent times. So, government should develop institutional capacities to ensure that appropriate uptake and integration of policies into existing activities. That is, integration of policy into private sector and community programs, such as: public-private partnership and community-based distribution network. These health policies can also support other program activities, in fact.

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HEALTH POLICY IMPLENTATION (OUTPUTS/OUTCOMES)

Outcomes of these activities help increase accountability and identify implementation barriers. There have been reported cases of fraud in America's healthcare system. Home-health fraud, such as charging for non-existent visits to giving insulin injections- got- so bad that the "Medicare and Medicaid Centres" (CMS), which run the programs called a moratorium on enrolling new providers in several large cities in 2013. Since tighter screening was introduced under "Obama care", the CMS has stripped 17,000 providers of their licenses to bill "Medicare"- services meant for the elderly recipients. Thousands of suppliers also quit after being acquired to seek accreditation and to post surety bonds of $50,000. It was reported that health-care fraud in America amounted to about $272 billion in 2013.Thus; the outcome of health policy implementation is improved health status for individuals and community. According to WHO (2000), the main objective of health action or series of health activities, whether in personal health care, public health services or through inter-sectoral initiatives is to improve health. Health policy implementation outcomes, therefore, can be summarized as: efficient services, improved health status, treated patients, community empowerment, trained staff, good sanitation and good quality of life.

ENABLING ENVIRONMENT IN HEALTH SYSTEM

For efficient services to emerge from health policy implementation, accountability and transparent mechanisms should be well established, so that civil society can monitor the implementation process, in terms of service coverage and quality, population coverage and equity, healthy behaviors by increased number of people.

BARRIERS TO EFFECTIVE HEALTH POLICY IMPLEMENTATION

1. **Economics:** The most commonly cited barrier to access to healthcare is economics. For example, in USA, majority of medical care is still paid for privately. Those who lack the income or insurance to pay for medical care may not have that medical care. Many who are poor but not sufficiently poor to qualify are not eligible to receive Medicaid benefits. Many people do not have health insurance. The elderly poor who have access to Medicare as a result of their age must still pay for parts of their insurance, at a rate that may deter some taking full advantage of healthcare program. Even having insurance as well as not having it can present troubles. The principal problem is that it can minimize mobility in the economy.
2. **Demand and Supply Barrier:** On the demand side, the economic literature is dominated by adaptations of Grossman model that analyze individual investment and consumption decisions to improve health and utilize healthcare (Grossman, 2000). Demand is influenced by factors that determine whether an individual identifies illness and is willing and able to seek appropriate healthcare. The model levels to a demand for healthcare of a given quality that is determined by individual and

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community factors as well as the price of medical care and other similar goods. Individual (and household) factors include age, sex, income. Demand barriers to utilization of healthcare include:

a. **Information on Health Care Choices:** This provides lack of knowledge of the providers.
b. **Education:** Low ability to assimilate health choices and negotiate access to appropriate providers. Education and knowledge about the characteristics of and need for medical treatment. Information and education are related to failures, either in the form of knowledge of healthcare choices or in the ability to utilize this information in an effective way.
c. Indirect Consumer Costs Barriers:
    i. Distance cost,
    ii. Opportunity cost.
d. **Household Preferences:** A symmetric control over household resources.
e. **Community and Cultural Preferences, Attitudes, and Norms:** Reluctance to seek healthcare for women outside home; community resistance to using modern medical care to assist pregnancy. For example, cultural barriers such as cultural norms, such as purdah restrictions can prevent women from seeking healthcare outside the home for themselves and their children (Rashid et al. 2001). The barrier is often raised still further when men provide services and has often offered as one reason why Asian women living in Western countries often make little use of health services (Whiteford and SZelag, 2000). Such restrictions may also interact with other barriers. Community factors may include cultural and religious influences and other social factors that affect individual preferences.
f. **Input Prices and Input Availability:** Substitute products and services patients seek treatment through providers that are inappropriate for their condition such as drug sellers (Ensor and Cooper, 2004). Price is a complex variable and includes direct price and distance cost, opportunity (time) cost of treatment-since treatment can be time consuming and any informal payments made to the facility for commodities or to staff. Quality of staff may be absent because of the price of the wages and staff not attracted to the area.
g. **Knowledge of Technology of Treatments:** Inability to treat disease with given technology
h. **Management Efficiency:** Poor quality of management training, lack of management systems.

The determinants of demand may generate barriers to utilization of healthcare services. Education and information assist to assimilate health messages and are important in determining demand. Finally, barriers may also interact with other demand barriers and act as important determinant of the willingness to travel long distances to obtain treatment. Therefore, increasing demand is far more complex than simply the provision of health education advice or information but is also strongly related to the relative position and educations are family members. Demand barriers present in low and middle-income countries and even richer countries among vulnerable groups.

SUPPLY BARRIER

The provision of healthcare is, in many ways, a monopoly or cartel. Entry into the marketplace for potential suppliers is limited by licensing requirements and further controlled by the professions themselves, which limits the number of places available in medical schools. Thus, unlike other industries, the healthcare field makes it difficult for competition to develop among suppliers. One possible means for promoting

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competition is to break down the monopoly held by the medical profession by giving nurse practitioners and other para-professionals a greater opportunity to practice. The medical profession rather vigorously resists such changes. Hospitals do compete increasingly for patients, however, and with that competition has come some greater attention to the quality of care. Moreover, price and quality of drugs and other consumables and weak cold chain may cause scarcity of supplies. Thus, supply barriers affect patients in obtaining treatments, especially for the poor and other vulnerable groups.

3. **High Medical Care Costs Barrier:** Medical-care costs are problem for government as well as for private citizens. Half the total medical care bill is paid by government. A number of factors have been identified as causing at least part of the increase in medical care costs. For hospitals, one factor has been a rapid increase in the cost of supplies and equipment. This has been true of large capital investments such as CAT Scanners, as well as more mundane items, such as dressings and surgical gloves. In addition, labor costs for hospitals have been increasing rapidly, as many professional and unprofessional employees unionize to bargain for higher wages (Aaron, 1991:8-37). Besides, physician costs also have been rising, not as rapidly as hospital costs. In addition to general pressures of inflation in the economy as a whole, increases in equipment and supply costs, increased insurance paperwork, the increasing cost of medical malpractice insurance and the practice of "defensive medicine" to protect against malpractice suits by ordering every possible diagnostic procedure have all produced increases in doctors' fees (Aaron, 1991: 45-47) Finally, the method of payment increases the cost of medical care. Over 76 percent of the hospital costs and approximately 60 percent of all medical expenses are paid by third party payers (Health Insurance Association, 1993)
4. **Quality Barrier:** In USA for example, both citizens and government must be concerned with the quality of medical care being provided. Citizens' obvious expressions of concern about quality have been the increased number of malpractices suits and complaints against physicians and hospitals. State Medical Associations and their Review Boards and other professional organizations that are supposed to discipline their fellow professionals and friends, find it difficult to do so. Government concern about quality extends from the general social responsibility for regulating the safety and effectiveness of medicines and medical devices on the market to the quality of care provided to Medicare and Medicaid patients to perhaps a more philosophical concern with the efficacy of modern medical care as a remedy for the health problems of American citizens.
5. **Unequal Access Barrier:** Medical care is mal-distributed, that is, the areas and persons with the greatest needs for healthcare are not the areas and persons with the greatest access to care. For example, in USA, Hospitals, nursing homes, clinics, doctors, dentists and other healthcare professionals are disproportionately located in well-to-do urban and sub-urban areas, as the highest fees can be generated there. The residents of these areas have better access to care than do the poor and residents of rural areas. This phenomenon is particularly true for access to specialized institutions and personnel, but it is also true to a lesser extent, for general practitioners and basic care institution. Medical care is distributed on the basis of ability to pay rather than on need. The limited access pattern contributes to the poor health and shorter life expectancy of those who are poor or live in rural communities. Black infant and maternal mortality rates are nearly twice those of whites and comparable to many countries in the Third world. The average life expectancy for blacks is six years lower than that for whites (Cochran et al, 1986). Unequal access is significant barrier to healthcare. Gaining equality in medical care is often difficult to the poor. Geography distantly

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plays a significant dual role in defining access to medical care. Aside from this, medical services would be even more pronounced if the areas of specialization of physicians and the standards and equipment of the hospital are considered. In some parts of USA, for example, high quality medical care may not be available even for someone who can afford it, without a substantial investment in travel. Thus, the relatively high rate of infant mortality in most low-and-middle-income countries is often taken as an indicator of poor access to medical care.

6. **Overspecialization of Healthcare:** Over specialization contributes to high cost of medical care as specialists charge more and use hospitals more than do general practitioners. For example, in USA as well as other developing countries, primary healthcare physicians, - family doctors and general practitioners constitute a small proportion of American physicians. Cardiologists Pediatricians, Urologists and other specialists are the dominant figures in the medical profession. Serious consequence from the predominance of specialists may help to account for the rather poor performance on measures of infant mortality and life expectancy relative to those of other developed nations, as these measures are more sensitive to high quality routine care than to sophisticated, exceptional procedures.
7. **Financial Inequities or Barriers:** Another problem to healthcare is the financial burden imposed on many individuals and families by its high cost. The gaps in public and private health insurance are wide enough to let millions fall into financial disaster. In America, five to eight percent of the population has no health insurance, public or private. Fifty to sixty million persons have no major medical coverage. The result is that nearly ten percent of all families every year have out-of-pocket medical-gross income. Most of these families are poor, so that even $1,000 out-of-pocket is a catastrophic expense. Almost half of all personal bankruptcies each year involve medical debts. Moreover, unintended consequences are major concern, as health education policy contributes to the over-specialization of physicians and recent changes in that policy have not yet shown an effect. Public policy, again particularly Medicare and Medicaid, in American health system contributes substantially to the cost of escalation in healthcare. As health care policy reduces the financial burden on specific individual, it increases on specific individuals, and increases on the society as a whole. Thus, the most important problem in healthcare, shared by many nations is its soaring cost to society. There are substantial problems with America healthcare policy. Many differences in quality and access to care still remain among various groups. Medicare and Medicaid have contributed to health care is inflated costs and have not challenged structural problems in its delivery. And neither regulatory policies nor Professional Standards Review Organizations (PSROs); Health Safety Agencies (HSAs); Health Maintenance Organizations (HMOs) have had the success hoped for in introducing rational coordination and cost control into the system. So, developing countries face financial barriers in health policy implementation.

CONCLUSION

Within the fundamental obligations of governments at federal, state and local authorities. The National Healthcare system should be developed to support in a coordinated manner a three-tier system of healthcare. Essential features of the system should be its comprehensive nature, multi-sectoral inputs, commu-

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nity involvement and collaboration with non-governmental providers of healthcare. The goal of health policy should be based on primary healthcare that is promotion-based, protective, preventive, restorative and rehabilitative to every citizen of the country within the available resources, so that individuals and communities are assured of productivity, social wellbeing and improvement of living standard.

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KEY TERMS AND DEFINITIONS

Health Policy: Health policy broadly describes the actions taken by governments—national, state, and local—to advance the public's health. It is not a single action but requires a range of legislative and regulatory efforts ranging from ensuring air and water quality to supporting cancer research. Health care policy is that piece of health policy that deals with the organization, financing and delivery of health care services. This includes training of health professionals, overseeing the safety of drugs and medical devices, administering public programs like Medicare and regulating private health insurance.

Health System: It's the organization of people, institutions, and resources that deliver healthcare services to meet the health needs of target populations.

Implementation: Public policy implementation consists of organized activities by government directed toward the-achievement of goals and objectives articulated in authorized policy statements.

Inputs: Resources such as people, raw materials, energy, information, or finance that are put into a system (such as an economy, manufacturing plant, computer system) to obtain a desired output. Inputs are classified under costs in accounting.

Policy Outcomes: The outcome of what is implemented.

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Chapter 61
Public Hospitals in China:
The Next Priority for Meaningful Health Care Reform

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ABSTRACT

China has had some initial success in its current health care reform efforts. Five areas of reform have been targeted and include providing universal coverage, equitable access to basic health insurance, establishing an essential medicine system, and improving primary health care facilities. The last area, the reform of the public hospitals, remains the most difficult to reform. General guidelines have been established by the national government and movement is being taken to delegate authority to local units for implementation. The aim of this paper is to compare China's formal government sponsored health care reform plan for public hospitals to the acknowledgement and acceptance by a sample of health care leaders in Guangzhou. Challenges are strong and include cost accountability, doctor training, employee empowerment, improprieties, and the influence of private hospitals. Based on this qualitative research, conclusions and recommendations are made by the authors as to what is necessary to have effective pubic hospital reform in China.

INTRODUCTION

China's health care reform is on the right track. Due to a decade of a growing economy, this country has been able to dedicate resources to increase medical access to its immense population. It has not been a smooth ride to achieve the results nor will it be easy to progress further in its reform. Some see the health care reform efforts prior to 2012 as a failure (Zhang and Navarro, 2014; Ramesh et al., 2013). Others credit the recent reform measures as a good testimonial to the Chinese policy development process (Korolev, 2014). In any case, this is an historic time for China to use its recent wealth to build infrastructure to support a new model for its health care delivery.

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The country recognizes that this fundamental change will take several years to accomplish. President Xi Jinping operates from a very solid power base so now is an opportune time to make the structural changes needed (Roach, 2013). The latest measure to assess if efforts are productive is from the three year reform plan launched in 2009 (Ho, 2011). The main provisions of China's Reform Plan 2009-2011 are listed in Table 1. This reform plan signaled the need for a systematic and comprehensive approach (Lin, 2012). Up until now though, it has not been well coordinated among the different areas within the health care delivery system. One sector is not likely to succeed without reforms in the other sectors (Cao et al., 2012).

In this earlier reform plan, China committed to double its government annual spending on health care. This new funding has provided improvements to public health, has built infra-structure, trained providers for the delivery of primary health care, and subsidized enrollment in insurance programs. Two large components that were not, however, impacted as hoped were addressing 1) the high cost areas of pharmaceutical sales and 2) reforming public hospitals. Nevertheless, significant progress has been made in the other areas (Yip et al., 2012).

More specifically, the first initiative was to provide affordable and equitable basic health care for all by 2020. With the initiation of three national health insurance programs, covering the basic health needs for urban residents, rural farmers and those living in poverty, China is well on its way to universal coverage. Research shows over 95% of the Chinese population now has some form of health insurance (Meng et al., 2012). Unfortunately, problems still exist even with this increased coverage. The rural and urban residents' insurance plan problems include reliance on local government capacity, reimbursement ceilings, and rates. Plus, there are incentives for unnecessary care and waste in the design of the programs (Barber and Yao, 2011). Also, recent studies show that even though access is increasing, the financial burden placed on patients has also increased (Long et al., 2013).

Making public health services available and equal to all is a lofty but necessary goal in any developing country. The increase in insurance coverage has led to advances in achieving equal access to services across and within regions. However universal health insurance coverage alone cannot mitigate the existing inequity in healthcare (Sun et al., 2014). Wide differences in the allocation of healthcare resources between urban and rural areas are still evident when comparing healthcare expenditures, the number of healthcare facilities, available beds, and personnel (Chen et al., 2014).

Another initiative was to establish a national essential medicines system to meet everyone's primary needs for medicine. A new national list of essential medicine consisting of 307 Western drugs has been created. Additional provincial approved and traditional Chinese medicines are being added to the formu-

Table 1. China's reform plan 2009-2011

Main Provisions of Reform Plan
1. Providing universal access to basic health insurance
2. Offering equitable access to basic public health services (greater rural and urban parity)
3. Introducing an essential medicine system
4. Improving primary health care facilities
5. Establishing pilot reform of state-run (public) hospitals

Source: Xinhua News Agency, April 11, 2009 (An, L. Editor).

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lary. The government has even set up special procurement mechanisms to have health facilities obtain the drugs (Tang, et al., 2014). If drug price mark-up is abolished, then adequate government compensation will be needed to augment the loss. Plus the drugs from the essential list must be provided at the clinic settings (Wang and Ouyang, 2011).

But it is the last two reform measures that remain elusive yet are interdependent. Improving the primary care delivery system to provide basic health care and to manage referrals to specialist care and hospitals, will not easily be accomplished. This must be done in cooperation and collaboration with the hospitals since they control most of the outpatient care. Currently, there is a division of labor between public hospitals and primary care facilities. China's former Health Minister Chen Zhu stated in an interview, that "closely knit" types of arrangements are needed rather than a "loosely knit" voluntary one (Cheng, 2012). Hospitals must develop vertical integrated models and refer triaged patients to either primary care or higher level facilities. This is why the last initiative, reforming public hospitals, is critical to the reform plan's continued success and is the focus of this paper.

THEORETICAL FRAMEWORK

This study is supported by the conceptual framework of diffusion of innovation theory. Rogers (1995) has written about diffusion of innovation since he first described it in 1962. Diffusion of innovation explains how the rate of new ideas and behaviors spread through cultures. Social systems applications are of special interests since it has models being proposed by large political bodies (in this case the National Congress of the People's Republic of China) and having these models implemented over a vast amount of area (as in China's health reform plan).

Diffusion of innovation is further explained using communication and social psychology theories when investigating into the dissemination of information needed to initiate change. Cross-cultural perspectives also need to be taken into consideration as the introduction of new models will need to be interpreted by various cross-sections of society and heterogeneous population groups. Rogers and Shoemaker (1971) in a later work gives many examples of diffusion of innovation theory, including within health care, using this certain emphasis.

The qualitative study presented here is an attempt to assess how China's health care reform is being accepted in one particular city (Guangzhou). The first two phases of diffusion of innovation theory are knowledge and persuasion. These are being tested through this research. The latter stages of decisions, implementation and confirmation will be shown over time as the health reform plan is initiated. Health care is an essential service in a social system. Any major changes to the service delivery will be difficult to accomplish and must be given the time to be understood and evaluated by the service providers.

AIMS AND METHODS

The general updated guidelines which oversee public hospital reform in China were announced by the State Council in 2012. There were distributed through a notice entitled, "On Deepening Medical and Health System: 2012 Notice of the Work Arrangements." They are divided into one overarching aim, within three domains and call for nine tasks to be accomplished. Specifically they are;

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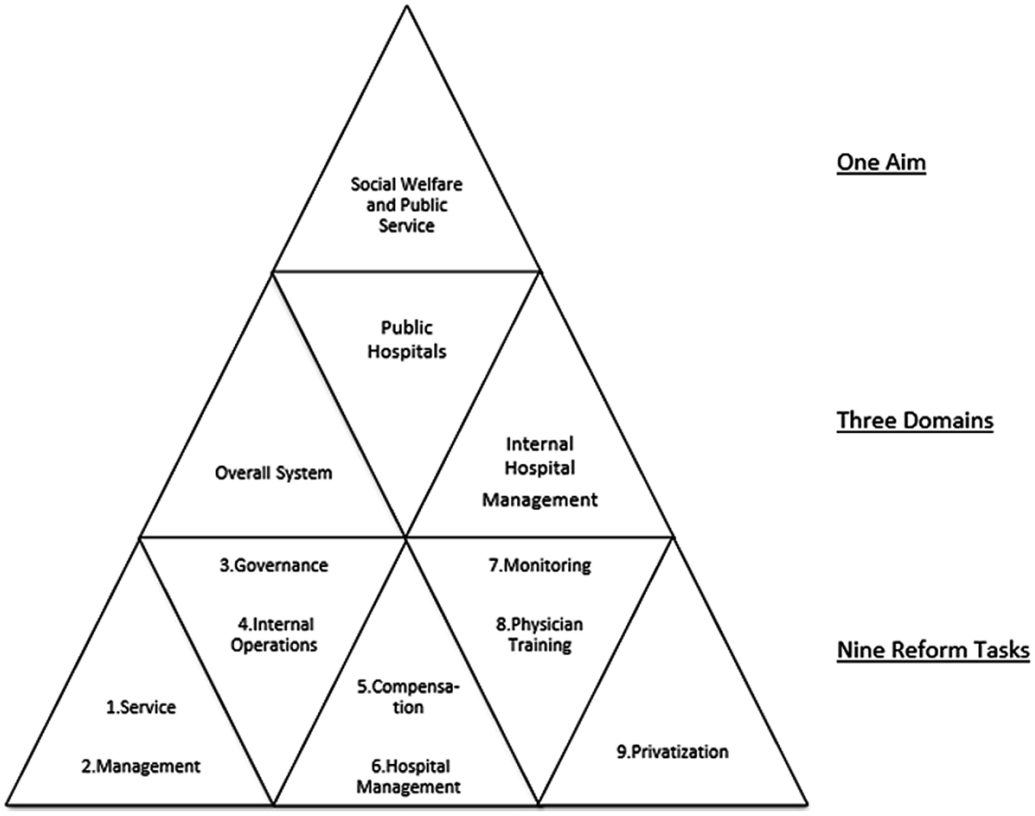
One Aim: To maintain the social welfare nature of public hospitals and encourage them to perform public service functions, thereby providing accessible and affordable healthcare services for the people.

Three Domains: First, perfect the service system to ensure that public hospitals perform their public service functions, through improved organizational arrangements. Second, promote innovations in the public hospital system and mechanisms to form a more scientific and regulated management system, and mechanisms for governance, compensation, and monitoring. Third, improve internal management to upgrade operating performance for safe, high quality, cost-effective, efficient and better services.

Nine Tasks: Perfecting and reforming the service system, management system, corporate governance mechanism, internal operating mechanism, compensation mechanism, hospital management, monitoring mechanism, the establishment of standardized resident physician training, and accelerating the use of social capital (private sector) to contribute to the medical sector. Figure 1 is a graphic representation of the overall guidelines for public hospital reform in China.

Taking the government's directives suggestions into consideration, one must look realistically at what can actually be accomplished keeping in mind the great challenges being faced with a country as vast and with a population so large. China's one aim, "to maintain the social welfare nature of public hospitals and encourage them to perform public service functions…" is what is being focused on in this

Figure 1. Overall guidelines for public hospital reform in China



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study. How does a government encourage its public entities to deliver the needed health care services? The authors conducted primary and secondary research to assess the progress being made, the challenges that are imminent, and then made recommendations for China's plan to be successful.

The authors used a grounded theory approach. This qualitative research method uses investigative study with no preconceived hypotheses. Grounded theory allows the researchers to use data to inform the discovery of theory. The data obtained is compared and analyzed to come to some assumptions which can be further investigated (Birks and Mills, 2011).

To begin, several research questions were formulated to ascertain health care leaders' understanding of China's health care reform plan. Human research protocols were followed and a network sampling strategy was selected. Eight high ranking hospital and healthcare leaders were interviewed in Guangzhou in February, 2014. The semi-structured interviews were conducted to get a sense of whether the secondary research material on China's current healthcare reform status could be validated. The questioning would allow for a pilot test as to frontline administrators' experience with the planning and early implementation stages. The research questions asked were as follows:

1. What do you consider the three most important goals of China's current healthcare reform?
2. Do you think that each of these goals will be successful?
3. What areas might not be addressed under China's healthcare reform plan that you think needs to be addressed?
4. What specific ways is the healthcare delivery system changing at your healthcare facility due to China's current healthcare reform?
5. What challenges are being faced as these measures are undertaken?

Key-word notes were taken during the interviews. Little information was provided as to changes which took place at their healthcare sites (question #4) due to the reform efforts not being fully initiated. Yet there seemed to be great anticipation of the changes about to take place. From the other four questions, themes were discovered from the participants in the study that addressed their knowledge of the reform plan and the concerns associated with it.

FINDINGS

The primary research results were derived from key-word notes which were converted to themes. These themes on the current state of China's health care reform concerning the public hospitals are shown in Table 2.

Thematic analysis was conducted. From this pilot study, the sample of healthcare leaders validated the information obtained from the secondary material reviewed as to the changes proposed. Cautious anticipation seems to be the prevailing force as these administrators have heard accounts as to the changes to be taking place at the public hospitals but have not yet experienced any substantial changes. Some skepticism toward true hospital reform is prevalent, even though this qualitative research seemed to give the impression that some movement will take place towards the goals stated sometime in the future.

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Table 2. Themes on current state of China's health care reform for public hospitals

Most Important Goals	Which Goals will Be Successful	Areas That Should be Addressed but are Not	Challenges Being Faced
Lower costs	Primary care emphasis	Hospital reform	No specific policy direction from government
Equality for all	Improved access through community health centers	Lack of human resources	Costs continuing to go up
Easier and increased access	Basic public health improvements	Upgrading technology	Access for all people (rural and urban)
Increased professional income	Better training of healthcare professionals	Understanding that bigger is not better	Communication to public about the changes taking place
Remove improprieties/ conflicts of interest	More government/private market partnerships	Price controls	No incentives for doctors to move from hospitals to other levels of care
Open up to the private side	Improved health insurance system	Conflicts of interest	Need more government funds for community health and improved human resources
Improved training of healthcare professionals		Collaboration between healthcare entities	Continued improprieties
Insurance reform			
Establish better primary care system (gatekeeper)			
Increase public health			

Source: Interviews conducted in Guangzhou in February, 2014 by authors

DISCUSSION

Public Hospital Reform

Over the last decade, world experts have recognized the importance of health care systems (Mills, 2014). By systems, this means China needs to address the institutions, organizations, and physical, financial, and human resources to deliver health care services to meet the needs of its 1.3 billion people. Typically, external funding for disease prevention far outweighs any support given to strengthen health care infrastructure in low and middle income countries. A key component to any health care system must be its public hospitals.

In China, the public hospitals are mostly large, bureaucratic, and political-charged. Statistics demonstrate their impact on the system. Hospital services as a percentage of total expenditure on health is 64.7%, much higher than most other nations (Barber et al., 2013). Yet, the actual amount spent as a percentage of GDP and per capita is much lower than other large countries. The percentage of government expenditure on health, though, is above some countries. The total expenditure on health for selected countries is listed in Table 3.

The trend is good though with increased proportion of government funds provided to health care and less proportion of out-of-pocket expenditure for individuals. The trend of government and consumer spending on health in China are shown in Table 4 and Figure 2.

The health system cannot be reformed unless public hospitals are addressed since they deliver more than 90% of the country's health services (Lancet, 2012). They have taken control over Chinese health care over the years and have become steadfast in providing care in the same manner. The general popu-

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Table 3. Total expenditure on health for selected countries, 2012

Country	Expenditures on Health as % of GDP	Expenditures on Health Per Capita (Intl $ 2012)	Percentage of Government Expenditure on Health
China	5.4	480	56.0
United States	17.9	8895	46.4
United Kingdom	9.4	3495	82.5
Australia	9.1	4068	66.9
Brazil	9.3	1109	46.4

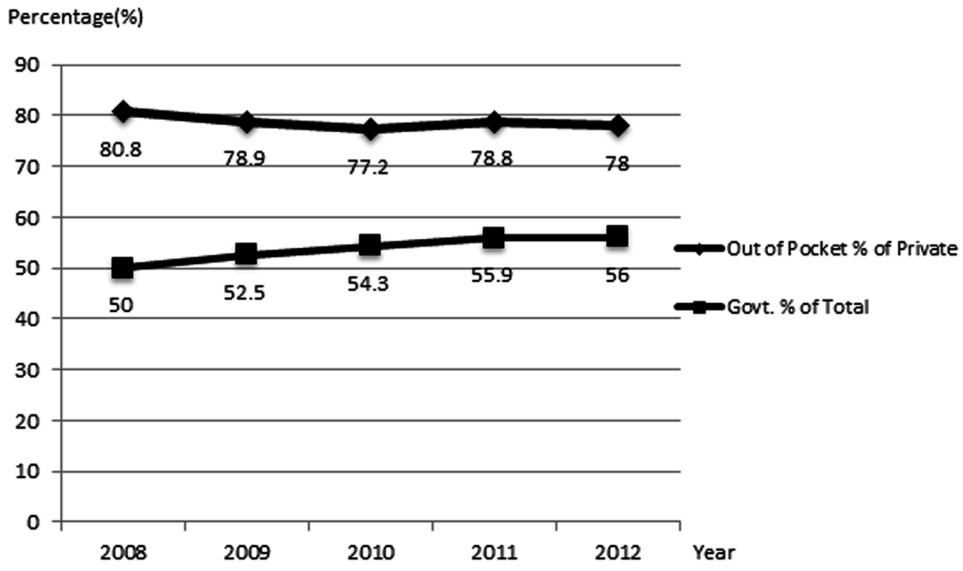
Source: www.who.int/countries, 2012

Table 4. Government and consumer spending on health in China (2008-2012)

%/Year	2008	2009	2010	2011	2012
Out-of-pocket expenditure as a % of private expenditure on health	80.8	78.9	77.2	78.8	78.0
General Government expenditure as a % of total expenditure on health	50.0	52.5	54.3	55.9	56.0

Source: www.who.int/countries, 2012

Figure 2. Government and consumer spending on health in China (2008-2012)



lation tends to rely on public hospitals for most of their health care needs. Tradition and mistrust in the doctor-patient relationship (Cao and Wei, 2014; Daemmrich, 2013) have allowed these hospitals to be very powerful. They are not going to give up their strong position easily. Therefore public hospitals must be reformed if there is to be an impact on overall costs and a better distribution of health care resources.

The respected global management consulting firm to the world's leading businesses, governments and institutions, McKinsey & Company, conducted an analysis of conditions which must be met if public hospital reform is to occur (Le Deu et al., 2012). The vision is to build a sustainable, cost-effective and

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high-quality public hospital system. Public hospitals need to refocus on the core of providing basic medical care to the general public. According to their experts, certain main building blocks are essential for success. First, there must be a proper funding mechanism that includes both government subsidies and medical service charges. The public hospitals have been dependent on drug sales in the past to sustain their operations but this cannot continue. Second, clear payer-provider relationships with effective cost-control mechanisms need to be established. Third, public hospital management needs to be transformed using clear key performance indicators to track service quality and operations efficiency. And fourth, resources must be reallocated to grassroots institutions like community health centers rather than to the large hospitals in the urban centers which is usually the case.

Pilot Hospitals

China has placed public hospital reform as one of the top areas needing improvement if the overall objective to establish a basic universal healthcare system that provides safe, effective, convenient, and low-cost healthcare services. The national government hopes this ambitious goal can be reached by 2020 (Le Deu et al., 2012). Recognizing the challenges to accomplish this, pilot hospitals have been selected to test the reform measures.

The State Council Reform Office issued guidelines for public hospital reform in 2010 based on these reform principles. The government selected 745 public hospitals to be in a pilot program in an attempt to test out some of the reform strategies (Barber et al., 2013). The government is examining several focus areas during these pilot reforms, including management, governance, compensation systems and supervising mechanisms, healthcare professional training, private healthcare institution development and medical services quality (Kahler, 2011). Some of the specific strategies these hospitals were encouraged to implement were:

1. Reduce their reliance on medicine sales for operational costs.
2. Collaborate and provide technical support between tertiary and county-level hospitals.
3. Undertake provider payment reform using prepayment methods.
4. Improve clinical quality and patient satisfaction.
5. Shift some of the responsibility to governing boards from the hospital director.
6. Conduct personnel management, including performance appraisals, with merit-based promotions.

Experts believe that the public hospital reform priority is the most difficult one. According to reports, there has not been much significant progress in reforming public hospitals in China over the three years in question (Tang et al., 2014). The pilot program is now underway. The next couple of years are critical if health care reform is to progress further.

Current State of Health Care Reform

In 2013, the Communist Party Central Committee approved the Twelfth Five-Year Plan for Health Sector Development. The Party congratulated itself on significant achievements in its health sector development during its previous five year plan and its more specific "Opinions on Deepening the Health Care System" that covered the period 2009 to 2011. Average life expectancy has increased, maternal and child health has improved, the basic medical insurance system became stronger, the New Rural Cooperative

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Medical Insurance System provided basic health care to populations not previously addressed, and public health made great advancements in consumer protections (National Development and Reform Commission, 2013).

The new plan calls out for a "push forward" to reform public hospitals. The movement now is to apply the pilot hospitals' changes to the nation's hospitals but to expand upon the reform efforts. Detailed strategies are listed in public documents, some reinforcing the pilots' responses and others being new measures (Communist Party Central Committee, 2013). Nonhospital medical sites are clearly being encouraged, as evident from some of the measures near the end of the list. They include;

1. Stop hospitals from using pharmacy profits to subsidize their medical services.
2. Encourage nongovernmental investments in hospitals.
3. Improve public hospital subsidy mechanism.
4. Establish a public hospital management system.
5. Optimize the governance mechanism of public hospitals.
6. Establish mechanism for selection, appointment, appraisal and punishment of hospital directors.
7. Make public hospital management more precise, more professional and more scientific.
8. Improve the evaluation and certification system for the health workers.
9. Encourage licensed physicians to practice at multiple stations.
10. Prioritize the development of local health facilities, focusing on county-level hospitals.
11. Strengthen the support and guidance of public hospitals towards primary care facilities.
12. Achieve a health care model with the primary healthcare facilities as the entry point to medical care.

This ongoing national government oversight and direction is very typical for China's other reform measures (education, environmental health, etc…). Multiyear comprehensive and sectorial plans are issued by the government. This permits the government to keep the essential functions of a planning system even as movement has been to a market economy. Public policy remains the driver as health care and other sectors continue their reform. This includes the national council taking on experimental programs like the pilot public hospitals one, conducting mid-course plan evaluations, and continued systematic top-level review (Heilman and Melton, 2013).

Cost Accountability

Prior attempts have been made to have public hospitals align with the national policies of reform to improve efficiencies, increase access and value, and control costs but the progress has been slow (Barber et al., 2013). It is difficult, though, to control costs without stricter government intervention. As stated, the overarching aim for public hospitals in China is to maintain the social welfare and perform public service functions, thereby providing accessible and affordable healthcare services for the people. This overall goal counters, to a degree, the ability to enforce cost accountability.

The World Bank points out the issues facing public hospitals in China in its China Health Policy Note series from 2010 (World Bank, 2010). It pointed out that hospital funds are controlled by the government hierarchy. Personnel management is subject to central public sector control over staffing and grades. There is a lack of plurality in hospital provision and little competition among providers. These have inhibited any true reform efforts. Hospitals have expanded infrastructure and high-technology equip-

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ment in a chaotic way. There has been an imbalance in the growth and distribution of hospital facilities. County-level hospitals dominate at the expense of primary care and outpatient facilities. There is an over-provision of high-end services for more affluent patients and over-prescribing of drugs have led to uncontrolled growth in medical expenditures. Patient dissatisfaction has also climbed.

The special report concluded that there had been little consistency in approach or the priorities of policy makers across China. Initiatives have been driven more by local politicians than by central direction, control and evaluation. The World Bank went on to say that there needs to be close coordination between policy design and implementation, and a matching of the scale and pace of reform, to the capacity for implementation.

Restrictions on economic development and management constraints need to be relaxed if public hospital reform is to move forward. But to assure efficiency, a sophisticated and precise accounting system should be mandated (Wang and Ouynag, 2011).

Additional Challenges

In transforming China's health and medical development, public hospital reform is considered the most complicated and difficult, yet absolutely necessary. Researchers state that the public hospital reform has been much slower than the other initiatives and has encountered great challenges (Hou and Dai, 2011). The issues which continue to challenge China's public hospitals include the poor integration among departments, the insufficient financial investment, the pharmaceutical care fee issue, and conflicting interests between public welfare and profit-seeking behavior (Zhou and Li, 2012).

Another tremendous challenge facing the reform efforts is increasing the competency level of physicians. Medical education in China has focused on specialists, not general practitioners. More family doctors are needed to work in the primary care clinics which will serve as the "gatekeepers," being capable of diagnosing and treating the most common diseases and referring out the more seriously ill. Not only is there a need for more in number, their education must be strengthened (Süssmuth-Dckerhoff and Wang, 2010). China's basic doctor training programs have traditionally stopped after 3 or 4 years of college. China is now moving to consolidate its education of doctors to two levels of 5 or 8 years after postsecondary school (Crisp and Chen, 2014). Shanghai's Vice Mayor, Xiaoming Shen, stated at the 2010 Global Forum on Urbanization and Health in Kobe, Japan, that "Health care in China… has many problems. The core problem is doctor training… I believe for health reform to succeed, we need to begin with the physician training system" (Cheng, 2013).

A new project has been launched to provide standardized training for its doctors nationwide. The National Health and Family Planning Commission has set into place a series of regulations to stipulate the training base qualifications, the duration of the training, as well as the training content and method. The national government is providing financial support to this upgraded residential doctor training (National Health and Family Planning Commission, 2014c).

In addition to the physician training, other hospital employee issues must be addressed if there is to be effective reform. Research shows that these employees perceive the culture of Chinese public hospitals as stronger in internal rules and regulations and focuses less on capability development, team orientation, and empowerment (Zhou et al., 2011). These findings would seem to conflict with making change happen within an organization.

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Influence of Private Hospitals

Private hospitals (most of them are also known in China as profit hospitals) have had a phenomenal growth rate in China in the last decade. A series of market-opening policies have sparked this increase. Most of these are specialty hospitals. The rate of growth of general hospitals from 2000 to 2010 was 1.4% whereas the growth rate for specialty hospitals over this same period of time was 9.4%. More recently, the increase has become even more dramatic and even has the same type of growth for private traditional Chinese medicine hospitals. (For trends on the influence of private hospitals see Tables 5 and 6 and Figures 3 and 4).

Table 5. Number of hospitals: China, (2008-2012)

Classification of Hospital	2008	2009	2010	2011	2012
Public Hospitals	14309	14051	13850	13539	13384
Private Hospitals	5403	6240	7068	8440	9786
Total	19712	20291	20918	21979	23170

Source: China health statistics yearbook 2013, http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2013/index2013.html

Table 6. Profit hospitals as percentage of different types of hospitals, 2008-2012 in China

Category	2008	2009	2010	2011	2012
Profit Hospitals as percentage of Specialized hospitals (%)	49.29	52.29	55.33	59.37	62.27
Profit Hospitals as percentage of Total Hospitals (%)	27.41	30.75	33.79	38.40	42.24
Profit Hospitals as percentage of General Hospitals (%)	24.29	27.76	30.98	36.03	40.26
Profit Hospitals as percentage of Traditional Chinese Medicine Hospitals (%)	13.54	15.25	16.20	18.12	19.76

Source: China Year Book of Health Statistics, 2009-2013

Figure 3. Number of hospitals: China (2008-2012)

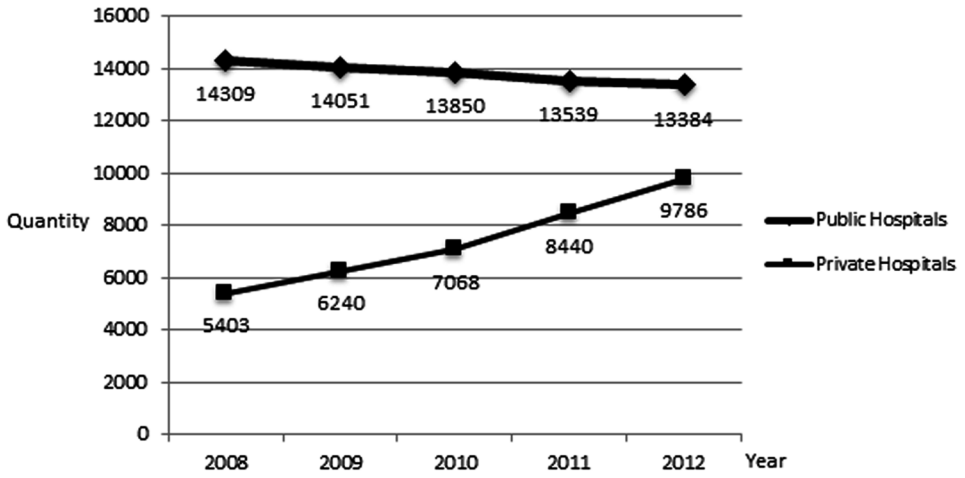

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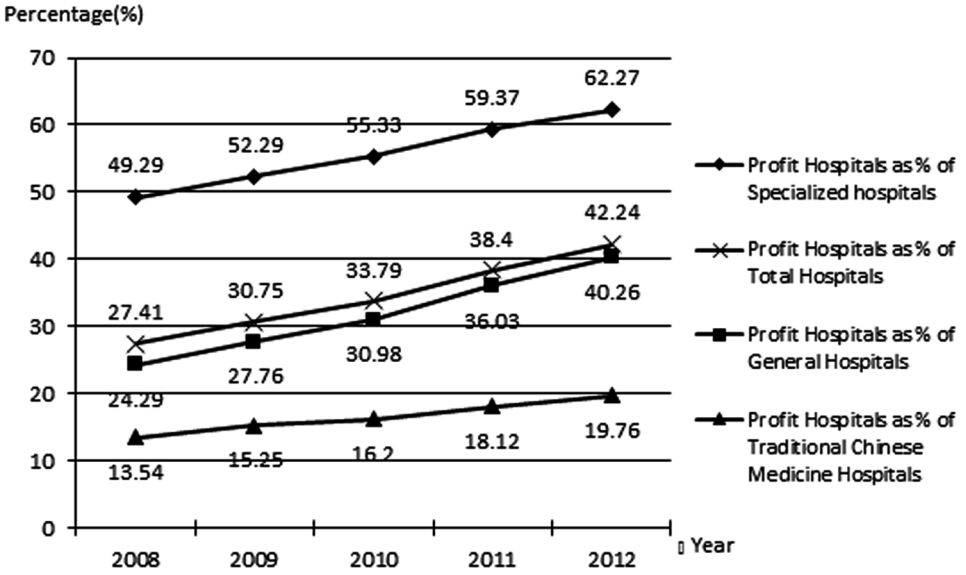
Figure 4. Profit hospitals as percentage of different types of hospitals, 2008-2012 in China



Factors associated with these new private hospitals are influencing the public hospitals. Not only do they supplement the number of beds available and visits made, they also compete with each other on quality, market share and price. It is speculated that the large growth in private hospitals is due to their better profit making ability and their ability to meet market demand for higher quality of services. Some studies have suggested, though, that changes in ownership type alone are unlikely to dramatically improve or harm overall quality (Eggleston et al., 2010).

Interesting to note, when comparing public hospitals to private, an unbalanced age distribution is noted. Approximately 22.03% of the physicians in private hospitals are over the age of 60 whereas in the public hospitals the percentage is only 2.97% (Tang et al., 2013). This difference might be due to the retirement age for working in the public sector is 55 for women and 60 for men. There are no restrictions for working in the private sector based on age. Therefore, as the workforce populations ages and remains healthier, more physicians will probably move to private hospitals in their later work years.

The Chinese Ministry of Health publicly stated it wants to see inpatient and outpatient visits at private, for-profit hospitals increase nationwide to 20% by 2015 (Shobert, 2012). This is an ambitious goal yet actually it is not far from reality. Professor Liu Guoen, from the National School of Development at Peking University, believes private hospital services will increase from the approximately 10% of the 2010 overall contribution to 15% by 2015 and 20% by 2016 (CCTV News, 2014). For patient visit trends see Table 7 and Figure 5. He sees this as very positive and welcomes additional societal resources to help develop the hospital system component.

Improprieties

Unfortunately, all the effort to reform the Chinese public health system will be for naught if organizational improprieties by public hospitals are not addressed. Some believe there has been a rise in misguided profiteering in public hospitals in China since the 1990s (Tam, 2011). It is speculated that the main

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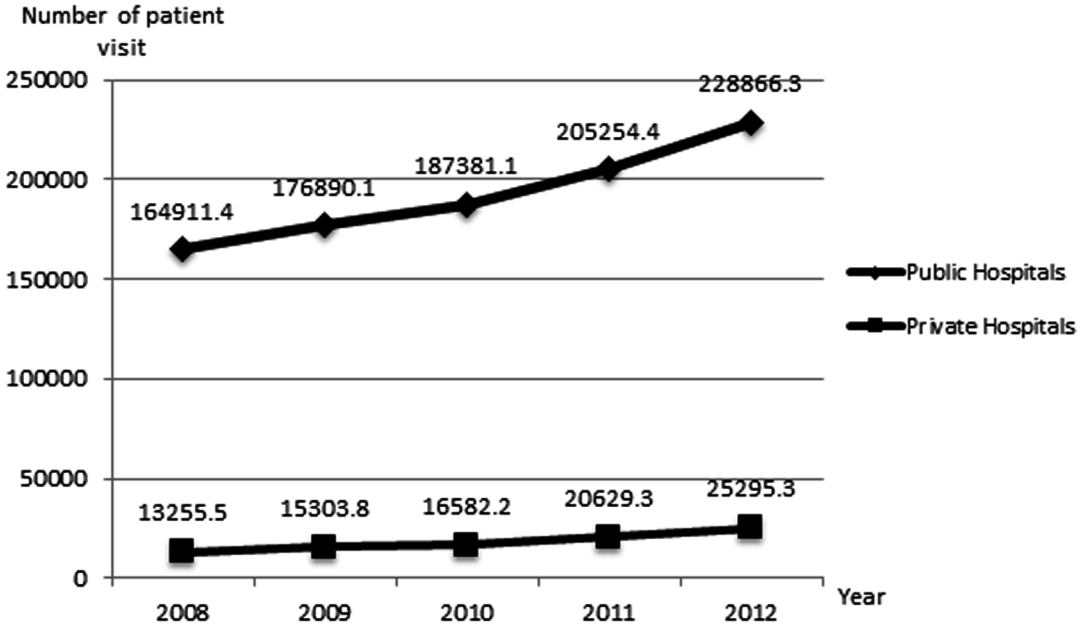
Table 7. Number of patient visits in hospitals: China, 2008–2012 (Unit: 10,000 man-times)

Classification of Hospital	2008	2009	2010	2011	2012	2015 Projected	2020 Projected
Public Hospitals	164911.4	176890.1	187381.1	205254.4	228866.3		
Private Hospitals	13255.5	15303.8	16582.2	20629.3	25295.3		
Total	178167.0	192193.9	203963.3	225883.7	254161.6		
% Private to Public	8.0	8.7	8.9	10.1	11.1	15 Not actual	20 Not actual

Source: China health statistics yearbook 2013, http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2013/index2013.html

Figure 5. Number of patient visit in hospitals: China 2008-2012 (Unit: 10,000 man-times)



reason is inadequate government funding and regulation, combined with the policy of allowing state agencies to generate, retain and use its own revenue.

The government is taking a much stronger position against fraudulent activities in all public services (China Daily, 2014). It is believed that the authorities are working to stop improprieties at its source by reforming the public hospitals (National Population and Family Planning Commission, 2013). Excess profiting is usually done through overprescribing medicines. One way to counter this is by raising salaries so that medical workers can have decent and substantial legal incomes. Also efforts will be made to build an open and transparent public bidding platform for medicine and medical equipment. It seems like the "stick" approach is being abandoned for the more fruitful "carrot" approach. This gives us more confidence that the reform measures will really work this time.

Unfortunately, wasted resources will counter the progress being made. An irrational and wasteful health care delivery system will create cost inflation. This increase will provide new money for providers' higher incomes and profits (Yip and Hsiao, 2008). Besides marketplace forces, China must act on any

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poor practices which will hamper the success of healthcare reform. The Chinese government initiated an anti-improprieties campaign in July, 2013, following an investigation into bribery and price fixing by GlaxoSmithKline, in what seems a longtime common practice in the pharmaceutical industry in China (Liu, 2013). The investigation resulted in a $492US million fine against the British drug manufacturer, the biggest penalty ever for any business entity, domestic or foreign, to date in China (Makinen, 2014). This strengthens the government position for the separation of service providers, and medicine purchasers and drug-makers to avoid any risk of collusion and conflicts of interest between the parties.

Expansion of Efforts

Late in 2013, the Decision on Major Issues Concerning Comprehensively Deepening Reforms was adopted at the close of the Third Plenary Session of the 18th CPC Central Committee. Under Social Services, the decision was to dive deeper into the reform of the medical and health sectors. Specifically, the decision was to speed the reform of public hospitals and encourage private investment in the medical sector. In addition, there was a decision to prioritize supporting nonprofit hospitals run by private investors, to allow doctors to have licenses to work in more than one hospital and to allow medical insurance to cover private hospitals (China.org.cn, 2013).

A new notice was issued in June 2014 which listed 17 additional pilot cities for public health care reform (National Health and Family Planning Commission, 2014a). This will give every province in China a pilot hospital. More recently, the National Health and Family Planning Commission has also decided to allow several cities/provinces to establish wholly foreign-owned hospitals to "promote health service development and better satisfy the medical needs of the public" (National Health and Family Planning Commission of the PRC, 2014b).

In its latest announcement, the National Health and Family Planning Commission has pledged its focus on public hospital reform to deepen comprehensive medical development (National Health and Family Commission of the PRC, 2014d). Some of the areas that are being emphasized that impact public hospitals are:

1. Finish the National Medical and Health Service System Plan for 2015-2020 including developing a regional plan.
2. Break links between drug sales and doctor's income.
3. Launch comprehensive reform of the second batch of public hospitals at the county level.
4. Establish and improve hospital management system and the public hospital governance structure.
5. Assure every province has at least one pilot city for comprehensive medical reform.
6. Use medical insurance and price approaches to promote new medical treatment system featuring primary diagnosis at the community level, graded diagnosis and treatment, and two-way referral system.
7. Deepen mutual support between urban and rural hospitals.
8. Arouse medical staff's work enthusiasm.
9. Advance resident doctor standardization training.
10. Upgrade medical service quality through construction of national and provincial modern facilities as well as grassroots-level care, and through the use of information technology to enhance medical and health personnel performance credibility.

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11. Push hospitals for internal operation mechanism reform.
12. Improve medical dispute mediation mechanism, promote medical liability insurance, explore medical accident insurance, and crack down on illegal medical activities and crimes.

CONCLUSION

A Call to Local Leadership

These recent announcements are a good indication that the government is pushing the hospital sector to accelerate its reform efforts. Even more significant, though, is its intent for local government to become more engaged in public hospital reform (National Health and Family Planning Commission of the PRC, 2014a). The call to these government leaders is as follows:

1. Fully understand the importance of advancing public hospital reform and strengthen guidance for reform.
2. Make scientific implementation plan for public hospital reform and strengthen responsibility implementation.
3. Strengthen supervision and inspection and steadily proceed with public hospital reform work.
4. Properly conduct publicity and training work, and create a good social environment of public hospital reform.

The national government expects the local entity to strengthen policy interpretation, provide training for relevant management personnel and heads of pilot hospitals, strengthen policy understanding, and work with management to push reform ahead. Also it is expected that these local leaders will publicize and explain reform content and guide public opinion. Giving over control to more local entities is surely a good sign that reform will deepen in China.

Much work has been accomplished already on China's latest effort for fundamental health care reform. Results are coming in from hospitals offering some insight into how hospitals are performing during this extended period of reform. The results so far have been for the most part positive in the way of controlling costs and improving delivery efficiency (Zhao, et al., 2013), but deepening reform measures must be undertaken.

Recommendations

The research conducted gives the reader a sense for China's new health care reform plan acceptance by its leaders in public hospitals. Public hospitals are the most difficult area to implement reform. There is no consensus as to the best way to accomplish this reform within the public hospitals but the authors believe there are several key areas which can be addressed to optimize the results desired.

Conflicts between hospitals and outpatient centers hamper the implementation of true reform. The revenue derived from outpatients is essential to the hospital's survival and cannot be cut out through a gatekeeper model. First, the gatekeeper system must be set into place through cooperation and col-

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laboration between public hospitals and community health centers/stations. The public is hesitant to go to these outpatient settings and insist on going directly to the hospital. Without this redirection of care, health care reform will be unsuccessful.

To get the public to switch to this model, physician training/education must be strengthened so the public will feel confident with the family doctors who staff these centers. In addition, the people need to have an incentive to go to the gatekeeper at the center. The insurance system should allow the patient to have less financial responsibility when he/she enters this model and have to pay more out of pocket when he/she enters through the hospital for primary care. By building a stronger primary care model, one which patients feel comfortable with the doctors and the quality of medicine provided, the public hospitals will finally have to give up their hold on outpatient care and render it to the more appropriate level.

Government policy must be enacted which support these reform mandates and its implementation must be monitored. Further efforts must be placed on the reform of public hospitals including the continuing entry of private health care facilities, the correct utilization of the essential medicine system, more internal control procedures and accountability, and a crack-down on improprieties and fraudulent conduct. Only through these deepening efforts will there be true and lasting health care reform.

Limitations

This study is limited by the methodological approach used, specifically the small sample size, the fact that it is only researched in one area and the use of the interviews. In addition, the time for diffusion will be different depending on many characteristics (i.e. loyalty to national body, past experience of participants, satisfaction with the current system, incentives, etc…). This study's data collection procedures which consisted of interviews, does not allow for measuring all variables that need to be considered. Even though, this work can give the reader some initial insight into how China's new health care reform plan is being rolled out and accepted by the public hospitals.

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Chapter 62
A Follow up to Semi-Automatic Systems for Exchanging Health Information:
Looking for a New Information System at Fixed E-Healthcare Points for Citizens in Greece

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ABSTRACT

The present research is an attempt to explore the applicability of the best possible service in the area of organized health care services, at fixed predefined points of service. The suggestion is that there should be a system that will receive and provide information about health matters of general public concern. Thus following the lead of Citizen Service Centers in Greece, it can be extended conveniently to mobile devices. The main survey was conducted on a sample of Municipalities and Citizens in the year 2013. The results indicate that the new proposed system could be more secure for citizens for future use, based on supervising procedure by proper employee who will provide more help to the users, instead of a fully automatic system.

INTRODUCTION

The primary goal of this research is related to the improvement of health service to citizens. One way to accomplish this, is to develop modern, natural, and technological methods, designed for use by citizens and by Health Services as well. Thus by emphasizing on primary health care, is proposed to timely and accurately exchange health information. A second objective is related to the requirement that the required

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and eventually selected solutions should be economical and catering effortlessly not only for the fastest service of citizens, in the context of primary health care, but also for saving time and resources in the health sector. The third objective is the achievement of general acceptance of the project benefits, by involved people and especially by service users, as everybody is potentially patient. Moreover, this new proposed system must be secure, based on supervising the procedure by the appropriate employee who will provide help to the users, instead of a fully automated system.

As regards the moral dimension of this research, the voluntary offer of personal information is a source of dilemmas and reflection for most people in modern society. That happens even if it is simply in the form of a medical record, which is expected to contribute further to the treatment of the health problem they might face. This is so because this kind of information considered as a patient's personal data must be therefore safeguarded so that none account should be drifted into unauthorized hands. Therefore, there are people who are reluctant to mention their name or age. Therefore, research surveys should respect the participants' wishes, whether they contribute to the achievement of the objectives of the research or not; mainly through the qualitative and not the quantitative value of the provided data.

This research was based on:

- The existing literature and expertise;
- Primary and secondary input data within its context;
- The use of PCs (including search engines and meta-search engines of data and information);
- The appropriate software;
- Questionnaires developed for its purposes.

Regarding the methodology followed, it focuses on random sampling field research as well as on scientific processing of collected data, on their analysis, on presentation of results and development of relevant proposals. To this end, the IBM SPSS Statistics 21 package (Gardelis, 2013) was used as it constitutes a state-of-the-art scientific tool.

The research was conducted, within three years (2012-2014), through strictly defined phases and sub-phases that cover its preparation, implementation, and completion.

More precisely, during the year 2012 and until May 15th, 2013, which was the time of preparation of the research phase, the following actions took place:

- Study of the literature and design of the stages of its preparation;
- Locating specific topics in the relevant literature and supply of the necessary electronic equipment (hardware) and the required software support for the execution of the project;
- Supply of special Web page development software Adobe Flash CS3 Professional;
- Deal with any omissions observed in terms of specialized equipment needed to perform the research and the realization of general education, as well as testing of all systems regarding compatibility and interoperability. Also, the necessary testing and simulations of the internal support systems of the general equipment were carried out.
- Development of specific Web pages required for this research.

In the execution phase, from May 16th, 2013 until January 5th, 2014:

- The collection of online questionnaires that were sent to citizens took place and completed;

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- The collection of the respective handwritten questionnaires distributed to and properly completed by the participants. So, the gap for supplementing an adequate number of questionnaires to be ensured a reliable sample for the study was swiftly covered.

During the last phase, from January 6th, 2014 to January 31st, 2014:

- The processing of the data collected during the survey, was done;
- The results of this phase, were been studied and analyzed;
- The appropriate conclusions ensued for more efficient design and acceptance of the new system of Electronic Citizen Service.

At the same time, research was held in selected Municipalities of Greece in order to determine the degree of acceptance of the new electronic citizen service system by the registered citizens.

Finally, with regard to the objectives of this work, the main aim was to investigate if there are ways to help more the average citizen on his daily activities of exchange information in the field of health services. For this reason it was necessary to take into account modern technologies as are expressed through automation, modernizing communications and the rapid spread of information technology (Kennedy, 1994). The combined use of ICT actions together with electronic automated machines for citizens' services, hypothetically can offer solutions particularly in local level governance, such as municipalities. Because most of Greek citizens are not familiar with modern ICT practices (especially elder), the implementation may involve semi -automated devices. Thus, a human operator (an employee of a municipality) may offer help to the users, thus being supervisor of devices proper use.

METHODOLOGY

The methodology followed for the collection of necessary data, was based on supply/distribution and filling out of appropriate questionnaire (electronic or paper) especially designed for this study (Apostolakis et al., 2008a; Ioannidi-Kapolou, 2005). Therefore, the field research was carried on by the collection of necessary data from citizens while the views of the municipalities and other institutions were collected using regular mail or electronic media. The questionnaire for completion by citizens (being the same in content both in electronic and in printed form) was designed in the form of:

- Short and stereotypical questions;
- Closed-type questions;
- Multiple-choice answers, not necessarily of single-option answer for each question, depending on the nature of the query itself.

The sampling method for the collection of questionnaires was simple random sampling both for electronic and non-electronic cases. The venues for filling in the printed questionnaires were randomly chosen as well, depending on the researchers' facility access. However, in the pursuit for better online results, the sampling method of "avalanche" was chosen. About the sampling method followed in the case of municipalities related to Primary Local Administration and invited to participate by expressing their views, it was preferred "multistage random sampling".

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Moreover, the collected data were analyzed by a software package for statistical data processing "IBM SPSS Statistics 21" (Apostolakis et al., 2008b; Gardelis, 2013). Thus, the collection of 278 questionnaires filled in by citizens was followed by their analysis with this software package.

Special Architectural Points of the Research

Municipalities

The description of the proposal was submitted to the municipalities for further study, comments and discussion to various municipalities. So, the relevance, applicability and possibility of adoption, could be explored by local governments.

The following description, of the proposed system, for implementation by all institutions involved, especially by the municipalities that constitute the fundamental pillar of this new system, was send to the participants:

---- Start of letter ----

It is already known that:

the Greek State with the local governments (municipalities), make significant efforts to serve their citizens in various ways regarding a variety of subjects. Some examples are:

- *the Citizen Service Centers (Apostolakis et al., 2008a, http://kep.gov.gr, http://ypes.gr & http://ydmed.gov.gr);*
- *the Taxpayer Service Centers*

Particularly with regard to the Civil Service in Health Care, one issue observed by citizens themselves focuses on the increasing difficulty to book a medical appointment, due to individual personal health requirements or an appointment for a diagnostic medical lab whenever they wish. The citizens themselves book for these appointments, by using telephone. The appointments are usually programmed for several weeks or even months later and this is long after the actual time that is required for the examination of the patient. This can lead to deterioration of the patient during the time elapsed from the day of booking up to the day of the examination. Furthermore, the location imposed on the patient for the examination is frequently rather far from his/her permanent residence, which results in additional round-trip costs for the patient and his/her relatives. Indeed, the citizens who are determined to reach deep in their pocket for the extravagant fee for an immediate arrangement for a medical examination at home, at an evening outpatient clinic of a public hospital, at a doctor's private surgery, or at a private medical hospital or clinic are excepted from the above predicament, as well as those who are already public or private insurance holders. Consequently, an Integrated Civil Service system must be introduced. Every citizen must be efficiently served on a variety of topics, including booking of medical and diagnostic appointments in an easy and direct way. Every such appointment must be scheduled for the shortest time ahead, which in our opinion should not exceed 72 hours, and at the nearest location from the patient's permanent residence. This system should not be operated by phone as phone services are liable to malfunctions and, therefore, are considered unreliable and in addition they are not in line with

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the potentials of modern technology. Naturally, the phone will continue to be useful for an immediate appeal to the family doctor, a pediatrician, and the dentist, or even to SOS Doctors and Dentists. Still, the aim must be the provision of electronic health services to citizens, including the booking of medical and diagnostic appointments. To briefly describe the new electronic citizen health service system (that will be simultaneously the subsystem of an Integrated Civil Service system on a broad range of areas), the following steps should be taken:

- ***About Doctors and Diagnostic Surgeries****: they must join the new online system 24 hours a day by using special software to schedule appointments (medical booking) to which the client-patient will resort to service. The software will display the bookings directly, as well as vacancies available per fifteen or thirty or sixty minutes. Also, it will prevent the overbooking by patients or booking when the doctor is unavailable because he/she rests or is absent. Therefore, it is obvious that if all providers of healthcare service at a municipality decide to join the system and participate actively in the system of online service:*
  - *they will gain in popularity, and they will increase their clientele because through the system will display their availability;*
  - *the citizens will benefit significantly from the improved service. That is because they will be able to choose the healthcare service provider within their district according to*:
    - *their actual needs, and*
    - *the medical specialty that is required, and*
    - *the proximity of the point of health assistance to their residency, and*
    - *the immediate availability of physicians.*

In addition, on the computer screen a variety of other information can be displayed, such as the expected cost of the visit and whether the relevant healthcare service provider is affiliated with Social Security Funds such as the Greek National Healthcare Service Provider (called "EOPYY").

Particularly for the electronic settlement of vacant appointments, the software must provide for the possibility of the doctor participating in the program to exclude specific hours from his/her daily schedule for medical visits, either due to rest, or because of sickness, absence from surgery, or because of other temporary impediment, so that these intervals will not be displayed on the system vacant for booking by citizens.

- ***About municipalities:*** *citizens' service healthcare special equipment should be installed in already existing Citizen Service Centers (GR: KEP) as well as in municipal primary clinics or other guarded communal sites. In this way, the municipalities will provide their citizens with health service facilities while at the same time they will be receiving a recompense for the use of the electronic machine, i.e. a symbolic monthly fee (e.g. 5-10 euros). The fee must be paid by the affiliated doctors and medical centers for entitlement to participation in the program, thus increasing the revenues of municipalities. Furthermore, the use of the machine operated by qualified municipal employee will be free of charge for citizens or, alternatively, a symbolic fee per transaction service (e.g. 0.5 euros) will be charged so that the annual maintenance cost can be covered (aided by the revenue for participation entitlement of the health service providers).*

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It is estimated that machinery, special equipment and operation software, can be supplied with the resources available by the Special European Funds (GR: ESPA). That is because the investment will serve the citizens, resulting in increased absorption of Community funds intended for the country. Finally, to make this citizen service more efficient, devices on the municipality's responsibility could be also placed in pharmacies that operate within the boundaries of the municipality by agreement with the relevant Pharmaceutical Association.

- ***The device under discussion,*** *which can be a suitably modified PC or other particular Bank type machine, should enable the user to book medical and diagnostic appointments through connection to doctors' surgeries, clinics, and medical centers of the municipality that will have installed the special software. The respective selection can be achieved through an appropriately configured table of options of existing districts and available medical practitioners & laboratories. The electronic device should also be able to interface via the Internet with the websites of:*
    - *Ministry of Health, so that the user can draw other useful information (e.g. drug prices, hospitals, pharmacies, etc.);*
    - *hospitals (if any) within the municipal boundaries;*
    - *the Greek Center of Special Diseases' Prevention & Control (GR: KEELPNO)*
    - *the National School of Public Health;*
    - *other useful sites regarding health matters.*

In addition, the site of the municipality should not be absent. All other sites should be excluded for the sake of rapid and precise search for information by the citizens through the use of the devices.

Furthermore, the municipal citizens should derive their social security number (GR: AMKA) which is already in implementation nowadays. In parallel, through the interconnection of the machines to other databases (e.g. of Hospitals within the municipality or of the nearest to it large health care structures), anyone who wishes, will have the option to insert in a system's file his personal primary medical record, under appropriate conditions. This record will be available to Health Services to cover the probability of a major accident or major illness, cases that the user will not be in position to provide personally and directly appropriate information about his prior state of health (e.g. allergies, major surgery, chronic disease, etc.). This will be a mini basic medical history of anyone, available anytime to the system for future use from the Health authorities. Moreover, it would be useful for the citizen to be able to print various useful or necessary documentation directly from the hospital in which was hospitalized or examined (e.g. hospitalization certificate, examination results, etc.). It would also be useful for both citizens and the national health system, if the users of devices could inform the health authorities with various necessary data through the online devices' system.

Regarding the access security of transactions through the devices, this can be implemented by providing a unique user-number or/and through the use of the unique for each person fingerprint (today this technology is already implemented). Thus, through this online system may safeguard the uniqueness and individuality of the transaction.

---- End of letter ----

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Citizens

Citizens' options are not and cannot be unlimited; therefore, they constitute a limited range of alternatives (Liaropoulos, 2007, 2010). By supplying and distributing to citizens appropriate for filling out a questionnaire both in online and paper format, they could choose between different options and participate in the formulation of the proposed new e-health service system.

REALIZATION OF THE RESEARCH

Municipalities

In terms of primary local government, the research was conducted in fourteen representative municipalities of Attica Greece and sixteen representative municipalities of the rest of the country, chosen as a pilot-driver sample. It was mailed in a registered letter in the name of their Mayor, positions and proposal of the new, under exploration, electronic citizen service system so that they could study, evaluate and commen on this. The municipalities specifically selected for this research were:

1. Municipalities belonging entirely to the Attica region and in particular in the Regional Sections of Central, Western, Southern and Northern Areas of Athens and also Piraeus. Central and densely populated Municipalities were selected for exploration; i.e. municipalities highly urbanized. For this reason, municipalities with more decentralization and a lesser degree of urbanization were not selected. That means our research was not interested in municipalities belonging to the Regional Sections of Eastern and Western Attica, as well as those of Regional Islands Unity. Therefore, the municipalities selected were:
    a. Nikea-Aghios Ioannis of Rentis;
    b. Piraeus;
    c. Nea Smyrni;
    d. Palaio Faliro;
    e. Elliniko-Argyroupoli;
    f. Aghios Dimitrios;
    g. Alimos;
    h. Glyfada;
    i. Aghion Anargyron-Kamaterou;
    j. Maroussi;
    k. Aegaleo;
    l. Peristeri;
    m. Athens;
    n. Zografou.
2. Municipalities belonging to the mainland Greek territory and are located on the land from the north borders down to the mainland of Greece. Those communities selected for our research were presumed central and densely populated, i.e. with a high degree of urbanization. The selected municipalities were: Ilis, Agrinio, Thessaloniki, Lamia, Komotini, Volos, Ioannina, Argos – Mycenae, Corinth, Alexandroupoli, Nafplion, Larissa, Kavala, and Patras.

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3. Municipalities belonging to the island part of the country. Central and densely populated Municipalities were selected for exploration, i.e. with a high degree of urbanization. As the most representative the two largest Municipalities of the island of Crete (Heraklion and Chania) were chosen.

Citizens

When the collection of the research questionnaires was completed, 278 participations were obtained. The questionnaires were collected either from the Internet for web-users or through filled-out handwritten forms. Six questionnaires were invalid; therefore, the valid questionnaires for analysis were limited to 272.

RESULTS

Municipalities

Fewer than half of the cities (Municipalities), which we contacted, replied, i.e. eleven out of thirty [11/30] or [1/3 +]. From these (11) cities, nine answered positively (with or without reservations), i.e. [9/11], or 82% of the actual participants in the research. These municipalities were: Athens, Thessaloniki, Nea Smyrni, Aigaleo, Lamia, Komotini, Alexandroupoli, Nafplio, and Kavala. One city responded negatively (Agrinio). One city did not take a position, simply presenting its program of actions regarding health care for the benefit of its municipal citizens (Aghioi Anargyroi-Kamatero).

Citizens

The results of the analysis of the questionnaires compose the dominant opinions and desires on the participating citizens. These are summarized as:

1. 54% of the residents would like the proposed system to be connected to all the options suggested in the questionnaire. That means to be connected with all the Health Care structures that exist in the municipality, with the municipality itself and their social security fund.
2. Citizens by 66% prefer full information and service from the new electronic health service system. Regarding the desire in particular of booking a medical or diagnostic appointment with a doctor or a medical laboratory respectively, the percentage of potential users exceeds 70%.
3. The majority of respondents (63.6%) would like access to electronic service devices available for all without exceptions.
4. The majority of potential users prefer to make use of the AMKA card (47.8%) in order to access the electronic service machine.
5. A majority of potential users would prefer to have access to the system via a touch screen (61%).
6. An overwhelming percentage of 86% would like to appeal to the new system “whenever needed.”
7. Although roughly 45% of people do not like to pay the slightest fee of even one euro to be entitled to use the service, more than half of the citizens believe that they should pay some price or fee.
8. The majority turned out to be the percentage of citizens who suggest that the State should undertake the daily cost of operation and maintenance (53%).

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9. An overwhelming percentage of 81% of the citizens want the rewarding use of the new electronic service system.
10. With an almost total majority of 92%, the people participating in the survey responded that they believe that the proposed new system will be useful and beneficial to society, in general.
11. The percentage of 71% of respondents believes that the creation of the new electronic service system is essential.

DISCUSSION

The proposed system is a bidirectional interactive Citizen Health Service information system that will consist of the following essential features:

System Design

1. People users, health information registrars or recipients, but also persons with appropriate technological training in order to provide adequate assistance to persons who are not familiar with information and communication technologies (ICT) and require the use of the system, as well as in order to protect the system as far as possible from any malicious or negligent damage that may arise from inappropriate use. It is these assistants' involvement who deprive the system of the feature of full automation. Therefore, this makes the addition of the prefix 'semi' to the term 'automated system' most suitable. It goes without saying that human intervention must exist in order to ensure an appropriate day-to-day operation of the system. When necessary, trained staff intervenes in order to provide adequate assistance to people who have difficulty in access or who have questions about the proper using of the machine.
2. Machinery that may be used is a simple (properly programmed PCs) or composite type [Bank ATM type (Apostolakis et al., 2008a)] that process the registration and download or upload the appropriate health information. To this end, these devices should be interfaced with the relevant databases (Pagalos, 1986). In particular, with dispensaries and diagnostic centers of the municipality where the appropriate special software should be in place, must be able to book for medical and diagnostic appointments, with the physicians and the diagnostic centers of the citizen's choice. An appropriate user interface may be a table of multiple choices, presenting municipal areas in parallel with the availability of doctors and medical laboratories. Furthermore, the devices should be able to interface via the Internet with:
    a. The website of the Ministry of Health so that the user can draw other useful information (e.g. prices of medicines, emergency hospitals, pharmacies, etc.);
    b. The websites of hospitals within the relevant municipality (if any);
    c. The website of KEELPNO;
    d. The website of National School of Public Health;
    e. Other sites that may provide health care information;
    f. The internet site of the citizens'municipality.

All other sites should be excluded for the sake of rapid & specialized information quest by the citizens.

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Moreover the residents of a municipality should be able to derive their social security number, their data from other databases: hospitals within the municipality or from health care structures. In addition, users will have the option to insert in a system's file their personal primary medical record, under proper conditions of security, safety and confidentially. This record will be available to health services to cover the probability of a major accident or major illness when the user will not be in position to give personally and directly appropriate information about his prior state of health (e.g. allergies, major surgery, chronic disease, etc.).

In addition, it would be helpful to the citizen to be able to print various useful or necessary documentation directly from the hospital in which was hospitalized or examined (e.g. certificates of hospitalization, examination results, etc.). At the same time, the citizen could provide online various information or data that have been requested. Regarding the security of transactions, access to the machine can be more secure by providing a unique user-number or / and through the use of the unique for each person fingerprint. Today this technology is already implemented. Thus, the uniqueness and individuality of the transactions is safeguarded. Such e-Government machines were spotted in Belgium (Brussels) and presented in the relevant unity of this research's presentation (see http://enterthecity.info/index.php/en/speakers).

3. Cutting-edge technology ensuring interoperability and satisfactory system performance. This includes software for booking medical appointments to which the client – patient will resort for immediate service and which must be developed appropriately. The software will display the booking directly as well as vacancies available per quarter of an hour or half an hour or hourly, while it will exclude bookings for hours that are already reserved for other patients or when the doctor rests or is absent. Therefore, it is obvious that if all providers of health services within the limits of the city, join the system, they will benefit from it. That is because their availability will appear on the system thus increasing their clientele. Also, the civil health service is expected to be improved since doctors appear online, per specialty in each district of the municipality. So, the nearest possible and most available doctors or laboratory may be selected. Besides, on the computer screen some other relevant information can be displayed. Such information can be the expected cost of the visit and the physicians' cooperation (or not) with the EOPYY and/or other Social Security Funds. Especially for the electronic settlement of vacant appointments, the software should provide the opportunity for the doctor participating in the program to exclude hours for incalls, due to any reason, so that these intervals will not be displayed on the system as vacant. Appropriate technology for the development of this software for "appointment booking" exists nowadays. Such software is used mainly in the private sector (e.g. online appointment booking is utilized by a well-known group of private Centers for Technical Checking of Vehicles) as well as by local government (e.g. the municipality of Athens).

The research design of the proposed system, was based upon the research that we conducted in the research field of:

- citizens-"potential users of the new system". Thus an appropriate questionnaire was offered to the sample of citizens.
- local government. Thus, we sent an appropriate letter to a sample of Greek mayors.

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In this way, i.e. taking into account the people's choices presented in the section "Results" and through the comments of the municipalities, the new electronic citizen healthcare service system was configured. Details about further funding and ensuring the desired efficient operation of the new system draw upon the existing rich literature as well as upon modern technological quiver.

Therefore:

- *Regarding the information network:*
  a. it should be extrovert (Apostolakis, 2005; Apostolakis et al., 2008a);
  b. it should have the ability to be connected to all the "external nets" (extranets) (Laudon et al., 2004) of the institutions with which it is necessary to interface with comprehensive information and services provided to the citizen. Specifically, have to be linked to multiple databases for appropriate and parallel service via of exchanging information and data.
- *Regarding the analytical technology* for the development of the ICT network, it should ensure and support:
  1. The appropriate architecture of the network (Tassopoulos, 2005; Vasilakopoulos et al., 1990) which refers to the emerging structures for the distribution of physical units in the network, controlling and information flow through the network as well as representation, interpretation and translation of the transferred information. Nowadays "cloud computing" (Apostolakis, 2011) seems the most valid architecture.
  2. The right network topology (Tassopoulos, 2005) which refers to the way in which the parts of the network (nodes and links) are connected. For this system "Bus" topology is proposed. This consists of a line of the communications transfer medium (coaxial cable or optical fiber) and to which the nodes of the network are connected, easily extendable and sufficiently functional. "Star" and "Ring" are not proposed because of their disadvantages, judging that they do not cater the requirements of the system. Of course may arise an objection to this choice and beyond of the main advantage of bus topology for future extension of the system. That is because if a failure appears in a single point of the topology, this might cause a provisional loss of connectivity for all networked devices. However, as is estimated, with the usage of bunch optical fibers (between away cable connections of devices), no serious problems are expected to appear. The only real practice implementation from the operational use of such devices, until today, is the example of Brussels with only ten devices installed. If, for example, the municipality of the city of Athens/Greece installs ten or twenty such devices, this will be a very big success for citizens' health service . Then, through the use of such facilities under real conditions, safer conclusions will be available.

Especially for nodes, proposed "distributed control" (Vasilakopoulos et al., 1990). All nodes of the system have the same privileges of sending and receiving information so that the maximum possible autonomy and flexibility of the system may be guaranteed.

  3. The appropriate technological tools (materials/devices) support this system should be of the latest technology, these include switches, routers, gateways and passive network components (Apostolakis, 2002; Laudon et al., 2004).

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4. The appropriate physical medium of information transmission. Regarding this system the bunch optical fibers is proposed (Laudon et al., 2004). As the relevant cable features host numerous advantages over the coax cable (Ferrer-Roca et al., 1999; Laudon et al., 2004; Tassopoulos, 2005; Vasilakopoulos et al., 1990) (possibility of broadband transmission, ensuring low noise, low signal attenuation, etc.). Besides, it is suitable for long-distance connections. We are not in favor of the solution of wireless connections (Laudon et al., 2004) as they may be affected by atmospheric conditions and various geographic or large artificial barriers.
5. The proper method for information transmission, namely through digital signal (Laudon et al., 2004), rejecting the analog as old and obsolete.
6. The appropriate bandwidth (Laudon et al., 2004) for the connections, is "broadband" (Gates et al., 1996). That is because it secures greater information transmission speeds, avoiding "medium band networks" (Gates et al., 1996).
7. The use of technologies "ADSL" (Gates et al., 1996) or even better "VDSL" in terms of fixed connections, is also appropriate in our case. For cases of mobile connections 4G technology (Ferrer-Roca et al., 1999) has better qualification under the condition that an appropriate application is in place to secure the fastest and most thorough transmission of information.

- *Regarding the intended interoperability* (Apostolakis, 2011; Apostolakis et al., 2008a) the system must provide both technological and semantic interoperability (Apostolakis et al., 2008a). To achieve the latter we would suggest using the "Semantic Web" technologies (Apostolakis, 2011; Laudon et al., 2004) which are intended to make the search on the Web more efficient by reducing human intervention in searching and processing information in the Web.
- Also, a fully structured system should *secure* the following:
  a. privacy issues, e.g. the right of every individual to control the disclosure of his medical information (Apostolakis et al., 2008a);
  b. security of information, e.g. the protection of information stored and transferred via PC, from unauthorized disclosure and/or use which could lead to exploitation, falsification or destruction (Apostolakis, 2002, 2011). As mentioned in the literature (The Legal Association of Northern Greece, 2004), "the diffusion of information technology knows neither hesitations nor distances, it is fast, silent, indiscriminate, and thus ends up being relentless". It is true that if the health information data of a citizen are reached an irresponsible or ruthless man, then it is possible that the citizen will become the target of pressures (The Legal Association of Northern Greece, 2004), of threats, of blackmail or another form of exploitation. Moreover, it is important to say that electronic crime (Laudon et al., 2004) becomes stronger enough up to the point of its generalization in a parallel course with the generalization of ICT technologies.

An additional factor, which is not overlooked, is that:

"If the citizen-user of the new system is not convinced that the whole package is fully guaranteed, he will be very hesitant to use the proposed machines even up to the point of utterly avoidance of their use". Thus, probably this will result in the generalization of this phenomenon and the complete obsolescence of the new system. The package we mentioned before is: privacy + security + confidentiality + features with which are secured the uniqueness of access to the electronic machine for information exclusively concerning individuals.

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Encryption technologies can indeed offer solution to all the above (Gates et al., 1996), as well as e-banking technologies and the techniques of securing the uniqueness of access to an electronic device such as the proposed system.

- *As for access to the machine,* a combination of different ways is proposed in order to ensure the confidentiality (Apostolakis, 2002). These are reflected both in the responses that the citizens have given to our questionnaire and in utilizing the available technology. Based on survey responses we would respectively suggest:
  a. the use of the unique number of AMKA for all citizens who have already social security;
  b. the use of another distinctive number for the people without social security.

Thus, the unconditional and unrestricted participation of all potential users of the system is preferred. However theoretically, the AMKA number could be given to all citizens by birth. Practically, the number could become 'valid' or remain as 'invalid' in the course of the individual's life according to the different circumstances of their working life and their ability to pay their social security's fee for health care. An 'invalid' AMKA number could affect in a negative way various actions and decisions from the part of the State regarding the citizens, with the exception of their right to use the devices. However, alongside the unique number (either AMKA or a substitute number) it would be useful to have an additional 'safety valve' of accessibility and, therefore, the use of fingerprint is proposed. Alternatively, instead of the fingerprint, the type of smart card called "biometric identification card" (Ferrer-Roca et al., 1999) may be used. This contains memory chip that in a compressed way can store data such as fingerprints, voice tone, hand geometry, etc. Anyhow we consider that the general public would be very hesitant to use it. A result from our survey regarding the fingerprint identification as an access mode to the machine was the low acceptance rate of 8.5%. Moreover in our opinion, the use of simple magnetic cards should be disqualified. That is because of the small percentage of acceptance they received in our research (9.6%) and also for other reasons (e.g. demagnetization of the cards in the course of their usage). On the contrary, the "Health Passport Cards" (Apostolakis, 2002) containing social security information and medical information have gained our interest. In the latter case, some universal coding could be used for reasons of abbreviation of the information. This coding as described in the 'Manual of International Statistical Classification of Diseases, Injuries" was approved by the 29th Assembly of the World Health Organization (WHO). Also, it could be used more efficiently for the benefit of health professionals and the sake of the patients themselves because this coding is a way of saving information space and also is an instrument of information encryption. Of course, by using holographic memory (Gates et al., 1996), this encoding would not be required.

- *About the machine's ease of use,* the touch screen (61% acceptance rate, according to the survey) is proposed. Also, other modern technological methods and solutions may be considered in order to facilitate the use of the machine by the individuals with disabilities (Apostolakis et al., 2008a). In addition, the availability of portable equipment for storing and providing information from/to the proposed device must exist.
- Further it is feasible to enhance the system capabilities by use of the following technologies:
  1. Telemedicine and eLearning technologies (Ferrer-Roca et al., 1999; Kristina et al., 2012; Paola Di, 2012; Pierrakos, 2008; Wayne et al., 2012)
  2. "Virtual Medical Dossier" technologies (Apostolakis, 2011; Malamateniou et al., 2002, 2003; Siwicki, 1997; van Bemmel, 1999)

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3. Electronic health folder technologies "IZIP" (Apostolakis, 2011)
4. "Intelligent agents" technologies (Dafonte Vazquez et al., 2007; Gates et al., 1996; Hoogendoorn et al., 2013; Laudon et al., 2004; Robson, 2009; Zaidi et al., 2002)
5. "Service search robots" technologies (Laudon et al., 2004)
6. Holograms technologies (Pepper, 2015)

- Regarding the demanded additional benefits of the system, the usage of "Health Portals" (Apostolakis, 2011) is recommended for informing patients about:
  a. various diseases and health issues that may concern them;
  b. ease of access to specific advanced high-cost treatments;
  c. the opportunity to participate in online communities for Information and Patient Support (Apostolakis, 2011) whose members suffer from the same illness (e.g. http://sugarfree.gr).

At a more advanced stage, the system could provide the usage of the so-called "Second Z" (Second Life) (Apostolakis, 2011; Laudon et al., 2004) for the benefit of patients-users of the system. Also Electronic Health Learning Communities (Apostolakis et al., 2008b) could become useful in the future. The conditions are favorable for providing accessibility to sites related to health education issues (Kornarou et al., 2007) for example updating and provision of specific directives, guidelines, advice, etc.

- Regarding scalability, such systems should be ready for the extension when start to function, besides public places, in home or on mobile devices. This means that it might be possible to use system functionalities at home or labor, and from any point having a fixed (pc) or mobile device (e.g. laptops, tablets, mobile phones with internet connection, smart phones (Laudon et al., 2004)), obviously in such cases some features not be available (e.g. printing pages type A4).
- In accordance with the results of the survey supporting this version by 54%, is that the system should be linked to all local Health Care structures, to primary social security funds, to the websites of the Ministry of Health, of the National School of Public Health, of the local municipality and to any other site deemed beneficial for the municipal citizens- users regarding health issues, as well as for other reasons, but to a limited extent for the sake of usability of the system.
- *As for* the intended *effectiveness* of the new health service system, the international indices should be taken into account. For example, the service description indicators of European Health Consumer Indicators- EHCI (Liaropoulos, 2010) include five categories:
  1. Immediate access to a doctor.
  2. Access to a family physician in 24 hours.
  3. Computed tomography scan (CT) in less than seven days.
  4. Treatment for cancer cases in less than 21 days.
  5. Primary chronic surgeries in less than 90 days.

Generally in the authors' view, for all the appointments to diagnostic laboratories and the appointments for medical examination, the system should ensure access to the patient or to the individual in order to be examined within 72 hours in any case under the following condition:

All health service providers will be registered in the system, and provide detailed daily availability and in the nearest area but also in the wider region of the user's residence.

The above providers may be:

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1. Doctors of any specialty;
2. Dentists;
3. Medical diagnostic laboratories with specific equipment and infrastructure referred to in detail. Such may be blood test equipment and biochemical laboratories, scanners of every kind, radiographic and other medical imaging equipment, e.g. ultrasonic, cardiographs;
4. Other health professionals, e.g. special nurses, physiotherapists.

However, the parallel direct use of the telephone as citizen service should not be ruled. It is obvious particularly in the case of emergency for everybody who may call at home a family general doctor, a personally trusted physician, a family pediatrician or even "SOS Doctors" and "SOS Dentists".

- *Regarding financing of potential project,* and until the proposed system becomes operational, the quest for financial resources may be directed to various alternative sources:
    1. To European funds in collaboration with the Public sector, in the event that the system is integrated into the Ministry of Health.
    2. To European funds in cooperation with the local municipality if Local Government is to become in charge of the system.
    3. The previous case combined with the participation of the Public Sector.

The case of Government partnership with the private sector should be excluded, as well as any form of loan, because it create debt repayment obligation or obligation for amortization.

- *As for the financing of the operation and of maintenance* of the new system it is desirable that this obligation should be undertaken by the State (Ministry of Health).

This is due to the choice of the majority (53% of respondents by questionnaire) which was based on the fact that every month the citizens pay insurance contributions and annually pay income taxes. However, it is estimated that the Government is not capable of exclusively undertaking this burden for this period and the following years:

1. Governmental budget allotted to the Ministry of Health is not sufficient to cover the growing public health costs due to the economic crisis. Indeed is the same crisis that leads thousands of citizens to hospitals for various health reasons;
2. The structural changes that the Greek Ministry of Health schedules which entail costs for the average citizen (e.g. the establishment of Primary Healthcare Network in Greece, called "PEDY").

Another finding of this research is that more than half of the citizens accept to pay some amount of money as a fee for the use of the online electronic system. This can be done either per service transaction fee separately or by payment in advance on a yearly or monthly basis as entitlement for participation in the system and the use of its services. The same pay system is implemented in the public urban transport in the Greek capital [tickets or passes (monthly or annual)].

The fee for this service can be reduced to zero if local municipality participate in the expenses with official state or/and other funds or undertake relative expenses at all. In the case that the municipalities accept the new system as free of charge for citizens, the mayors must be honest with their citizens. This

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means that any other charges must not be disguised to municipal taxes and will not be transferred to the citizens, but to private Health Service Providers who participate in the system. Therefore, these providers should pay a monthly fee for inclusion and participation. Besides, by the online daily exposure of their availability on the electronic system their "clientele" is expected to increase and they will eventually benefit from this. Furthermore, it must be expected the further extension of equipment's use on 24h basis for the benefit of the patients. Of course damages and schedule, maintenance is not excluded but this situation discontinues the daily availability of the equipment. All the above serve the coverage of increased demand which today creates large waiting queues. The efficiency of the system will be always in relation to the urgency of an examination and the cost that patients pay to providers of health care services for using the system. Regarding the partial or total patient's contribution to the cost of use, this depends on whether the patient is insured (or not) in EOPYY and from whether the provider has a contract with EOPYY or other Fund. Also, this may depend on other factors (e.g. existing laws, directions from Ministry of Health for specific diseases).

- About the reciprocation as a form of reward for extensive usage of online health services (from citizens), hailed by 81% of the citizens, should be made in favor of all citizens –users and in a form that will be discussed. Indicatively, if the use of the system exceeds a certain number of transactions, this could result in a reduction of the system usage fee. Further, a discount on the cost of a medical visit or of examination at a diagnostic lab will be possible, after relevant agreement with the provider of that service.

The development of the system is based on the results of the research carried out by citizens, according to which they consider that the new system is:

1. Useful with a very strong majority of 92%;
2. Necessary to be created (71%).

Also, is based on the favorable welcoming (by 82%) of the municipalities that eventually participated in our survey. They are the ones that offer substantial development of the new system since they accept the suggested devices to be placed at every possible point of citizen service:

From Citizen Service Points at Citizen Service Centers (called "KEP" in Greece) or elsewhere (an option adopted by the municipality of Athens) to the City Hall (an option by the municipality of Aigaleo).

Specifically the above points are the "Fixed Preset (by municipalities) Points for e-Health Services to the Citizens". Nevertheless, the citizens would also like these machines to be mainly installed in, besides municipal shops, pharmacies as well as in hospitals and health centers, or in other public access areas. Furthermore, municipalities greeted the "digital convergence enthusiastically" as essential to their further development. The Greek State contributes to the further development of Citizen Service Centers –CSCs as a focal point of service, by using various ways. Recently (2014) a decision of the Ministry of Internal Affairs says: KEPs are connected with direct access to the central database of the ministry so that all the attestations and certificates that are demanded by citizens may be printed out. Therefore, one more official step is detected on the path to the full integration of all databases of the institutions that are responsible for citizen service, as is the case with Health Care providers.

Another point deserv attention is that of the possible results attributed to the development of the new system of citizen electronic health service in a municipality. Among them, a random or a studied decision

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of a mayor for the establishment of the new system could cause citizens' migration to the municipality which has accepted the new system. This may happen since better services will be offered to citizens of the relevant municipality, thus rendering it more appealing to those who would like to enjoy the extra services provided. In this case, the degree of urbanization of this municipality should be expected to increase (Richardson, 1979), a fact that will also contribute to greater municipality (and town) development.

Finally, the focal point of taking or not actions towards the final development of such a system in a Municipality will be facilitated by the result of a pilot operation, whether get success or not. Therefore, an implementation of such a system in a small municipality, allows relatively easily and inexpensively to estimate its effectiveness in practice.

CONCLUSION

According to the analysis of the technology and the user requirements, is technologically possible to implement systems for electronic citizen healthcare service operational at fixed predefined points. The institutional and legal framework for establishing such a system nowadays in Greece is available. Therefore, implementation at each municipality depends on the citizens' acceptance and the sanction of the local municipal authorities.

According to the questionnaire results, the system has been adopted by both citizens and municipal authorities in Greece and according to the financial analysis the appropriate conditions to support the building and operation stage may be available. Recently in Greece, some local municipal authorities expressed their interest for immediate action in order to put into operation the proposed system. This approach promotes e-governance at local administration level alongside the improvement of the level of e-health services as offers –planned options for citizens –users. Finally, at least initially this system must be secure for citizens, based on a supervising procedure by the appropriate employee who will provide assistance to the users, instead of an entirely automated.

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Chapter 63
The Future of Antibiotics and Meat

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ABSTRACT

This chapter discusses antibiotic use in the livestock industry and potential ramifications for human health. Antibiotics are routinely administered to food animals, primarily at sub-therapeutic levels. The extensive use of antibiotics in global animal husbandry in quantities greater than used for humans is creating antibiotic resistance. There is evidence that antibiotic resistant organisms emerging in food animals transfer to humans through the food chain, environmental contamination, direct association with animals or through mobile resistant genetic elements resulting in co-resistance to other antibiotics. No new classes of antibiotics have been developed since the 1980s. Intensifying use of existing antibiotics for meat production poses new challenges for treating humans, needs to be taken seriously and dealt with urgently. This chapter argues that reduced meat consumption is an under-considered but essential part in any suite of solutions aimed at preserving the use of antibiotics for human treatment.

INTRODUCTION

Demand for animal protein for human consumption is escalating worldwide at a record pace. To meet this challenge, intensification of production has occurred. Contemporary intensive animal production processes are associated with systematic, therapeutic and non-therapeutic use of antibiotics to control infectious diseases or to promote efficient production. Antibiotic use in meat production is likely to pose new challenges for treating human illness and infections. There is an increasingly likely possibility of

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a post-antibiotic world where bacterial infections, now largely treatable, become the life-threatening scourges they once were. Antibacterial resistance is becoming a " ticking time bomb in our midst, which needs to be taken seriously and urgently dealt with (HAIAP & TWN, 2013, p. 2).

This chapter describes the potential impending international crisis of antimicrobial resistance in relation to increasing meat consumption. It argues for the urgent need to take action through reducing both, meat consumption and antibiotic use.

ANTIBIOTIC USE

Before we engage with the threats posed by the wide application of antibiotics, it is useful to define some of the terms used in this chapter. This is followed by a brief history of the antibiotic era.

Terminology

For the layperson, the terminology around the use of antibiotics may be unclear. Antibiotics are defined as substances, which can kill or inhibit the growth of bacteria and can be produced by microorganisms or synthetically (but still chemically related to natural versions). Antimicrobials include antibiotics as well as other substances (such as fungicides and disinfectants) that kill or inhibit the growth of microorganisms. In the medical literature the two terms are used interchangeably.

Antibiotic or antimicrobial resistance is when the targeted bacteria are no longer controlled or killed by the presence of antibiotics but are able to survive and even multiply. In the literature antibacterial or antibiotic resistance (ABR) and antimicrobial resistance (AMR) are also used synonymously. In this chapter we refer only to antibiotics and thus use the acronym ABR.

A Brief History of the Antibiotic Era

Antibiotics made a significant contribution to the control of infectious and bacterial diseases that for much of humanity's existence were the leading causes of human mortality and morbidity. Although it is common belief that exposure to these substances has been confined to the modern antibiotic era, research reveals antibiotics have been in use since antiquity. Traces of tetracycline found in Sudanese human skeletal remains (from 350-550 CE) point to tetracycline-containing materials in the diets of these ancient peoples (Bassett, Keith, Armelagos, Martin & Villanueva, 1980; Nelson, Dinardo, Hochberg & Armelagos, 2010). Although it is not clear whether these were used specifically for disease control, histological samples taken from late Roman period skeletal remains from the Dakhleh Oasis in Egypt also evidence the presence of tetracycline in the diet at that time (Cook, Molto & Anderson, 1989). Interestingly, rates of bacterial infection documented in these two population groups were low (Armelagos, 1969; Cook et al., 1989). Anecdotes about red soils in Jordan historically used for their antibiotic-like properties in treating skin infections have led to discovering antibiotic-producing bacteria and concomitant antibiotic production in these soils. Traditional Chinese medicine used remedies for millennia based on plants containing powerful antimicrobial substances (Cui & Su, 2009) also offering evidence of human exposure in the pre-antibiotic era.

The modern "antibiotic era" is associated first with Paul Ehrlich and then with Alexander Fleming. Ehrlich in 1904 envisaged a magic bullet that selectively targeted only disease-causing microbes

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and not the host (Aminov, 2010). This became the cornerstone of the pharmaceutical industry's drug research strategy resulting in a variety of antimicrobial drugs identified and translated into clinical practice. Penicillin, somewhat serendipitously discovered by Fleming in 1928 and mass produced and distributed from 1945 heralded a golden era (1950 -1970) of discovery of novel antibiotic groups. No new classes have been discovered since the 1980s (Alliance to Save Our Antibiotics, 2014). The existing mainstream approach for the development of new drugs to combat emerging and re-emerging resistance of pathogens to antibiotics has been the modification of existing antibiotics (Chopra, Hesse & O'Neill, 2002). For more than 60 years antibiotics have been the cornerstone of modern medicine, suppressing and combating myriad potentially deadly infections (Todar, 2012).

Projections about the future of antibiotic development highlight there are few potential avenues that offer benefits over existing antibiotics. There are no magic bullets in the antibiotic pipeline that will eradicate bacteria resistance to existing antibiotics, including superbugs (Butler & Cooper, 2012).

ANTIBIOTIC RESISTANCE

Antibiotics are essential for combating human illness and various infections. Recently, however, we are witnessing the emergence and spread of antibiotic resistance which poses a serious challenge and threat to humanity.

The Potential Impact of Antibiotic Resistance (ABR)

Antibiotics are commonly used for the treatment of a wide range of bacterial infections from pneumonia and strep throat to meningitis and food poisoning making them treatable conditions rather than life-threatening scourges. Now much of the progress achieved in recent decades towards improving human health is at risk (WHO, 2014a). Rather than declining, bacterial infections and diseases have become an increasingly serious threat to global public health with once life-saving drugs now worthless and bacterial infections failing to respond to antibiotic treatment. This increasing ineffectiveness of antibiotics in treating common infections is on the rise (Laxminarayan et al., 2013) and we are at the dawn of a post-antibiotic era (CDC, 2013c; WHO, 2014a). Some experts warn that "antibiotic resistance is a catastrophic threat and a nightmare on par with terrorism and climate change" (Davies and Frieden in Sample, Harvey & Campbell, 2013, n.p.).

The World Health Organization (WHO) estimates that, since their development, antibiotics have added around 20 years of life expectancy — a benefit that we are now in danger of losing (Grant & Taylor, 2013). "If we fail to act, we are looking at an almost unthinkable scenario where antibiotics no longer work and we are cast back into the dark ages of medicine where treatable infections and injuries will kill once again" (Cameron in Walsh, 2014, n.p.).

As with the threat of climate change, ABR has no borders and humans are largely responsible for its causes. The immense potential scale of disease and resistance evolution does not respect national boundaries, cultures or geographies. International trade and travel are contributing to the problem. Although the contribution of this problem is largely unknown and empirical research is lacking, national responses by individual countries taken to protect their populations stand defunct in the face of these challenges. Only an understanding of the causes underlying ABR can assist in successfully dealing with the threats.

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How Does It Happen?

Simply explained, antibiotics are used to kill (bacteriocidal) or inhibit (bacteriostatic) bacterial growth. Bacteria that don't succumb to the applied antibiotic, survive to propagate and become resistant. Therefore the use of antibiotics drives the selection process for the development of bacterial resistance.

Drug resistance is a particular problem in bacteria because it is readily transmitted, even to different bacteria species. One normally thinks of inherited characteristics passing only to successive generations of that particular organism. This is not the case for bacteria. It makes sense to think of the entire bacterial world "as one huge multicellular organism in which the cells interchange their genes" (Levy cited in Miller, 1998, p. 67).

The speed with which bacteria propagate makes the problem of drug resistance particularly acute. The generation time of bacteria can be measured in minutes (Goforth & Goforth, 2000) and a single bacterium produces over a million new bacteria in under a day. One Escherichia coli (E.coli) bacterium can produce well over a million progeny (20 generations) in a mere seven hours (Harrison & Svec, 1998; Witte, 1998). Just one drug-resistant bacterium can create millions of resistant bacteria first in the host and then in other hosts or in the environment.

Resistance which develops in animal populations may emerge in humans through organisms transferring to people either through the food chain, environment contamination or through direct association with these animals. Once the resistant bacteria are in the human population they can spread quickly and easily amongst increasing numbers of people. The interconnected ecosystems within the microbial environment "allow exchange of DNA, promoting the spread of resistance from one genus to another. The combination of increased bacterial virulence and increased drug resistance creates a potential for increased risk of morbidity and mortality for animals and humans that some have extrapolated to a catastrophic potential" (NRC, 1999, p. 70).

Further, the continued use of a single antibiotic can lead to resistance to multiple structurally unrelated antimicrobials. Pathogenic bacteria can be either zoonotic (which transfer between animals and humans) or sapronotic (which are in the wider environment) or both (Woolhouse, Ward, van Bunnik & Farrar, 2015). This interplay between different ecologies is particularly important in the context of ABR (Woolhouse et al., 2015). Mobile resistant genetic elements within bacteria can be transmitted between bacteria of the same or different species thereby resulting in co-resistance to other antibiotics (Rushton, Ferreira & Stark, 2014; Woolhouse et al., 2015).

There are multiple links between animal, environmental and human ecologies and because of the movement of genetic elements, livestock animals act as a vast "reservoir of resistant genes" (Woolhouse et al., 2015). Scientific evidence shows "[t]his reservoir of resistance can be transmitted directly or indirectly to humans through food consumption and direct or indirect contact… and… antibiotic-resistant strains can be disseminated to the environment via animal waste" (Economou & Gousia, 2015). The key causes of antimicrobial resistance are further explored as part of natural evolution, misuse in human medicine, overuse for livestock production and under the influence of vested interests.

Natural Evolution

Bacteria are one of the most successful colonisers of the planet and are found in almost all environments including the human body. We inhabit a world of bacteria – there are more bacteria in our bodies than we have human cells (Laxminarayan, 2015). Many of the bacteria that live on and in the human body

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are beneficial to the host; some are even essential. Antibiotics originated in soil where microbes have been producing antibiotics for millennia (Smith & Coast, 2013). For billions of years, before antibiotics were considered or used for medicinal purposes, bacteria have been developing resistance to these natural compounds (D'Costa et al., 2011; Whitman, Coleman & Wiebe, 1998).

Pathogenic bacteria are those capable of causing disease (Goforth & Goforth, 2000). It is these pathogens we are concerned about and attack with antibiotics. Factory mass-produced antibiotics are now presenting bacteria with a chemical attack they have been evolving for billions of years to overcome. Since the 1940s and the commencement of the industrial manufacture of antibiotics, production of antibiotics has been on a rapid increase. Today 20 tonnes of antibiotics are produced every hour by a global industry worth more than US$30 billion per annum (Woolhouse & Farrar, 2014).

The deployment of antibiotics is fighting against well-established evolution. Resistance will inevitably arise after any new antibiotic is introduced. This has been illustrated time and time again and it is known now beyond doubt that there is a continuing race between the discovery and use of new antibiotics and bacterial response through emerging resistance mechanisms.

Any use of antibiotics places selection pressure for resistant bacteria to endure – Darwinian selection at play. Antibiotics kill off the sensitive bacteria, letting the resistant ones survive. These mechanisms naturally select stronger and more resistant bacteria whether in humans or animals. However, "the selection pressure caused by the use of millions of tonnes of antibiotics over the past 75 years since antibiotics were introduced has made almost all disease-causing bacteria resistant to antibiotics commonly used to treat them" (Laxminarayan et al., 2013, p. 1).

As a result of the evolutionary programming of bacteria, use of antibiotics is the single most important factor leading to antibiotic resistance around the world (CDC, 2013b). Indiscriminate use of antibiotics exacerbates and accelerates the problem of resistance. Wherever antibiotics are administered in large volumes, whether in humans or animals, there is a risk of having infections that are caused by organisms that do not respond to antibiotics.

Human Medicine

There is a strong correlation between levels of human antibiotic consumption and antibiotic-resistant infections (Goossens, Ferech, vander Stichele, Elseviers & ESAC Project Group, 2005). This relationship has been relatively well researched and publicised. Antibiotics are essential therapeutic tools but there are cases when they are used sub-optimally. Reasons include frequent intake due to regular prescription or access without prescription as well as incomplete or "blind" treatment.

Over-Prescription

Antibiotics are often prescribed when not needed:

- In countries such as Japan, USA and Australia patient expectations often drive antibiotic prescriptions (Laxminarayan et al., 2013) requesting antibiotics when they are not needed (e.g. for simple viral infections);
- Hospitals, in countries including China (Daemmrich, 2013) rely on pharmaceutical sales for income generation, creating an incentive for medical staff to prescribe and overprescribe;

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- Antibiotic providers such as pharmacies, may offer commission to doctors for directing patients to their businesses. Pharmacies in some countries, such as India, routinely compensate doctors for sending patients to them as customers (Sweidan et al., 2005); and
- Patients with health cover are less likely to be price sensitive, thus antibiotic sales and prescriptions increase with insurance status (Dong, Bogg, Rehnberg & Diwan, 1999).

Non-Prescription Use

Non-prescription use, including self-medication, varies from country to country and can account for between 19% and 100% of all antibiotics consumed (Morgan, Okeke, Laxminarayan, Perencevich & Weisenberg, 2011). Whilst generally consumers seem to have positive attitudes about antibiotics, they also paradoxically have a limited knowledge about these drugs and diseases (Hawkings, Butler & Wood, 2008). Studies in Europe show a strong positive correlation between a higher prevalence of antibiotic resistance and lack of knowledge about antibiotics (Grigoryan et al., 2007).

The availability of antibiotics without prescription is driven primarily by the following factors (Grigoryan et al., 2008; Planta, 2007; Buchman et al., 2008; Gartin, Brewis & Schwartz, 2010):

1. Absence of prescription-only regulations;
2. Lack of access to appropriate medical facilities;
3. Ineffective law enforcement; and
4. Poverty-driven practice, cultural and social norms.

Such self-medication lacks key attributes of successful therapy such as proper diagnosis, suitable antibiotic choice, correct usage, compliance and treatment efficiency monitoring, thus contributing to the mounting resistance problem (Aminov, 2010).

Sub-Optimal Compliance

Sub-optimal compliance includes (Zarb & Goossens, 2012; Aminov, 2010):

- Taking left-over antibiotics from previous treatment courses;
- Not properly complying with drug use regimens;
- Sharing unused drugs with other people;
- Starting "blind" antibiotic treatment before diagnosis can be confirmed; and
- Selecting antibiotics "empirically" because determining the bacteria, which are causing the illness, and the antibiotics to which they are sensitive, can take a few days and can be expensive.

Clearly use of antibiotics in human medicine is making us vulnerable. However, there could be a larger problem in use of antibiotics in animal agriculture (Laxminarayan, 2015) to which far less attention is paid.

Livestock Production

There are four uses of antibiotics in animal agriculture:

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1. **Therapeutic:** For treatment of manifested illness in individual animals or groups;
2. **Metaphylactic:** Application involves medicating at risk groups, with no clinical disease, at therapeutic concentrations to prevent expected outbreaks;
3. **Prophylactic:** Prolonged, mass administration of antibiotics at sub-therapeutic levels for intensively raised animals; and
4. **Growth Promotion:** Prolonged, mass administration of antibiotics at sub-therapeutic levels to promote growth of livestock animals and enhance feed efficiency.

Both prophylactic use and administration for growth promotion have the sole purpose of increasing meat production output. Yet it is increasingly difficult to discount the scientific evidence indicating sub-therapeutic dosing of livestock is a contributing factor in the spread of antibiotic resistant organisms.

Commercial Interests

In intensive factory farming, commercial interests often take precedence over human and animal welfare and wellbeing. Below are some examples of the power of commercial influence:

- **High Antibiotic Sales for Use for Livestock:** Evidence gathered by Foer (2009) in the US shows that for every dose of antibiotics taken by a sick human, eight doses are given to a "healthy" animal;
- **Rejecting the Link between Antibiotic Use in Livestock and Antibiotic Resistance:** The World Organization for Animal Health states that concerns for bacterial resistance in humans is overblown (de la Hamaide, 2012); the Responsible Use of Medicine in Agriculture Alliance (RUMA), a trade alliance representing the interests of the pharmaceutical and intensive-farming industries, dismisses claims that the overuse of antibiotics in intensive farming adds to the serious public-health threat from antibiotic resistance calling this a "myth" (RUMA, 2012, 2013);
- **Safeguarding Economic Viability of Animal Agriculture:** The use of subtherapeutic doses of antibiotics makes factory farm practices feasible" (O'Brien, 1996, p. 413); "one reason large confinement systems have worked so well is because of antibiotics. Without the antibiotics it would be hard to have these larger systems" (Goforth & Goforth, 2000, p. 56); antibiotics enable cost-effective economies of scale (Scully, 2002);
- **Successfully Lobbying for Tax Exemptions and Subsidies:** Farming, including livestock production, "is protected by deference and vested interest, excluded from the regulations, planning conditions and taxes other businesses must observe" (Mombiot, 2015, n.p.); livestock industry is feasting from the federal trough (Shapiro, 2015) and;
- **Blocking Regulations Limiting Antibiotic Use in Livestock:** The monitoring and regulation of antibiotic use in industrialized countries have been difficult because the meat industry is enormously powerful and able to successfully thwart attempts to collect data let alone create effective regulation" (Sharma, 2015, n.p.).

Magnitude of the Threat

Given that antibiotic resistance is scientifically undisputed, it is not unreasonable to expect policy awareness and urgent responses. Despite this, the facts point to the contrary as discussed below.

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Although governments haven't kept records of quantities of antibiotics issued for farm animals, it is conservatively estimated that well over 50% of total global antibiotic use is attributable to the international livestock industry. Limited data available vary from country to country, animal species and stage of production. In the non-medical areas of animal agriculture some countries use four times the amount of antibiotics administered in human medicine; estimates are that 80% - 90% of all antibiotic sales in the USA is used in livestock production (Philpott, 2011a, 2011b; FDA, 2010, 2013a, 2013b; Shea, Florini & Barlam, 2001; Mellon, Benbrook & Benbrook, 2001).

The practice of antibiotic use in sub-therapeutic concentrations began as a developed world phenomenon and it would appear that this is where the problem lies. For example the USA uses more antibiotics per kilogram of meat produced than any other country in the world (Aarestrup & Wegener, 2009).

With increases in affluence, the middle-income countries are experiencing unprecedented and rising demand for meat causing significant increase in antibiotic use (Myers & Kent, 2003; Tilman, Balzar, Hill & Befort, 2011). To meet growth in demand for meat, Brazil, Russia, India, China and South Africa (the BRICS economies) have shifted towards more intensive livestock production systems, which rely on antibiotics instead of good husbandry practices. Calculations show that China's swine and poultry production industries alone used over 38.5 million kg of antibiotics in 2012 (Wu, 2012; Krishnasamy, Otte & Silbergeld, 2015).

A study by van Boeckel et al. (2014) estimates that the global consumption of antibiotics in food animal production is projected to rise by 67% between 2010 and 2030. Two thirds of this growth is due to the burgeoning numbers of animals raised for food production and the remaining third is attributable to a shift to increased intensive farming practices. By 2030 Asian consumption will represent 82% of the 2010 global antibiotic consumption in food animals.

In 2010, the five countries with the largest shares of global antimicrobial consumption in food animal production were China (23%), the United States (13%), Brazil (9%), India (3%) and Germany (3%). Whilst China and Brazil are currently amongst the largest consumers of antimicrobials for livestock production they have already initiated a shift towards more intensified livestock production and are using antibiotics to maintain animal health and increase productivity. The five countries with the greatest projected percentage increases in antibiotics consumption by 2030 are likely to by Myanmar (205%), Indonesia (202%), Nigeria (163%), Peru (160%) and Vietnam (157%) (van Boeckel et al., 2014, p. 5650; WPAPM, 2015). For BRICS the increase in antimicrobial consumption will be 99% (van Boeckel et al., 2014), up to seven times the projected population growth (13%) in this group of countries (World Bank, 2015).

As far back as the 1960s scientists warned against extensive and non-therapeutic use of antibiotics in farmed animal feed (e.g. The Swann Committee Report, Parliament of the United Kingdom, 1969). The World Health Organisation (WHO), United States Food and Drug Administration (FDA), the US Department of Agriculture, the Centres for Disease Control and Prevention (CDC) and the Institute of Medicine (a division of the National Academy of Sciences) have testified to the link between routine non-therapeutic use of antibiotics in food animals and antibiotic resistance in humans and called for a ban (Rogers, 2012). According to a former FDA commissioner, "[w]e have more than enough scientific evidence to justify curbing the rampant use of antibiotics for livestock, yet the food and drug industries are not only fighting proposed legislation to reduce these practices, they also oppose collecting the data" (Kessler, 2013, n.p.). In fact, global data on antibiotic use in livestock are scarce, stemming from the absence of surveillance systems combined with lack of support from the livestock sector to report antibiotic consumption and reluctance of pharmaceutical companies to provide accurate information on sales.

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It is clear that those with vested interests argue that it can be difficult to accurately trace or prove the link between antibiotic use in animals and antibiotic resistance in humans. However, we are already confronted with examples of resistance in humans directly related to antibiotic use for livestock. Nonetheless there remains a lack of essential research on the evidence how these specific links occur.

Examples of Resistance Related to Livestock

Studies have confirmed and traced the spread of resistance determinants in bacteria found in animals to those found in humans. For example nourseothricin was used for growth promotion in pigs but not given directly to humans. Nonetheless within a few years of its introduction in sub-therapeutic doses into pig feed, resistant E.coli were observed not only in pigs but in employees at the pig farms, their family members and members of the surrounding community (Hummel, Tschäpe & Witte, 1986). In this study, the resistant bacteria in humans was not attributable to the direct use or misuse of antibiotics in the human population as the antibiotic was only fed to pigs (Hummel et al., 1986). Other cases have been recorded of human infections with bacteria originally acquired from farm animals, such as Staphylococcus, without any contact with livestock or meat products (Chang, Wang, Regev-Yochay, Lipstich & Hanage, 2015).

Most classes of antibiotics that are prescribed for humans are also used sub-therapeutically in food animals. Tetracycline, penicillin, streptomycin and bacitracin are common additives in livestock feed. Similarly, critically important classes of drugs such as third and fourth generation cephalosporins and fluoroquinolone are also given to livestock (Aarestrup, Wegener & Collignon, 2008). Whilst some restrictions apply in specific countries –for example, the use of fluoroquinolone in food animals is banned in Australia but permitted in numerous other countries, including the United States (Shaban, Cruickshank, Christiansen & Antimicrobial Resistance Standing Committee, 2013), all important classes of antibiotics are being used in livestock production somewhere around the world. This renders every class of antibiotic susceptible to development of resistance (Silbergeld, Graham & Price, 2008).

Examples of resistant bacteria linked to antibiotics commonly used in livestock (Knox, 2012) include:

- "Common bacteria (for example, Escherichia coli [E.coli], Klebsiella pneumonia and Staphylococcus aureus) that cause common health-care associated and community-acquired infections (urinary tract infections, wound infections, bloodstream infections and pneumonia)" (WHO, 2014a, p. 12) . In particular, E.coli is spread by food with for example, meat becoming contaminated with bacteria during the slaughtering process;
- The use of fluoroquinolones (egenrofloxacin) in food animals resulted in the development of ciprofloxacin-resistant Salmonella, Campylobacter and E.coli, which have caused human infections, and spread worldwide through travel and food trade (Wegener, 2003);
- Enterobacteriaceae resistant to carbapenems have been linked to antibiotic use in livestock feed (Carlet et al., 2012). Carbapenems are a class of antibiotics considered a drug of last resort and carbapenem-resistant enterobacteriaceae (CRE) are seen as a new "superbug" (Eisler, 2013), a nightmare bacteria (Breslow, 2014) which currently kills half of those who contract bloodstream infections (CDC, 2013c);
- A CDC study recently found over half of chicken meat in the US were contaminated with the Enterococcus bacteria resistant to the antibiotic virginiamycin (CSPI, 2014, n.p.);
- Multi-drug resistant strains of Listeria monocytogenes were found in hamburger patties in supermarkets and other retail shops in Malaysia (Wong et al., 2012);

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- A study by the FDA (2000) found that 20% of supermarket samples of ground beef, pork, chicken and turkey were contaminated with Salmonella; 84% of these were resistant to at least one antibiotic, and more than half were resistant to at least three antibiotics;
- Campylobacter infections that are resistant to fluoroquinolone antibiotics are a serious concern as they cause more food poisoning than any other bacteria (Collingon, 2005). In the United States, 19% of Campylobacter isolated from humans were ciprofloxacin resistant in 2001 (Gupta et al., 2004) but in 2010 this percentage increased to 22% (NARMS, 2010). Resistance rates higher than 90% were seen in Spain (Luangtongkum et al., 2009). By contrast, in Australia, where fluoroquinolones were never approved for use in food animals, domestically acquired infections with fluoroquinolone-resistant Campylobacter spp. are rarely found in humans (Helms, Simonsen, Olsen & Mølbak, 2005); and
- Vancomycin-resistant enterococci can spread from animals to humans (Wegener, 2003; Baragona, 2010). This antibiotic is on the World Health Organisation's List of Essential Medicines – the most important medications needed in a basic health system (WHO, 2013).

These examples illustrate that driven by increasing meat consumption, excessive antibiotic usage in intensive animal husbandry practices ABR will become a more global problem in the coming years. Ironically, whilst there is growing awareness of the threats presented by growing antibiotic resistance, while medical use is decreasing farm use of critically important antibiotics (WHO, 2012) is on the rise with more animals being raised intensively (Antibiotics Alliance, 2014).

Whilst these threats may still in cases be located within countries, no-one country is immune. Antibiotic resistance "is happening right now in every region of the world and has the potential to affect anyone, of any age, in any country" (WHO, 2014b, n.p.) . Antibiotic resistance can cross international boundaries and spread between continents with remarkable speed and ease. World health leaders have described antibiotic resistant microorganisms as "nightmare bacteria" that "pose a catastrophic threat" to people in every country in the world (CDC, 2013b, p. 11).

SUSTAINABILITY IMPLICATIONS OF ANTIBIOTIC RESISTANCE

As well as the obvious public and animal health impacts antibiotic resistance also carries significant economic, social and environmental impacts.

Economic Implications

A 2014 report commissioned by the UK's Review on Antimicrobial Resistance (Taylor et al., 2014) paints a bleak picture about what might happen to the world's economy if the problem of antibiotic resistance is left unchecked (Zuraw, 2014). The overall message of the Review is that the cost of taking action now to slow the spread of resistance is much smaller than what it could cost over time.

It is unavoidably clear in light of the existing body of research that there is a significant externalised economic impact arising from antibiotic resistance. Yet there is only limited information qualifying and quantifying this impact. However, studies have shown that costs are directly proportional to the prevalence of resistance. Experience with bacteria such as Streptococcus pneumonia have shown that resistance rises

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exponentially over time (Turnridge, Nimmo, Francis & Australian Group on Antimicrobial Resistance, 1996) and the financial costs of management will also increase exponentially.

In Australia the financial costs of antibiotic resistance (such as use of more expensive antibiotics, multiple courses of antibiotics, increased length of hospital stay and increased mortality) are largely borne by the government and the patient (JETACAR, 1999; Holmberg, Solomon & Blake, 1987). In the UK drug-resistant strains of bacteria are responsible for 5000 deaths a year while in Europe, drug-resistant bacteria are responsible for 25000 deaths a year, with related healthcare costs and productivity losses of €1.5 billion (US $2 billion) (Aminov, 2010; Norrby et al., 2009; Walsh, 2014; Grant & Taylor, 2013). In the US, a recent assessment of antibiotic resistance by the CDC found more than two million people each year get infections that are resistant to antibiotics and at least 63000 people die as a result of hospital-acquired bacterial infections (Norrby et al., 2009; NIH, 2014) again incurring related healthcare costs and productivity losses. In the EU, the costs of treating hospital-acquired infections from just six species of antibiotic-resistant bacteria were estimated to be at least US $1.87 billion in 2006 dollars – more than the annual spending on influenza (Laxminarayan, Malani, Howard & Smith, 2011). Another economic consequence of resistance surrounds the inability to do other interventions such as surgery, biopsies, transplants and chemotherapy (Laxminarayan, Malani, Howard & Smith, 2007).

No reliable estimates are available for low and middle-income countries but the higher burden of infectious disease and limited access to new antibiotics suggest a bigger problem than in high-income countries (Kayange, Kamugisha, Mwizamholya, Jeremiah & Mshana, 2010). This is exacerbated by the limited ability in low and middle income countries to pay for or access second-line drugs (Laxminarayan, van Boeckel & Teillant, 2015).

As a result of market failure no new class of antibiotics has been developed since the 1980s. On average, pharmaceutical companies spend $5 billion to develop any new drug, including new antibiotics (Krans, 2015). "In the current world of complex treatments and interventions, pharmaceutical companies pursue more profitable causes than the development of new types of antibiotics… it is also difficult to justify the expenditure required for research and development in a commercial environment when it has been demonstrated that resistance to a new antimicrobial is likely to emerge within a foreseeable timeframe, rendering the new product less marketable" (Australian Commission on Safety and Quality in Health Care, 2013, p. 5). Evidence shows that the time lag between a new antibiotic being introduced and the first instance of resistance to it has drastically shortened in the 2000s (Australian Commission on Safety and Quality in Health Care, 2013). Pharmaceutical companies are more interested in developing other drugs that can be used regularly without losing their effectiveness, such as antidepressants or anti-inflammatories (Krans, 2015). With the pipeline drying up, stewardship of antibiotics in health and farming is increasingly economically important.

Environmental Implications

Antimicrobial use in food animals is a primary source of aquatic and terrestrial antibiotic contamination mainly through excreted biological matter (usually faeces and urine). Antibiotics reach the environment through application of antibiotic laden manure or slurry on agricultural lands or direct deposition of manure by grazing animals. Surface run-off, driftage and leaching into deeper layers of the earth often follow (Kemper, 2008). A proportion of the antibiotics that reach the environment this way remains biologically active. Such sub-therapeutic build-up of antibiotics accumulates over time effecting ecosystems.

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Antibiotic concentrations may also exert pressure on environmental bacteria or foster the transference of resistant genes creating an environmental mixing pot of genetic ABR traits.

A growing number of studies provides evidence of high concentrations in soils of antibiotics used in livestock (Rooklidge, 2004; Kay, Blackwell & Boxall, 2004; Aust et al., 2008), such terracumulation (the concentration of antibiotics in soil) runs-off or leaches into surface and/or ground water. A study of 47 groundwater sites tested in the US found that 23% of them were contaminated with sulfamethoxazole – an antibiotic used in both humans and livestock and one of the most frequently detected chemical compounds in national surveys of waste water contaminants (Michigan State University, 2011). The bacteria in these water and terrestrial environments move to new areas and new hosts by many routes, through contact with other animals and insects, as well as with food produce (Levy, 2002).

It has also been shown that airborne particulate matter from feedlots disperses and spreads several antibiotics used in livestock. The microbial communities containing antibiotic resistant genes are also carried in airborne particulate matter. A recent study shows that airborne particulates downwind of feed yards had significantly greater amounts of genes resistant to tetracycline antibiotics (McEachran et al., 2015).

Antibiotics are designed to kill or inhibit bacterial pathogens in animals and people but they can also be hazardous to many types of non-targeted environmental microorganisms (Martinez, 2008). Antibiotic residues have been reported to markedly hurt plant growth and development, causing inhibition of germination, root and shoot growth (Brian, 1957). Residues have also shown toxicity to aquatic organisms (Wollenberger, Halling-Sorensen & Kusk, 2000) affecting places of ecological significance.

Social Implications

There is a number of significant social impacts associated with intensifying livestock production, increasing meat consumption and public health inequities and injustices. People in developed countries generally can afford better medical care, including new and more expensive antibiotics. By comparison, the average person in a developing country can barely afford even older, cheaper but often less effective, antibiotics. Increasing access to antibiotics is morally and critically important particularly as previously antibiotics were unavailable to treat infections to populations of developing countries. There is no quantification of the increased human morbidity and mortality occurring in developing countries due to treatment failure with older antibiotics, such as tetracyclines and penicillins that may be the only antibiotics available to people living in poverty. The tragedy of resistance is that when people in these countries become wealthy enough to afford antibiotics, these drugs won't work (Laxminarayan, 2015) and that increasing global meat consumption is associated with building antibiotic resistance.

Similarly, there is also the question about intergenerational justice. Antibiotic resistance is condemning those ahead of us to an era of infection that for all intents and purposes could and should be behind us.

PROTECTING THE ANTIBIOTICS

"Unless we take significant actions to… change how we produce, prescribe and use antibiotics, the world will lose more and more of these global public health goods and the implications will be devastating" (Fukuda cited in WHO, 2014b, n.p.). Clearly economic vested interests are stronger and more protected than the public good. Surveillance of drug use in livestock is still relatively poor and looks set to remain

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this way due to vested interests, the huge growth in demand for meat and the concomitant growth of intensive factory farming operations around the world.

No doubt surveillance and reporting are essential but they do not offer solutions. The WHO accepted in 2014 that considerations around ABR might fall within the remit of the international health regulations (implemented in 2007 to deal with events such as influenza pandemics). Many calls to action have been made over the last few decades and scientists have been sounding alarm bells about the inevitability of the evolution of disease-causing microbes to become resistant to drugs for decades but there has been too little progress (Woolhouse & Farrar, 2014; Woolhouse et al., 2015). Now committed and coordinated action and response are urgently required on the root causes of resistance, primarily the misuse of antibiotics and the paucity of development of new drugs. Guidelines must be implemented to improve the use of existing drugs and a better regulatory environment, coupled with education is needed to help those working in both the human and livestock sectors to help them change their ways. Woolhouse and Farrar (2014, p. 556) call for the creation of an organisation similar to the Intergovernmental Panel on Climate Change (IPCC) to marshal evidence and catalyse policy across governments and stakeholders. Such an independent organisation, namely the Intergovernmental Panel on Antimicrobial Resistance (IPAMR) (Woolhouse & Farrar, 2014), would be able to foster further research and evaluate barriers and obstacles to mitigating ABR. It could set targets and limits for antibiotic use in livestock. Others argue that we should return to more humane farming methods with less need for sub-therapeutic use of antibiotics (CIWF, 2011). This could be included in the options explored by an independent IPAMR.

Although all these calls are important to mitigate the growing threat, there is a much more logical and immediately accessible solution. It is simply to reduce the amount of meat in human diets through appropriate food policies both in developed and transitioning countries. This will reduce meat related production and consumption consequences, including uncontrolled use of antibiotics. As western diets exceed healthy levels of meat consumption (Marsh, Saunders & Zeuschne, 2015), there is ample space for reduction in the demand for meat and hence, the use of antibiotics.

Developing countries are projected to have the greatest increase in meat consumption and antibiotics used based on them emulating the western path of development. This is where the largest potential for protecting antibiotics lies. Growing affluence in developing countries should be decoupled from growing meat consumption and concomitant growth in antibiotic use. This would allow the preservation of traditional diets which are typically low in meat. It will also facilitate a number of other significant benefits concerned with public goods.

Increasingly affluent consumers should benefit from their wealth. This is a given, especially in light of the meagre lifestyles that many of them may have previously experienced and the far greater consumption of long-affluent countries. However, it is in the self-interests of all countries, as well as in the interests of any individual that we learn from our mistakes, restrict further damage and protect the antibiotics for present and future generations.

CONCLUSION

Clearly the problem of antibiotic resistance is complex. This complexity does not however diminish the dimensions of the problems posed by antibiotic resistance nor in any way detract from the urgent need to find ways to address the threats. Whilst some might consider that sub-therapeutic dosing of animals is not *the* major cause of the problem, it is clearly *a* cause. Increased and globally collaborative data col-

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lection and surveillance informing management and mitigation measures are unquestionably essential, perhaps through an IPAMR. Even more critical are development and widespread adoption of appropriate national and global food policies moderating the currently unmitigated demand for meat that underlies the most widespread application and consumption of antibiotics.

Whether such appropriate national and international food policy will solve the problem is not the key question. It is whether the existing evidence suggests that such food policy and dietary intervention are an equitable, affordable and judicious part of the solution. There seems no cause for doubt that antibiotics must be used judiciously in humans and livestock because both uses unquestioningly contribute to the emergence, persistence and spread of antibiotic-resistant bacteria (AVMA, 2015; CDC, 2013a, 2013b, 2013c). "It's time to get serious about preserving antibiotics for people, instead of using them on healthy livestock" (Tomson, 2013).

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KEY TERMS AND DEFINITIONS

Antibiotic: A type of medicine made from bacteria or mould. Kills or slows growth of other bacteria. Examples include penicillin and streptomycin.

Antibiotic Growth Promotion: Prolonged mass administration of antibiotics at sub-therapeutic levels to promote growth of livestock animals and enhance feed efficiency in order to produce more meat.

Antibiotic Resistance: The result of bacteria changing in ways that reduce or eliminate the effectiveness of antibiotics. Antibiotic resistance is one type of antimicrobial resistance.

Antimicrobial Resistance: The result of microorganisms changing in ways that reduce or eliminate the effectiveness of drugs, chemicals, or other agents used to cure or prevent infections. In this chapter, the focus is on antibiotic resistance, which is one type of antimicrobial resistance.

Bacteria: Single-celled organisms living in and around us. Some bacteria are beneficial, but others can be pathogenic causing diseases and infections.

Food Animals: Animals reared for meat consumption.

Metaphylactic Use: Application of medicine at therapeutic levels to risk groups with no clinical symptoms to prevent disease outbreak.

Prophylactic Use: Application of medicine at sub-therapeutic levels to prevent disease from occurring.

Sapronotic: Comes from a source of infection in an abiotic substrate (soil, water, decaying plants, or animal corpses, excreta, and other substrata) or non-living environment.

Therapeutic Use: Application of medicine for treatment of manifested illness.

Zoonotic: Infectious diseases in animals which can be transmitted to humans.

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Chapter 64
Towards European Modern Societies with Health Systems That Are Able to Add More Years to Life, But Also to Add More Life to Years

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ABSTRACT

The political context in Europe is changing including health. Among the priorities in seeking to influence the future of healthcare is a renewed attachment to health for all, health in all policies and a better coordination between social and health policy. Health issues are by definition international, and Europe has a duty to extend solidarity to the wider world population, in strategy and in delivery. Ensuring equitable access to high-quality healthcare constitutes a key challenge for health systems throughout Europe. The chapter will emphasise the importance of European public health policies. The chapter will offer a real opportunity to address public health areas and values such as right to access to healthcare into the detailed mechanisms of European policy. The chapter will form a tool for health leaders, to enrich their knowledge in the public health spectrum from a European perspective, to support, promote and improve healthcare access at a national level.

INTRODUCTION

The political context in Europe is changing including health. Health systems in EU Member States are varied, reflecting different societal choices. However, despite organisational and financial differences, they are built on common values, as recognised by the Council of Health Ministers in 2006 (Council Conclusions, 2006/C 146/01): universality, access to good quality care, equity and solidarity. The sus-

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tainability of national health systems is a core concern of the European Member States, the European Commission, and the World Health Organisation (WHO). The aim of the chapter is to offer insights for the health inequalities policies in the EU as a whole by presenting the most recent picture and trends across time.

BACKGROUND

Among the priorities in seeking to influence the future of healthcare, is a renewed attachment to health for all, health in all policies and a better coordination between social and health policy. High performing health systems are critical to address key health challenges faced by Member States in the European region, such as changes in disease burden and population dynamics, in governance and funding mechanisms, and in technology and clinical management practice (WHO, 2012). As outlined in the WHO report a set of key challenges facing health systems in the European region are:

- Ageing and the rising burden of (multiple) chronic conditions
- Unequal distribution of health across the region
- Financial crisis raises concerns of affordability and sustainability
- Access to technological advances and medicines
- Fragmentation, commercialisation and hospital-centric systems (WHO, 2012).

Health issues are by definition international, and Europe has a duty to extend solidarity to the wider world population, in strategy and in delivery.

WHO defined health systems as comprising 'all public and private organisations, institutions and resources mandated to improve, maintain and restore health. Health systems encompass both personal and population services, as well as activities to influence the policies and actions to address the social, environmental and economic determinants of health' (WHO, 2008a).

The WHO acknowledges that due attention must be given to all levels of care as well as the integration and coordination of functions and care mechanisms to meet the challenges of an ageing population, with increasing expectations of service quality and safety and with the ability to access these services nationally and through cross border care (WHO, 2012).

The importance and implications of the 1977 World Health Assembly resolution '' Health for All'' and the 1978 Declaration Systems development placed special emphasis on primary health care and stressed family health services. The mix of various sources of financing of Health care systems, which determined the policy and nature of Health Systems, has a great impact on the equity and accessibility.

The Lisbon Strategy in 2000 set out to make the EU: "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" through economic, social, and environmental renewal and sustainability. It stressed the importance of poverty reduction and elimination of social exclusion in the EU, (The Lisbon Special European Council, 2000).

One of the first Commission Communications to address health inequalities was ''The health status of the European Union: Narrowing the health gap'', published in 2003. This report highlighted areas of action for Member States, and at EU level, to narrow health inequalities, (European Commission, 2003).

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In 2007, the European Commission developed this agenda in the white paper ''Together for Health: A Strategic Approach for the EU 2008-2013'', Commission of the European Communities (2007). This indicated that reducing inequalities in health must be a core value of future EU level activities on health and tasked the Commission with developing actions to take this forward. The European Council underlined this commitment in the Presidency Conclusion of 2008 which stressed the importance both of "closing the gap in health and in life expectancy between and within Member States and of preventative activities in the field of major chronic non-communicable diseases", (Council of the European Union, 2008).

The 'Council conclusions (2011); towards modern, responsive and sustainable health systems' under the Hungarian Presidency further emphasise innovative approaches and models of health care focusing on effective investment with the overall aim of "moving away from hospital centred systems towards integrated care systems" (Council of the European Union, 2011) moreover the Council conclusions (2013) on the "Reflection process on modern, responsive and sustainable health systems", took under consideration the progress achieved in the reflection process, in terms of including health in other policies in the frame of the implementation of the Europe 2020 Strategy, identification of themes for possible closer cooperation among Member States, exchange of best practices and progress towards more coordinated EU-level cooperation in order to support Member States, where appropriate, in their efforts to ensure that their health systems meet future challenges; and welcome the on-going work on the reflection process on the five defined objectives:

- Enhancing the adequate representation of health in the framework of the Europe 2020 Strategy and in the process of the European Semester;
- Defining success factors for the effective use of Structural Funds for health investments;
- Cost effective use of medicines;
- Integrated care models and better hospital management;
- Measuring and monitoring the effectiveness of health investments, (Council Conclusions, 2013).

In addition the Communication of the European Commission '' on effective, accessible and resilient health systems'' focuses on actions to:

1. Strengthen the effectiveness of health systems
2. Increase the accessibility of healthcare
3. Improve the resilience of health systems (COM, 2014-215).

The need for a shift to modern health systems is also highlighted by the European Union's draft 'Health for Growth Programme, the third multi-annual programme of EU action in the field of health for the period 2014-2020' (COM, 2011-709), which focuses on the links between economic growth and a healthy population. In line with Europe 2020 objectives and policy priorities, it is aimed at supporting Member States' efforts to improve the efficiency and financial sustainability of their health systems through the identification and implementation of innovative solutions for improving the quality, efficiency and sustainability of health systems. Specifically, the programme aims to encourage a shift of resources in the health care sector towards "the most innovative and valuable products and services" while also seeking to support a greater shift towards community care and integrated care. Monitoring of inequalities in health is an important public health task.

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MAIN FOCUS OF THE CHAPTER

Addressing How Healthcare Policies Are Linked With Healthcare Service Quality

Citizens' health is a core EU priority (European Commission, 2013a).

WHO has introduced and recommended that ''*Assuring the quality of health care in the European Union''* is a result of many factors, including movement of patients and professionals (facilitated by rulings of the European Court of Justice), common public expectations across Europe, dissemination of new medical technologies and techniques through information technology (IT), and the enlargement of the EU (WHO, 2008a).

In addition, Tallinn Chapter is a commitment of the Member States of the World Health Organisation (WHO) in the European Region to improve people's health by strengthening health systems, while acknowledging social, cultural and economic diversity across the Region. Improved health contributes to social well-being through its impact on economic development, competitiveness and productivity. High performing health systems contribute to economic development and wealth (WHO, 2008b).

EU health policy complements national policies to ensure that everyone living in the EU has access to quality healthcare (European Commission, 2013a).

The main objectives of EU health policy are to:

- Prevent disease,
- Promote healthier lifestyles,
- Promote well-being,
- Protect people from serious cross-border threats to health,
- Improve access to healthcare,
- Promote health information and education,
- Improve patient safety,
- Support dynamic health systems and new technologies,
- Set high quality and safety standards for organs and other substances of human origin,
- Ensure high quality, safety and efficacy for medicinal products and devices for medical use.

While the organisation and delivery of healthcare is the responsibility of individual countries, the EU brings added value in helping countries achieve common objectives. EU health policy generates economies of scale by pooling resources, and helps countries to tackle the common challenges, including health threats such as pandemics, the risk factors associated with chronic diseases or the impact of increased life expectancy on healthcare systems (European Commission, 2013a).

The European Union explained that one of the key challenges is health inequalities. Huge differences in health and healthcare exist between and within EU countries and regions. The level of disease and the age at which people die are strongly influenced by factors such as employment, income, education and ethnicity, as well as access to healthcare (European Commission, 2013b).

In particular, poverty and social exclusion continue to be serious challenges across the European Union and for health systems in Member States. People living in poverty or who are at risk of social exclusion are more likely to face health problems and there is evidence that they sometimes do not receive the care that best responds to their needs. There is therefore room for improvement of both health

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promotion and prevention strategies with these groups in mind, and for more active policies to tackle barriers of access to high-quality care. This has been recognised at an EU level. Achieving access for all to adequate healthcare and long-term care and tackling inequalities in access has been an objective for social protection and social inclusion to support EU policies (European Commission, 2008).

Addressing Health Inequalities in the EU

Health inequalities are largely due to the unequal distribution of health determinants between people with different positions at the social hierarchy. People in lower socioeconomic are more exposed to health hazards in the physical environment, they more often experience psychosocial stressors, and they are more likely to adhere to unhealthy behaviours, such as smoking, inadequate diet, excessive alcohol consumption, and lack of physical exercise. As a result of their greater exposure to such risk factors, people in lower socioeconomic groups more often suffer from disease and disability. Part of this association may be attributable to reverse "selection" effects of health of poor health on educational level or occupational position, e.g. due to health problems in early childhood on school attainment. However, these reverse effects have been found to play a minor role only (Mackenbach, 2007). Health inequalities thus are principally a problem of unequal distribution of risk factors and health risks affecting mostly lower socioeconomic groups:

- Health inequalities are caused by a wide range of other factors which are not necessarily discriminatory, but may be regarded as unfair. These include policies which contribute to systematic differences between social groups in income, education, living conditions, and access to services.
- Health inequalities are due to systematic differences in factors influencing the health of people from different social groups and people living in different places. Large health inequalities exist both between and within EU Member States.
- They impact both on access to appropriate and affordable health and social services, and also on the quality of services which need to be low threshold and targeted to the needs of vulnerable groups.
- Health inequalities are not solely related to access to healthcare. Mostly socio-economic factors and common lifestyle-related risk factors are at the basis to health inequalities.
- On the positive side the considerable differences in life expectancy and infant mortality between EU countries are narrowing.
- Available data on citizens' perception of their unmet needs for care (from the SILC survey) show that the cost of healthcare is an important barrier to access to care for citizens with low income. The same can be said regarding distance to healthcare, where populations in rural areas face the most serious problems of access.
- Measuring access to healthcare encompasses significant difficulties. Available indicators are based on survey or opinion poll where citizens are asked whether they face unmet needs for care but we have no tool allowing for an objective measurement of access. For instance, indicators for coverage, waiting times and affordability are either non-existent or inadequate. An improvement in the tools available to measure access to healthcare is needed (Mackenbach, 2007).

WHO targeted the reduction of health inequalities both within and between countries by launching the programmes "Health for All by the year 2000" and "Closing the Gap" (WHO, 2008c). The relevant

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WHO report reached to the conclusion that health inequalities should be a major concern of governmental policies in all countries and that it is a matter of social justice to combat poverty and health inequalities, particularly among the most disadvantaged. Some EU states, such as the UK, have developed over the last 40 years a growing concern to investigate and tackle socioeconomic inequalities in health. After the publication of the Black Report in 1977, the Acheson Report in 1998 and the Marmot report in 2010, several actions and public health policies have been implemented aiming at the improvement of the living standards of the poor and the reduction of overall health inequalities among regions and socio-economic groups.

Even if health inequalities have been addressed highlighting the fact that most analyses of the relationship between health and the economy focus on average health, but health is actually very unevenly distributed across society; the global financial crisis that began in 2007 can be classified as a health system shock – that is, an unexpected occurrence originating outside the health system that has a large negative effect on the availability of health system resources or a large positive effect on the demand for health services. In 2009, WHO's Regional Committee for Europe adopted a resolution (EUR/RC59/R3, 2009), urging Member States to ensure that their health systems would continue to protect and promote universal access to effective health services during a time of economic crisis. This policy summary aims to address a gap in the literature by presenting a framework for analysing health policy responses to economic shocks; summarizing the results of a survey of health policy responses to the financial crisis in the European Region's 53 Member States; and discussing the potential effects of these responses on health system performance (European Observatory, 2012).

To date, there has been no systematic cross-country analysis of health policy responses to the financial crisis in Europe, although some overviews of health system responses to the crisis have been published (European Observatory, 2012).

The Marmot report on heath inequalities in the EU was published in December 2013 highlights: "health inequalities are killing on a grand scale''. While the impact of the economic recession is likely to have increased these risks, the start of the recovery is an opportunity to begin to reduce them. There is now overwhelming evidence that everyone in Europe should and could live in better health for longer, provided all government policies prioritise reducing health' (European Commission, 2013b).

Overall, the Commission's action aims both to support policy development in EU countries and improve the contribution of EU policies to address health inequalities.

In 2009, the Commission adopted a strategy on health inequalities entitled "Solidarity in Health: Reducing Health Inequalities in the EU" (COM, 2009- 567). It aims to support Member States and develop the contribution of EU policies towards addressing health inequalities in areas such as public health, employment, social, research and regional policy. In September 2013 the Commission reported about implementation of the strategy by publishing the Staff Working Document (SWD) (SWD, 2013-328) which looks at how far we have come on the five main challenges laid out in the strategy: 1) an equitable distribution of health as part of overall social and economic development; 2) improving the data and knowledge base; 3) building commitment across society; 4) meeting the needs of vulnerable groups; and 5) developing the contribution of EU policies.

The main message from the SWD was that *Gaps in life expectancy and infant mortality narrow across the EU.* The report presented the following results:

Inequalities in infant mortality between EU countries went down by 32% between 2001 and 2011. Overall infant mortality fell from 5.7 to 3.9 over this period with the gap between the top and bottom Member State moving from 15.2 to 7.3.

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People in different EU Member States now have a more similar life expectancy than in earlier years. The gap in male life expectancy at birth between the highest and lowest values for the EU-27 Member States was 11.8 years in 2011. However this gap has narrowed since 2007 when it was 14.2 years, an improvement of 17%. The gap in female life expectancy at birth between the highest and lowest values among the EU-27 Member States was 7.9 years in 2011, which is also below its peak of 8.2 years in 2006, an improvement of 4%.

However, health inequalities between and within Member States remain unacceptably high. The report confirms continued gaps in health between social groups, between rich and poor and between those with the highest and lowest levels of education. The report points to some positive developments in implementing the EU strategy on health inequalities, 'Solidarity in Health', but concludes that more action is needed at local, national and EU levels. More specifically health inequalities between countries, regions and social groups (2011 figures) were outlined:

- Sweden has the highest life expectancy for males – 79.9 years, and Lithuania the lowest 68.1 years – a difference of nearly 12 years.
- In 2011 life expectancy for women is highest in France – 85.7 years and lowest in Bulgaria – 77.8 years.
- When it comes to healthy life years in men, there is a difference of 19 years between the lowest and highest values in the EU. For women, this was nearly as high at 18.4 years.
- In 2010, the gap between life expectancy at birth between most and least advantaged regions in the EU was 13.4 years for men and 10.6 years for women.
- In the same year, there were seven EU regions with infant mortality rates greater than 10 per 1000 live births. This is more than 2.5 the EU average of 4.1/1000.
- In 2010, the estimated gap in life expectancy at age 30 for males between the least and the most educated varied from around three years up to 17 years in different Member States. For females the gap was slightly smaller, varying from 1 to 9 years.

The report examines various factors causing health inequalities and finds that social inequalities in health are due to a disparity in the conditions of daily life and drivers such as income, unemployment levels and levels of education. The review found many examples of associations between risk factors for health, including tobacco use and obesity, and socioeconomic circumstances. This reflects the influence that lack of control, stress and reduced capabilities – all strongly associated with social disadvantage – have on both health and health-related behaviours.

When the report was published the former European Health Commissioner, Tonio Borg, said:

It is encouraging that for overall life expectancy and infant mortality we have managed to reduce inequalities between EU countries. However, more progress is needed, particularly in narrowing the health gaps between social groups. Action on health inequalities must remain a public health priority for the EU. It is in everyone's interest to avoid the waste in human potential and the related economic loss, which is conservatively estimated at between 1.5% and 9.5% of GDP (European Commission press release, 2013).

More specifically:

Achieving the goals of Europe 2020 for inclusive growth is fundamental to addressing health inequalities. In February 2013, the Commission adopted a paper on Investing in Health (SWD, 2013-43), as

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part of the Social Investment package. The paper establishes the role of health as integral to the Europe 2020 strategy (COM, 2010-2020). It strengthens the link between EU health policies and national health system reforms and presents the case for: smart investments for sustainable health systems; investing in people's health; and investing in reducing inequalities in health. Investing in health helps the EU rise to the challenges identified in its Health Strategy (COM, 2007-630) that have been compounded by the economic crisis: an ageing population, an increase in chronic diseases, a greater demand for healthcare and the high cost of technological progress. More specifically the pillars are:

1. Investing in sustainable health systems combines innovative reforms aimed at improving cost-efficiency and reconciling fiscal consolidation targets with the continued provision of sufficient levels of public services.
2. Investing in people's health as human capital helps improve the health of the population in general and reinforces employability, thus making active employment policies more effective, helping to secure adequate livelihoods and contributing to growth.
3. Investing in reducing health inequalities contributes to social cohesion and breaks the vicious spiral of poor health contributing to, and resulting from, poverty and exclusion.
4. Investing in health through adequate support from EU funds (SWD, 2013-43).

The EU Health Program, the Cohesion and Structural Funds, as well as the Research and Innovation Funds (Horizon 2020) can support investment in health all across the European Union. In addition in the Commission Communication on health systems of April 2014, increasing accessibility of healthcare was presented as one of the three pillars of the EU agenda for effective, accessible and resilient health systems. Moreover this document complements the Commission Communication *Towards Social Investment for Growth and Cohesion* (COM, 2013-83) by showing how investing in health contributes to the Europe 2020 objective of smart, sustainable and inclusive growth.

Increasing the Accessibility in Quality Healthcare

Access to good quality healthcare services is a prerequisite for social integration and inclusive growth. It was recognised as a key objective of EU Member States' social protection systems as early as 1992 (Council Recommendations, 92/442/EEC).

Accessibility to health care is human right. This is one of the principles stated in the European Social Charter (Revised European Social Charter, 1996), which emphasises the importance of transparent criteria for access to medical treatment, and the obligation for Member States to have an adequate healthcare system which does not exclude parts of the population from receiving healthcare services (COM, 2014-215). However, access to healthcare is difficult to measure and there is no EU wide detailed methodology to monitor it and promote best practice. This would be an important step to reduce health inequalities (COM, 2009-567).

There has been increasing convergence of equity and health systems agendas as demonstrated by the reports of the Commission on Social Determinants of Health (WHO, 2008d) and the WHO reports on health financing and on health systems (WHO, 2010, 2000). Health equity, health governance, the economics of prevention, and health systems strengthening and public health form the four pillars (socio economic, environmental determinants, lifestyle and behavioural factors and capacity and efficiency

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of the health care systems) of the WHO European Health 2020 strategy (WHO Regional Office for Europe, 2011).

Equity and Choice: A Gender Issue

Men and women are biologically different because of differences that exist in their reproductive system, and this aspect, hence, forms the basis of differentiation of their health needs.

Equity in health also depends on the recognition by the health sector that men and women might be different in roles and responsibilities that society assigns to them (WHO, 2005a). The equity and choice discussion therefore has to include the gender discussion. The distinct roles and behaviours of men and women in a given society, dictated by that society's gender norms and values, give rise to gender inequalities – inequalities which so far systematically empowered one group over the other (Sen & Östlin, 2007). Besides, there are many other issues like access to health services, cost of recovery, distance to health facility, etc. have differential connotations and implications on the health of men and women.

In relation to health, women are often seen as the group having a natural disposition to health and care issues. They are most often the ones caring for the family – providing food, care as well as a warm and safe home. Women might have a higher sensitivity than men regarding health issues. Providing easy access to health information and care and facilitating system and market navigation for those almost exclusively assuming the sole responsibility for health is essential.

Gender differences are more relevant when considering the reasons for unmet medical needs: women are usually more likely than men to be constrained by barriers to access, such as the cost of medical care, time and geographical barriers (European Commission, 2010). In 2011, there was a more than one percentage point difference of self-reported unmet medical care between men (6.1%) and women (7.2%) in the European Union (EU27). This disadvantage to women comes from specific barriers of access to health care: too expensive, too far to travel or waiting list (3.9 vs. 2.8%). The countries with the lowest reported unmet needs for medical examination for reasons of barriers of access, by sex and age are Slovenia, Austria and Netherlands. Latvia has the highest percentage of unmet needs in EU27 (European Commission Conference Conclusions, 2014).

Women are more likely than men to report that they are unwell or that their imperfect health hampers their daily activities - partly attributable to women's lower socioeconomic status. There is considerable variation in reporting self-perceived health between Member States. While cultural differences in reporting are evident, controlling for all three socioeconomic indicators described above accounted for a significant part of the differences in reporting that exist between Member States (European Commission, 2013b).

The different roles and behaviours of men and women in a given culture, dictated by that culture's gender norms and values, give rise to gender differences between men and women in health status and access to health care. For example:

- A woman cannot receive needed health care because norms in her community prevent her from travelling alone to a clinic.
- A teenage boy dies in an accident because of trying to live up to his peers' expectations that young men should be "bold" risk-takers.
- A married woman contracts HIV because societal standards encourage her husband's promiscuity while simultaneously preventing her from insisting on condom use.

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- A country's lung cancer mortality rate for men far outstrips the corresponding rate for women because smoking is considered an attractive marker of masculinity, while it is frowned upon in women (WHO, 2015).

In each of these cases, gender norms and values, and resulting behaviours, are negatively affecting health (WHO, 2015). In fact, the gender picture in a given time and place can be one of the major obstacles - sometimes the single most important obstacle - standing between men and women and the achievement of well-being. These unfair and avoidable gender inequalities are resulting mainly from patriarchy, the systematic domination of women by men.

The good news is that gender norms and values are not fixed. They evolve over time, vary substantially from place to place, and are subject to change. Thus, the poor health consequences resulting from gender differences and gender inequalities are not static either (Sen & Östlin, 2007).

It is important for all health personnel especially the policy planners and those associated with implementation, to have knowledge and awareness of the ways in which gender issues affect the health differentially for men and women in any society. The process of creating this knowledge and awareness 'of' and responsibility 'for' gender among professionals enabling them to address gender issues in appropriate and most effective ways is called 'gender mainstreaming'. A key focus is given to raising awareness of gender inequalities. This is done by getting participants to challenge stereotypes, gender power relations and gendered assumptions about the factors that influence women's and men's health. Participants are encouraged to explore how services can be provided to women and men in gender-sensitive ways. It is not simply an 'add in' of a gender component in any policy, programme, reform or activity or viewed as a measure to act as 'watch dogs' in the domain of differentiation or inequalities emerging as a result of biological differences. Mainstreaming gender perspective in the health sector has to go beyond the feminist view, often construed with patriarchy to include aspects such as socially constructed discrimination, cultural construction of roles and status on the basis of sex, etc. The goal of gender mainstreaming is to transform health policy, planning and service delivery ensuring equal outcomes for women and men (Piang, Khattar & Nandan, 2010).

Gender mainstreaming is not just about women's health; it is a process for identifying and acting upon the gender-related factors that affect women's and men's health. This is important as gender norms, gender roles and gender relations impact on women's and men's health in different ways. Gender mainstreaming has implications for a whole range of health interventions. In this training guide the focus is given to providing gender sensitive health services (Pillinger, 2014).

There are other areas that potentially could be included, but are not the part of the content of the training. For example, women are often not included in clinical trials and clinical data is often not subject to a specific gender data analysis. Even if women are included in clinical trials the results are not always analysed by gender. This is also relevant for medical education and training. In gender mainstreaming, a broad approach is taken to health, so that the factors or determinants that influence health are addressed across the broad spectrum of inequalities in health. This is important because gender intersects with other population groups such as older people, minority ethic groups including travellers, and across other determinants such as poverty and disadvantage (Pillinger, 2014).

Core to this is bringing the experience, knowledge, interests and voice of women and men into policy making, service planning and service delivery. Gender mainstreaming requires a whole systems approach. This means policy makers, planners, managers and front-line service providers make a commitment to implementing gender mainstreaming in practice.

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Except from the gender mainstreaming policies, the European Union has been active in promoting women's reproductive health, in particular through aid for actions on reproductive and sexual health and related rights - one of the two thematic areas of the EuropeAid Cooperation Office. The European Commission, through its Directorate-General for Development, has affirmed its conviction that the United Nations Millennium Development Goals should be linked to the health and rights of women and children, as well as its commitment to the implementation of the United Nations Millennium Declaration (Maastricht University, 2009).

Similarly, EU countries have affirmed, both at the global and regional level, their belief in reproductive health and rights as a development priority. At a meeting organized by the Swedish government and the United Nations Population Fund in Stockholm, in April 2005, over 20 developing and developed countries issued the 'Stockholm Call to Action: Investing in Reproductive Health and Rights as a Development Priority', by which they committed, among other things, to mobilize political commitment on this issue in national and global meetings, to strengthen health systems to support reproductive and sexual health, to invest in efforts to increase women's decision-making power in all aspects of their lives, and to continue to work towards improved aid effectiveness in this area. In January 2006, in the Latvian capital, Riga, parliamentarians from the new EU Baltic member states expressed similar concerns and their wish to contribute to increased awareness on the subject. Through the Riga parliamentary statement of commitment, they committed themselves, in particular, to give high priority to sexual and reproductive health and rights in international development policies at national level and in European institutions (Maastricht University, 2009).

The WHO has also prioritised a gender analysis approach to their work on health and implements gender mainstreaming activities at every level globally. The aim is to shift thinking and attitudes so that the gender-related causes of ill health can be addressed by health professionals. Core to this is providing gender sensitive services (Pillinger,2014).

Chronic Diseases

The long-term nature of many chronic diseases, and in particular multiple conditions, calls for a comprehensive health system response that brings together a trained workforce with appropriate skills, affordable technologies, reliable supply of medicines, referral systems, and active engagement of people with chronic health problems to manage their own care, all acting over a sustained period of time. Major chronic diseases often result in premature morbidity and loss of healthy life years (WHO, 2005b). They are preventable through addressing their common risk factors, including unhealthy nutrition, lack of physical activity, tobacco use, and alcohol related harm. The prevalence and burden of chronic diseases is increasing worldwide. In the EU, 86% of all deaths, or 4 million per year are related to chronic diseases. 70% to 80% of all healthcare costs, about €700 billion, are currently spent on chronic diseases in the EU (EU Health Policy Forum Report, 2012).

Chronic diseases contribute to reduced economic productivity and labour market participation. 23.5% of employed people suffer from a chronic condition (ENWHP, 2011), and experience restrictions in their daily activities due to it, and absenteeism due to ill-health represents a yearly cost of an estimated 2.5% of GDP (SWD, 2013- 43).

The European Union has a number of activities in place to complement the efforts of Member States to address chronic diseases. Examples include (i) action on major risk factors: tobacco legislation, EU-strategies on nutrition and physical activity, and alcohol-related harm (ii) disease-specific initiatives e.g.

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on cancer and mental health (iii) funding of projects related to chronic diseases through the Health and Research Programmes (iv) the establishment of fora for the sharing best practices, such as the European Innovation Partnership on Active and Healthy ageing (Council Conclusions, 2010a).

The UN process on non-communicable diseases (NCDs) sets a political framework for action. The WHO action plan on NCDs sets global targets to be reached until 2020 (WHO, 2013).

The EU Reflection Process on chronic diseases (2012 – 2013) illustrated the importance of the issue and the need to take action to curb the rise of chronic diseases (Council Conclusions, 2013). As a first outcome of the process, a Chronic Diseases Summit took place in April 2014 (EU Summit on Chronic Diseases, 2014). It called for stronger political leadership, enhanced efforts to target key societal challenges including ageing; more efficient use of resources; greater involvement of citizens, patients and the health and social sectors in policy development and implementation; and stronger evidence and information on prevention, treatments, cost-effectiveness and demographic change. To take forward work, it called for the establishment of a "Coalition on chronic diseases". The "Coalition" would consist of voluntary members from Member States and stakeholders, and would work on the implementation of action plans around specific issues. This could include for example: early detection of atrial fibrillation, diagnosis and management of depression or effective self-care strategies for improved health outcomes, in order to produce recommendations which could be up-scaled in other settings (EU Summit on Chronic Diseases Conference Conclusions, 2014).

Migrant Health: A Critical Issue of Modern Societies

Migration is present all over the world, and especially in Europe it plays a major social and economic role. Mostly migrants are considered to seek better opportunities in other countries for themselves and their children (European Health Forum Badgastein, 2005).

Migration connects whole populations as well as societies. Migrants traveling for different reasons and surely not always of their own accord. In common with other lower socio-economic groups they frequently have more health problems. Furthermore, minority groups are most vulnerable and at a special risk of not receiving the same level of care and treatment than the average population (LBISHM, 2005). These problems, many times already existing before migrating to another than the home country – low socio-economic and educational level – are often intensified due to lacking or insufficient access to and understanding of healthcare options and treatments in home and destination countries (European Health Forum Badgastein, 2005).

Migrant health – the state of physical, mental and social well-being of migrants and mobile populations (International Organization for Migration, 2005). In general, migrants have greater difficulty maintaining their health and well-being. Ethnic minority groups and migrants are disproportionately more affected by disease and illnesses (Mladovsky, 2007).

Many experience mental or emotional vulnerability and low self-esteem, acquired in source or transit countries on the journey or as a result of their socio-economic conditions, lost family ties and safety networks characterizing their stay in the host country. Migrants with health problems entering European countries are having important implications for public health. They represent potential and possible risks to destination countries as migration is always concerned with transitioning diseases from one country to another. For the host countries, migrants are having special health and welfare priorities that are associated with their basic human rights, including the right to health and access to available health and

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welfare services. This puts destination countries in the position where they have to equilibrate between their responsibility to safeguard citizens' rights and security as well as their international obligation. The fact that migrants often do not fit in bureaucratic regulations and insurance systems puts an extra strain, both on patients and on professionals (European Health Forum Badgastein, 2005).

Migration has become a priority in the new Commission 2015-2020 (European Commission priorities, 2014). Access to health care for migrants is an issue which is not harmonised in the European level (EQUI-HEALTH, 2013). The right to healthcare is guaranteed under international and European human rights law. These standards apply to everyone regardless of their migration status (FRA report, 2011). Although this does not oblige EU Member States to guarantee access to all health services on an equal footing for citizens, it does impose some minimum requirements such as access to the emergency and necessary healthcare for all, equal access to healthcare. Currently the legal framework which applies is:

- The Return Directive 2008/115/EC covers access to healthcare of those irregular migrants who are subject of return procedures (both in detention centres and outside detention): The Return Directive obliges Member States to provide emergency health care and essential treatment of illness to illegally staying third country nationals who are subject of return procedures (Articles 14(1)(b) and 16(3) of the directive) (Directive, 2008/115/EC).
- The Charter of Fundamental Rights reinforces the EU commitment to equal opportunities and antidiscrimination and also guarantees access to health care (Official Journal of European Union, Chapter of Fundamental Rights of the EU, 2010/C 83/02).
- **Article 10 of the Treaty on the Functioning of the European Union:** The Union shall aim to combat discrimination when defining and implementing all its policies and activities (Official Journal of European Union, 2012/C 326/49).
- **European Parliament Resolution on "Undocumented Migrant Women in the EU (4 February 2014):** Underlining the need for equal access to justice and services for all women regardless of administrative status. The resolution calls on national and European authorities to ensure that a woman's immigration status does not prevent her from accessing decent housing, health care, education, and justice (European Parliament resolution on undocumented women migrants in the European Union, 2013/2115(INI)).
- Council Conclusions on the Common Values and Principles of EU Health Systems, June 2006. In their declaration, ministers agree that health services must be underpinned by the values of universality, access to good quality care, equity and solidarity (Council Conclusions, 2006/C 146/01).
- The European Union Council Conclusions on ''Equity and Health in all policies: Solidarity in Health'' (Madrid, 8 June 2010, Article 8), the European Parliament Resolution ''Reducing Health Inequalities in the EU (A7-0032/2011, 8 March 2011 points 5-22) address the issues of vulnerable groups (Council Conclusions, 2010b).
- The Commission, as part of its economic governance under the European Semester, highlighted the "twin aim of a more efficient use of public resources and access to high quality healthcare" in its 2013 Annual growth Survey (Priorities at EU level: the Annual Growth Survey, 2015). In follow-up, both under the 2013 and 2014 European Semester, the Commission proposed recommendations to improve or maintain the accessibility of health systems in selected Member States (in 2014 for Romania, Latvia, Spain as adopted by Council on 8 July 2014) (The European Semester, 2015).

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- In its Communication on "Effective, Accessible and Resilient" health systems of 4 April 2014, the Commission presented the accessibility of health services as one of three key general topics on the EU's health systems agenda (COM, 2014-215).
- The Europe 2020 Strategy gives a new impetus to efforts addressing poverty and social exclusion in the EU (COM, 2010-2020).

The EU is committed to tackling all forms of discrimination. Specific antidiscrimination activities include the legal framework; support for the development and exchange of good practice; projects, studies and the work of agencies such as the Fundamental Rights Agency (FRA).

It is important to mention that Member States are responsible for the provision of health care such provision needs to comply with EU law. This includes the right for legal migrants to have access to health care on the same basis as nationals. Irregular migrants must have as a minimum access to emergency medical care and access to healthcare for children, as well as antenatal, delivery and postnatal healthcare for mothers.

Modern societies need migrant-friendly hospitals initiatives. An initiative exclusively addressing the urgency of migration is the "migrant-friendly hospitals" initiative. Increasing migration and ethno-cultural diversity due to migration in Europe is and important issue for health systems and services. Many of the problems related to migration and care are not only related to language barriers and cultural diversity, but include scarcities in hospital and care resources as well as low levels of minority purchasing power. These additional problems pose new challenges to health professionals, especially in hospitals, playing and particularly important role in serving the migrant segment of the population. The migrant-friendly hospitals initiative is composed of a group of hospitals from diverse European countries collaborating with a number of high-profile experts and a wide range of international and European organizations. The collaboration aims at putting migrant-friendly, culturally-competent health care and health promotion higher up on the European health policy agenda as well as to support new interested hospitals improving their migrant friendliness by providing practical knowledge and instruments. Participants are aiming at becoming migrant-friendly and culturally-competent organizations. The priorities of the collaboration are set on the following areas: (1) Improving interpreting services; (2) migrant friendly information and training for mother –and child care, and (3) staff training towards cultural competence (LBISHM, 2005).

Modern Hospitals in Europe

For several years, hospitals have been required to act more efficiently and to increase their performance. Yet, today healthcare systems are facing conflicting trends: increasing demand of an ever-expanding and ageing population: short and long-term impacts of an economic and financial crisis and increasing request/availability of technological innovations. To adapt to this situation, the role of hospitals is further evolving.

In practice, change has taken place with emerging trends involving the creation of chains and networks in countries such as Sweden, Slovenia and the Netherlands, the formation of integrated providers as in the UK and Hungary, the development of regional systems as for example in Denmark and France. Other trends include a rising trend towards mergers, with examples including the UK and Norway. Indeed, in Norway, mergers have presented the main approach to more than halving the number of hospitals from around 50 since 2002. This was accompanied by a number of configurational changes including for example the introduction of observational units next to Accident and Emergency (A&E) departments

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as a means to reduce admissions, as well as changes to management structures such as the involvement of physicians and nurses at the various levels of governance alongside investment in training of hospital managers (WHO, 2012).

These examples illustrate that change is possible although difficult questions remain such as trade-offs between centralization and decentralization, for example maternity wards; or the role of small hospitals in rural areas. It was recognized that hospitals form part of integrated population health management, and the hospital should be a full part of the pathway. However, especially in relation to the issue of geographical location discussants expressed concerns of whether the answer to multimorbidity indeed involved a shift from hospital to primary care, in particular in sparsely populated areas, or whether it might be more appropriate for training to accommodate generalist skills in the hospital setting. More broadly, this raises the general question about the appropriate 'delivery system' to respond to the challenge posed by chronic diseases (WHO, 2012).

In addition to the aforementioned discussion WHO is giving 3 possible different pillars:

At the macro-level, the need:

- For the development of a clear vision for system design regarding how future health care should look like
- The development of new incentives for hospitals
- To engage with the EU level (subsidiarity)

At the meso-level, the need:

- To identify and implement new ways of organising primary care
- To describe the level of population health coordination
- To better understand how hospital change in terms of the delivery model has been achieved

At the micro-level, the need:

- To invest in the workforce involving the development of new skills as well as redesigning the work of specialists to be better suited to chronic care
- To develop and strengthen the ability to describe and measure what is being produced
- To identify better ways of working between organizations (World Health Organisation Regional Office for Europe, 2010).

Emphasis should be given to the management of primary care, as well as ongoing work on the role of hospitals in the context of integrated health care delivery (European Observatory on Health Systems and Policies, 2009).

RECOMMENDATIONS

There is a need to rethink the role and function of the 'modern' health system. Causes of health inequalities vary between Member States and between specific population groups. Addressing health inequalities effectively requires policies which include both actions to address the gradient in health across the

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whole of society as well as actions which are specifically targeted to vulnerable groups. The primary responsibility for health systems rests with the Member States. Member States should aim to establish, in close collaboration with the European Commission, a common set of indicators to monitor health inequalities and a methodology to audit the health situation in Member States aimed to identify and prioritizing areas of improvement and best practices. The European Commission could support Member States to achieve their objectives by providing analysis and support on the basis of available information. This could prove to be a useful tool for Member States when designing, prioritizing and implementing more efficient and effective policies adjusted to their specific situation, and to better use the existing EU tools to support their actions. The EU has taken a number of actions that can support Member States, in particular by providing guidelines and as monitoring or evaluation tools. Member States' future ability to provide high quality care to all will depend on making health systems more resilient, more capable of coping with the challenges that lie ahead. Controlled investment in the health sector, particularly for health infrastructure and expensive equipment, public health measures to reduce the burden of disease, integration and coordination of primary care and secondary care, and of health and social care could be considered as opportunities to use structural funds and other funds.

FUTURE RESEARCH DIRECTIONS

Action on health inequalities is being taken forward as part of Europe 2020 initiative and through the Commission's communication on health inequalities. The reduction of health inequalities is part of the objective of 'inclusive growth'; to ensure that all Europeans can benefit from a smarter, more sustainable economy. Future research directions may include more visibility to best practices in specific health areas which will enable stakeholders to interact amongst each other, countries profile overview on health inequalities with up to date data, tools to encourage reform of health systems aiming at cost-efficiency and sustainability which will ensure patient access to healthcare in the long term and mechanisms to ensure quality health care to all.

CONCLUSION

National governments, regional authorities in many countries have an important role in public health and health services and thus need to be actively involved. The health sector has a leading role to play, with the local governments, workplaces, and other stakeholders also to have a vital contribution to make.

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Chapter 65
Improving the Effects of Global Health Initiatives through FOMENT:
An Enhancement to the Diffusion Process

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ABSTRACT

The incidence of communicable and non-communicable diseases is rising globally in both developed and developing nations. New methodologies are required for reaching the general population and promoting preventative behavior. The objective of this chapter is to discuss the Focus, Organization, Management, Environment, Network, and Technology (FOMENT) process as a strategy and a tool to enhance the impact and efficiency of the diffusion process within public health systems and change agencies, especially in developing countries. FOMENT can be seen as an extension of Everett Rogers' Diffusion of Innovations Theory (DOI) and can be used by organizations to maximize the diffusion rate of health initiatives into a community. The understanding of individual variables from DOI and organizational variables from FOMENT, as well as their corresponding indicators will support the convergence approach to enhance diffusion capacity building (DCB) needed for the adoption of innovations and related behavior change.

INTRODUCTION

According to the latest Millennium Development Goals Report, there is a continuing need to address existing and emerging health issues globally. Despite significant progress in meeting these goals by 2015, the report emphasizes some of the remaining problems worldwide, to include: the prevailing and universal levels of poverty; the lack of sanitation facilities for more than 2.5 billion people; the

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significant decrease in the world's resource base with the continuing loss of forests, species, and severe impacts of climate change; and the remaining gaps in basic knowledge regarding communicable and non-communicable diseases (UN, 2013).

Although all of these issues deserve equal attention, the enduring and wide-reaching impact of communicable and non- communicable diseases has had a significant impact within the global community. According to the World Health Organization's World Health Statistics 2012 report, recent trends in communicable and non-communicable diseases include:

- Sixty per cent of global deaths are a result of non-communicable diseases (WHO, 2012).
- Communicable diseases such as malaria, influenza, and hepatitis continue to increase dramatically in certain parts of the world (WHO, 2012).
- Communicable, maternal, neonatal, and nutritional causes remain the dominant reasons of years of life lost in sub-Saharan Africa (Lozano et al, 2012).
- Population growth, an increased average age of the world's population, and largely decreasing age-specific, sex-specific, and cause-specific death rates combine to drive a broad shift from communicable, maternal, neonatal, and nutritional causes towards non-communicable diseases (Lozano et al, 2012).

In order to improve and expand the quality of life and avoid a continuing increase of communicable and non-communicable diseases, a transformation of behavior is necessary. Furthermore, especially in developing countries, the transformation needs to occur not only in individual communities but as a systemic change in the institutional implementation of various initiatives that may reduce disease burdens. Effective communications can be used within the context of demographic, economic, political, social, religious, and environmental factors to improve quality of life and meet the 2015 Millennium Goals.

The Rome Consensus, developed by The World Congress on Communication for Development in 2007 (World Congress on Communication for Development, 2007), endorses a better health promotion framework through enhancements made in communications methods and behavioral change models. Factors essential for this developmental process include:

- The right and possibility for people to participate in the decision-making processes that affect their lives.
- Create opportunities for the sharing of knowledge of skills.
- Ensure that people have access to communication tools so that they can communicate within their communities and with the people making the decisions that affect them (e.g. communication radio and other community media).
- Generate a process of dialogue, debate, and engagement, which can build public policies that are relevant, helpful, and have committed constituencies willing to implement them.
- Recognize and harness current communication trends occurring at local, national, and international levels for improved development action.
- Adopt an approach that is contextualized within a cultural framework.

By taking into account each community's social and cultural schemas, health organizations can encourage and implement health strategies and programs that are tailored to the needs of the populations they hope to serve, and can be diffused among the society at a more rapid pace.

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Understanding the diffusion process in a community has been studied in many fields and described in several models such as the Technology Acceptance Model (Venkatesh & Bala, 2008) and the Lazy User Model (Tetard & Collan, 2009) which explain factors that promote or hinder the acceptance of a proposed behavior change. Few social science theories, however, have a history of conceptual and empirical study as long the Diffusion of Innovations Theory (DOI) (Rogers, 2003). While DOI began as a technology adoption model, general acknowledgement of successful, effective practices, program, and policies resulting from clinical and community trials have resulted in the translation of this theory into numerous disciplines.

Despite its wide reaching application, DOI does possess some challenges. One of the challenges in DOI research has been the issue of how to diffuse preventive innovations at a more rapid pace. Preventive innovations and initiatives are new ideas that require action at one point in time to avoid unwanted consequences at some future time (Rogers, 1995). According to Rogers, "preventive innovations diffuse rather slowly" in part due to a low perceived relative advantage (Rogers, 2002). Another challenge in DOI is that the variables used in the diffusion model to predict adoption of preventive innovations are conceptualized to indicate the success or failure of the individual adopting a behavior within the system rather than as indications of success or failure of the system (Rogers, 1995). These criticisms suggest a need for a complementary model that, instead of focusing on the adoption process in a community, focuses on measuring and analyzing the adoption processes and diffusion capacity of a preventive innovation among the institutions that implement health initiatives within their communities. Understanding ways to accelerate the decision making process and diffusion capacity, as well as identifying the individuals within a community who can recognize the needs of adopters at varying stages can make DOI more sustainable, build assurance for funding, and ensure prospective rather than retrospective assessments of how different people respond to innovations.

The focus, organization, management, environment, network, and technology process (FOMENT) is a strategic response to the challenge of how to accelerate and measure the adoption of health initiatives within a public health organization/institution at all management, planning, and implementation levels to most efficiently diffuse the initiative in a community. In other words, instead of focusing solely on the diffusion process of a health initiative among individuals in a society, FOMENT underscores and provides a template to understand and measure the process of health innovation diffusion within institutions in any community and to emphasize the nature of an adoption of a public health initiative within the systems that implement the initiatives. The acronym FOMENT stands for the interaction of the five factors mentioned; focus on a specific behavior change, organization of the behavior change plan, environment that is conducive to behavior change, network to diffuse innovations at individual and organizational levels; and technology available to diffuse the innovations (Haider & Kreps, 2004).

Successful adoptions of innovations begin with effective diffusion. While the theory of the DOI (Rogers, 2003) has been used to study the spread of new ideas and practices in a wide variety of settings, among the various health promotion programs (Ferrence, 2001; Finney et.al, 2004), preventive health innovations tend to diffusion relatively slowly (Rogers, 2002) and FOMENT can complement DOI in diffusing health initiatives and health promotion programs through a focus on the institutional systems and organizations that implement these programs in underserved or developing communities.

The rest of the chapter will focus on the process of diffusion and show how FOMENT can complement diffusion and dissemination research in order to understand the individual institutional characteristics that can increase the implementation rates of a public health initiative.

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Diffusion Process Overview

E.M. Rogers (2003) posits that the adoption of an innovation is affected by (a) the perceived attributes of the innovation, (b) the type of innovation decision, (c) the nature of the social system in which the innovation is diffused, (d) the extent of change agents' (or facilitators of change) promotional efforts in diffusing the innovation, and (e) the nature of the communication channels used. These variables determine the adoption of an innovation. Diffusion is further used to communicate messages about new ideas, behaviors, or products (Haider, 2005). When practically applied, the diffusion process serves as a means by which an innovation is communicated through certain channels over time among the members of a particular social system or community (Haider, 2005). These innovations can include a change of behavior or a modification of social norms and value systems (Haider, 2005). Results of public health innovations can be classified as desirable versus undesirable, direct versus indirect, and anticipated versus unanticipated (Haider & Kreps, 2004). Additionally, behavior change falls into three measurable categories: *commencement,* which describes initiating a new, desirable behavior within the target population; *cessation,* which refers to ending pre-existing and undesirable or risky behavior; and *prevention* which is associated with the circumvention of undesirable behavior all together (Haider & Kreps, 2004). The diffusion process can be a useful catalyst in understanding and obtaining a desired behavior change.

The critical tenets of the diffusion process are best described in DOI (Rogers, 1995). Within this theory, the facilitators of change are called *change agents*. These change agents can aid in opening the lines of communication and encourage innovation adoption by promoting the following conditions within a target population (Haider & Kreps, 2004):

- Develop a need for change;
- Establish an information-exchange relationship;
- Diagnose problems;
- Create intent in the target population to change;
- Translate intent into action;
- Stabilize adoption and prevent discontinuance;
- Achieve a terminal relationship.

There are five basic stages of achieving change within any particular target population. These five main stages are: *knowledge, persuasion, decision, implementation,* and *confirmation* (Rogers, 1995). *Knowledge* occurs when an individual concedes the existence of and begins to have some understanding of the new idea (Rogers, 1995). *Persuasion,* the second stage, is a result of a person starting to hold a certain positive or negative attitude or emotion toward this new idea (Rogers, 1995). An individual reaches the *decision* stage when they engage in activities that lead to a choice of the adoption or rejection of this new idea (Rogers, 1995). During the *implementation* stage, an individual applies this new idea or practice in his or her daily life (Rogers, 1995). Finally, *confirmation* occurs when the person seeks reinforcement or confirmation of the innovation when inconsistent messages appear (Rogers, 1995).

In order for a recipient of the innovation to change their behavior, he or she needs to identify the relative advantage, find compatibility, overcome the complexity, and have the ability to be sampled and observed as a trial (Rogers, 1995). Each individual's rate of accepting an innovation or new behavior falls into five adopter categories: *Innovators, Early Adopters, Early Majority, Late Majority, and Laggards.*

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The *innovators*, which comprise 2.5% of the population, are the first members of a group to adopt a new innovation (Rogers, 1995). This group is often more adventurous, educated, and can handle a higher degree of uncertainty than their peers (Rogers 1995). The *early adopters*, encompassing 13.5% of the population, are less adventurous, and more uncomfortable with uncertainty than the innovators (Rogers, 1995). The *early majority* is likely to deliberate before adopting a new innovation, yet will most likely adopt a new behavior just before the average person (Rogers, 1995). They are typically 34% percent of the population, while another 34% of the population is considered the *late majority* group. These individuals are often skeptical of new innovations and require peer-pressure to change their behaviors (Rogers, 1995). The last 16% of any population to adopt an innovation are the *laggard* group. The people within this group tend to be the least educated and are often suspicious of innovations, subsequently waiting a great deal of time before willingly embracing new behaviors (Rogers, 1995).

The use of DOI in the promotion of an innovation has been successful because of how the theory is able to customize initiatives to particular target groups by taking into account their social norms and value systems (Haider, 2005). As such, the DOI theory often results in the dissemination and promotion of health awareness, education, and positive decision-making (Haider, 2005). Although the utilization of the DOI theory has resulted in achieving desired outcomes and behavior change, it does have some limitations.

Challenges include determining how to speed up the decision-making process, identifying appropriate change agents optimized for reaching different target populations, increasing understanding of adopter categories, making DOI more sustainable, building assurance for funding, and ensuring prospective rather than retrospective assessment of how different people respond to innovations (Haider & Kreps, 2004). These limitations also include pro-innovation, individual blame, and recall biases (Rogers, 1995).

Pro-innovation basis assumes that an innovation/program should be diffused and accepted by all members of the community should be diffused more rapidly, and in a manner, which is neither re-invented nor rejected (Rogers, 1995). This leads diffusion researchers to ignore the study of ignorance about innovations, to underemphasize the rejection or discontinuance of innovations, to overlook re-invention, and to fail to study anti-diffusion programs designed to prevent the diffusion of "bad" innovations (Rogers, 1995).

Individual blame bias tends to fault the individual for his or her rejection of a new behavior rather than account for the broader system of which an individual is a part (Rogers, 1995). The individual-blame bias is a type of source bias or a tendency for diffusion research to side with change agencies that promote innovations rather than with individuals who are the potential adopters (Rogers, 1995). The variables used in diffusion models to predict innovativeness are conceptualized to indicate the success or failure of the individual within the system, rather than as indications of success or failure of the broader system (Rogers, 1995).

Finally, because diffusion of innovations takes into account the factor of time, research depends on an individual's recall of when their behavior changed (Rogers, 1995). Usually, participants are asked to look back in time in order to reconstruct their past history of innovations experiences (Rogers, 1995). This hindsight ability is potentially not completely accurate (Rogers, 1995).

These limitations however, do not detract from the potential of DOI's effectiveness. Invention and diffusion are simply means to an ultimate end: the consequences of adoption of an innovation (Rogers, 1995). As such, Roger offers solutions to improving on the relatively low adoption of preventive innovations, i.e., innovations that require action at one point in time to avoid an unwanted health consequence at some future time (Roger, 1995). These solutions include:

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- An attempt to increase the perceived relative advantage;
- Utilizing champions to promote preventive innovations;
- Changing the norms of the system regarding preventive innovations through peer support;
- Using entertainment-education to promoting preventive innovations;
- Activating peer networks to diffuse preventive innovations.

These solutions require a committed effort from the organization that is implementing the health initiative. However, the implementation cannot be successful if the strategy is not known or has not been previously diffused adequately throughout the implementing organization; this includes the strategy being adopted at all levels- by organization management, planners, and field workers.

While DOI's effectiveness in endorsing dissemination of an innovation in a community is unparalleled, one of the challenges in DOI is its lack of focus on the organizational systems and the measurement of impact of these health innovations. In other words, analysis of DOI begs the question of whether or not organizations are implementing the most effective strategies to diffuse a health innovation. Specifically, from a public health perspective, a challenge in the current model of diffusing health initiatives is the lack of focus on the institutions that promote these actions and do not take into consideration the adoption of the initiatives among individuals within the organization. For example, there are no assurances that individuals pushing change at base levels have adopted suggested changes and guidelines received from higher levels of management when implementing a certain health initiative in the community. In addition, methods do not exist to measure the efficiency of this implementation when applied within the community.

The percentage to which the initiative is successfully and efficiently implemented is based on effective diffusion of communication and strategies within the organization. Further, diffusion capacity challenges include determining how to speed up the decision-making process, identifying appropriate change agents optimized for reaching different target populations, increasing understanding of adopter stages, making DOI more sustainable, building assurance for funding, and ensuring prospective rather than retrospective assessment of how different people respond to innovations. The FOMENT process is a complementary theory to DOI and attempts to address and measure these challenges. More specifically, FOMENT complements DOI insofar as it expands DOI's use in organizational settings. While DOI may be used in organizational settings to understand adoption and implementation of a health initiative, FOMENT can provide a more focused approach to organizational diffusion and provide measurable indicators that can assess the rate of implementation.

FOMENT OVERVIEW

FOMENT, a strategy in the sphere of communication dissemination and behavior change, is proposed as a complement to the diffusion process. This strategy attempts to concentrate on measuring the rate and scope of diffusion throughout groups and organizations and confronts the demonstrated need to improve on the innovation-decision process (Haider & Kreps, 2004). FOMENT can be used by organizations to streamline their innovation-decision process and can help diffuse the preventive innovation in the most efficient way possible within a given community. FOMENT theorizes a manner of integrating

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individual characteristics into organization, planning, and management levels (Haider & Kreps, 2004). This process-oriented tool comprises of six diffusion-enhancing elements that complement factors in the DOI model (Haider, 2005):

- DOI's Innovation component can be adopted at a greater rate thorough a *focus* on a specific behavior change.
- The communication channels can be enhanced in a public health institution via *organization* of the behavior change program and *management* that supports and approves the behavior change plan.
- The adoption of the initiative in the social system can be influenced through an *environment* that is conducive to behavior change and through *network*s that diffuse innovations at individual and organization levels.
- The time factor in DOI can be influenced by the *technology* available in an organization to diffuse innovations.

Through further examination of each of these elements, it is shown that the *focus* element assesses how a specific behavior change can result from the successful targeting of a specified group; assists in identifying change agents, stakeholders, and other key partners; and establishes the vision and mission of any one initiative. Using *focus*, innovations should address whether goals have been established in response to the issue at hand and if sufficient attention is being given to these and newly occurring issues by identified change agents and stakeholders. In implementing a new health initiative through an institutional system, there are certain factors that can accelerate the diffusion of the innovation through an organization and increase the "focus" on behaviors. These include: (1) whether the issues have been defined in the organization; (2) whether the change agents have identified the assets and stakeholders that can help implement the initiative; and (3) whether the issue has been sufficiently discussed by all parties, including change agents.

FOMENT's *organization* element brings together the diffusion channels throughout all tiers of a community and aims to establish a leadership structure, identify necessary versus unnecessary overlap(s) in channels, discover diminishing versus persistent capacity, and assesses compatibility between communication channels. FOMENT's *organization* element also takes into account whether a core group of change agents have been identified and if these agents have come to a consensus in developing unified and comprehensive strategic methods and plans in promoting the initiative. The organization element again pinpoints factors that if taken into consideration, can help diffuse a health innovation through an organization and ease implementation of health initiatives. These factors include: (1) identification of a core group of change agents who are in agreement with the initiative; (2) establishing a leadership structure in the organization to champion the health initiative; and (3) developing a strategic plan to address the issues and initiatives.

With FOMENT's *management* element, an interface and support framework is created for communication and innovation channels and for assessing overall performance, which ensures long-term sustainability. This includes taking budget items into consideration, defining the roles and responsibilities of change agents, developing an implementation process, acquiring operational resources, and developing an assessment/evaluation system.

FOMENT's *environment* element considers the effect that diffusion has on the relationship between a change agent and/or communications channels and the adopter; impact on capacity for adoption; com-

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munication capabilities; and overall support through all capacities within a community. For example, the *environment* element may evaluate and consider upper-level management, leaders, and policy makers' support and direction of an innovation and if policies, procedures, and organizational structure are in place and conducive to the adoption of an innovation.

Through *network,* the capacity for change is determined by communication between change agents and adopters and through the ability of change agents to promote a coordinated approach towards diffusion of innovations. The objective of this element is to understand the degree of cross interaction, speed, and impact on a population following the adoption; to monitor the perceptions of the adopters; and to analyze the potential technological and social barriers. Through the evaluation of informal and formal network systems, the degree of coordinated efforts to promote the innovation can be evaluated among change agents.

Finally, the *technology* element describes the manner in which diffusion occurs. *Technology* consists of the impact on networks, relevance of the innovation to the population, ability and equity in receiving the innovation through the utilized technologies, general perception of the innovation, and rate of acceptance by adopters. Evaluation of this element includes exploring the use of media and new technologies, as appropriate, for a target population.

The *focus, organization,* and *management* elements utilize components of communication, while *environment, network,* and *technology* address the manner in which diffusion occurs. When applied to diffusion of innovations initiatives, FOMENT can enhance the effectiveness of the initiative at organizational and managerial levels and proposes that targeting these levels, instead of individuals in the community, may result in an increase in the adoption of innovation. The following table (*Table 1, FOMENT Factors*), outlines the considerations that should be taken into account for each element of FOMENT when implementing an initiative.

The Utility of Integrating FOMENT and the Diffusion Process

The complementary relationship between FOMENT and the diffusion process is important for developing an efficient framework of diffusion capacity within implementing organizations. As shown in *Figure 1, Complementing Diffusion of Innovations: The FOMENT Theory*, elements of the Diffusion of Innovations Theory and FOMENT can easily be associated. As portrayed in this figure, DOI's *innovation* relates directly to *focus*; DOI's *communication channels* are supplemental to FOMENT's *organization* and *management;* DOI's *social system* can be matched to FOMENT's *environment* and *network;* and DOI's *time* relates to FOMENT's *technology.*

While the successes of the diffusion process employed in global initiatives have been showcased time and time again, FOMENT can attend to its identified gaps. As the diffusion process aims to bring about adoption of ideas at the individual level, FOMENT's model strives to bring about adoption of ideas at the forefront of organizations (Haider & Kreps, 2004). Ideas concerning health behavior change are often more easily modified and communicated by aiming at a group rather than an individual (Haider & Kreps, 2004). Furthermore, FOMENT can reduce pro-innovation and individual blame biases by promoting innovations at these said organizational and management levels. Additionally, FOMENT can improve the recall of innovations through its *network* component, whereby messages are reinforced through interaction with others, including innovators and change agents (Haider & Kreps, 2004). Finally, using FOMENT can help researchers analyze an intervention before implementation of a program, while most diffusion processes examine the intervention after the program is already implemented (Haider &

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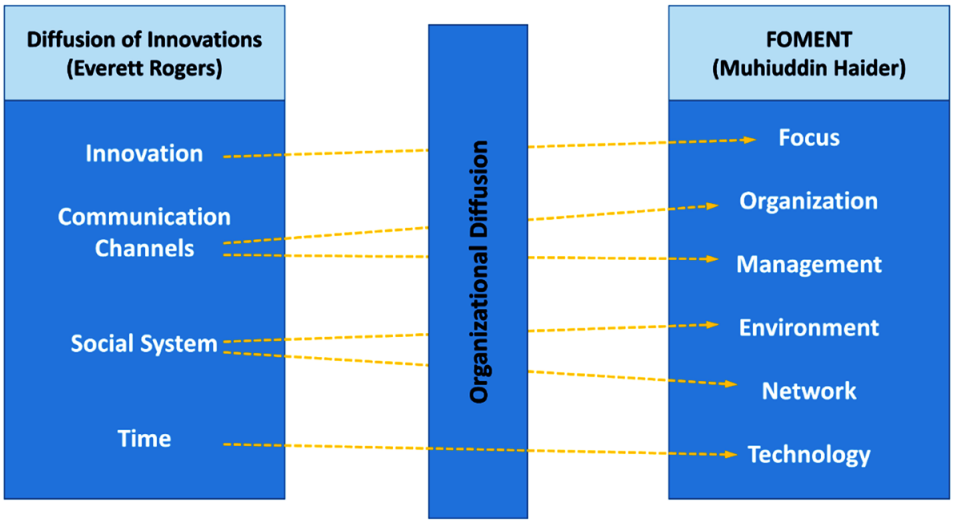
Table 1. FOMENT factors

Focus (Focus on the Behavior)	• Have the issues been defined? • Have needs and assets been identified by change agents (e.g. stakeholders and other key partners)? • Has a vision and mission been established? • Have goals been established in response to the issue(s)? • Is sufficient attention given to the issue(s) and innovation by all identified change agents?
Organization (Organizational Structure of Involving All Tiers of the Community)	• Has a core group of change agents been identified? • Has a leadership structure been established? • Are members of the target population engaged as change agents in issue selection and planning? • Are change agents in agreement as to the issue(s)? • Have change agents developed a strategic plan to address the issues? • Do change agents agree on comprehensive methods/strategies to promote the innovation?
Management (Management System to Ensure Sustainability)	• Have the roles and responsibilities of change agents been defined? • Has an implementation process been developed? • Has a budget been established? • Have operational resources been acquired? • Has an assessment/evaluation system been developed?
Environment (Environmental support through all capacities)	• Do upper-level management, leaders, and/or policymakers support the innovation and direction(s) of the change agents? • Are policies and procedures conducive to supporting the adoption of the innovation and the work of the change agents? • Are organizational structures and/or services in place to support innovation adoption?
Network (Use of Formal and Informal Network Systems)	• Do change agents have an opportunity to connect for the purpose of planning, acting, and celebrating (e.g. coalition meetings)? • Is there open communication between the change agents? • Are efforts to promote the innovation coordinated among the change agents?
Technology (Technology Channels and Appropriateness)	• Is the media used by the change agents to promote the innovation or organizational effort? • Are new media technologies (e.g. cell phones, Internet) used to communicate the innovation(s) to the target population(s)?

Figure 1. Complementing diffusion of innovations: the FOMENT theory



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Kreps, 2004). As a result, FOMENT can minimize issues and complications in applying the innovation prior to its implementation, and can thereby maximize its overall programmatic effectiveness (Haider & Kreps, 2004).

CASE STUDIES: THE POTENTIAL APPLICATION OF FOMENT ON GLOBAL DISEASE MANAGEMENT

Because the strategies comprising FOMENT have not been applied in the field, the theoretical benefits of FOMENT as a complement to the diffusion process need to be empirically evaluated and studied further. FOMENT offers a broader view of encompassing change agents or the advocates for the innovation, adopters, environment for all of the interactions, and the technology that facilitates or hinders diffusion. While empirical data has yet to be collected on indicators of FOMENT and their utility in increasing the rate of adoption of a health initiative, we can attempt to understand how FOMENT could be potentially be utilized with in the public health arena. The following are a selection of case studies that provide a brief description of each initiative and its corresponding programmatic components. In an effort to better understand how FOMENT could potentially be utilized within the field, its elements are applied to these case studies in an attempt to evaluate FOMENT's value in enriching these programs.

Case Study 1: Factors Affecting the Diffusion of Solar Water Disinfection: A Field Study in Bolivia (Heir & Moser, 2008)

The purpose of this study was to evaluate the capability of the variables derived from the theory of diffusion of innovations to predict the current and intended use of solar water disinfection (SODIS). SODIS is a simple low-cost technology for treating drinking water at the household level, with the intent of quickening health gains and paving the way for universal access to safe drinking water. Additionally, the study proposed to utilize the information garnered to provide a framework for developing theory-based SODIS-diffusion programs (Heir&Moser, 2008).

In order to evaluate the usage of SODIS, one visit was planned to 644 households from eight areas throughout Bolivia. Evaluators reviewed current behavior and the intention of future behavior in relation to potential use of SODIS. What was found is that 88% of the participants believed water to be a cause of diarrhea, indicating that indigenous health concepts and beliefs were not a barrier for the incorporation of SODIS. As a result, the study focused on the diffusion of innovation factors to explain the adoption of SODIS in households (Heri & Mosler, 2008).

The results of the study found 60% of the interviewed households stated that they used SODIS, 13% of them knew about the technology but had not yet used it, and 17% of them had never heard about the technology. Ten percent stated that they had used SODIS but had since abandoned it (Heri & Mosler, 2008).

Based on the results and information gathered from participants, the study identified several recommendations that could result in future initiatives with the goal of increasing the use of SODIS. While the current and intended use of SODIS was generally explained by variables in the diffusion model, the SODIS foundation could possibly have had a more effective outcome in the water sanitation program and have a more fine-tuned strategy for diffusing the water treatment if FOMENT was taken into account. For example, using the *Focus* element in FOMENT, SODIS could have established a targeted message

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comparing the relative advantages of the solar water disinfection to traditional methods of cleaning water. In addition, using *Organization* and *Management* elements, SODIS could have increased the rate of adoption in the community by encouraging peer support within the organization of solar treatment and directed resources to selection, training, and supervision of SODIS treatment promoters. FOMENT could have affect the rate and success of the implementation itself. The incorporation of FOMENT could have resulted in greater usage of SODIS with the integration of stakeholder support via local networks and leaders/policy makers on regional and country-wide levels. Furthermore, broader messaging, targeted media campaigns, and continuing communications could have resulted in faster dissemination and overall wider acceptance of SODIS throughout Bolivia. *Table 2, Use of FOMENT in the Promotion of SODIS,* further illustrates how FOMENT could have enhanced the process of diffusion.

Case Study 2: Analysis of Avian Influenza with Special Focus on Pakistan (Haider, Frank, & Noreen, 2010)

In 2006, the virus strain H5N1 of Avian Influenza officially was confirmed in Pakistan after numerous losses of poultry and wild birds throughout the country caused millions of dollars in damages. Without the government and general public having the necessary information, farms in both rural and commercial areas were severely impacted by the disease. Research found that especially within low-income and out-of-the way communities, dead birds were not being disposed of properly. Additionally, diseased populations of birds could not be brought under control, with a major problem being the lack of knowledge regarding the handling and sanitary treatment of diseased birds (Haider et al., 2010).

In response, the government established the National Program for the Control and Prevention of Avian Influenza (NPCPAI). In accordance with this program, a three-day training workshop was arranged, with the main objective being awareness and information sharing about Avian Influenza. For the purposes of this project, the overarching objective was applied to two groups of women. One group of women was from Union Council (UC) Pairan, which was given the poultry management and Avian Influenza information and who served as a manipulated variable to show how well education and information

Table 2. How FOMENT utilization could expand promotion of SODIS

Focus	• Establish a clear initiative mission to include not only the usage of SODIS, but promotion of better tasting water and financial savings to individual households when using SOID in comparison to alternate and traditional methods of cleaning water.
Organization	• Identify change agents within local communities and regions that can influence behavior. • Encourage peer support of SODIS usage and other innovations that encourage diarrhea prevention through change agents.
Management	• Emphasize careful selection, training, and supervision of SODIS promoters. • Encourage and integrate regular follow-up action within the communities by SODIS promoters and change agents.
Environment	• Integrate upper-level management, leaders, and/or policy makers into diffusion strategies in order to facilitate widespread dissemination of SODIS initiative.
Network	• Utilize interpersonal networks among neighbors as a means of influencing individual decisions. • Promote SODIS bottles in highly frequented places and offer workshops for community-based organizations that display the benefits of SODIS.
Technology	• Utilize entertainment-style education to promote preventive innovations. • Implement targeted media campaigns at peer networks to influence adoption decision-making.

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regarding Avian Influenza could decrease disease. The other group, from UC Parhana, had information withheld in an effort to have a control group who would serve as the norm for the majority of the people/ farmers throughout the country (Haider et al., 2010).

With an average score of 69.5%, the training and further education of the women of UC Pairan demonstrated a positive impact. The positive results included that, (1) the majority of the women from the UC Pairan knew the basics of Avian Influenza, (2) how it was transmitted from bird to bird, (3) how to prevent transmission to humans, and (4) how to keep their poultry free from the virus. On the other hand, the 19.9% pass rate from the UC Parhana group showed the lack of training and information disseminated in this region resulted in only a few women knowing anything about the aforementioned topics regarding Avian Influenza, and with the majority of women knowing only the basics of the disease (Haider et al., 2010).

Table 3 , on how *FOMENT Utilization Could Increase Effectiveness of Public Information Efforts to Reduce the Rate of Avian Influenza*, provides an outline describing how the use of FOMENT by the organization could have resulted in a more focused and sustainable training, a manner of evaluating the effectiveness of the training at varying levels, a variety of stakeholders providing input on how to best manage an outbreak, mechanisms of support through a broader organization and management, consistent messaging regarding disease management techniques, and regular communications through available technologies. Plan Pakistan could have used FOMENT to create multi-level targeted approaches that could have been used to diffuse information and preventive behaviors regarding avian influenza at an accelerated rate, even before the implementation, and ensure that the information regarding the disease

Table 3. How FOMENT utilization could increase effectiveness of public information efforts to reduce the rate of avian influenza

Focus	• Identify the existing level of education relating to Avian Influenza and determine the ideal level of education that will help mitigate the spread of disease. • Identify the issues outlined by change agents and local leaders relating to the spread of Avian Influenza.
Organization	• Incorporate all levels of change agents within the identified stakeholder groups (e.g. farming groups, women's groups, health practitioners, etc.) in initiative planning process. • Promote a consistent message about the importance of education relating to this disease. • Develop training that is consistent and relatable across all regions within the country, tailoring information/ guidelines as needed.
Management	• Identify a budget and sustainable funding sources. • Develop ongoing training to be distributed to trainers and stakeholder groups. • Develop an evaluation method for the level of education obtained through the monitoring of implemented training practices. • Provide resources and a method for sharing relevant and new information.
Environment	• Promote national and regional campaigns regarding the dangers of Avian Influenza and techniques for the caring of diseased animals. • Develop national and regional incentives for management and control of disease amongst farmers and other impacted groups. • Develop national and regional resource centers for information and support during outbreaks for farmers and impacted groups.
Network	• Develop forums for farmers to discuss ongoing issues and problem solving techniques. • Involve all stakeholders in the discussion of best-practices in controlling and responding to Avian Influenza.
Technology	• Use sources of communication most common amongst the farming communities to relay important messages regarding Avian Influenza, to include where outbreaks are occurring, reminders about response protocols, and available resources.

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was being diffused throughout the entire community. Using FOMENT, the organization could have *focused* on assessing the actual need for education, as well as evaluating the current education levels of their targeted community, allowing for the opportunity to better prepare their field and community workers. In the initial planning stage, Plan Pakistan could have used *organization* to promote a consistent message to all change agents and use their inroads in the community as a way to bring all stakeholders on board with the initiative. Finally, *environment* and *network* could have been used to strengthen communication for the initiative within the organization and developing training that is consistent and relatable across all regions within the country.

Case Study 3: Diffusion of an HIV Prevention Intervention for African American Women: Integrating Afrocentric Components into the SISTA Diffusion Strategy (Prather et al., 2006)

The Sisters Informing Sisters about Topics on AIDS (SISTA) intervention addresses the lack of culturally relevant HIV prevention programs targeting African American women in the United States. The overall goals of the interventions were to increase knowledge of HIV and risk reduction methods, empower women to become more assertive, enhance their communication with their sexual partners around condom use, and increase partner support of consistent condom use (Prather et.al, 2006). Sixteen organizations in cities throughout the United States participated in implementing this health initiative. Overall findings from the SISTA project, suggested that most of the agencies required assistance with the planning process, implementation, and evaluation of the intervention. It was further established that many agencies desired more culturally specific resources. While the project implemented its own training program within the organization, only for the agency staff had the skill set to facilitate group sessions.

Per Table 4, on *How FOMENT Utilization could have further Promoted SISTA*, the project could have used FOMENT as a way to *focus* and identify issues in the African American population and provide a systematic way to understand the existing levels of education among their target audience. The project could have further *organized* all change agents within the organization not just the staff with a specific skill set to promote a consistent message about HIV and existing cultural barriers, as well as better facilitate HIV prevention practices among African American women. Using FOMENT could have also

Table 4. How FOMENT utilization could have further promoted SISTA

Focus	• Identify issues and provide a systematic way of understand the existing levels of education relating to HIV within the African American population. • Identify issues outlined by field workers and local leaders relating to the spread of HIV. • Identify management leaders to spearhead project and gather resources.
Organization	• Incorporate all change agents with varying levels of skills in the planning process. • Gather funds and resources to develop ongoing training.
Management	• Identify the budget and sustainable funding resources for project duration. • Identify community leaders that can sustain the intervention after project completion. • Provide community leaders with monetary and non-monetary resources for intervention sustainability.
Environment	• Add resource centers among participating agencies to give other women in the community access to materials on HIV.
Network	• Develop forum for women where they can converse about the cultural barriers facing them regarding HIV.
Technology	• Use targeted education and media campaigns using local opinion leaders to influence adopter decision.

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assisted the organizers in developing a budget and identifying sustainable funding sources to develop ongoing and continuing training sessions. While the project itself was successful, SISTA might have diffused these preventive measures even further within the community if the *environment* was more effectively taken into account. Most women received the culturally targeted HIV information through this program, but only within their focus groups. Better utilizing the *environment* factors of FOMENT could have added resource centers in the agencies where other women, not just the ones participating in the focus group sessions, could have received similar information. As such, usage of FOMENT could have ensured further diffusion of the health initiative in the underserved community.

Case 4: Diffusion of Wood Burning Stoves in Guatemala and Ghana (Agarwal, 1983)

The extensive use of wood as a source of fuel in developing countries has resulted in an international "wood fuel crisis" (Agarwal, 1983). Bina Agarwal conducted a study in the effectiveness of promoting improved wood-burning stoves through diffusion models. The study by Agarwal provided two examples of the diffusion of improved wood-burning stoves; one in Guatemala and another in Ghana. The outcomes of the interventions in both Guatemala and Ghana noted an increased level of diffusion within the community; however, evaluation of the interventions also observed that the specificity of users' needs was not adequately taken into account in the design of the stove. More specifically, it was also stated that, "appropriate modifications could have been made without a loss of technical efficiency", if the local methods of cooking had been better understood by the implementing agency (Agarwal, 1983).

In this regard, the use of FOMENT could have helped the implementing agency to involve local users in the process and development of a more adaptable wood-burning stove design. Specifically, the agency could have used *focus* to identify the actual need to better the efficiency of the existing wood-burning stove model, to better understand the general cooking methods of each population, and to examine existing levels of education relating to wood-burning practices. Using stakeholders within each target population, the implementing agency could have used FOMENT's *organization* and *environment* components to develop resources for field workers to implement broader educational campaign on the wood fuel crisis. In addition, the *network* element of FOMENT could have guided the agencies in identifying key stakeholders who utilize and depend on wood-burning stoves, (i.e., the women that use stoves to cook, local artisans who design and build stoves, etc.) to encourage their involvement in promoting the improved wood-burning stove, and to potentially develop a tailored-made stove that better met the needs of the community overall. *Table 5, Use of FOMENT in Improving the Diffusion of Wood- Burning Stoves in Rural Communities,* further illustrates how FOMENT could have enhanced the process of diffusion.

FUTURE DIRECTION

Although FOMENT's theoretical utility can be seen through the examination of these case studies, this process-oriented tool has not yet been implemented in the field. The next phase in realizing the full potential of FOMENT is through its application in cases where the innovation may be applied at the organizational level and where management and local networks can take an active role in the diffusion process. Collaboration amongst all levels of a social group, particularly in the selection of capable stakeholders and change agents with vested interest in promoting healthy behavior changes, may result in an

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Table 5. Use of FOMENT in improving the diffusion of wood- burning stoves in rural communities

Focus	• Identify actual need for wood burning stoves. • Understand existing levels of current methods of cooking. • Examine existing levels of education relating to wood-burning practices.
Organization	• Identify stakeholders who are familiar with the needs of the individuals within the community. • Promote a consistent message about educating the population on usage and efficiency of the improved wood-burning stove.
Management	• Provide resources toward identifying specific community needs to be integrated into the stove design.
Environment	• Integrate upper level management leader and policy makers to implement a re-education campaign.
Network	• Utilize local community of women and others who are the main users to influence the stove design and utility. • Utilize the local community to demonstrate the non-monetary benefits of the wood-burning stoves.
Technology	• Utilize available technology to develop working models for local women and get input on suggested designs of the stove.

even greater pace of diffusion and acceptance of important and life-saving innovations than ever seen before. Placing FOMENT and the diffusion process in the context of social change, economic development, and modes of sustainability may allow the flexibility of the diffusion theory to more effectively cater to different target populations in a variety of settings and hopefully result in longer-lasting impacts of healthy behaviors.

In addition, diffusion capacity building (DCB) requires the implementation of innovation in ideas, behaviors, and practices. Such capacity can use dynamic power to focus on pushing the curve of adoption of behavior change through interventions. The effective use and synergy between FOMENT and DOI in initiatives has the capability of reaching both the organizational and individual levels of any one community. The understanding of these two sets of variables (individual and organizational) and its indicators will support the convergent approach to enhance DCB, needed for the adoption of innovation and related behavior change. Thus, the individual characteristics from DOI and organizational characteristics from FOMENT can complement each other to build, support, and strengthen infrastructure capacity (organizational and community) to ensure an adaptive preventive system that is receptive to change. Using DOI and FOMENT strategies concurrently can also address a number of infrastructure factors that can facilitate capacity building needed to sustain an intervention. However, there is a need for collective action and measurement of DOI and FOMENT integrated capabilities, in order to better understand the impact to DCB in an enabling environment.

CONCLUSION

The adoption of an innovation is dependent on how knowledge is received, diffused, and understood within a community. Recipients of an innovation must first become aware that an innovation exists, must gain an understanding of how an innovation works, and then must identify its corresponding benefits. This type of knowledge is not acquired within a vacuum, but rather within the global intersection of culture, systems, societies, and politics. Individuals must have the ability and resources to participate in the decisions that affect their lives. These abilities and resources include understanding current policies, taking advantage of available opportunities, and engaging in local, national, and global dialogues. Change agents must communicate an innovation while keeping in mind that cultural beliefs exist and are held in

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great esteem by individual societies. Yet, these change agents must also balance the reality that values within societies are ever-changing and that new technologies are altering the needs within communities. Because populations are comprised of individuals within specific social structures who perform certain roles which connect, both formally and informally, to a number of other individuals within any given organization, FOMENT can potentially improve access to that necessary knowledge and to all levels of a social structure through *Focus, Organization, Management, Environment, Network,* and *Technology.*

In today's public health world, where globalization is in many cases making the spread of information and therefore, the spread of health innovations possible and rapid, the collaboration between the diffusion process and FOMENT's enhancement to diffusion capacity could offer global health programs an avenue to increase positive behavior change. Although the potential advantages of FOMENT have yet to be fully explored in the field, further research and implementation of this strategy must be conducted in order to verify its effectiveness and better understand the synergies between diffusion and FOMENT. Increasing and improving the rate of adoption of public health initiatives can lead to positive and lasting changes in the advancement and sustainability of health and improve quality of life among populations worldwide.

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KEY TERMS AND DEFINITIONS

Advocate: To promote a particular initiative or cause, or to speak on behalf of particular individuals.

Change Agents: An individual, group, or organization that indirectly or directly cause and/or promote change.

Communication Channels: A manner in which messages are transmitted in a variety of forms to a particular target audience.

Diffusion: To disseminate an idea or product throughout a target population.

Health Behavior: Actions taken by an individual that reflect their beliefs about maintaining their well-being.

Innovation: A new idea, product, or methodology.

Preventive Innovation: A new idea that an individual adopts in order to lower the probability of some unwanted future event.

Social System: The connections and interactions amongst individuals, groups, and institutions (government entities, organizations, religions, etc.) that exist as a sum of all parts.

Synergy: The interaction of two or more entities that as a result of their collaboration, are able to create a greater impact than as separate entities.

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Chapter 66
The States as Generators of Incremental Change in American Health Care Policy: 1935 to 1965

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ABSTRACT

The literature defines the role of interest groups and administration officials in the evolution of health care policy but does not acknowledge the impact of Congressional casework or the initial Social Security (OASI) eligibility criteria. There is, as a result, an inadequate appreciation for (1) the extent to which the initial development of federal policy was a function of Congressional delegations pursuing initiatives that would increase the flow of federal dollars their states could use to expand health services or (2) the way in which the regional cleavages created OASI eligibility criteria combined with the South's control of Congressional leadership positions to yield an expansion of health care for indigent people while intentionally delaying the creation of Medicare. This chapter addresses these gaps and provides a more complete picture of the way in which the incremental, unplanned evolution of federal health care policy was the product of using federal resources to diminish the states' fiscal needs and the south's capacity to temporarily control the health care agenda.

BACKGROUND

The literature relating to the evolution of federal health care financing and policy has not adequately examined the roles of the states in the growth of federal programs or the unintended effects of the initial Social Security (OASI) eligibility criteria. Although the literature has delineated the evolution of federal health care matching formulas from their origins in the public assistance programs to the establishment

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of the Medicaid and Medicare programs, the analyses focus on the strategies and tactics of federal officials to the exclusion of the states and their congressional delegations. There is, as a result, inadequate understanding of the financial implications of the partnership between state officials and their congressional delegations that enabled them to increase the flow of federal funds for the purpose of advancing their states' policy goals. In similar fashion, the literature acknowledges that the initial OASI eligibility criteria created regional variations in the percentage of people aged 65 and older who received OASI benefits (Corson, 1939; Sloman, 1942; Trafton & Feinroth, 1944). However, it does not examine the impact of these patterns on the origins and composition of the Kerr-Mills Medical Assistance for the Aged (MAA) program that was the precursor to the Medicaid program (Engel, 2006; Gilman, 1998; Olson, 2010; Patel & Rushefsky, 2006; Smith & Moore, 2009; Sundquist, 1968).

To address the gaps in the literature and convey lessons arising from the American experience, the next section outlines the policymaking model for the interactions between the state and national governments. The discussion is followed by descriptions of (1) the revisions of public assistance matching formulas that were initiated by the states for the purpose of increasing the flow of federal health care dollars to the states, (2) the basis for and the regional implications of the initial OASI eligibility criteria, (3) the impact of the regional patterns on Kerr-Mills, and (4) the manner in which the preceding factors affected the development and enactment of the Medicaid and Medicare programs in 1965. The chapter's final section summarizes the findings and examine their implications for health care finance and policy.

MODEL FOR THE EXPANSION OF FEDERAL HEALTH CARE FINANCING

During the thirty years between the establishment of the public assistance matching formulas in 1935 and the enactment of the Medicare and Medicaid programs in 1965, the states' pursuit of their self-interest affected the evolution of federal health care funding for elderly and indigent citizens. Kingdon's (1995) policymaking model suggests that the state's success in placing their health care financing proposals on Congress' agenda was a function of their congressional delegations' ability to merge the problem, policy, and politics streams to take advantage of windows of opportunity (Gilman, 1998). The problem component, as defined by the states, focused on minimizing welfare dependency, i.e., providing health care services that would enable public assistance recipients to become self-sufficient. Given definition of the problem and the states' desire to limit the demands on their resources and the need for state tax increases, the states' policy was to expand the flow of federal grants-in-aid via federal matching formula revisions. As an increasing share of states availed themselves of the expansion of federal funding, there was a concomitant increase in the probability of securing Congressional support for additional matching formula revisions. The process, in other words, was self-perpetuating: an expansion in the number of states benefiting from the revised federal matching formulas enhanced the feasibility of enacting additional changes that would generate further increases in federal outlays.

The probability of achieving their policy goal was also facilitated by procedural strategies: the process of adding matching formula revisions to larger bills virtually guaranteed that congressional attention would be focused on the legislation's primary components. By deflecting the lawmakers' attention in this manner, the proponents of matching formula revisions were able to minimize the number of congressional supporters that was needed to assure passage. In addition, whenever the proposal was attached to must

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pass legislation, the probability of a presidential veto was reduced (Gilman, 1998). Due to the preceding elements, the revisions of federal matching formulas reflected the initiatives of state governments and federal health care policy was incremental.

PUBLIC ASSISTANCE MATCHING FORMULAS: THE FOUNDATION FOR FEDERAL HEALTH CARE SPENDING

Although the American Medical Association's (AMAs) opposition to national health insurance resulted in its removal from the social security legislation that the Roosevelt Administration sent to Capitol Hill (Olson, 2010; Patel & Rushefsky, 2006; Smith & Moore, 2009), federal health care funding was not dead: the bill's public assistance matching formulas contained the seeds for the subsequent growth of federal health care expenditures. More specifically, each of the three public assistance matching formulas (Aid to the Blind (AB), Aid to Dependent Children (ADC) and Old Age Assistance (OAA)) specified the percentage of benefits that would be funded by the Federal Government, the ceiling on federal reimbursements, and a prohibition against using federal funds for payments to individuals who were in public institutions (49 Stat. 620-648 (1935)). At first glance, the final element does not appear to provide a basis for establishing and expanding the federal government's role in health care finance. However, the subsequent actions of Members of Congress clearly indicate that the prohibition provided an opportunity to dramatically increase federal health care spending.

The first instance of exploiting the opportunity occurred in 1949 when Congress undertook a major revision of the Social Security Act of 1935. The Congressional Record reveals four rationales for terminating the prohibition against using federal public assistance funds to defray a portion of the cost of providing health care to public assistance recipients. The first rationale emanated from the equitable treatment of recipients. Given that the Federal Government was covering a portion of the payments to individuals who were in private institutions, it was argued that federal funds should also match payments for those who were in public institutions. In so doing, the affected individuals would no longer have to give up their public assistance checks when they receive extended medical care in county or local facilities. The second rationale focused on the states' capacity to provide a wider array of services that would reduce dependence. More specifically, lawmakers argued that insufficient health care and chronic illness are barriers to securing a job and economic self-sufficiency. The provision of health care services therefore is an essential tool for ensuring or restoring health and thereby minimizing the citizens' reliance on public assistance programs (U.S. House of Representatives, 1949).

The third rationale is persistent and persuasive lobbying for federal financing of health care services. During the House floor debate, Representative Cooper (Democrat-Tennessee) noted that the representative from Wisconsin, for a number of years, was advocating for federal funding of health care services that were provided to public assistance recipients. The record also indicates that the House Committee on Ways and Means was "most favorably impressed by his appearance before the committee [and] . . . endeavored to take care of the situation which he so ably presented to the committee" (U.S. House of Representatives, 1949, p. 13899). The fourth and final rationale addressed the need for additional facilities to serve the chronically ill. If health care would be added to the public assistance matching formulas, then the states could use the additional federal monies to support a greater volume of health

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services for recipients. The additional income, in turn, would enable communities to "develop" additional facilities for chronically ill patients and thereby assist in fulfilling the need for such facilities (U.S. House of Representatives, 1949). In this respect, the liberalization of public assistance matching formulas was a forerunner of Hill-Burton (Patel & Rushefsky, 2006) which provided federal funding for hospital construction.

Congress approved the addition of medical vendor payments to the public assistance matching formulas (64 Stat 477–561, (1950)) but was not willing to approve the Social Security Administration's Wilbur Cohen (Smith & Moore, 2009) or Senator Lehman's (Democrat-New York) proposals to establish two public assistance matching formulas: one for payments to recipients and one for payments to doctors and hospitals. Senator Lehman argued that the establishment of distinct matching formulas was necessary for states in which the average public assistance payments were approaching or exceeding the ceiling on federal reimbursements. If Congress did not approve the proposal, the states would be forced to use the limited space between existing assistance payments and the federal reimbursement ceiling to increase payments to individuals or institute a program of payments to health care providers. Under these conditions, the senator argued that the matching formula would constrain the extent to which these states could provide health services that would minimize dependency emanating from "medical neglect and chronic illness" (U.S. Senate, 1950, p. 8791).

He also noted that his amendment was supported by the interassociation committee on health and its decision was "formally confirmed by the governing boards of its six constituent organizations–the American Dental Society, the American Hospital Association, the American Medical Association, the American Nursing Association, the American Public Health Association and the American Public Welfare Association" (U.S. Senate, 1950, p. 8791). The associations' support was based on the premise that the additional federal funding would stimulate the provision of quality care and the accompanying proviso that the assistance would be administered by public health departments and the administrative arrangements would be approved by the six organizations (U.S. Senate, 1950). As is the case for third party insurance, the AMAs support of Senator Lehman's amendment suggests that the organization is not opposed to all publicly-financed health care initiatives: it opposes initiatives that insert a third party, rather than members of the medical community (e.g., Blue Cross/Blue Shield insurance as initially constituted and public health departments), into the doctor/patient relationship.

As indicated by the data in Tables 1 to 4, two years after enacting the Social Security Act Amendments of 1950, the Federal Government was defraying a portion of the health care costs for two adult public assistance programs (AB and OAA) in 18 states, the adult public assistance program Aid to the Permanently and Totally Disabled (APTD) program (established in 1950) in 12 states, and the ADC program in 17 states. The data also reveal that federal health care expenditures in FY 1952 were greatest for the OAA Program ($49.6 million). Federal health care reimbursements for the other programs, in descending order, were $9.4 million for ADC, $5.9 million for ATPD, and $1.3 million for AB. By 1956, the number of states for which the Federal Government was subsidizing public assistance health care costs rose to 20 to 24 states for the adult public assistance programs and 22 states for the ADC program. The evidence also indicates that the gap between health care reimbursements for the OAA program and the remaining public assistance programs widened. Federal health care reimbursements were $130.5 million for the OAA program, between $23 and $24 million for the ADC and APTD programs and a relatively paltry $3.4 million for the AB program.

Given the dramatic increase in the number of states availing themselves of federal health care matching funds and the explosion in federal health care outlays, it is not surprising that the Senate Committee on

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Table 1. Amount of medical vendor payments for the medical care of OAA recipients for selected years, by state

State	1952	1954	1956	1958	1960
Alabama		11,902	17,511	20,439	12,455
Alaska					
Arkansas				2,096,364	4,010,575
California			1,564,227	14,362,380	26,866,177
Colorado				2,157,471	10,071,078
Connecticut	1,981,999	2,318,567	3,265,761	3,264,386	3,633,356
Delaware					
Florida					4,178,406
Hawaii		115,210	224,972	107,772	133,930
Idaho					453,481
Illinois	8,931,585	18,498,983	22,681,883	25,351,489	25,915,059
Indiana	3,185,747	3,951,588	5,377,734	5,724,926	6,188,975
Iowa					2,745,306
Kansas	1,478,125	1,989,953	2,585,045	3,500,339	4,068,951
Louisiana	531	772	3,497	1,593,738	2,912,301
Maine			514,548	1,001,181	1,599,495
Maryland				60,047	598,662
Massachusetts	2,500,609	10,481,939	24,692,145	21,040,010	40,504,037
Michigan	298,617	1,375,499	1,887,870	4,720,536	5,140,094
Minnesota	8,368,903	11,441,907	15,201,125	6,979,084	19,483,833
Missouri					231,720
Montana					15,744
Nebraska	2,059,885	1,735,841		1,409,350	4,124,864
Nevada	18,954	41,859	78,647	168,891	188,466
New Hampshire	728,376	958,935	879,708	1,001,551	1,048,049
New Jersey				2,612,959	7,592,296
New Mexico		300,652	380,181	753,849	1,094,728
New York	14,078,448	20,788,569	25,533,901	20,499,796	32,699,781
North Carolina	102,984	150,284	357,578	786,102	1,168,436
North Dakota	266,458	339,456	1,637,844	1,314,734	2,681,646
Ohio	2,192,640	2,613,178	3,074,712	6,723,203	11,238,456
Oklahoma				6,735,336	12,451,356
Oregon				4,015,672	5,446,931
Pennsylvania			1,593,419	3,044,355	2,255,779
Rhode Island	9,524	704,470	612,672	792,261	1,145,508
South Carolina					819,206
South Dakota					

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Table 1. Continued

State	1952	1954	1956	1958	1960
Tennessee				537,832	875,174
Utah	5,470	11,688	11,330	633,244	406,811
Vermont					298,681
Virginia					1,201,892
Washington			11,903,083	8,038,062	16,268,222
West Virginia				713,659	825,963
Wisconsin	3,439,250	4,738,523	6,468,050	6,944,504	17,494,968
Wyoming				335,025	361,396
Total	49,648,105	82,569,775	130,547,443	159,040,547	280,452,244

Source: Social Security Administration. 1951-1960. Social Security Bulletin, 14(12)-23(9), Operating statistics: Amount of vendor payments for medical care for recipients of public assistance, by program and state, month and year.

Table 2. Amount of medical vendor payments for the medical care of ADC recipients for selected years, by state

State	1952	1954	1956	1958	1960
Alabama		7,347	12,064	9,922	6,461
Alaska					
Arkansas				226,599	260,648
California				7,026,414	11,683,743
Colorado				380,042	474,250
Connecticut	812,872	771,334	1,168,142	1,054,920	1,940,626
Delaware	5,536	10,042			
Florida					224,642
Hawaii		197,695	74,663	369,177	295,164
Idaho					
Illinois	757,206	1,903,662	3,037,599	4,311,303	6,017,599
Indiana	553,166	542,142	881,164	1,255,103	1,605,734
Iowa					781,535
Kansas	322,642	379,613	496,271	695,618	1,033,239
Louisiana	27,031	37,797	50,617	104,051	157,416
Maine			159,201	190,566	308,962
Maryland				107,659	979,341
Massachusetts	335,136	1,011,089	1,695,599	1,607,853	2,439,737
Michigan				548,129	997,947
Minnesota	551,929	827,650	1,311,709	1,678,466	2,362,867
Missouri					40,424
Montana					481

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Table 2. Continued

State	1952	1954	1956	1958	1960
Nebraska	108,999	64,138		49,557	109,226
Nevada					
New Hampshire	226,401	184,882	163,391	168,511	203,335
New Jersey	138,695	133,688	201,594	333,934	249,577
New Mexico		143,575	378,876	663,111	704,520
New York	4,456,819	5,690,101	8,252,545	10,189,326	13,174,185
North Carolina	58,032	94,637	166,808	425,437	631,109
North Dakota	12,143	49,343	196,070	284,595	340,626
Ohio	88,868	191,354	212,475	129,800	993,022
Oklahoma				2,506,862	51,023
Oregon				418,330	309,417
Pennsylvania			1,335,140	2,433,923	3,747,785
Rhode Island		264,761	352,009	671,949	916,385
South Carolina					224,687
South Dakota					
Tennessee				281,965	275,230
Utah	3,009	7,615	13,326	440,102	288,617
Vermont					
Virginia					
Washington			1,540,348	2,138,623	2,095,658
West Virginia				763,987	1,036,332
Wisconsin	915,942	1,129,364	1,423,262	1,759,563	2,249,787
Wyoming				52,270	72,818
Total	9,374,426	13,641,829	23,122,873	43,277,667	59,284,155

Source: Social Security Administration. 1951-1960. Social Security Bulletin, 14(12)-23(9), Operating statistics: Amount of vendor payments for medical care for recipients of public assistance, by program and state, month and year.

Table 3. Amount of medical vendor payments for the medical care of AB recipients for selected years, by state

State	1952	1954	1956	1958	1960
Alabama		31	435	119	28
Alaska					
Arkansas				77,924	118,643
California			140,749	739,236	1,414,977
Colorado			2,677	25,188	29,451
Connecticut	31,234	44,859	58,423	62,992	86,959
Delaware				8,509	12,940
Florida					98,532

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Table 3. Continued

State	1952	1954	1956	1958	1960
Hawaii		5,048	11,898	7,063	6,299
Idaho					4,872
Illinois	249,552	523,408	699,738	691,785	768,469
Indiana	115,300	131,084	218,325	251,967	315,120
Iowa					102,848
Kansas	32,356	36,872	45,861	62,900	69,569
Louisiana	1,534	2,050	6,196	32,842	44,784
Maine			19,176	36,768	43,014
Maryland				2,326	16,062
Massachusetts		3,925	26,547	231,118	234,523
Michigan	3,166	19,920	28,560	104,115	122,724
Minnesota	54,850	268,856	386,172	205,781	419,323
Missouri					
Montana				13,182	7,156
Nebraska	7,055	6,653		134,496	336,541
Nevada				8,901	12,882
New Hampshire	27,278	31,239	28,926	33,269	42,609
New Jersey			883	24,305	2,415
New Mexico		11,014	23,208	24,572	25,986
New York	574,990	801,833	1,003,189	743,462	1,245,875
North Carolina				42,492	96,721
North Dakota	1,005	3,051	8,763	10,014	16,332
Ohio	65,763	83,228	105,253	308,849	304,191
Oklahoma				137,580	228,783
Oregon				40,227	38,190
Pennsylvania			333,381	704,719	610,744
Rhode Island	60	16,702	15,566	9,480	11,424
South Carolina					27,814
South Dakota					
Tennessee				30,766	22,452
Utah	92	1,306	1,672	15,168	7,047
Vermont					2,704
Virginia					54,175
Washington			112,918	88,905	204,053
West Virginia				28,109	30,517
Wisconsin	94,265	110,119	152,550	170,058	366,896
Wyoming				6,132	5,885
Total	1,258,500	2,101,198	3,431,066	5,115,319	7,610,529

Source: Social Security Administration. 1951-1960. Social Security Bulletin, 14(12)-23(9), Operating statistics: Amount of vendor payments for medical care for recipients of public assistance, by program and state, month and year.

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Table 4. Amount of medical vendor payments for the medical care of APTD recipients for selected years, by state

State	1952	1954	1956	1958	1960
Alabama		4,442	7,128	5,643	3,491
Alaska					
Arkansas				295,267	583,403
California					1,381,039
Colorado				100,789	159,861
Connecticut		58,157	797,054	799,634	1,060,738
Delaware					
Florida					639,710
Hawaii		86,124	188,016	80,268	104,439
Idaho					34,923
Illinois	435,266	2,051,366	3,260,319	4,851,383	4,774,283
Indiana					
Iowa					
Kansas	190,119	279,908	382,765	586,069	714,805
Louisiana	13,415	16,634	23,904	340,388	615,978
Maine			30,828	136,465	204,435
Maryland				43,905	192,025
Massachusetts	1,010,978	4,246,105	5,948,127	3,928,636	6,975,199
Michigan	48,402	224,487	313,529	236,856	344,052
Minnesota		10,251	110,130	94,664	112,961
Missouri					31,305
Montana					2,765
Nebraska				148,203	421,456
Nevada					
New Hampshire	288	35,100	63,640	120,205	161,571
New Jersey				538,782	1,591,938
New Mexico		54,971	71,186	147,016	236,264
New York	4,101,017	7,101,780	9,717,901	9,661,355	13,597,663
North Carolina	17,258	47,645	113,918	430,688	678,884
North Dakota	17,382	45,862	268,871	236,582	482,029
Ohio				607,090	1,264,780
Oklahoma				568,374	1,272,068
Oregon				891,896	1,123,526
Pennsylvania			547,765	1,125,650	1,149,318
Rhode Island	60	149,050	208,756	290,112	502,605
South Carolina					241,011
South Dakota					

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Table 4. Continued

State	1952	1954	1956	1958	1960
Tennessee				40,201	138,601
Utah	1,209	2,247	4,894	130,290	136,625
Vermont					30,533
Virginia					341,705
Washington			1,335,259	1,068,031	2,357,672
West Virginia				284,365	287,868
Wisconsin	69,301	234,569	448,903	510,605	1,781,588
Wyoming				49,090	54,159
Total	5,904,695	14,648,698	23,842,893	28,348,502	45,787,276

Source: Social Security Administration. 1951-1960. Social Security Bulletin, 14(12)-23(9), Operating statistics: Amount of vendor payments for medical care for recipients of public assistance, by program and state, month and year.

Finance added the Kerr-George amendment that accomplished the goal Senator Lehman was unable to achieve in 1949: establishing a federal matching formula for medical vendor payments that was separate from the formulas for payments to public assistance recipients. By establishing a separate formula for health care costs, it was no longer necessary for medical vendor payments to compete against income support payments for federal dollars. They could generate federal matching funds from the new formula that obligated the Federal Government to cover 50 percent of the health care costs up to $6 for the adult public assistance programs and up to $3 for the ADC program (70 Stat. 846-848 (1956)).

The data in Tables 1 to 4 indicate that the states represented by Senators Kerr (Democrat-Oklahoma) and George (Democrat-Georgia) did not receive federal reimbursements for medical vendor spending prior to Congress's consideration of the Social Security Act Amendments of 1956. However, Senator Kerr's motivation for introducing the amendment is suggested by the fact that Oklahoma's payments to AB, APTD and OAA recipients by the mid-1950s. Given the benefit levels, the establishment of a medical vendor program would have been financed primarily by the state's own resources. The introduction and passage of the Kerr-George amendment therefore enabled the state of Oklahoma to shift a significant portion of its medical vendor costs to the Federal Government. The validity of the assumption is supported by the fact that Oklahoma began to receive federal medical vendor payments within one year of the amendment's enactment and federal reimbursements increased from $10 million in 1958 to $14 million in 1960.

The rationale for Senator George's support is not evident because his home state of Georgia did not establish a medical vendor program during the 1950s and payments to public assistance recipients were significantly less than the federal reimbursement ceiling. His home state therefore could have established a medical vendor program under the public assistance matching formulas without resorting to the medical vendor formulas created by the Kerr-George amendment. Given that he retired slightly more than a year after the legislation was approved, there may have been a political or policy rationale for Senator George to champion the amendment.

It is noteworthy that the new medical vendor matching formulas were not beneficial for all states. In the case of 13 states whose medical vendor spending exceeded the new ceilings on reimbursable expenditures, switching from the public assistance formulas to the medical vendor formulas would have resulted

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in less federal funding. To avoid this outcome for his and the other states, Senator Douglas (Democrat-Illinois) proposed an amendment that would enable the states to use the new formula to calculate the federal share of health care costs. For any medical vendor spending greater than the ceilings set by the new formula, the states could move the unmatched health care expenditures to the matching formulas for public assistance payments. The floor manager for the bill, Senator Byrd (Democrat-Virginia), agreed to take the amendment to conference committee.

Although the 1950 and 1956 matching formula revisions were portrayed as mechanisms for assisting the states in broadening and improving their health care services for public assistance recipients (Schottland, 1956), the evidence suggests that the changes were a function of the states pursuing matching formula changes that would minimize the demand on state coffers by maximizing the flow of federal funds. The record also reveals that the success of the efforts to shift costs was a function of Congress's focus on other parts of the legislation. In 1950, most of the debate focused on the Social Security (OASI) benefits and eligibility standards. In similar fashion, the Senate debate in 1956 focused on the OASI eligibility standards and whether disability insurance should be added to the OASI program. The provisions relating to federal reimbursement of health care costs therefore could be entitled the "who cares" provisions.

As is the case with other policies such as public assistance (Advisory Commission on Intergovernmental Relations, 1980), the "who cares" provisions generated dramatic increases in spending. Between 1952 and 1960, the data presented in Tables 1 to 4 indicate that total medical vendor spending increased from $66.2 million to $393.1 million, which is a growth rate of more than ten times the rate of growth for all federal outlays (Office of Management and Budget, 2015). It is also evident that a disproportionate share of the expansion relating to the adult public assistance programs (AB, APTD and OAA) was due to an increase of more than 50 percent in the number of participating states. Plus, health care spending for OAA recipients generated between two-thirds and three-quarters of total expenditures. If, as was suggested by Senator Douglas (Democrat-Georgia), nursing homes were "having an increasing importance in the care of the aged" (U.S. Senate, 1956, p. 13092), then nursing homes were responsible for a significant and increasing share of the health care expenditures for OAA recipients and were a harbinger of future spending trends for the Medicaid program.

Another harbinger of the future is the prescient statement of Senator Martin (Republican-Pennsylvania) who predicted the future track of incremental change. According to the Senator,

Once a separate fund has been established with the "Disability Insurance" label, it will be argued that temporary disability insurance benefits, hospitalization benefits, and other health benefits are not significant new departures. A full-scale health insurance program is the possible result after a few years' time.

Thus, disability benefits—particularly with the new feature of the separate health benefit fund—are the beginning of an almost inevitable chain of events. And yet, under the scheme of the George amendment [disability insurance], this is done merely by increasing the familiar Social Security tax. The real issue is not presented clearly and openly to the American people—namely, whether we wish to start down the Government health insurance road by the imposition of new compulsory taxes. (U.S. Senate, 1956, pp. 13053-13054)

Although the Senator's statement focused on the insurance side of the ledger (i.e., the eventual passage of Medicare Part A insurance for hospitalization and Medicare Part B for health care provided outside of the hospital setting), the incremental argument also applies to the subsequent changes in

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the public assistance health care provisions. Given the previously discussed gradual expansion in the federal financing of public assistance health care programs, Kerr-Mills, which will be addressed in the following section, and Medicaid were incremental expansions of the medical vendor payment programs established in the 1950s.

The preponderance of evidence therefore indicates that the Federal Government's role in financing health care gradually evolved from the toehold provided by the Social Security Act of 1935's public assistance matching formulas. It is also apparent that the Federal Government's expanding role was a function of members of Congress endeavoring to minimize the demands on their state's resources by proposing matching formula revisions that would enable their states to shift an increasing share of the health care financial burden to the Federal Government.

REGIONAL CLEAVAGES ARISING FROM THE SOCIAL SECURITY ACT OF 1935

The Social Security Act of 1935 not only established a toehold for the growth of federal health care expenditures but also established eligibility standards that determined regional patterns for the percentage of citizens aged 65 and older who received OASI benefits. The unintended regional impact was a function of abundant caution, i.e., President Roosevelt's warning concerning "the importance of "avoiding" any danger of permanently discrediting the sound and necessary policy of Federal legislation for economic security by attempting to apply it on too ambitious a scale before actual experience has provided guidance for the permanently safe direction of such efforts" (U.S. House, 1949, p. 13820). The legislation establishing OASI therefore limited eligibility to groups for which there was adequate documentation and that would be most likely to qualify for benefits, i.e., individuals who were full-time employees and worked most of the year so that they would fulfill the eligibility requirement within a reasonable amount of time (Smith & Moore, 2009; U.S. House, 1950; U.S. Senate, 1950). The primary group that fulfilled these prerequisites was industrial workers. Due to President's recommendation to gain administrative experience before changing eligibility requirements and Congress's subsequent focus on World War II (Advisory Commission on Intergovernmental Relations, 1980), the eligibility criteria were not appreciably altered until the enactment of the Social Security Act Amendments of 1950 (U.S. House, 1950; U.S. Senate, 1950).

The regional implications of limiting eligibility primarily to industrial workers are reflected in the data contained in Table 5. In 1949, the greatest percentages of individuals aged 65 and older who received OASI payments occurred in the industrial Northeast, Mid-Atlantic, East North Central and Pacific Regions of the country while the lesser percentages occurred in the Southern and West North Central Regions. As experience with the OASI program increased and members of Congress endeavored to cover a greater share of their constituents, eligibility standards were liberalized during the 1950s.

The effects of liberalizing the OASI eligibility criteria are evident in the increasing share of elderly citizens who received OASI benefits and the dramatic reduction in the interstate variation of the percentage of elderly citizens who received OASI benefits. More specifically, the data in Table 5 indicate that the percentage of elderly citizens receiving OASI benefits increased from 16.0 percent in 1949 to 63.8 percent in 1960 and 74.5 percent in 1964. During the same period, the coefficient of variation, which measures the extent of variation, declined from .385 in 1949 to .102 in 1960 and 0.076 in 1964. Although 2010 is beyond the study's scope, it is also noteworthy that the percentage of older individuals who received benefits rose to 89.4 percent while the coefficient of variation fell to .041. The data therefore

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Table 5. Per capita income in 1950 and number of social security beneficiaries per 1,000 aged population for selected years (1949, 1953, 1956, 1960, and 1964), by state

State	Per Capita Income	Aged Social Security Beneficiaries Per 1,000 Aged Population, End of				
	1950	1949	1953	1956	1960	1964
United States	1510	160	338	479	638	745
Alabama	909	106	250	353	540	674
Alaska	2400	140	394	509	586	531
Arizona	1367	135	333	462	591	742
Arkansas	847	77	226	325	561	695
California	1877	189	390	515	621	733
Colorado	1521	129	299	431	565	694
Connecticut	1891	247	435	608	716	795
Delaware	2075	193	389	554	677	812
Florida	1304	162	421	546	631	747
Georgia	1065	92	222	328	512	651
Hawaii	1429	193	365	496	645	760
Idaho	1329	114	300	432	680	779
Illinois	1831	173	347	489	657	746
Indiana	1524	159	349	512	702	798
Iowa	1532	94	247	388	642	755
Kansas	1463	97	254	403	620	725
Kentucky	990	101	251	377	614	733
Louisiana	1117	99	234	332	456	603
Maine	1195	201	440	575	712	797
Maryland	1642	164	349	498	608	722
Massachusetts	1656	230	435	601	680	758
Michigan	1718	183	384	545	719	812
Minnesota	1437	114	284	424	635	739
Mississippi	770	54	165	262	529	669
Missouri	1427	121	283	431	605	724
Montana	1654	114	276	398	654	760
Nebraska	1560	83	227	376	633	751
Nevada	1991	157	329	572	583	748
New Hampshire	1348	213	439	580	719	811
New Jersey	1802	229	433	609	709	792
New Mexico	1204	73	219	334	525	651
New York	1858	204	401	569	685	769
North Carolina	1077	103	236	348	628	757
North Dakota	1360	46	154	274	643	783

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Table 5. Continued

State	Per Capita Income	Aged Social Security Beneficiaries Per 1,000 Aged Population, End of				
	1950	1949	1953	1956	1960	1964
Ohio	1608	184	367	513	661	761
Oklahoma	1144	76	223	328	518	660
Oregon	1657	201	421	575	709	804
Pennsylvania	1552	214	409	559	686	783
Rhode Island	1553	278	486	635	736	810
South Carolina	925	91	215	313	565	699
South Dakota	1283	56	189	327	634	750
Tennessee	1028	89	230	347	568	710
Texas	1363	84	226	351	530	673
Utah	1348	135	318	485	640	734
Vermont	1169	161	348	489	676	789
Virginia	1257	119	278	424	609	726
Washington	1721	195	405	540	671	774
West Virginia	1056	166	367	488	660	761
Wisconsin	1506	151	342	497	701	799
Wyoming	1719	125	277	410	631	722
Coefficient of Variation	0.233	0.385	0.265	0.219	.0102	0.076

Source: Social Security Administration. 1956, 1960, 1964. Social Security Bulletin, 19(12), 23(11), 27(12), Individual beneficiaries: Number of aged beneficiaries receiving monthly benefits per 1,000 population aged 65 or over, by State, at end of (year).

U.S. Census Bureau. 2014. Median family income by State: 1959, 1969, 1979, 1989, and 1999.

indicate that most of the increase in the percentage of elderly citizens receiving OASI benefits and most of the decrease in the interstate variation of benefits occurred during the 1950s.

The preceding regional patterns were also reflected in the distribution of per capita income. Although the per capita incomes of northern industrial states were more widely dispersed among the top three quartiles of states than was the case for the percentage of elderly citizens receiving OASI benefits, the Southern states dominated the lowest quartile for both measures. The relatively small percentage of elderly citizens receiving OASI benefits meant the Southern states were able to shift a lesser percentage of their OAA clients to the OASI rolls than was the case in other parts of the country. Since OAA was partially funded by the states while OASI was funded entirely by the Federal Government, the shift of a relatively small proportion of the OAA clients meant that the Southern states were also able to transfer a relatively small share of the OAA financial burden to the federal OASI program. When the ability of Southern states to offload a part of the fiscal burden is combined with their less than average per capita incomes, it is evident that the states with the smallest tax base and associated capacity to fund public services also received less fiscal relief from the transfer of OAA clients to OASI rolls than was the case for their wealthier, northern industrial counterparts.

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The implications of the regional patterns were voiced by Southern Members of Congress. During the Senate debate concerning the Social Security Act Amendments of 1956, Senator Long (Democrat-Louisiana) noted that

in highly industrialized States, most of the workers are covered by OASI, whereas, on the other hand, in many of the agricultural States, and particularly in quite a number of Southern States, only a small percentage of the people are covered by the social-security system, and that situation also enters into the overall picture. In many [Southern] States with low per capita income, the economy still suffers from the after effects of [post-Civil War] reconstruction days. In some of those States many people were born in poverty, and have very limited resources. Therefore more welfare assistance is needed, of course, in comparison with the amount of welfare assistance needed in wealthy States. (U.S. Senate, 1956, pp. 12875-12876)

[The low per capita incomes also means that] it is those same States which have the greatest difficulty in providing essential services of State government and raising sufficient revenues to provide adequately for the needy within their boundaries. (U.S. Senate, 1956, p. 12671)

Six years earlier, Representative Elliot (Democrat-Alabama) observed that

the coverage of the Social Security Act must be expanded. This is shown by the fact that in all of the State of Alabama with its 3,000,000 people, there are only 15,000 persons now drawing old-age pensions [OASI] under the Social Security Act. As contrasted with this figure we have some 71,000 people now receiving old-age assistance through the county and State departments of public welfare. (U.S. House, 1950, p. 13956)

A similar perspective was raised by Representative Curtis's (Republican-Missouri) questioning of Representative Boggs (Democrat-Louisiana): "Why is it that Louisiana has 8 out of 10 people on OAA, when the national average is about 2 out of 10?" (U.S. House, 1950, p. 13960).

Due to the Southern states being able to shift a smaller portion of their OAA clients to the OASI rolls and thereby accruing less fiscal relief than the northern industrial states, the regional disparities set the stage for the next iteration of federal health care policy: the Kerr-Mills component of the Social Security Act Amendments of 1960.

THE SOCIAL SECURITY ACT AMENDMENTS OF 1960

The political viability of national health insurance was set during the first half of the 20th Century. President Woodrow Wilson was the first President to propose the establishment of national health insurance (Patel & Rushefsky, 2006). Following a 20 year hiatus, health insurance was on Presidents Roosevelt and Truman's agendas. However, the combination of government policies and charges of socialized medicine during the McCarthy era reduced its political salience. More specifically, the imposition of wage and price controls during World War II forced employers to compete for scarce labor on the basis of benefits and resulted in an increasing share of the workforce securing employer-provided health insurance. The share of workers covered by employer-provided insurance was also boosted by federal tax laws

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that enabled employers to write off part of their health care insurance costs. Due in large part to these government policies, the percentage of public and private employees with hospitalization coverage rose from 48.7 percent in 1950 to 68.9 percent in 1960. During the same period, increases of approximately 30 percentage points were achieved for surgical and regular medical insurance coverage (Kolodrubetz, 1972). The growing pervasiveness of employer-provided health insurance, in conjunction with charges of socialized medicine during the McCarthy era, significantly diminished public support for national health insurance coverage for working people and their families. However, due to the number of workers who lost their health insurance coverage upon retirement, health insurance advocates shifted their attention to elderly citizens (Patel & Rushefsky, 2006).

The pivot toward the elderly was also motivated by the increasing share of voters who were elderly and society's positive view of the age group. Between 1950 and 1960, the percentage of Americans who were aged 65 and older rose from 8.1 percent to 9.2 percent while the share of people between the ages of 19 and 65 declined. Due to these demographic shifts, the percentage of voting age people who were elderly increased by slightly less than three percentage points (Infoplease, 2014). The clout generated by their greater numbers was enhanced by the fact that they were more likely to vote than their younger counterparts and, because of their lifetime of hard work and sacrifices, were prone to be viewed positive terms. Due to these characteristics, the elderly possessed the political clout to secure a greater share of government resources and society was likely to contend that they deserved the additional benefits (Schneider & Ingram, 1993).

Although the changing political landscape led three Democratic presidential candidates from northern states (Kennedy, Humphrey and Symington) to propose health insurance for OASI beneficiaries (Sundquist, 1968), the probability of enacting a program in the early 1960s was modulated by regional schisms. Due to the existence of safe districts and the role of seniority in selecting committee chairs, Southern members of Congress had sufficient longevity to secure key committee and leadership positions. In 1960, four of the five Congressional leaders represented Southern states. The Speaker of the House Sam Rayburn and Senate Majority Leader Lyndon Johnson were from the state of Texas while the chair of the House Committee on Ways and Means Wilbur Mills and the chair of the Senate Committee on Finance Harry Byrd represented the states of Arkansas and Virginia, respectively.

Representatives Mills and Rayburn and Senator Johnson had strong incentives to pursue additional federal funding for medical vendor payments instead of establishing a new health insurance program. The data in Table 5 indicates that their home states were among twenty states with the lowest median household incomes. Although the rate of decline in OAA caseloads for the period 1950 to 1960 was slightly greater in the state of Arkansas than nationwide (16.5 percent versus 15.5 percent), more than one-quarter of the elderly citizens in Arkansas and Texas continued to receive OAA benefits (Social Security Administration, 1951; Social Security Administration, 1960; United States Census Bureau, 1968). Due to these factors, the states of Arkansas and Texas had less than the average tax base (incomes) to finance government programs but were among the eight states with the highest ratios of OAA caseloads to elderly citizens.

The incentives to support an expansion of medical vendor payments were further enhanced by several political factors. The first relates to the relatively weak unions. Since the states of Arkansas and Texas were among the bottom ten states for the percentage of nonagricultural union members (Hirsch, Macpherson, & Vroman, 2001), the unions were unable to exert significant political pressure for the adoption of health insurance. The second factor involved the AMAs vehement opposition to the adoption of health insurance but support for medical vendor payments. The AMA House of Delegates Proceedings suggest the

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divergent positions were a function of the extent to which participation in the programs was voluntary vs. mandatory, whether the programs were state or federally administered, and the extent to which doctors were included in the promulgation of rules as well as program oversight (American Medical Association, 1961). The AMA pronouncements and Arkansas Medical Society correspondence with Representative Mills suggest an additional rationale. In order to minimize the validity of the unmet need argument, the AMA encouraged its members to provide charity care. Although the option was feasible for physicians serving areas with relatively few poor people, it was not feasible for those who served areas with high proportions of people who, due to their low incomes, were unable to pay their medical bills without assistance. Medical vendor payments therefore were a mechanism for enhancing the financial viability of practices with relatively high percentages of low income patients. It is for this reason and the desire to provide assistance to indigent elderly people who "really need help" paying their health care bills that the Arkansas Medical Society unanimously supported medical vendor payments (Mills, personal communication). The final factor is the strong opposition of Southern voters to the expansion of federal power. Lawmakers who represented the states of Arkansas and Texas therefore tended to support the medical vendor programs that were state administered and therefore more palatable to their constituents than a health insurance program that would be administered by the Federal Government.

The policy implications of the preceding factors were brought into focus by the Constitution of the United States and House committee jurisdictions. Given the constitutional requirement that legislation such as medical vendor payments and health insurance must begin in the House of Representatives (U.S. Constitution. Art. I, sec. 7) and the programs were within the jurisdiction of the House Committee on Ways and Means, House Speaker Rayburn (Democrat-Texas) and committee chair Mills (Democrat-Arkansas) were in a position to be the gatekeepers for health care legislation. Their capacity to control the flow of health care legislation was enhanced by the composition of the Ways and Means Committee. The committee, in more specific terms, consisted of 10 Republicans and 7 Southern Democrats who were prone to oppose health insurance and only 8 Democrats who were likely to support the legislation. Representative Mills was able to use his persuasive powers and the committee members' policy preferences to gain support for his recommendation that a subcommittee could investigate and study the administration of existing laws but could not consider or hold hearings on health care legislation. Since subcommittee member Forand (Democrat-Rhode Island) was a proponent of health insurance and introduced a bill during each session of Congress, the action was clearly intended to prevent him from developing a bill in subcommittee and sending it to the full committee for consideration (Peters, 2004).

The legislative tactic was effective until Representative Mills and Rayburn recognized that health insurance was becoming too popular for them to continue blocking legislation that would benefit the elderly (Peters, 2004). At this point, they had two options. The first was to advance the Democratic Party's agenda by passing health insurance legislation that President Eisenhower was prone to veto several months before the 1960 election and thereby virtually guarantee the election of the Democratic presidential nominee and a greater number of Democratic Representatives and Senators (Congressional Quarterly Almanac, 1960; Congressional Quarterly Weekly Report, 1960). The second was to advance their state's interests and political philosophy by developing an alternative to health insurance that would enable them to claim they were addressing the health care needs of elderly citizens and, in the process, derail efforts to establish a health insurance program for OASI beneficiaries. Due to the previously described political factors and the limited number of their constituents who would immediately benefit from the establishment of a health insurance program, Representatives Mills and Rayburn decided to use their position as legislative gatekeepers to enact an expansion of the medical vendor program (Peters, 2004).

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The capacity of Representatives Mills and Rayburn to control the legislative process was not diminished after the legislation was reported out of committee. Due to the tradition of sending Ways and Means Committee legislation to the House floor under a closed rule and the Speaker's ability to influence the House Rules Committee, the rule under which the House considered the legislation prohibited House members from introducing amendments (Peters, 2004). The actions of health insurance proponents therefore were limited to voicing their desire to establish a health insurance program and their displeasure with the prohibition against introducing amendments that would add health insurance to the bill. When casting their votes for passage, the rule also limited their options to possibly killing the bill by voting against it or voting for the bill in the hope that the Senate would add health insurance provisions to the legislation (U.S. House, 1960).

Unlike the proceedings in the House committee and on the floor, members of the Senate Committee on Finance had an opportunity to vote on an health insurance amendment. Of the 17 committee members, six Republicans joined six Democrats—five of whom represented Southern states and one was from an industrial State—to oppose the amendment while one Southern Democrat and four Democrats from other parts of the country supported the measure. During the committee's deliberations, Senator Long (Democrat-Louisiana) introduced an amendment to raise the maximum federal match rate for the second part of the OAA matching formula. Since the federal match rate for this part was inversely related to a state's median income, the proposal to increase the federal match rate for low income states from 65 to 80 percent while retaining the federal match rate of 50 percent for high income states meant that the flow of federal funds to low income Southern states would expand by 21 percent while the rate of increase for other regions of the country would be in the eight to nine percent range (Peters, 2004).

Senator Long's effort to significantly increase the flow of federal funds to his and other Southern states was based on the fact that Louisiana had the highest percentage of elderly citizens who were receiving OAA payments (51.8 percent versus the national average of 14.2 percent) and the lowest percentage of elderly citizens who were receiving OASI benefits (45.6 percent versus the national average of 63.8 percent) (United States Department of Health, Education, and Welfare, 1960). It was also based on the fact that one-half of the state's patient days were provided by state-subsidized hospitals. The proposed hike in the federal match rate therefore was intended to defray above average OAA costs emanating from the state's inability to shift a larger share of the elderly population from the state-federal OAA program to the federally financed OASI program and the rising cost of providing health care for Louisiana's elderly population (Peters, 2004).

THE SOCIAL SECURITY ACT AMENDMENTS OF 1965

The literature suggests President Johnson's 1964 landslide victory facilitated the establishment of the Medicare and Medicaid programs in two respects. First, it enabled President Johnson to claim he had a mandate to enact a major component of his Great Society program: health insurance for OASI beneficiaries. Second, Johnson's coattails carried new Democrats into the House and Senate: Democrats who were beholden to Johnson for their election and therefore were more likely to support his agenda (Johnson, 1971; Patel and Rushefsky, 2006). The data also suggest the legislative outcome was affected by a regional shift in the number of seats occupied by Democrats. Due to redistricting that reflected a westward shift of the population and the 1964 general election, the Democrats lost 13 seats in the Southern states that tended to oppose health insurance but picked up 30 seats in states that were more

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favorable to Medicare: 15 in the industrial states and 15 in the western states. However, the electoral effect on the Senate was less beneficial. The Democrats lost two Southern seats and three western seats but gained five industrial state seats—a net gain of only two seats in states that tended to be supportive of health insurance (Peters, 2004).

An additional, readily apparent factor was the change in the White House's occupant. President Eisenhower who opposed an expansion of federal power and endeavored to return programs and power to the states (Advisory Commission on Intergovernmental Relations, 1980) was replaced by President Johnson who was a strong proponent of federal policy initiatives. President Johnson also possessed the political skills to neutralize the potential roadblocks imposed by Southern committee members and secure the support of key Republicans. Although the House Ways and Means Committee chair recognized that Johnson's landslide victory made it impossible to block passage of the Medicare legislation, the Senate Finance Committee chair Harry Byrd (Democrat-West Virginia) continued to oppose the legislation. After the House Committee on Ways and Means reported the legislation, President Johnson summoned the Congressional leadership to the White House for the purpose of reviewing the bill's status. Following the session, he escorted the leadership into the Cabinet Room where the media was waiting. President Johnson proceeded to ask Finance Committee chair Byrd whether there was anything "that you know of that would prevent that [a thorough hearing] coming about in a reasonable time?" When Senator Byrd responded that there was "Nothing in the committee now," Johnson surmised that "when the House acts and it is referred to the Senate Finance Committee, you will arrange for prompt hearings and thorough hearings?" Under the circumstances, Senator Byrd has no option but to respond in the affirmative and thereby eliminate the option of bottling up the bill in his committee (Johnson, 1971, p. 217).

On the House side, President Johnson understood that he needed the support of a key Republican to secure a sufficient number of Republican votes to offset the votes of Southern Democrats who would oppose the legislation. Since a key Republican lawmaker was interested in securing NASA jobs for his Ohio district, Johnson contacted the NASA Administrator and communicated in clear terms that the administrator had to satisfy the lawmaker's demands. The president's skillful use of pork barrel politics therefore facilitated the enactment of the health insurance legislation (Johnson, 1971).

It is also noteworthy that the final legislation combined Johnson's program of insurance for hospitalization with the Republicans' proposal for the coverage of non-hospital medical services and the Southern states' preference for a Medicaid program that would serve the needs of their relatively large populations of poor people. Due the merger of these programs into one piece of legislation, the Social Security Act Amendments of 1965 was the culmination of incremental changes that were initiated by the Social Security Act of 1935. As previously suggested by Senator Martin (Republican-Pennsylvania), Medicare was incremental because it was an additional example of grafting a new program onto the OASI system (U.S. Senate, 1956). And Medicaid was an incremental expansion of the medical vendor and Medical Assistance for the Aged (MAA) programs.

CONCLUSION

Even though the Roosevelt Administration's decision to remove health insurance from the social security legislation appeared to doom efforts to engage the Federal Government in the financing of non-military physician and hospital services, the public assistance federal matching formulas provided a toehold for incrementally achieving the goal. The first exploitation of the toehold occurred in 1950 when Congress

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enabled the states to use the public assistance matching formulas to secure federal funding of medical vendor payments. Congress's next step involved the establishment of a separate matching formula for medical vendor payments and, in 1960, liberalizing the medical vendor program's eligibility criteria to create the Medical Assistance for the Aged (MAA) program. President Johnson's 1964 landslide electoral victory set the stage for the establishment of the Medicaid and Medicare programs that were extensions of health care programs for indigent citizens and Social Security programs, respectively.

The evidence therefore indicates that the evolution of American health care policy was a function of incremental change. It is also evident that the impetus for each of the revisions that preceded the establishment of the Medicaid and Medicare programs was an outgrowth of the states' desire to achieve their short-term policy goals. Even though officials in the Truman Administration advocated the establishment of separate public assistance and medical vendor matching formulas, Congress chose in 1950 to forgo the advice and simply add medical vendor payments to the public assistance matching formulas. During the ensuing two years, the fact that only 15 states established federally approved medical vendor programs suggests that the states and their Congressional delegations did not perceive a need for separate medical vendor programs and matching formulas. They were interested in relatively small matching formula adjustments that would assist them in setting up health care programs for public assistance recipients or using the additional federal funds to expand existing programs.

During the ensuing six years, however, the public assistance formulas prevented an increasing number of states from adequately providing for the income support and health care needs of their public assistance recipients. In an effort to address the problem, Congress approved the previously rejected proposal to establish separate medical vendor matching formulas. Both sets of public assistance formula revisions suggest that the states' financial needs are a useful barometer of the magnitude of change Congress is willing to support; the greater the need the greater the liberalization of the matching formulas' scope.

Congressional approval of the MAA program in 1960 indicates that an essential, additional element is control of the legislative process. Due to the unintended effects of the initial OASI eligibility criteria, a relatively large percentage of workers in the New England, Northeastern, North Central, and Pacific states were receiving OASI benefits and therefore would have benefited from the establishment of a health insurance program for OASI recipients. However, individuals aged 65 and older who resided in the agricultural states of the South were disproportionately reliant on public assistance and therefore would not have benefited from health insurance for OASI beneficiaries. As public support for health insurance for OASI recipients increased, Southern control of key Congressional leadership positions and the effective use of House rules enabled Southern Congressional leaders to address their constituents' needs by shepherding legislation through Congress that expanded the medical vendor programs rather than following public opinion and establishing a health insurance program for OASI recipients.

Although the 1964 general election produced conditions that were conducive to the establishment of a health insurance program for elderly citizens, the preceding analysis indicates that passage was facilitated by the evolution of federal health care funding for indigent individuals and the establishment of the Social Security disability insurance program during the 1950s. By the time Congress considered legislation to create the Medicaid and Medicare programs, federal financial participation in health care and the precedent for grafting programs and earmarked taxes onto OASI were established. The magnitude of change engendered by the Medicaid and Medicare programs, and the related challenge of securing Congressional approval therefore was less than would have been the case in the absence of the incremental expansions of health care and Social Security programs.

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The evidence therefore indicates that the evolution of federal matching formulas and programs was a function of the states' needs during the period in which legislation was being considered. Since the needs of the states tended to evolve at a relatively slow pace, the process was predisposed to consider and approve small incremental changes in policy. It was these incremental changes that fostered greater change over time than fundamental change. They also facilitated the enactment of initiatives such as health insurance that were initially defined as fundamental change but, at the time of Congressional approval, were incremental.

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KEY TERMS AND DEFINITIONS

Aid to Dependent Children: Public assistance program for indigent children and their caretakers.

Aid to the Blind: Public assistance program for indigent individuals who are blind.

Federal Reimbursement Ceilings: The maximum amounts of public assistance and health care benefits that are eligible for federal matching funds.

Federal Share: Percentage of public assistance and medical benefits that is defrayed by the Federal Government and defined by federal statute.

Medicaid: State-Federal health care program for indigent individuals, primarily public assistance recipients.

Medical Vendor Payments: State-Federal public assistance health care programs that preceded Medicaid.

Medicare: Federal health care program for Social Security recipients.

Old Age Assistance: Public assistance program for indigent, elderly individuals.

Public Assistance: State-Federal income support programs for indigent individuals.

Social Security (OASI): Federal payments to insured individuals who are retired, disabled or offspring of insured, deceased parents. Although the OASI program became OASDI when disabled individuals were added to the list of eligible recipients, OASI is used throughout the chapter.

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Chapter 67
Change through Experience:
How Experiential Play and Emotional Engagement Drive Health Game Success

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ABSTRACT

The following chapter presents an overview of the research and practice related to the application of theories in games for health. In particular, theoretical frameworks that embrace experiential play and emotional involvement are discussed, and their ability to dictate game design and evaluation are explored. A series of evidence-based games for health are presented as examples of interventions that have applied theory during game design and have shown success. By embracing theoretical concepts in health games, the present chapter will advance one's understanding with respect to how health games contribute to behavior change, patients' self management of care, or adherence to care. The chapter concludes with some potential implications for future research in the context of health game design and evaluation.

INTRODUCTION

In the past decade, health digital games and gamified interventions have drastically evolved, embodying Sir Arthur C. Clarke's maxim: "Any sufficiently advanced technology is indistinguishable from magic." Close to magic, game-based applications have led to vast opportunities for health communication and health behavior change. With the immergence of games through personal computers and mobile devices, researchers and designers have begun to design, test, and implement game-based interventions for health promotion and disease prevention.

Digital games have become successful vehicles for health promotion, therapy, and disease prevention (Ritterfeld & Weber, 2006). In fact, in the context of a wide variety of health issues, digital games and gamified interventions have shown several positive outcomes. Evaluation studies have highlighted the success of such interventions as they improved physical activity (Baranowski, Baranowski, O'Connor, Lu, & Thompson, 2012; Lyons, Tate, Komoski, Carr, & Ward, 2012), diet (Baranowski, 2013), medica-

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tion adherence (Kato, Cole, Bradlyn, & Pollock, 2008), psychological and mental health (Mert et al., 2013; Procci, Bowers, Wong, & Andrews, 2013), and smoking prevention and cessation (Buller et al., 2008; Prokhorov et al., 2008).

Despite the vast evidence of the positive effect of health games on health promotion and behavior change (Noar & Harrington, 2012), conceptual frameworks that explicate their success deserve attention. One can easily wonder, how does fighting cancer cells with a nano-robot in a cancer patients' body improve medication adherence? Also, how does collecting fruits and vegetables to save a kingdom governed by a ruthless unhealthy king encourage fruit and vegetable intake? The answer lies in the psychosocial frameworks that connect in-game behavior to real-life improvement in health knowledge, attitude, and practice. In fact, several health game scientists have stressed on the role of psychosocial concepts that explicate changes in health outcomes (Baranowski, Buday, Thompson, & Baranowski, 2008; Kharrazi, Lu, Gharghabi, & Coleman, 2012; Lu, Baranowski, Thompson, & Buday, 2012).

A handful number of organizations such as the Robert Wood Johnson Foundation, Games for Change, and Games for Health have worked successfully to promote health promotion among gaming designers and developers. However, several games that incorporate a health-related topic or tackle a particular health issue are not necessarily designed and disseminated based on behavioral science and psychosocial influence. In a thorough review of the literature on games for health, Kharrazi and colleagues (Kharrazi et al., 2012) systematically identified 149 peer-reviewed publications involving a gaming intervention for health. Of all publications, only 18.8 percent applied a behavioral change theory that drives the design of the game. Looking specifically at the exercise and rehab games, only 5 percent were theory-driven.

Considering the important role of theory in driving health game design, the present chapter will advance one's understanding with respect to how health games contribute to behavior change, patients' self management of care, or adherence to care. First, a thorough definition of games for health is provided to account for all its potential applications, and a distinction is made between health games and gamified health interventions. Then, several behavior change theories are inspected, highlighting four main concepts that drive the success of health games: experiential play, social modeling, effectance, and emotional involvement. These concepts' ability to drive health outcomes is thoroughly outlined through a series of evidence-based and theory-driven studies. In particular, their ability to mediate between game elements and health outcomes is presented, allowing a wide theoretical framework in games for health research. By embracing such concepts in health games, game designers, social scientists, and public health professionals can find common grounds that would allow them to successfully collaborate in order to bring about the design, development, and implementation of successful games for health.

BACKGROUND

Most researchers and game designers would agree that a game is a problem-solving activity (i.e., including a goal and a set of rules) that is approached with a playful attitude (i.e., with curiosity, creativity, and enjoyment; Ferguson, 2012; McGonigal, 2011; Schell, 2008). However, this simple definition does not highlight several specific characteristics that form games. Based on a series of conceptualizations presented by several researchers and game designers, a game can be defined as a physically and/or psychologically engaging, self-rewarded activity that uses only means permitted by specific rules and obstacles in order to uncover riddles and apply strategies that move players toward intrinsically motivated objectives (Ferguson, 2012; Suits, 1967; Wixon, 2006). This definition highlights several key elements

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that describe a game. Similar to the pieces of a puzzle, such key elements complete a picture of what a game is. First, physical or psychological engagement is crucial in a game. For instance, chess players invest a lot more psychologically than physically during game play in order to solve strategic moves and reach victory. On the other hand, "hide and seek" is a game that demands physical engagement in order to hide from or seek other players. In addition to engagement, game play requires the presence of a self-rewarded activity. Self-reward is key because it does not only highlight the players' intrinsic motivation to play but also their perception to have a personal stake when taking part in an entertaining activity. Third, games involve rules and obstacles provided by the game designer. Rules (e.g., the need to have a certain weapon in order to fight a specific enemy) and obstacles (e.g., the need to surpass certain objects in order to reach the enemy) form new norms for the players by creating boundaries of what can and what cannot be achieved. When players are presented with a certain scenario that requires specific rules to be followed, it creates virtual norms that the players will have to follow. Such boundaries allow fairness during multiplayer games and add to the players' psychological engagement in order to strategically overcome obstacles in the context of these specific rules. Ultimately, players are able to uncover riddles that move them toward certain objectives. As a result of obstacles, players find themselves unable to predict the next steps in the game, making future events seem a mystery.

On the other hand, gamified health interventions are non-gaming systems in which game elements were embedded in order to improve one's experience (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011b). Through *gamification,* game designers include game elements in the context of non-gaming environments (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011a). By taking advantage of elements such as rules, riddles, objectives, and rewards, non-gaming activities become gamified. As a result of their gamification, such activities become able to produce gaming-related affordances such as emotional involvement and enjoyment, in order to ultimately reach health outcomes (Terawaki et al., 2013). Considering such definitions, games for health are those that take advantage of game elements in order to bring about health-related change. Ultimately, playfulness facilitates an improvement in health outcomes (Ferguson, 2012). A more thorough description and definition of gaming features that may be used for gamification can be found in McGonigal's book on games and social change (McGonigal, 2011).

This distinction between games and gamified interventions is crucial because it stresses on the difference in the designed features and the designers' intentions. Games are mainly designed to purposefully stimulate enjoyment and are self-sufficient in their ability to reach health outcomes. On the other hand, gamified interventions are primarily cognitive-based interventions that have been packaged with gaming elements in order to boost their effects on health outcomes.

With such conceptualizations in mind, what then defines health outcomes? In the context of holistic medicine and public health, it is important to study games for health as interventions that are able to address game players' health as a whole by tapping on physical, mental, and/or social well-being of both patients and healthy individuals. In a detailed editorial paper on the history and emergence of health games, Ferguson presents a list of potential health issues that are addressed by the *Games for Health Journal* (Ferguson, 2012). The health issues include, but are not limited to:

- Nutrition, weight management, and obesity;
- Disease prevention, self-management, and adherence;
- Cognitive behavior and mental and emotional health;
- Clinical training, simulation, diagnosis, and treatment;
- Rehabilitation and therapy.

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While such a list of health issues conveys an idea about the potential topics that games for health can address, two important dimensions of health outcomes must be considered from a holistic perspective. On one hand, games can reach several health-related psychosocial outcomes. With a variety of psychosocial effects, games may affect players' attitudes toward health, knowledge about health, health-related information processing, social influence concerning health, health behavior, and/or actual health status (Lieberman, 2001). On the other hand, games may be applied for different stages of disease prevention, depending on the intended population. At the *primary prevention* stage, games are designed to help healthy individuals gain knowledge and build new skills to avoid disease incidence. Examples of such game-based interventions for primary prevention are those for healthy eating and physical activity among at-risk children (Baranowski et al., 2012), and smoking prevention among non-smoker adolescents (Prokhorov et al., 2008). During *secondary prevention*, games are designed to answer to the needs of at-risk individuals who are at pre-clinical stages in order for them to reduce risky behaviors, make informed decisions related to screening, and cope with screening results. Examples of such game-based applications are smoking cessation interventions among smokers (Prokhorov et al., 2008) and dementia screening games (McCallum & Boletsis, 2013). Game-based interventions at the *tertiary prevention* stage are designed for newly diagnosed individuals who need assistance making health decisions, fighting stress and anxiety after diagnosis, and adhering to their treatment. Examples of game-based interventions for tertiary prevention are those for medication adherence (Kato et al., 2008), asthma and diabetes management (Lieberman, 2001), and stress management among patients (Bidarra et al., 2013; Ferguson, 2012). During tertiary prevention, games are also aimed to help patients cope with adverse psychosocial outcomes as a result of treatment and/or disease (Knox et al., 2011).

With a wide scope of contexts in which games for health may be applied, researchers have worked to understand the mechanisms by which game play is linked to health. Figure 1 presents a conceptual framework of dimensions of health outcomes in game-based intervention with referenced examples of games and gamified interventions.

CONNECTING GAME PLAY TO HEALTH OUTCOMES

Health Game Evaluation

While the term "health game" calls for a link between games and health, our understanding of such a connection is still primitive and deserves thorough investigation. By evaluating game-based interventions, scientists have been able to measure their actual impact and uncover some of the mechanisms that make games successful for public health.

While health games and gamified interventions are carefully crafted by game designers based on formative research (assessment of players' needs and preferences and the consideration of previous successful game designs), the evaluation of their design as it relates to health outcomes is crucial for several reasons. First, similar to a medication, a game for health needs to be approved by the scientific community so that it is not perceived as merely a toy, but an engine of healthy outcomes. By identifying the overall success of a game, public health professionals become confident implementing the game in their health care settings. As a result of preliminary success, a game becomes repeatedly implemented, readily available to the mass, and easily diffused. Second, the evaluation of health games may allow public health professionals to identify potential unintended effects before any wide implementation. By

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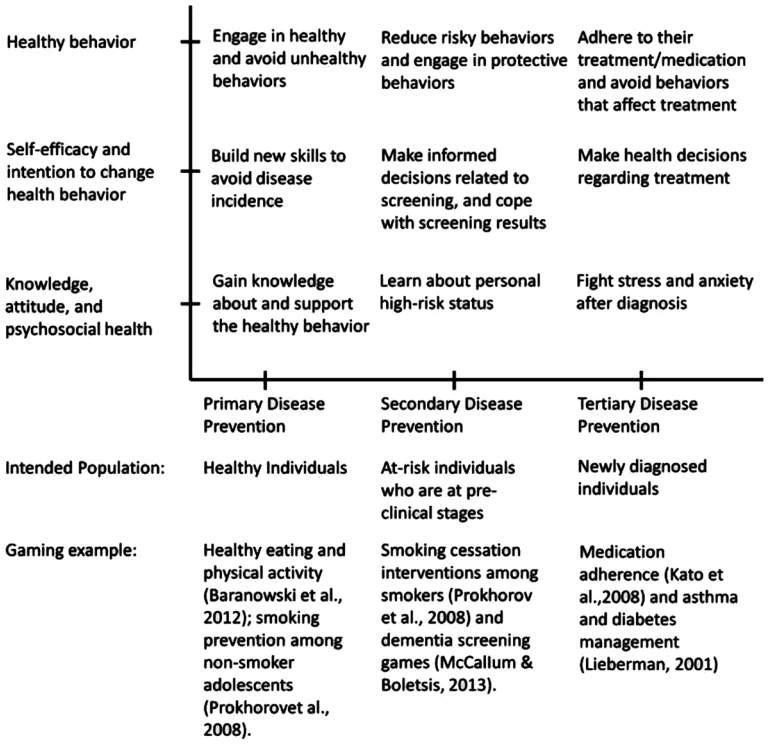
Figure 1. Dimensions of health outcomes in games for health



uncovering possible unintended outcomes, health professionals can predict side effects and attempt to avoid them. Finally, careful evaluation of health games allows evaluators to pinpoint specific gaming elements that are particularly successful and responsible for the observed health outcomes. As a result, evaluators may work in conjunction with game designers in order to refine the gaming intervention in order to boost its effects. Evaluation can be conducted by receiving the opinion of a sample of players that can provide evaluation with the quality of their personal experience with the game. Such a qualitative evaluation can be conducted through a series of focus group discussions and in-depth interviews.

Most evaluations of games in health promotion and disease prevention have been conducted through randomized controlled trials (RCT's). RCT's for health games have become routine methods of evaluation that help us understand the overall program efficacy and the strength of program effectiveness. The research literature refers to Sir Austin Bradford Hill's randomized trial as the first published RCT, evaluating the effect of streptomycin treatment on pulmonary tuberculosis (Hill, 1952). After Hill's publication, RCT became a universally accepted method of evaluation. In short, the RCT design involves the random allocation of individuals to one of two or more intervention conditions (Jadad, 1998). A health intervention may refer to any clinical or psychosocial strategy that may have an effect on participants' health status. Examples of interventions are preventive programs, promotional programs, screening programs, and treatment programs (Jadad, 1998).

Several games for health and gamified interventions have shown success after RCT evaluation. For instance, "Escape from Diab" and "Nanoswarm: Invasion from Inner Space" were video games for primary prevention designed to encourage healthy eating and physical activity behaviors among ten

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to twelve year-old youths at risk for type 2 diabetes. The games promote consumption of low energy dense nutrition and energy expenditure via physical activity. The two games are designed to be played on personal computers, and each game had 9 sessions and a minimum of approximately 40 minutes of game-play per session. In a randomized controlled study, it was found that children playing these video games increased fruit and vegetable intake by 0.67 servings per day. However, the two games did not increase water consumption or physical activity (Baranowski et al., 2011).

Another intensively studied game for tertiary prevention is "Re-Mission". "Re-Mission" is a third-person shooter game released in 2006 by an organization called HopeLab. The game was designed for adolescents and young adults who have cancer, in order to help them adhere to their medication. Players of the game control an avatar called Roxxi, and navigate in the virtual body of cancer patients to destroy cancer cells (Beale, Kato, Marin-Bowling, Guthrie, & Cole, 2007; Kato et al., 2008). The evaluation study randomized participating cancer patients to either "Re-Mission" play or a control game. In addition to an increase in cancer knowledge among participants, blood assays showed higher increase in medication adherence for "Re-Mission" players compared to players in the control group (Kato et al., 2008).

A third successful game was "Bronkie the Bronchiasaurus", a game designed to help pediatric patients who have asthma and diabetes avoid emergency hospital visits. In an evaluation study, players of the game reduced diabetes-related urgent and emergency visits by 77 percent after six months of game play. On the other hand, players of the control game (i.e., a game with no health content) did not change in their number of visits. Positive impacts were also found in clinical trials of games for asthma self-management (Lieberman, 2001).

One example of a successful game in a clinical application is a game designed for pain and discomfort distraction at the dental clinic. Due to stress-inducing experiences, patients tend to experience hesitation or resistance to visiting the dentist. In order to relief any stress induced by a dental visit, Bidara and colleagues pilot-tested a virtual reality game for dental patients. The game was found to be immersive, allowed patients to relax, and manage their stress. Such outcomes of game play were obtained with the patient being able to listen to the dentist and follow instructions when needed (Bidarra et al., 2013).

With the aim to improve psychosocial outcomes among children and adolescents, a video game that takes advantage of a biofeedback system was designed and evaluated by Knox and colleagues (2011). The game involved eight sessions on psycho-education and identification of anxiety triggers. Game evaluation revealed difference in anxiety and depression scores between game players and a control group (Knox et al., 2011).

Finally, a successful gamified intervention that has been evaluated is ASPIRE™ (MD Anderson Cancer Center, Texas), which stands for "a smoking prevention interactive experience." ASPIRE is designed to promote smoking prevention and cessation among adolescents (Prokhorov et al., 2008). The program is presented in the form of a website that provides high school students with health information, facts, and strategies to avoid tobacco, with hopes that the program leads to lower percentages in smoking initiation. The ASPIRE program has been evaluated through a long-term study funded by the National Cancer Institute and designed by Prokhorov and colleagues at the University of Texas MD Anderson Cancer Center (Prokhorov et al., 2008). A randomized controlled design evaluating ASPIRE at more than 15 public schools in Houston, Texas examined several main intervention outcomes such as self-reported smoking status, processes of change, nicotine dependence, and symptoms of depression. Other variables such as self-efficacy, knowledge, personal beliefs, and perception of parents' and peers' norms were also considered (Prokhorov et al., 2008; Shegog et al., 2004). As an immediate result of ASPIRE, smoking initiation rates were significantly lower in the experimental condition, compared to participants in the

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control group. At follow-up one year and a half later, results showed that significantly fewer participants began to smoke in the intervention group, when compared to the control group. Also, participants who experienced the ASPIRE program reported higher decisional balance against smoking and became less tempted to smoke during stressful situations (at 6-, 12-, and 18-months follow up; Prokhorov et al., 2008).

While intervention evaluations have shown how game-based interventions can improve health outcomes, such evaluations tend to treat a game as a single product. This perspective may have been applied mainly due to the medical origins of RCT's, when all participants in an experimental group are asked to follow a specific treatment or adhere to a medication regimen. A medication or a treatment is evaluated as one product because it is an entity that is expected to be universal among all participants in the experimental group. On the other hand, a game-based intervention involves a complex combination of features with different functions and health information content that are dynamic and dependent upon the player's actions during game play (Brendryen & Kraft, 2008). By evaluating a program as a single product, game scientists may neglect differences in the way players experience the game.

Ultimately, in addition to highlighting the overall success or failure of several health games, it is important to build a theoretical understanding of the players' experience that is responsible for such outcomes. Regardless of their findings, evaluators need to be able to interpret the mechanisms responsible for the outcomes. Such mechanisms form a series of psychosocial and communication theories and models that link the anatomy of games to health outcomes. Theories and models of behavior change are crucial for game design and effectiveness. Building on basic psychosocial and communication models of health behavior, the next sections of the chapter outline the mechanisms by which play experience can improve health and well-being.

THEORIES LINKING GAME ELEMENTS TO HEALTH

Researchers and evaluators have worked to identify the reasons behind the attained and unattained effects in order to find potential means of improvement during game design. Despite the proclaimed effectiveness of games for health, a thorough inspection of several RCT's indicates that some expected effects were not found to occur. For instance, the RCT for Re-Mission among cancer patients indicated that self-efficacy or knowledge increase did not mediate the relationship between game play and medication adherence. Also, after the RCT for the smoking prevention gamified program ASPIRE, results showed that the program was not successful with specific ethnic groups such as Hispanic adolescents. Such results make scientists wonder: What feature of Re-Mission is responsible for its success? And what is needed in ASPIRE so that it becomes effective with the Hispanic population?

With such questions in mind, evaluators discover the value in the study of the theoretical frameworks that explicate health game success. In other words, evaluators need to be able to interpret the source behind the outcomes in order to link game elements to health. A theory-driven design of games allows game designers and evaluators to interpret their findings effectively, even when the results show no intervention success. The following sections will describe some of the commonly used cognitive theories in games for health and explicate how game elements bring about the application of such theories in order to drive health outcomes.

One cognitive theory of interest that is applied in games for health is the social learning theory or social cognitive theory (SCT; Bandura & McClelland, 1977). The theory explains that learning takes place through *social modeling*, that is, by observing other people (e.g., virtual characters and avatars)

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act in a particular situation and modeling their behavior after exposure. In particular, the social learning theory has allowed researchers to explicate narrative effects by investigating social modeling of virtual characters and inspecting character-related psychosocial effects such as *parasocial interaction* (i.e., interaction and the building of relationships with characters), *homophily* (i.e., the likability of the character), and *identification with characters* (i.e., the perception that characters are similar to self). In addition, SCT stresses on the importance of self-efficacy. *Self-efficacy* to healthy behavior is a concept that describes one's belief in being capable to succeed in undergoing a healthy behavior. Interactive games that allow players to rehearse healthy behaviors can boost self-efficacy.

Another important cognitive theory that is mainly applied in persuasive messages is the theory of reasoned action (TRA). The theory highlights three main concepts: *behavioral intention* (i.e., one's intention to take a health action or make a healthy decision), *attitude* (i.e., one's belief that taking a healthy action is the right decision), and *subjective norm* (i.e., one's belief that society supports the healthy behavior and that it is socially acceptable; Montano & Kasprzyk, 2008). Interventions work to help individuals or patients perceive the norms to support a healthy action and allow them to have a positive attitude toward the healthy choice. As a result, their intentions to engage in healthy behaviors increase. In addition to attitude, intentions, and subjective norms, the theory of planned behavior (TPB) adds a fourth concept called perceived behavioral control. *Perceived behavioral control* is similar to self-efficacy and describes one's beliefs about having the necessary resources to perform a behavior (Ajzen, 1991). TPB's introduction of perceived behavioral control explains the importance of self-efficacy in driving health behavior change.

A fourth theoretical model applied in health games is the elaboration likelihood model (ELM). Richard Petty and John Cacioppo's (1986) ELM has extended our understanding of the persuasive process. In fact, the ELM is one of the most cited models in the persuasion literature, despite minor critiquing citations (Gass & Seiter, 2011). By applying the ELM, researchers embrace its ability to explain the effect of a message on *central processing* (i.e., cognitive processing, attention to message content, and opportunity for long-term attitude change) and *peripheral processing* (i.e., non-cognitive affective processing, attention to the messenger, attention to the quality of the message, and opportunity for short-term attitude change). Game designers can strategically design messages that stimulate peripheral processing as well as those that stimulate central processing in order to attain their intended outcomes.

When theoretical frameworks are considered in the evaluation of health games, most of such frameworks are built based on cognitive theories alone. According to the review by Kharrazi and colleagues on evaluations of games for health, the most commonly applied theories have been the SCT (42.9 percent) and the TPB (10.7 percent) (Kharrazi et al., 2012). Cognitive theories such as SCT and TPB stem from the KAP (Knowledge, Attitude, Practice) model of change, which assumes that individuals' knowledge and attitudes drive healthy practice (Valente, Paredes, & Poppe, 1998). The KAP model has been found to be useful during the evaluation of health communication campaigns, as it assists researchers in the framing of the health information provided by the intervention. However, the KAP model is limited because it does not consider player involvement or characteristics of the behavior (Chaffee & Roser, 1986). Also, cognitive theories highlight the content of health information but do not clarify how such information should be presented (e.g., what the gaming features need to be). Such a limitation becomes more prominent in the context of games for health because the ability of such theories to induce gaming-specific effects is not well considered.

While all concepts presented by such theories (e.g., knowledge, attitude, perceived risk, motivation, self-efficacy, and subjective norms) can be outcomes of game play, game play-related concepts must

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be examined in order to understand the link between game features and health. In particular, research has considered the role of narrative experience and experiential play in driving emotional involvement, and a feeling of presence inside the game (Ritterfeld & Weber, 2006). Such experiences may lead to changes in knowledge gain, attitudes, subjective norms, and self-efficacy, and ultimately drive disease management, treatment adherence, and healthy behaviors.

Narrativity

Narratives that are integrated in video games add immersive qualities to game play. *Immersion* into narratives occurs when players pay complete attention to the storyline presented by the game and become emotionally involved in the storyline. Storyline characters that shape certain events in a story form the main component of narratives and determine the players' tendency to be immersed in the story (Green, Strange, & Brock, 2003). By shaping storyline events, a character's decision can drive the player's decision during game play (Jacobs, 2002; Surmelian, 1968). This phenomenon allows the character to become a virtual source of health information (Drewnowski, 1997). In addition, a narrative plot decides the environment and the style in which a story is conveyed. The plot's main role is to influence the sequence of events that occur in the storyline, and ultimately create moments of suspense for the player. With unexpected suspenseful scenes, the player builds excitement and becomes eager to uncover new events and move forward with the game (Brown, 1987; Labov, 1972). As a result, narrativity becomes able to boost play frequency and replay (Baranowski, Maddison, Maloney, Medina Jr, & Simons, 2014).

Immersion stems from a narrative-based concept called *transportation* or *absorption*. Since the early 1990's, researchers have thoroughly investigated individuals' tendency to be absorbed or transported by a narrative-based message. As described for the first time by Gerrig (1993), transportation (i.e., absorption or engagement) induces the transported individual or traveler to go on a journey and return somewhat changed. Following Gerrig's description, Green and Brock (2000) presented transportation as a three-dimensional concept that involves emotional involvement, attention, and a lack of awareness of surroundings. During the narrative experience, when players are transported by a health message, they find themselves in a world where they do not only pay attention to the message, but also affectively experience every element that the message is trying to convey. As a result, their health-related beliefs and attitudes are reshaped with the help of the narrative. Transportation is a concept that is in accord with the ELM, since it is through peripheral processing that strong emotional involvement, attention, and lack of awareness of surroundings can cause attitude and behavior change (Hargie & Dickson, 2004).

In addition to the role of narrative transportation, narrative characters play an important role in games for health. The players' tendency to interact with virtual characters in a storyline may lead to narrative persuasion. First, the narrative becomes personally relevant to the player due to the player's intrinsic motivation to allow the character to win the game (Green, 2004; Green, Garst, & Brock, 2004). Second, players experiencing a narrative may begin to identify with the storyline characters who engage in healthy behaviors. As a result and in line with the SCT, virtual characters become role models that players would want to follow. As players perceive to have similarities with the characters, they begin to build confidence that they are able to engage in the same healthy behaviors of the characters (Kreuter et al., 2008; Maibach & Cotton, 1995).

One example of a video game that extensively uses narrativity is "Escape from Diab". The game's sessions involve several interactive activities intertwined with a dramatic storyline. The story of "Escape from Diab" involves a character called Deejay. Deejay is a soccer player that follows a healthy diet and

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exercises regularly. One day, Deejay falls into a parallel world where a ruthless unhealthy king imposes unhealthy eating on his city. Deejay's mission is to help a group of youngsters who live in that city and teach them about the importance of consuming fruits and vegetables. The narrative of the game links immersive game play to several health outcomes. A study by Lu and colleagues (2012) has found that immersion in the storyline of the game positively correlated with an increase in fruit and vegetable preferences, intrinsic motivation for water, self-efficacy to consume vegetables, and self-efficacy to engage in physical activity (Lu et al., 2012).

In addition to regular narrativity, interactive narrativity can be a powerful tool in games for health. Interactive narratives are those that allow players to determine the fate and decisions of the characters. Interactive narrativity allows players to become equipped with decision making skills related to health. With interactive narratives, players' interaction with the environment can lead to an alteration in the story plot (Ryan, 2006). Players' decisions drive the virtual characters' behaviors, and ultimately lead them on a new path that brings about certain consequences. Narratives that allow players to interact with the virtual world and characters foster self-efficacy and give players the ability to think for themselves, in order to trace story events, as well as health events (Ryan, 2006). Such freedom in narrative creation allows players to make health decisions in a virtual world and discover the potential consequences of their health decisions.

Experiential Play

Experiential play is characterized by players' ability to explore a gaming environment (Klimmt, 2009). During experiential play, players navigate in virtual environments and uncover information through their actions. Such an in-game behavior fosters discovery and facilitates learning. Unlike traditional learning methods that involve exposure to health information, experiential learning entails the experience of health information through personal or social exploration. For instance, driven by curiosity, "Re-Mission" players browse the environment and discover different gaming scenarios as they confront virtual cancer cells. Discoveries lead to the experience of consequences (e.g., cancer cell multiplication and attack), and ultimately allow players to transfer their experience from the virtual environment (i.e., the body of virtual patients) to real life (i.e., their own body; Fox, Bailenson, & Binney, 2009; Wang & Singhal, 2009).

Through health games that involve virtual environments, players have the freedom to experiment with virtual objects, embody certain characters, and solve virtually simulated problems that they may encounter in the real world. As a result of trial and error in a risk-free, active learning environment, players are able to understand how certain behaviors may be healthy (e.g., eating fruits and vegetables), while others may have negative consequences (e.g., accepting a cigarette from a friend; Taylor & Walford, 1972; Walljasper, 1982; Wang & Singhal, 2009). On one hand, players' unhealthy choices may result in the loss of points in the game. On the other hand, healthy choices may become opportunities for rewards.

In essence, as a result of experiential play, players learn from their actions whether they make wise or unwise decisions (Corbett & Beveridge, 1982). Players can also engage in experiential play by interacting with other players in a game. During multiplayer games, opponents who engage in unhealthy actions lose, while those engaging in healthy actions win. Such gaming outcomes may shift subjective norms, allowing unhealthy individuals to believe that the healthy behaviors are normal. In addition, both players benefit from taking part in the game and from following up with discussions related to the game (Boocock & Schild, 1968; Hankinson, 1987; Thatcher, 1990).

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Experiential play is only possible when players are provided with an interactive environment. Research has identified interactivity as the communication attribute with the greatest potential to enhance health promotion (Rice & Katz, 2001; Street Jr & Rimal, 1997). Researchers studying interactivity have made the distinction between medium interactivity and human interactivity (Bucy, 2004; Chung & Yoo, 2008; Lee, 2000; Outing, 1998; Schultz, 1999; Stromer-Galley, 2004; Stromer-Galley, 2006). *Medium interactivity* involves a two-way communication between the player and the content of a medium (i.e., the game content). On the other hand, *human interactivity* involves the interaction between the players, which could be mediated or face-to-face. Such interactivity is observed during competitive and cooperative multiplayer games that foster social connections and competition (Howcroft et al., 2012).

Different characteristics of the medium interface allow a state of interaction between the user and the interface. A two-way communication takes place between the player and the interface, such that actions from the player lead to reactions from the interface, and actions from the interface lead to reactions from the player. Research on *medium interactivity* has defined such a concept as a state during which individuals use a set of system affordances that allow them to manipulate a media content (Sundar, Xu, & Bellur, 2010). Some scholars have suggested that interactivity involves several levels, depending on the extent of flexibility allowed by the interface (Sundar, 2008).

Interactive methods employed in game design play an important role in games for health. Fullerton and Hoffman (2004) explain that a successful design for a game applies the traditional dramatic arc by presenting a stage of exposition (i.e., introduction of characters and plot), rising action (i.e., the presentation of a challenge), climax (i.e., players in action, attempting to overcome the challenge), falling action (i.e., players are getting closer to loss or victory), and resolution (i.e., loss or victory of the players). Game design is expected to have several elements of interactivity that are introduced at different stages of the dramatic arc. Examples of interactive elements are the dimensions of a setting, the characteristics of the avatars within a game environment, and goal-oriented interactions that include actions and feedback to the players (Dickey, 2005). All such characteristics of game play form gaming features that inform designers of a game's success in reaching direct outcomes such as effectance.

Effectance is an element of interactivity that occurs during the falling action stage of the dramatic arc. Generally, effectance is a concept that describes players' feeling of control and empowerment, beyond which they are confident that they will attain a winning or losing condition. At high effectance, the player is at flow state (i.e., there is a balanced state between the difficulty of the challenge and the player's ability to overcome the challenge; Jackson & Marsh, 1996). The player takes action and receives feedback as a response from the game during conflict. Consequently, such feedback stimulates higher effectance by increasing a player's sense of control (Klimmt, 2003). During the experience of effectance, players build a sense of enjoyment (Klimmt & Hartmann, 2006) characterized by positive emotions such as happiness. An increase in perceived control over the game (i.e., high effectance) gradually increases positive emotions and arises from being able to control the enemy (e.g., unhealthy behaviors or characters engaging in unhealthy behaviors). Effectance can be crucial during the experience of the video game Re-Mission. Research findings following a study of brain activity after Re-Mission game play showed that players of Re-Mission experience a stimulate in the amygdala, indicating the experience of reward as a result of game victory against the virtual cancer cells (Cole, Yoo, & Knutson, 2012). The experience of effectance is crucial as part of games for health because it can boost self-efficacy by allowing players feel in control when attempting to overcome a challenge.

The stimulation of effectance is particularly effective in games that aim to assist during rehabilitation among the disabled. Disabled players' feeling of control during exergames allow them to build self

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confidence in their ability to achieve certain physical tasks, and ultimately build skills as they play the game (Howcroft et al., 2012; Maier, Ballester, Duarte, Duff, & Verschure, 2014). For in their investigation of a social game for stroke patients, Maier and colleagues found that by boosting effectance through a virtual reality game, players with stroke report building skills of social interaction and feel in control over their gaming navigation (Maier et al., 2014).

In their manipulation of effectance (i.e., control over a challenge), Klimmt and colleagues (2007) have shown that lower effectance in a digital game reduces enjoyment, and ultimately disrupts the user's experience. While enjoyment may act as a mediator between effectance and the health outcomes, the lack of effectance has disrupted several aspects of the experience. For instance, low effectance may result in loss in the game, which in turn does not allow players to experience the rewarding gaming events.

In addition to such characteristics, health games can give the player the opportunity to participate in the narrative, pursue different positive goals, experience challenges and conflicts, and attain victory. From the perspective of games for health, such characteristics can help the player feel that he/she can gain power over the disease, and build self-efficacy to attain healthier behaviors (i.e., preventive, treatment, and post-treatment behaviors).

During the design of ASPIRE, formative research was conducted in order to define the website design and content. The health content necessary for reaching health outcomes was deduced as a result of a series of qualitative research and feasibility studies among high school students (Peters et al., 2006). Health messages introduced in ASPIRE were the result of focus group sessions, diaries, and booklets of adolescent smokers (Shegog et al., 2003). In addition, such research showed that adolescent users of ASPIRE prefer to be exposed to virtual characters that they can identify with, and learn information about tobacco through the experiences of those characters. Also, the results revealed that adolescents want to engage in computer activities that give them the skills to avoid cigarettes and understand the effects of smoking. In addition, adolescents reported that they would prefer learning about such health information through humoristic and dramatic scenarios. As a result, ASPIRE was gamified through the introduction of several virtual characters and interactive activities that involve the experience of health information through narrativity and experiential play.

Emotional Involvement: A Direct Outcome of Games

Emotions have a crucial role in moments of experiential play, as they form players' biological reaction to unique events in the game. Previous research has presented the mechanism by which game play can reach emotional involvement (Lindley, Nacke, & Sennersten, 2008). In short, players find themselves immersed in a virtual environment full of possibilities allowing them to feel present inside the game and ultimately use their senses to navigate in the environment. Through game play, players find themselves in an immersive environment that drives perceived presence and ultimately elicits an emotional response (Wong et al., 2007). S*patial presence* is conceptualized as one's perception of being in one place or environment, when in reality, one is physically in another environment. Spatial presence in the virtual world may facilitate emotional reaction (Ravaja et al., 2006). Players tend to feel *present* in the virtual reality that encourages a suspension of reality and the belief in the virtual world (Klimmt, 2003). Additionally, game players need to pay close attention to the stimuli in order to feel present inside the game and ultimately perceive game events as real. As a result of perceived realism, players emotionally respond to the environment (Wong et al., 2007). In short, players tend to *escape* to an imaginary world that fosters the belief in the virtual world, and ultimately the belief in the events that occur in such a

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world (Klimmt, 2003). The experience of dramatic events in the game allows players to be emotionally involved (Ravaja et al., 2005).

Previous research has established the direct link between games and several psychosocial outcomes that emerge as a result of interactive play. One of such outcomes is emotional involvement. Previous research has shown the relationship between game play and emotional involvement (Lindley et al., 2008). During digital game play, emotions can be captured through players' biological reaction to unanticipated or unique events of play. For instance, by applying facial EMG during game play experience, researchers have been able to find promising results. In fact, unique activity of such muscles during different phases of game play have been identified (Ravaja, Turpeinen, Saari, Puttonen, & Keltikangas-Järvinen, 2008). By experiencing specific gaming events, players ultimately showed evidence of emotional involvement in the game (Ravaja et al., 2005; Ravaja et al., 2004; Ravaja et al., 2008). Ravaja and colleagues have also found that different emotional reactions were expressed during the experiences of different phases of play in a shooting game called James Bond. Using real-time electromyographic measurement, significant decreases in orbicularis oculi and zygomaticus major contractions were observed when the enemy was killed in the game. On the other hand, an increase in such facial muscle contractions was obtained when James Bond was killed in the game. Consequently, emotional response at specific gaming events may shed light on their effectiveness. While the study was not necessarily conducted with a game for health, it highlights evidence of emotional involvement during game play.

Interactive narratives may allow players to experience certain emotions. Unlike narratives through traditional media (e.g., television drama and film), emotional involvement during interactive narratives is a result of the discovery of consequences that come from the players' own decisions (Dickey, 2006; Louchart & Aylett, 2004). As a result, researchers have suggested that emotions can affect the subsequent user decisions and ultimately influence the path of the storyline (Louchart & Aylett, 2004). As a result of strong attention to peripheral cues in the message, emotions are stimulated and expressed during a narrative experience (Carter, Aldridge, Page, & Parker, 2009). From a psychological perspective, emotional involvement is determined by the intensity or depth of the players' emotions as they experience a narrative. As a short term stimulus, emotional involvement increases mental imagery and facilitates short-term memory. However, as a long term outcome, emotional involvement in a message can stimulate moral judgment and influence decision-making (Greene, Sommerville, Nystrom, Darley, & Cohen, 2001).

Social gaming can also have a strong impact on emotional involvement of players. In a study examining physiological arousal to game play, Ravaja and colleagues have found that compared to playing against a stranger or alone, playing against friends can elicit a greater feeling of being present inside the game environment and drive the expression and experience of self-reported emotional involvement and physiological arousal. Ultimately, the kind of opponent in competitive gaming can have an impact on direct outcomes of arousal and emotional involvement. As a result, games for health may take advantage of social gaming features in order to boost players engagement in game play.

The relationships between game components and emotional reactions can shed light on a series of behaviors during game play that are responsible for emotional stimulation. In turn, a series of emotions responses to media may ultimately predict certain health outcomes. "Re-Mission" is one example of a health game that has been studied for its stimulation of emotions and effect on health outcomes. While "Re-Mission" was mainly designed for medication adherence among cancer patients, recent research suggests that this game can increase cancer risk perception among healthy young adults in the context of primary prevention (Khalil, 2012). A pilot randomized group study conducted by Khalil (2012) showed that young adults who played "Re-Mission" at a high level of conflict with cancer cells (i.e., challenge)

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experienced an increase in perceived susceptibility to and severity of cancer when compared to players at low level of conflict. In this context, players of "Re-Mission" confront cancer cells that multiply and continuously attack them. Such a confrontation occurs while players are in a state of perceived realism, which allows them to believe that the virtual cancer cells are threatening. As a result, perceived threat from virtual cancer cells may drive emotional involvement during game play. After conducting path analyses, results of the study show that *fear when being attacked by virtual cancer cells* and *happiness when killing cancer cells* mediate relationships between challenge in "Re-Mission" and change over time players' perceived risk of cancer. Such findings imply that the investigation of emotions may allow researchers and game designers to pinpoint in-game events responsible for health outcomes (Khalil, 2013).

SOLUTIONS AND RECOMMENDATIONS

With several health games designed and disseminated on different platforms (e.g., smart phones, computers, and gaming consoles), gaming has become of interest to both designers and public health researchers. One main recommendation of this chapter is the importance of game evaluation, which allows for the dissemination of a reliable evidence-based game for health. Game design followed by immediate dissemination neglects the importance of creating products that can be accepted by the health care community. When games are introduced to health care without any scientific evidence of success, they will not be considered seriously and implemented. As a result, game designers may benefit from researchers in health behavior who can provide a scientific evaluation through an RCT in order to show evidence of success before dissemination.

By highlighting the role of behavioral change alone, several evaluations of games for health may easily overlook game-related concepts that can provide insight on theoretical implications or explicate the findings of game evaluations. As a result, the second recommendation of this chapter is to consider a careful collaboration between game designers and health behavior researchers in order to correctly design games that successfully reach changes in health outcomes based on theories that embrace psychosocial and game-related concepts. In addition to the expertise and skills of game designers, a successful design methodology for health games includes the application of theories linking game elements to emotional and health effects and the consideration of the players' needs. For instance, the design of "Re-Mission" involved a scientifically-driven method that considered a constant collaboration between game designers, health communication scientists, health care professionals, public health scientists, and young cancer patients who form the intended population. As a result of this collaboration, game designers were able to introduce appealing game elements that specifically address the needs of cancer patients and psychologically reshape their thoughts and emotions in order to adhere to medication (Tate, Haritatos, & Cole, 2009).

Table 1 shows a list of some game features described in the present chapter and link such features to their direct outcomes and cognitive theory concepts. In summary, game features involving exploration of environments, experience of gaming consequences, and the pursuit of healthy goals allow players to engage in experiential play. As a result, players can increase in self-efficacy and shift in their perceived norms concerning a health topic. On the other hand, game features involving riddles and narrativity boost emotional involvement and virtual characters that allow players to model the healthy behavior of the characters and recall health-related information. Finally, game features allowing players to interaction

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through collaborative or cooperative play lead to social influence and encourage health-related interpersonal discussions during or after game play. Considering both Figure 1 and Table 1, it is possible to link game features to health outcomes by allowing theoretical concepts such as emotional involvement and experiential play act as mediators. For instance, Exploration of virtual environments, the presence of consequences of interactivity and the presence of multiplayer options are all gaming features that facilitate experiential play, which ultimately allow players to gain knowledge about health information, learn about their high-risk situation, manage stress and anxiety, and build new skills to avoid disease. The scientific understanding of the connection between game features and health outcomes is still in its infancy and deserves further research. The present chapter merely provides an overview that creates a practical starting point for the advancement of games for health.

In addition, the connection between game features and health outcomes delineated in Table 1 can facilitate the design of gamified interventions. When one aims to boost the success of a health intervention through gamification, it is crucial to choose the game features that relate to the intended outcomes. For instance, a health intervention that is capable of increasing self-efficacy about condom use may be gamified by creating a virtual environment that allows exploration, exposure to challenges in decision making when facing a sexual partner, and the experience of positive or negative consequences of decisions. Such gaming features allow experiential play to emerge, and ultimately increase self-efficacy.

Before the application of Table 1 among game designers, game researchers need to solidify such relationships by confirming them through experimental designs, and then provide the correct recommendations to game designers in order to end up with a successful gaming product. While the work of game designers is related to the art and programming of game design, the work of health game researchers (e.g., health behavior and health communication scientists) is related to the psychosocial effects of

Table 1. Some game features and their relation to concepts from cognitive theories for health

Gaming Feature	Immediate Outcomes	Cognitive Theory Concepts
Exploration of a virtual environment	Experiential play, spatial presence	Self-efficacy, knowledge
Positive and negative consequences of interactivity (including rewards and punishments)	Experiential play	Self-efficacy, knowledge
Balance between difficulty of game challenge and player's ability to overcome the challenge	Flow state, Effectance, sense of control	Self-efficacy
Pure narrativity	Emotional involvement, identification with characters, suspension of disbelief, transportation	Social modeling, shifted subjective norms, positive attitudes, knowledge
Interactive narrativity	Emotional involvement, identification with characters, suspension of disbelief, transportation, experiential play	Self-efficacy, social modeling, shift in subjective norms, positive attitudes, knowledge
Riddles	Suspense, emotional involvement	Replay, frequency of play, knowledge
Multiplayer options	Experiential play, identification with actual players, emotional involvement	Social influence, shift in subjective norms, social support, positive interpersonal discussions about health
Options and resources to pursue healthy goals	Experiential play	Self-efficacy, shift in subjective norms

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game features. By considering each game feature and its outcomes, researchers in games for health are able to become health game architects who can scientifically orient game designers during the design of health games.

A third recommendation addresses the importance of continuously testing the direct and long term effects of game elements (i.e., features) that form a game, in order to make sure that such elements do indeed lead to the expected health outcomes. In fact, a simple RCT design has not been able to explicitly pinpoint why some effects have emerged as a result of game play, while others have not. In other words, a bundled evaluation of games through an RCT does not allow the identification of the different elements of the intervention that are responsible for its ability to drive health outcomes. Researchers need to dissect health games based on their elements and pinpoint outcome-related features. Several studies have highlighted the importance of feature identification as a way to clarify the findings obtained from RCT's. For instance, in their evaluation of a web-based smoking prevention program called Happy Ending, Brendryen and Kraft (2008) explain that the complex and multi-faceted nature of health games is the result of several mechanisms at play. Consequently, despite the positive outcome of the evaluation, "further research is necessary to detect the active intervention ingredients and their relative contributions" (Brendryen & Kraft, 2008; p. 483). As a result, the application of theories of experiential play and emotional involvement allows researchers to evaluate the effect of program elements and pinpoint successful features, as well as features with needs for improvement.

FUTURE RESEARCH DIRECTIONS

Based on the complexity and variability of the mechanisms by which games reach health, several implications for future work are needed in order to provide solutions and recommendations for game designers and public health professionals. In this respect, a diverse number of pathways linking media features, emotional reactions, and health outcomes can provide new theoretical models that may be explored by future research. In addition, by applying experiential play elements and emotional elements during game design, it is possible for researchers to strategically use game elements to gamify non-gaming technologies in order to drive experiential play, and emotional engagement. Gamification may ultimately improve effects and allow the reach of wider populations in need.

One emerging field of study is the investigation of emotional involvement in games for health. The study of emotions in games for health is novel and deserves attention in future research. Health communication professionals may assist game designers in the study of emotions as players go through certain gaming events and identify how such emotions relate to health outcomes. Research has established the link between playfulness and emotional engagement (Lindley et al., 2008) and has highlighted the effect of negative emotions on health outcomes (Peters, Burraston, & Mertz, 2004). Future work may attempt to design and evaluate games for health that stimulate emotions. On one hand, an environment in which perceived threat can lead to negative emotions may ultimately induce perceived risk of disease. Also, an environment in which reward as a result of healthy behaviors can lead to positive emotions, which in turn induce health promotion.

In addition, as a future direction, research may consider the dissection of games in order to understand the effect of specific game features. The manipulation of a feature or group of features as part of an experiment is a common method during the study of the effects of specific features on health outcomes (e.g., Lu, 2009; Ritterfeld, Shen, Wang, Nocera, & Wong, 2009). During this procedure, researchers

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manipulate (i.e., change) a specific characteristic of the video game (labeled the independent variable) and assign users to either the manipulated game or the un-manipulated game in order to measure its effect on a specific outcome (labeled the dependent variable). This method allows researchers to control the gaming feature in order to observe different outcomes as a result of different feature manipulations.

Research on digital games has explicitly mentioned the need to "separate intertwined and confounding factors in order to manipulate and thus attribute the outcome to one property independent of another" (Ritterfeld et al., 2009; p. 691). Similarly, in their chapter on online-based interventions for changes in health behavior, Buller and Floyd state that "exactly which content, feature, and/or message is responsible for intervention success is only now being examined" (Buller & Floyd, 2012; p. 68). Buller and Floyd call for research studies that allow health game researchers to evaluate the effect of game elements and pinpoint successful features.

Ultimately, research on games for health aims at moving beyond the overall evaluation of games and studying the mechanisms by which games influence health. With the complex structure of games, existing cognitive theories alone do not consider all the pieces of the puzzle. Going beyond Sir Arthur C. Clarke's maxim, the uncovering of game mechanics related to health is able to move our understanding of games from magic toward predictable science.

CONCLUSION

In conclusion, a careful consideration of theoretical frameworks of health effects during game design can facilitate later evaluation and ultimately allow for the emergence of successful elements in the game. Cognitive-based theories such as SCT and TPB only define concepts that form outcomes of game play. Little is known, however, about the frameworks and mechanisms that allow behavior change to occur in a video game for health.

By considering concepts related to experiential play (e.g., interactivity, discovery of consequences, and effectance) and narrativity (e.g., identification with characters, homophily, and transportation into narratives), games may allow players to become emotionally involved and ultimately provoke them to change their attitude toward health, boost in health knowledge, and engage in healthy behaviors. By applying such concepts of behavior change and health communication, it is possible for game designers to successfully design game elements that are able to reach health outcomes. While this field is still in its infancy, future research can expand on the research review presented in this chapter in order to solidify the connection between game elements and health. As a result, a collaboration between game designers, health behavior and communication scientists, and public health professionals can lead to a successful design for a game that can save lives from a holistic perspective.

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Chapter 68
Emerging Role of Technology in Health Education for Youth

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ABSTRACT

The Information Technology (IT) produces significant impact on the emotional and social health of young people. It is obvious that IT is playing an increasingly important part in people's lives. This chapter reviews the current state of youth health and the role of digital landscapes in health education of youth. The chapter also provides insight into how youth, particularly youth of color, use technology to learn, communicate, and discuss various health-related issues. Specific technology needs and usage patterns are identified and success of various initiatives of use of technology for health educations is assessed. Various implications and recommendations are provided for optimizing technology use in young people health education.

INTRODUCTION

As children enter into adolescence and youth, they face a new set of health challenges. These challenges are more linked to behavior and the unprotected environment around them. These challenges include injuries from accidents, tobacco and substance abuse, HIV/AIDS and other sexually transmitted infections, and mental health issues. Consequently, accidents and related injuries are the leading cause of death among 15 to 24 year olds (Baum, Singer, & Singer, 2013). Despite the magnitude of ill health and disability among the youth, most young people are not aware of the specific health issues that affect youth, and the risk factors associated with their health. This situation calls for intensified efforts to increase awareness about their health issues. Young people, especially in developing countries, encounter barriers in accessing health services (Gupta, Goel, Shah, & Misra, 2012). Many health facilities and communities do not have confidential and youth-friendly services where young people feel comfortable in seeking care, and those who seek care are often confronted with negative attitudes from health-care providers. Additionally, many young people do not have the financial resources to enable them to seek care on their own, and restrictive laws and policies often require a parent or husband's written permission to access

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services. Mental health is increasingly gaining recognition as a major problem globally (Wilson, 2007). Recent reports from WHO indicate that mental disorders and psychosocial distress are affecting millions of children and adolescents in all parts of the world. Suicide and depression are alarmingly common among both rich and poor and in both urban and rural environments. New evidence shows that most mental health problems that continue through adulthood are manifest before the age of 14, suggesting that mental health assessment in childhood could provide early warning and early treatment, possibly diminishing the impact in later life. It is estimated that one in five adolescents will experience a mental health problem during their lifetime, and yet they are less likely than adults to recognize the symptoms of mental disorders or seek treatment (voiceofyouth.org, 2014).

Recent global investments in fiber and wireless infrastructure, and innovations in e-learning, electronic health (eHealth) and mobile health (mHealth) and in the social media, have become great tools for health education (Schweitzer & Synowiec, 2012). The International Telecommunication Union estimates that, in only four years (2007–2011), mobile broadband subscriptions in the developing world increased by more than tenfold: from 43 million to 458 million. Mobile devices and internet access are becoming increasingly preferred tools for accessing health information. New fiber and wireless infrastructure, as well as the rapid growth of computer processing power, provide an unprecedented opportunity to scale up the provision of, access to health information, and improve its quality (Bollinger et al., 2013).

Youth entering college today have always had access to email, the Web, cell phones, text messaging, and all other sorts of gadgets. To them, these are normal. In addition, it is normal for them to see technology constantly changing. Four-out-of-five teens now own a cell phone. Cell phones are the second leading item for a teen's social status and 42% of teens indicate they could text blind-folded. In a broader sense, the U.S. saw 14.3 billion searches (via Google and Yahoo) in April 2009 (National Sexual Violence Resource Center, 2011). It was estimated that in August 2008, over 210 billion emails were sent daily, and an estimated 2.3 trillion text messages will be sent in 2010 (Kittleson, 2009). The resulting stalemate has forced professionals to make decisions based on their own technology comfort level, capacity for using new technology, and organizational constraints. Such an approach is not driven by the value of their own knowledge and experience. As such, this approach fails largely to cater for the needs and actions of their audience.

According to Charlton et al. (2002), we have very little information about how new technologies affect the health of young people, especially their social and emotional health, and there is a distinct lack of attention towards monitoring ways in which new communications technologies impact upon young people. The field appears to be open now for much speculation. There is a wide range of positions that can be taken on this issue. There are the doom-mongers who believe all this technology is sending our children, and ultimately our society, to a disaster. In the early 1990s, some condemned all use of technology, especially computers, as means to generate chaos and confusion (Postman, 1992). Many believe that the media has blurred the boundaries between childhood and adulthood and exposed children to activities they are not ready for (Buckingham, 2000). IT is said to induce aggressive behavior and destroy healthy social bonds, which may inhibit such behavior. There are concerns about addiction, e.g. to computer games, chat rooms, and texting on mobile phones.

Many are concerned about the growing social gap between those who can access the information required i.e. information rich and those who cannot i.e. information poor. According to Ling (2000), the ownership and use of Information Technology (IT) by the young people will shape their needs for friendship, emancipation, and status in the current technological environment. Non-access to IT may

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restrict interactions with peers and delay the development of social skills, a sense of belonging, and learning to understand and accept others (Ridge and Millar, 2000). The study by (Feast, 2003) reinforced that concern. According to Feast (2003), the girls considered not having a mobile phone, or having the wrong one, was a major cause of anxiety in their age group, because it led to exclusion from the social group and being labelled a technological have-not'.

However, the more common view about IT is to think that the advantages very much outweigh the disadvantages. Children's expertise with technology can be seen as giving them access to new forms of communication, and, far from being passive victims of the media, in possession of a powerful and empowering form of media literacy that adults are missing (Buckingham, 2000). Some even argue that there are social advantages. Young people may prefer the distance and anonymity of virtual communication that is achieved by using computers than face-to-face interaction (Tobin, 1998). Communicating with peers may be easier and less traumatic for an adolescent when it is virtual and not face-to-face; and through eliminating embarrassment, serve to improve relationships as opposed to ruining them.

There is too the argument that the Web constitutes a powerful force for health improvement by providing easily accessible health information, to young people as well. There is indeed some support for this view from empirical research carried out by the US Kaiser Family Foundation (2001) and Ortiz & Clancy (2003). Even in 2001, there was a massive amount of online activity by young people in the US, much of it directly related to health. For example, Kaiser Family Foundation (2001) showed that, among all 15-24 year-olds, nine out of ten had gone online and one in four had a lot of health information from the Internet. Three out of four had used the Internet at least once to find health information, about the same proportion who played games and downloaded music, and many more than those who used it to buy something or to participate in a chat room. About half had used the Internet to look up information on a specific disease such as cancer, or diabetes, or on pregnancy, birth control, HIVIAIDS, or other STDs. About one in four had researched depression or mental illness and problems with drugs or alcohol. Four out of ten said they generally found online health information very useful (National Sexual Violence Resource Center, 2011).

Over the past many years, the school-based health education (especially sex and reproductive education) efforts focused on abstinence-only models (Simovska, 2007). Today, the health education has moved outside the classroom and into the world of technology. This technology world has expanded access to critical health information in a manner consistent with today's youth culture. Today, there exist literally hundreds of online and mobile programs conducting awareness, outreach, advocacy, and parent-engagement activities. These sites and programs provide health information and encourage professional development to advance the field of health education.

While the number of programs and activities continues to grow, concerns about the quality and sustainability of efforts, particularly for underserved youth populations and their parents, continue to hamper broader, more widespread acceptance and use. Lack of technical standards and professional guidance have led to a dizzying array of choices without a clear sense of what works and why. A fundamental question, yet to be explored in depth, is that do we go where youth are and send messages; or do we build and ask them to come to us?. In addition, despite conventional wisdom, lore, and organizational self-promotion, another fundamental question requires a confident answer: do youth respond better to digital content created by other youth, or would they prefer to get information online from experts? (National Sexual Violence Resource Center, 2011)

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There exists a need to better understand the environment and examine measures to ensure quality and standards around health education and digital media. The focus of this chapter is on how youth and young adults, especially urban youth of color, use technology for their health (especially sex and reproductive health).

CURRENT STATE OF YOUTH HEALTH EDUCATION

The picture depicted by the statistics and first person narratives is mixed. This picture shows an overall troubling portrait of the youth healthcare landscape despite many years of efforts in youth health education. The various programs and services of youth health education have reached the mainstream but the youth of color still show risky health behaviors.

In USA, 80.5% adolescents in 12-17 years of age were in excellent or very good health while 4.9% of adolescents in 12-17 years of age missed 11 or more days of school in the past 12 months because of illness or injury. 18.4% of adolescents in 12-19 years of age were obese. 6.6% of adolescents in 12-17 years of age smoked cigarettes in the past month and 12.9% of adolescents in 12-17 years of age used alcohol in the past month. 3.8% of adolescents in 12-17 years of age had no usual source of health care and 8.7% of adolescents in 12-17 years of age were without health insurance. More than 9,000 adolescents died in the 15-19 years of age and there were 44.8 deaths per 100,000 population for adolescents 15-19 years of age (Centers for Disease Control and Prevention, 2012). Changes in the racial and ethnic composition of the population have important consequences for the health of the adolescent population because many of the measures of risk behavior, health status, and disease differ significantly by race and ethnicity.

In USA, about 42% of 15 to 19 year, unmarried people engaged in sex at least once and 25% were sexually active on monthly basis. Youth belonging to communities of color and low income families engaged in sexual behavior in much early ages. Most teenagers received formal sex education before they were 18 (96% of female and 97% of male teenagers). Female teenagers were more likely than male to report first receiving instruction on birth control methods in high school. Younger female teenagers were more likely than younger male to have talked to their parents about sex and birth control. Nearly two out of three female teenagers talked to their parents about "how to say no to sex" compared with about two out of five male teenagers (National Center for Health Statistics, 2010). Teens in the United States and Europe have similar levels of sexual activity. However, European teens are more likely than U.S. teens to use contraceptives generally and to use the most effective methods; they therefore have substantially lower pregnancy rates (Finer & Zolna, 2014). The U.S. teen pregnancy rate stood at 71.5 per 1,000 teens in 2006. The rate is declining though. However, is it is still high as compared with other developed western nations? This rate is higher in communities of color. Similarly, the 2009 birth rates for all US teens stood at 39.1 per 1,000 teens. Again, these birth rates were higher in communities of color. Most youth utilized birth control and most (around 80%) used birth control during their first intercourse (Family Planning Association, 2010).

For most young people, weight control and fitness are the most important and specific health-related topics. Women and men differ significantly with respect to the priority they attach to sexual and reproductive health topics and women are more interested than man in the issues of birth control and pregnancy, STIs, and menstruation. Women recognize the greater responsibilities they have toward sexual and reproduc-

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tive health and taking care of their own bodies (National Sexual Violence Resource Center, 2011). Many different factors in adolescents' lives affect their sexual health and responsible sexual behavior. Gender, age, and race and ethnicity play a role, as do attitudes, involvement in activities, academic performance, and relationships with parents. Sexually active adolescents increase their risks of becoming HIV infected, contracting other STDs, and becoming pregnant unintentionally. Teenagers who begin having sex at younger ages are exposed to these risks over a longer period. Those who have had multiple sex partners further increase their risk of becoming pregnant and acquiring sexually transmitted diseases, including HIV infection. Most young people who smoke regularly continue to smoke throughout adulthood. Over 80 percent of adults who are addicted to tobacco began smoking as adolescents. Alcohol is the most commonly used psychoactive substance during adolescence, even though the minimum legal drinking age is 21 years. Alcohol use is associated with motor vehicle crashes, injuries, and deaths; problems in school and the workplace; and fighting, crime, and other activities with serious consequences (Centers for Disease Control and Prevention, 2007; Centers for Disease Control and Prevention, 2013).

Age, race/ethnicity, and socio-economic status are significant factors that affect young people priority for their health issues. In general, younger people are more concerned with their changing bodies as they enter adolescence. While younger boys are more interested in learning "how to do it," women are more interested in how to manage men's sexual expectations and interactions. With growing age, men and women become sexually active and are more concerned with the risks and consequences. As they mature past sexual initiation, these issues become less concerning. For example, 40% of US women aged 13 to 15 were concerned about STIs, compared to 45% of women aged 16 to 18 and 46% of women aged 19 to 21. Thirty-eight percent of women of ages 22 to 24 were least concerned with STIs. Interest in pregnancy issues slightly declines as women reach their mid-twenties. In case of men, the concern about STIs decline in the age between 19-21 and increases when they reach the age of 22-24. Men typically are less concerned about their sexual health while the women have more concerns and actively discuss how they struggle with the after-effects of pregnancy and the effects that a baby would have on their future. Both men and women, however, are equally concerned about STIs and debate whether they would prefer to have an STI or get pregnant, recognizing the serious consequences of both (National Sexual Violence Resource Center, 2011).

Access to and use of health care services for adolescents is dependent, to a great degree, on the ability to pay for services. Compared with their insured counterparts, the uninsured are more likely to lack a usual source of care, have unmet health care needs, and go without contact with a physician during the course of the year (Centers for Disease Control and Prevention, 2013).

Learning about Health

Today's youth needs similar health education that past generations needed. Young people are looking for information, guidance, and services to facilitate healthy and positive attitudes and behaviors. Today, there exists abundant information that was never available before. However, youth find it difficult to acquire this information. In the highly sexualized culture of today, young people face greater health risks. Every type of media has its take on sex but still youth find a lot of this information unreliable. One reason could be that the formal sex education youth receive is incomplete or misleading and that leads to youth belief that despite an environment filled with sex and sex education, they continue to be ill informed about the mechanics and intricacies of the subject (Wong, Zimmerman, & Parker, 2010).

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Man and women also differ in their thinking about health. While men are more likely to think about negative consequences of various health issues, women are more concerned about the emotionally related effects of health issues. When it comes to learn about health issues, school, friends, family, health professionals, and online sites are some of the most important sources of information that youth use to learn about their health (Travis, 2014).

Health Education at School

Health education or health classes in school are the normal ways used to expose youth to various health issues including sexual health. The youth generally finds teaching style and information presented in these classes relevance to their lives. However, there are concerns that some of the activities in these classes may be repeated unnecessarily leaving no for new topics, concerns, or complexities. Making topics relevant in these classes and setting a teacher's tone is crucial for success of these classes. Teachers of these classes need to gain the trust of youth. This is especially important in sex education because fear may not work to deter sexual activity when the competing messages to be sexually active in mainstream culture are so strong (Centers for Disease Control and Prevention, 2014).

Health Care Professionals as Trusted Sources

Young people generally consider doctors and health professionals as well respected and as trusted sources of information and providers of health care. However, some young people might be uncomfortable going to a family doctor (e.g., their pediatrician) because of the relationship they had with them. Another reason could be that they feel the doctors would share their private conversation with their parents. Despite this, youth see doctor more as a helping person who could assist them in their health problems but not necessarily solve these problems (Cutilli, 2010).

Relationship to Family

Today's youth tend to have closer relationships to their parents than any other generation. As such, they often turn to their parents for assistance in health-related issues. Today's youth have developed good experience of talking with their parents, older relatives, and immediate family members (such as sisters and brothers). To many, the life experience and wisdom of their older relatives could be very valuable in matters that could potentially affect them. While here exists a prevalence of these cultural values in communities of color, these experiences may also lead to faulty beliefs. Youth may feel constrained by traditional gender roles and expectations (Ryan, Huebner, Diaz, & Sanchez, 2009).

Friends as a Source of Information

Recognizing the variation in quality of information and advice, youth generally do not consider their friends as a source of good advice for health issues. One possible reason could be that young people might consider their friends as less educated and often fins it better to go online, talk to trusted family members or health professionals, rather than get advice from their friends (Gray, Klein, Noyce, Sesselberg, & Cantrill, 2005).

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USE OF TECHNOLOGY BY YOUTH FOR HEALTH EDUCATION

Today's youth engage with a vast array of technology options and most own a variety of digital and mobile platforms (such as laptops, digital music players, cell phones, and smart phones). With little difference in technology usage based on different socio-economic strata, the digital divide has almost disappeared. Mobility is paramount for these young users of technology and the higher level of ownership of laptops than PCs is a reflection of this trend. A majority of urban youth regularly access the Internet at home or on a mobile phone and youth of color utilize the advanced functions (such as web surfing, video viewing, and gaming) on their "dumb" phones) (Leena, Tomi, & Arja, 2005).

According to a recent Kaiser Family Foundation (2001), US youth aged 8 to 18 spent used the digital devices for almost 11 hours a day and spent an additional one and a half hour on texting and talking via mobile phone. Daily media usage included TV (4.5 hours), music (2.5 hours), computer (1.5 hours), movies (0.4 hours), print (0.4 hours), and texting/talking via mobile phone (1.5 hours). Youth performed much of these activities in multi-tasking mode as they watched videos, texted and communicated via chat or Instant Messaging at the same time. More than 60% listened to music, chatted or used Instant Messaging, visited a social network, watched online video, or played video games on a weekly basis. Men were more likely to play video games (64%) than women were. However, women were more likely to visit social networks (71%), and chat (76%) (National Sexual Violence Resource Center, 2011).

Social Networks

Social networks have become an integral part of youth's lives. Today, social network sites attract around sixty-six percent of US youth that are actively using social networking sites. Facebook has become the key social network and young people from lower income families are more likely to use online social networks than young people from high-income families. Those who already use social networks are more likely to utilize these social networking sites to perform most of their online activities (such as chatting, emailing, and reading the news) (Smith & Christakis, 2008; Scanfeld, Scanfeld, & Larson, 2010).

Facebook

Facebook is the preferred social networking tool for most young people that have arguably become a miniature version of the Internet. Many young people use Facebook to perform certain more appealing activities. The success of many life simulation games (such as CityVille, Farmville, and The Sims) is good example of this behavior. In the month of February 2011 alone, around 100 million people played CityVille (Scanfeld, Scanfeld, & Larson, 2010).

Despite this popularity, many young people also have mixed feelings about Facebook and feel that too much information sharing using Facebook can be troublesome and a threat to privacy. Many feel that the Facebook, especially with its 'burn' pages, can be a source to incite issues and fights. A Facebook 'burn' page is created for the specific purpose of taunting and teasing others. In one instance, schoolchildren in Portsmouth, Hampshire were setting up special Facebook 'burn' pages to post vile and abusive messages about their peers. Eight of these pages were shut down after police and schools contacted Facebook. Three students, two boys and girl, were victims of particularly depraved sexual comments (Owen, 2012). While Facebook is still being used by youth as a place to pursue personal relationships and not as a learning channel for their health-care issues, many designers of healthcare initiatives are developing or

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managing Facebook presences to engage youth online in current, topical conversations. Researchers are using online social networks to understand risk-taking relationships and behaviors within these social networks. In one such project, University of Colorado School of Public Health was working on analyzing the data from 3000 respondents using Facebook to come up with strategies to promote sexual health among youth of color (National Sexual Violence Resource Center, 2011).

Mobile Phone Usage

Use of cellular phone by the youth is increasing with texting, talking, and taking photos as the most common uses of cellular phones. Besides these uses, cellular phones are also being used to access social media network sites, surf the Internet, play games, and watch videos. While the social networks and mobile platforms are gaining popularity among youth, the advanced services (such as mobile maps and locations-based services) are being used infrequently (Hong, Chiu, & Huang, 2012).

Twitter

Use of Twitter by youth to get health-related information, whether through mobile phone or Internet, is yet to gain momentum. One possible reason could be that Twitter does not provide advanced services similar to the ones Facebook provide. Another possible reason could be the youth impression of Twitter as a channel used by celebrities and companies to market different brands. However, Twitter has potential to become a significant and positive channel for youth looking to learn about health-related issues (Scanfeld, Scanfeld, & Larson, 2010).

Video Game Usage by Youth

In US, video games are in mainstream and more than half the population play some time of video game on weekly basis. A study Kaiser Family Foundation (Kaiser Family Foundation, 2001) found that for every 17 minutes a youth spends playing online games, more than one hour is spent playing games on other platforms. The ownership of handheld game players does not vary by household income or race/ethnicity and currently sixty-seven percent of 12 to 14 year olds own a handheld game player. Some of the most popular game consoles among young people include Xbox 360, Wii, and PlayStation 3. Young people also like playing violent games (such as Halo or Call of Duty) and not the games with sexual orientation. Women tend to prefer online casual or social games (such as Farmville, CityVille and Bejeweled Blitz) that are played within online social networking sites. Mobile devices, such as iPad and iPhones are significant gaming platforms and provide hundreds of games through their app store. Potential exist for application that could be used to teach and engage young people around health-related issues. Casual games that are accessed through dumb phones continued to grow in a consistent manner (Van Rooij, Schoenmakers, Vermulst, Van Den Eijnden, & Van De Mheen, 2011).

Shifts in the Media Landscape

In media industry, we see rapidly evolving shifts in ownership and usage. MySpace.com was launched one year before the launch of Facebook in 2004, and by 2009 MySpace.com had more unique visitors than Facebook. By 2011, Facebook became the dominant social network with 600 million unique visitors,

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and the total number of unique Facebook's page visits were expected to surpass that of Google by 2012 (DigitalStrategyConsulting.com, 2012). This rapidly changing media landscape depicts the difficulties to be faced in efforts to keep up with youth communication trends. Email, an effective communication tool few years ago, has now been replaced with Facebook chat, Instant Messaging, and texting. There is a need to tailor heath education communication to new technologies (i.e. social media and mobile platforms) without ignoring World Wide Web that is still considered as the main tool concerning digital outreach.

These new technologies, combined with in-person support and clinical services, are great tools to reach, access, and interact with youth. Multimedia mobile platform, especially as smartphones, are gaining importance as their costs coming down and their adoption is proliferating. Many programs are now focusing simple services of these mobile platforms (such as texting) to reach the widest possible young audience. Some of the most popular sources youth use to get health-related information include Friends and family, schools, health professionals, and the Internet.

Online search or a visit to a school clinic is preferred by young people for health-related issues they want to discuss in private (such as birth control, menstruation, and pregnancy). For information related to such issues, youth still learn from traditional media such as TV and magazines and seldom use other media (such as social networks, online video, newspapers, mobile apps, and video games) (Cutilli, 2010).

Online Searching for Information

In order get answers to health-related issues, especially sexual health, online search is the preferred method used by young people to get answers to their questions. Google is the preferred search engine. However, other search engines (such as Bing, Yahoo!, and Ask.com) are also used. Young people use these search engines to get answers to a variety of questions (Cutilli, 2010).

Mobile Technologies for Information

The use of mobile technology is not very common among youth to answer health-related queries. While the ownership of cellular phones, especially smartphones, by youth is increasing, many do not have a cellular phone that supports mobile apps. Young people vary greatly with respect to their interest in mobile apps related to health-related issues (Levine, 2011).

Triangulation of Information

Young people tend to use a variety of information sources to obtain what they could call reliable and authentic information regarding their health issues. The use of multiple sources of information is more common in case of sexual health issues that young people prefer to discuss in private. In many cases, Internet search is the first step in getting information related to health issues (Whittle, 2011).

TV as a Source of Information

Youth consider TV as a significant source of health information (Advocatesforyouth.org, 2004). In USA, '16' and 'Pregnant and Teen Mom' were the two TV shows related to sexual health. Youth found these shows provided realistic depictions of teenage parenthood and appropriately highlighted various difficulties (such as financial, emotional, and physical difficulties) faced by young mothers. To many, these shows were a source of motivation not to get pregnant. Other heath-related shows, such as The Doctors, Maternity Ward, and shows on TV channels such as The Learning Channel (TLC), HBO, and BET are

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also considered important sources of health information for US-based young people (Dockterman, 2014). South Korea is notorious for having one of the world's highest suicide rates. For years now, it has ranked consistently near the bottom in global happiness indices. However, despite these glaring statistics, few if any, South Koreans talk openly about mental health. The South Korean TV show, titled "It's OK, That's Love," stars Gong Hyo-jin, who plays Ji Hae-soo, a psychiatrist working at a hospital in Seoul. She meets a successful novelist struggling with Obsessive-Compulsive Disorder and schizophrenia. What begins as a series of comedic encounters soon transforms into a budding romantic relationship between two individuals coming to grips with their own inner turmoil. There was an uptick in the number of visitors to psychiatrists seeking treatment since the show aired this summer on Korean channel SBS. Many of them wanted to know whether they suffer from Obsessive-Compulsive Disorder (OCD), like the main character in the show. Most of these new patients were young people. The show's impact could also be seen in online chat forums such as Naver, where one Seoul resident posted the following anonymous comment: "Before I watched this drama, I thought seeking help for things like depression was bad." The user goes on to explain that he lost his job because of depression and asks for suggestions of hospitals that offer counseling (Kim, 2014, p. 2).

Online Video as a Source of Information

Online video sharing is a popular and powerful activity for exchanging information (Advocatesforyouth.org, 2004). Anyone with Internet access can upload, share, view and comment on video footage, and this new ability to participate in video sharing are becoming immensely popular. Using video-sharing sites to disseminate tailored health education and health communication messages helps provide an engaging experience for consumers to view and create health and safety information. With people watching over 100 million clips a day, these online video sources can be a powerful mechanism in distributing current and accurate science and health messages CDC-TV is a video-sharing site on CDC.gov that hosts short, consumer-friendly videos that can be watched, downloaded and shared. View CDC videos at www.cdc.gov/CDCTV. The CDC Streaming Health channel on YouTube currently hosts almost 60 videos on a variety of health topics, from flu to HIV/AIDS and many more. Online video is a relatively less used source of information for health-related information and the graphic nature of the content, in many cases, repulse many young people (Centers for Disease Control and Prevention, 2014).

Video Games for Health Education

Certain video games may be useful tools for psychological and physical therapy. Many games aim to improve health through education. Re-Mission helps adolescent cancer patients understand more about cancer, and Packy & Marlon is an interactive video game in which two adolescent elephants save a summer diabetes camp from rats and mice who have disrupted the camp's food and diabetes supplies. Virtual reality and other video games are used for pain distraction during distressing medical procedures (University of Pittsburgh School of Medicine, 2012). Using a series of scenarios, "The Paper Boyfriend" taught women how to be a good girlfriend. During the last few years, the serious game movement has gained momentum. A serious game or applied game is a game designed for a primary purpose other than pure entertainment. These games are clear evidence of the fact that efficacy of education and health-related efforts can be increased through edutainment or gamification. While serious games have a serious potential for youth healthcare, their tone needs to be youth-centered and culturally appropriate.

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Radio, Newspapers, and Magazines as a Source of Information

Use of radio and newspaper is not preferred by youth as a means to get health-related information and women prefers traditional teenage, women, and fitness magazines (such as Seventeen, Cosmopolitan, Women's Health and Shape) to get health-related information (Child and Young Health, 2012).

Most Effective Ways to Learn about Sex

For youth, a best way to learn about health-related issues (especially sexual and reproductive health) is high school or college programs. Women tend to prefer family as a source of health-related information. It appears that these ways of learning are moderately successful in educating youth about health-related issues (Centers for Disease Control and Prevention, 2012).

YOUTH AWARENESS OF DIGITAL SERVICES/ PROGRAMS FOR HEALTH EDUCATION

Currently, the awareness of various online educational programs is low and youth uses the Internet as the main source to get their answers for healthcare related questions. While Google is the most commonly used search engine many other popular sites (such as About.com, Answers.com, Ask.com, Craigslist.com, Facebook.com, Health.com, WebMD.com, and Yahoo! Answers) are also used by youth. For most young people friend, doctor, parents, or Google's searches are the main sources to hear about specific sites related to health and very few know who provides the content of these sites. In some cases, it is also not clear who funds the site and who are the founders of these sites. That makes youth search for unbiased, accurate answers for their questions more difficult (National Sexual Violence Resource Center, 2011).

The technology-based services/programs for youth health-care are still in their early stages and as such, technology-based intervention and education programs are limited in number. The US-based Planned Parenthood's pilot texting program provided allowed users to receive information about issues like emergency contraception and pregnancy testing via text and IM. This program was considered by some as a success but while others criticize the program for its limited rollout across nation. However, in its first year, the program was able to provide sexual and reproductive health info to 32,589 people and that those people used the service during times of "particular worry" (Alvin, 2013). Media-Smart Youth: Eat, Think, and Be Active! is an interactive after-school education program for youth ages 11 to 13. The curriculum is designed to empower young people to become aware of media's role in influencing their nutrition and physical activity choices and build skills that help them make informed decisions about being physically active and eating nutritious food in daily life. The curriculum combines media literacy and youth development principles and practices with up-to-date research findings and federal recommendations about nutrition and physical activity. It is also consistent with widely accepted, national learning standards. There are a number of smaller Internet, social media, and mobile pilots focusing on youth health across the USA operated by local and state health departments and small not-for-profit organizations. However, few programs have developed evaluation measures, plans for scale, and replication. Many programs are still using the Internet to reach groups of youth, but they have not yet fully leveraged it or assessed its impact on youth health-promotion behaviors. Two text-messaging programs gained popularity in USA: BART (adaptation of Becoming a Responsible Adult) and SEXINFO. BART was a program that supplemented an existing HIV education program while SEXINFO was a program

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that provides sexual health information and referrals. In its first 25 weeks of operation, SEXINFO served 4,500 texts. The program was able to reach the target demographic. The Youth Advisory Program, run by Center for Young Women's Health trains and mentors urban high-school girls and boys to participate in outreach activities of their peers in Boston and surrounding communities. The mission of this innovative peer leadership program is to positively influence and improve the health and well-being of adolescent girls (Cornelius & St Lawrence, 2009).

PRACTICAL/MANAGERIAL IMPLICATIONS AND RECOMMENDATIONS

Clearly, young people are not using health information gained on the Internet in isolation, but are integrating with other aspects to their lives. Many change their personal behavior because of health information, they got online, and many discuss the information with various people. Most of the young people are worried about pornography on the Internet, and thought it harmful.

We can conclude that, clearly; IT is here to stay, but clearly too it raises a range of issues that those of us, who are interested in health, would be unwise to ignore. One aspect to the problem could be that youth, with their undeveloped minds, often use IT in addictive, hazardous, and inappropriate ways. On the other hands, people responsible for planning health-elated issues belong to the old generations who consider communication and learning as a social not technological affair. We are so anxious to take advantage of IT that we tend to forget what impact technology can have on our youth. It seems we all, youth and adult, have become IT addicts to a level where we are unable to see a much larger problem arising from this IT addiction, i.e. massive dependency on technology.

Styles of Communication

It is clear that youth are searching for accurate, helpful, and in-depth information about their health issues. Information outlets that could provide accurate and verifiable information could be of great help. Such information outlets may work on "User Reviews and Recommendations" (such as Yelp) or a "Like/Dislike" model. It is important that channel used to communicate with youth provides communication that is respectful and relevant. When using online channels of communication to communicate with youth, the tone of communication should echo youth's voice. In talking about many health-related issues, such as sex, gaining youth's trust is a key element in any youth communication strategy.

Discretion and Privacy

Youth, in their search of health-related information, look for privacy and discretion. They prefer programs and services (especially online programs) that leave no trail of use. Programs should be developed that provide their users communication with privacy. One example could be a text-messaging application that uses code words in communication. Youth may be concerned about getting random messages containing on their cellular phones without their consent. The youth healthcare-information initiatives need to adopt a push strategy where they should design various programs that push information to the user upon request.

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Platforms

Internet search engines (such as Google) are often the starting point of youth search for health-related information. Therefore, designers of youth healthcare initiatives should make the best use of search engine optimization (SEO) to improve visibility of sites that provide youth healthcare information. While the Internet is usually the preferred way, youth use to seek information related to healthcare, designers of youth healthcare initiatives should abandon existing offline healthcare programs in favor of new online programs. Various healthcare initiatives also need to take into account the power of pornography that almost all youth have some contact with in their developmental years. There is a need to utilize the arousal component of pornography to provide youth with healthcare information specifically related to sex and reproductive health. Nowadays, cellular phone with its texting capability is a ubiquitous platform of communication for youth. There is a need to investigate the use of texting for health behavior change and learning especially the context in which texting is done to come up with some specific recommendations and actions for youth healthcare campaigns that involve text messages.

Smartphones and mobile apps are a new reality that youth extensively use including those with the lowest socioeconomic status. While this adoption of smartphones and apps appears to be in its early stages, apps need to be developed to attract the early youth adopters in order spread word-of-mouth. This word-of-mouth would be helpful in increased use of these apps when mainstream adoption of smartphones and apps begins.

Social networks have gained widespread popularity among youth. Due to their public nature, social networks are not a suitable channel for sharing personal, sensitive information though these networks can be used to supplement the marketing of healthcare by proving an opportunity to get feedback and interact with youth. These social networks are now used by youth to perform their online activities within the closed boundaries of social networks. There is a need of switching the communication mechanisms, typically used to communicate with today's youth, from private communication using email to services provided within social networks.

Men are more likely to involve in using edutainment platforms to perform many online entertainment activities (such as online games and videos) than women. Designers of healthcare initiatives should come up with plans to incorporate learning for young men into these edutainment platforms. While there exists emerging services, such as Twitter and Foursquare, their use among youth is not universal yet. These services may be a good choice for communications and education-based programs but can serve as good channels to hear from youth, especially those early adopters of these services.

Traditional media (such as TV) still matter, and these traditional media should be used as partners to promote new techniques for promoting health among youth. These techniques can include showing celebrity messages on social media (e.g. Twitter) and iPhone applications. Since youth are using a variety of sources such as family, friends, online, and healthcare professionals) to compile the information, they can trust, multimedia programs should be developed that could connect all of these disparate sources of information to provide guidance that youth could trust. Programs should be developed that provide youth communication they could relate to. In this regard, celebrities (such as musicians or sports heroes) can be used to make public service announcements and youth healthcare related campaigns.

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Evaluation and Funding

While there exist many digital and new media programs worldwide for youth healthcare, there is a critical need to develop the baseline measures of success and then integrate the standardized evaluation methods and research into these programs. It is unclear how much mobile and social networking program development costs. It is therefore, necessary that public price estimates should be created for various technological services (e.g. text messaging). To minimize the stakeholders' concerns about the duplication and scaling of various youth healthcare initiatives, a platform is needed that could be used to share successes and challenges among researchers and program staff worldwide. This platform can then be used to standardize best practices within the field.

FUTURE RESEARCH DIRECTIONS

There is a need to research further the issues scaling various health-related programs (especially sexual health-related programs) to a larger set of users. Such scaling requires an aggressively proactive plan. Another area that needs further investigation is the policy deployment. It is imperative that a policy be developed (if working with a government health service, it must be in accordance with their policies) to address various issues.

Another area that needs further investigation is how we can build life skills in young people and provide them with psychosocial support in various settings (such as schools and other community settings) to help promote good mental health. Promoting nurturing relationships between parents and children early in life can help to prevent violence. Further investigation is needed to determine possible ways of providing effective and empathetic care to young survivors of violence that could help them deal with the physical and the psychological consequences.

CONCLUSION

As digital technologies rapidly evolve, great opportunity exists for health care professionals to develop and leverage these new technologies to improve learning around sexual and reproductive health and change risk-taking behaviors and attitudes of youth and young adults, particularly youth of color.

Health professionals must recognize that in an increasingly public digital arena, youth and young adults are often reluctant to share sensitive and sexually related personal information. As such, programs that use the immense reach of the Internet and social networking to market services that discretely and privately support youth, and young adults will be better received. In addition, an approach with full saturation of messaging via multimedia digital channels and reinforced by in-person communication with trusted adults has the most potential to reach youth where they are—with messages to which they can relate.

Research and evaluation are key to ensuring that digital programs reach their goals, by proving their effectiveness and scalability for greater reach. Professionals must be flexible within the ever changing digital world, and budgets must support the greater range of technology-based sexual and reproductive health programs.

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KEY TERMS AND DEFINITIONS

Privacy: Privacy is the ability of an individual or group to seclude themselves, or information about themselves, and thereby express themselves selectively.

Reproductive Rights: Reproductive rights are legal rights and freedoms relating to reproduction and reproductive health.

Sex Education: Sex education is instruction on issues relating to human sexuality, including human sexual anatomy, sexual reproduction, sexual activity, reproductive health, emotional relations, reproductive rights and responsibilities, sexual abstinence, and birth control.

Sexual Health: A state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity. Sexual health requires a positive and respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence. For sexual health to be attained and maintained, the sexual rights of all persons must be respected, protected and fulfilled.

Sexual Heath: Reproductive health, or sexual health/hygiene, addresses the reproductive processes, functions and system at all stages of life.

Sexually Transmitted Diseases (STDs): Sexually transmitted diseases (STDs), or sexually transmitted infections (STIs), are generally acquired by sexual contact. The organisms that cause sexually transmitted diseases may pass from person to person in blood, semen, or vaginal and other bodily fluids.

Social Network: A dedicated website or other application which enables users to communicate with each other by posting information, comments, messages, images, etc.

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Chapter 69
Clinical Communication in the Aspect of Development of New Technologies and E-Health in the Doctor-Patient Relationship

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ABSTRACT

Patient-clinician communication presents the views of several national authorities on the principles and expectations of shared decision-making between patients and their healthcare providers, including doctors, and nurses and oncology nurses. In this chapter authors focus on the communication challenges facing doctors who trained in medical environment in Poland, in order to prepare communications training designed specifically for doctors and to illustrate how a close analysis of professional discourse can be transferred to work environments beyond the medical world. Authors draw attention to clinical roles performed by medical staff practicing locally and trained doctors.

INTRODUCTION

Clinical Communication Skills

Issues related to health have become increasingly critical and complex in our society; and the link between communication and health is increasingly recognized as a crucial element for improving personal

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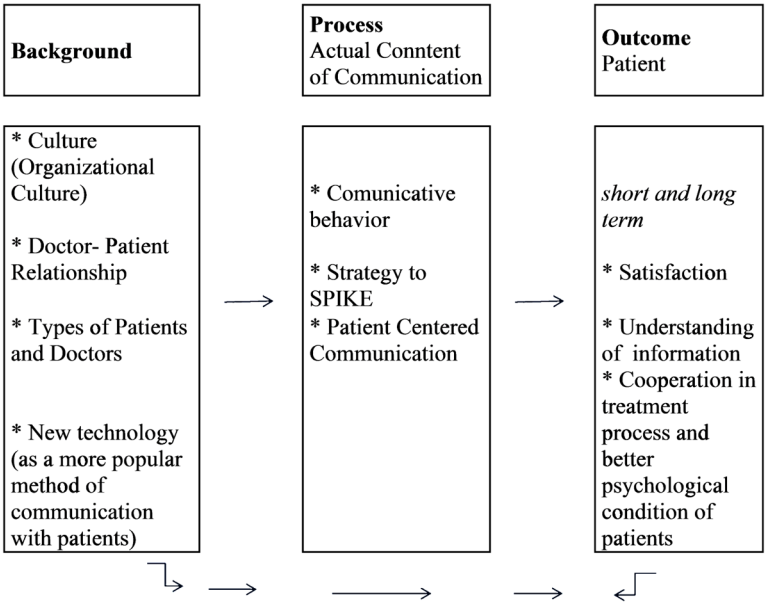
and public health (Piotrow, Kincaid, Rimon, Rinehart, & Samson., 1997; Dutta, 2008). Health communication contributes to disease prevention and health promotion, doctor-patient relations, the design of public health campaigns, dissemination of health risk via the mass media, and change in individual and public attitudes and behaviors. For individuals, effective health communication can help raise awareness of health risks and equip them with skills to reduce these risks. For the public, health communication strategies can influence the public agenda, advocate for policies and programs, promote positive changes in attitudes and environments, improve the delivery of public healthcare services, change the social climate to encourage healthy behaviors, and endorse beliefs, values and social norms that benefit health and quality of life in general.

Poor communication and handovers between clinicians can lead to patients receiving the wrong treatment to delays in diagnosis and to life threatening adverse events, as well as to an increase in patient complaints, health care expenditure and length of hospital stay (Haig, Sutton & Whittington, 2006; WHO, 2007; Brown, 2004; Joint Commission Perspectives on Patient Safety, 2005). Because of that the new studies could also give insight into how 'disease characteristics' influence doctor-patient communication, for example how chronic, life-threatening diseases influence the communicative behaviors of physicians. Clinical communication demands some changes in both doctors' and nurses' behaviors and in hospital's an organizational culture. Describing this subject, the most important goal would be to establish a systematic theory of doctor-patient communication. Such a theory would relate background, process and outcome variables. These are presented in detail in Figure. 1.

Starting with the relationship between background and process variables, cultural variations appear to have an effect on the information - giving behavior of physicians (Holland, Geary, Marchini & Tross, 1987). For example telling the truth to a patient in the case of cancer diagnosis may be considered humane in one culture and cruel in another (Holland, Geary, Marchini & Tross, 1987). There is however

Figure 1. Background, process and outcome variables
Sources: Author's own study based on Buchman (2005), Breaking bad news: the S-P-I-K-E-S strategy. Commun. Oncol. 2005; 2:138–142 with authors own modifications



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a clear trend towards open communication between doctors and cancer patients worldwide (Holland, Geary, Marchini & Tross, 1987; Seale, 1991). Although in many cases of cancer patients doctors not only communicate openly to patients but are also open to patient's questions and are able to answer them with empathy and knowledge of the subject including various treatment methods. This helps to build positive relationship with patients and build trust between a patient and to his/her doctor. Several factors seem to play a role in this open and empathic communication with patients. First of all is concern for patient's rights and his/her rights as a customer/client in medical care process (Holland, Geary, Marchini & Tross, 1987). Insight into the positive relationship between information - giving doctors and patient's compliance with treatment and doctor's advice (Arnaudova & Jakubowski, 2005; Roter, 1989) contributed to draw attention to clinical communication in practice in most countries. Also, different patient and physician characteristics appear to have an effect on doctor-patient communication. This fact is confirmed by many researchers (Manning, 2007) and wanting to discern positive factors which influence communication and patient care prompted the application of a framework to support clinical communication. This framework is a good example of how clinical communication should be supported by government programs.

The relationship between process and outcome is better known and more widely researched. Carter, Inui, Kukull & Haigh in 1982 found positive relationship between sharing opinions and patient's knowledge about diseases, and subsequent adherence to medical recommendations. In other words, effective communication exerts a positive influence not only on the emotional health of the patient but also on symptom resolution, functional and physiologic status and pain control. The historical experience shows that, physicians should ask a wide range of questions, not only about the physical aspects of the patient's problem, but also about his or her feelings and concerns, understanding of the problem, expectations of therapy and perceptions of how the problem affects function. Patients need to feel that they are active participants in the treatment process and that their problem has been discussed fully. Patients should share in decision making when the plan for treatment is formulated by their doctors. They should be encouraged to ask them questions and should be given clear verbal information which should be supplemented, when possible, by emotional support and written information packages. These factors and learned doctors' behaviors are the base on which a better organizational culture in hospital environment, and better outcomes for patients can be created.

Summarising this, background and process in assessment of clinical communication seem to influence communicative behaviors. These behaviors in their turn have an effect on patient outcomes. The presented theory relating to different variables (background, process and outcome) could result in the development of interventions (strategy of communication) which improve clinical communication in the medical practices especially, the doctor-patient relationship and patient outcomes.

Clinical Communication and the Role of Organizational Culture

The role of culture in health communication started to receive increasing attention in the 1980s alongside the increasing mobility of people from culture to culture (Dutta, 2008). Culture encompasses our total way of life - our way of thinking, doing and being. "The culture of an individual has a profound effect on the perspective from which they deal with health and illness" (Todd & Baldwin, 2006, p. 28). Airhihenbuwa (1995) writes that health is a cultural construct and that health theory and practice must be rooted in cultural codes and meanings. Embedded in our cultures are health beliefs, rules, traditions, socio-economic systems, education, religion, spirituality, gender roles, and the mass media. Commu-

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nication in health care needs to take all these factors into consideration, particularly in a multicultural text. As people are cultural beings, their views and attitudes towards health are deeply influenced by their cultural backgrounds. For example, concepts such as public hygiene, disease, and health risk could be interpreted differently across different cultures, not to mention the differences within cultures. Local cultures are entwined with global economy and communication in health care is related to issues of economy and power structure at the global level. Dutta (2008) indicates, that culture offers the entry points for meaning-making through which communication is possible. It also offers a framework for community members and for offering resistance to the structures of power at the global level. Thus, the dynamic relationship between culture, communication and health care is very complex and requires research that spans across various academic disciplines, including communication, health science, psychology, sociology, political science and linguistics.

Communication with patients is a core clinical skill for all health care professionals that can be evaluated, taught and improved. Medical schools historically taught this skill informally and referred to physicians as having or not having a "good bedside manner". Today, more emphasis is placed on communication as a teachable skill in the health care setting, with a shift towards communication skills being more explicitly taught and evaluated. In the United States, the Accreditation Council for Graduate Medical Education states requires that "residents must be able to demonstrate interpersonal and communication skills that result in effective information exchange and teaming with patients, their patients' families, and professional associates" (Hutul, Carpenter, Tarpley & Lomis, 2006, p. 401) It is a good practice because these skills allow rapid adaptation in the hospital organizational culture.

In the hospital's organizational culture, we can distinguish two strategies, which improve doctor-patient communication skills. Two strategy to SPIKES (doctors-patients) which improve patients-doctor communication and relationship skills can be described as *SPIKES protocol strategy* and *Four E's* (Engagement, Empathy, Education, and Enlistment) *strategy*. Those strategies not only improve communication with patients but also influence patients' satisfaction with health delivery services and help to achieve better patient's outcome. As a result, these strategies of effective communication between doctor and patients can provide the benefits for financial side of organizations (e.g. a hospital). This is a reason why, in the last decade, more and more countries (alongside such organizations as WHO and European Joint Commission) pay attention to and are more interested in improving physicians' communication with patients.

The strategy to SPIKES with patients:

The First Strategy. The SPIKES Protocol: This strategy recommends that health care professionals consider the sequential steps.

S: Setting; In this step clinicians attend to the setting. During this session significant news is discussed at a time when privacy is assured, the appropriate individuals are present, the clinician can be comfortably seated at the same level as the patient, and the clinician can be attentive and not rushed.

P: Perception; The clinician asks patient before he or she starts to speak to the patient. Clinician asks open questions and strives to obtain thorough information about the problem from the patient.

I: Invitation; In this step clinician asks the patient how much detail he or she would like to hear. The physician may say, "Some patients want me to cover every medical detail, but other patients want only the big picture. What would you prefer."

K: Knowledge; During this step knowledge is conveyed to patients. A "warning shot" can advise a patient that bad news needs to be conveyed. This statement gives the patient a little time to

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prepare. Language similar to the patient's language can be chosen for conveying information, rather than overly technical scientific language, unless a patient answers the clinician's question with this style of language. The rate of offering information is tempered for the patient, and pauses can help a patient grasp what the clinician is saying and offer an opportunity to check that the patient understands.

E: Empathy; Clinicians need to demonstrate that they connect emotionally with patients. This step involves listening and identifying both the emotions that the patient expresses and the source of the emotions. Clinicians who pause and acknowledge a patient's emotional response show that they understand the human side of a medical issue.

S: Summary (Strategy to Treatment). In this step of doctor-patient communication, the clinician checks that the patient understands both the main point of the discussion (disease and its treatment methods) and the next steps (patient's acceptance of the strategy of treatment). During this step doctor should also formulate a plan for treatment, which the patient can accept and in which she/he will be an active participant.

In general, when we look on the SPIKES protocol, we can conclude that this strategy recommends that clinicians attend to all the steps which are necessary for correct doctor – patient communication. This will help to create a positive relationship with a patient and build the trust between a patient and his/her doctor.

The Second Strategy. Four E's strategy: The second model of communication strategy in health care settings is the Four E's strategy. It means - Engagement, Empathy, Education, and Enlistment. This model of communication strategy was promoted by the Institute for Healthcare Communication in every region of the United States and several other countries, including Canada, Australia, Pakistan, the United Kingdom, and East Africa (Foxman, 2006). This communication model assumes a thorough patient education about the disease and refers to the maximum involvement of a doctor at every stage of the meeting with the patient.

What the strategy means exactly for doctor and patient:

- **Engagement:** Engagement with a patient can begin with the clinician assuring that the patient is comfortable, asking open-ended questions that cannot be answered by a rapid yes or no, and not interrupting when the patient is speaking.
- **Empathy:** During this step clinicians indicate that they comprehend the problem from the patient's perspective and understand that the patient may have an emotional reaction to bad news, which doctor may communicate.
- **Education:** Education addresses what bothers patients most in the language used by clinician and how much information is comprehensible to each patient.
- **Enlistment:** The fourth step refers to patients as active collaborators, not passive recipients of medical treatment. Clinicians cannot be confident about a patient's ability to carry out a prescribed regimen if they have not ascertained that the patient believes in the efficacy of the treatment.

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Both Four E's strategy and SPIKS model include the concept of asking patients how much they already know and how much more detail they would like to know about the diseases or their health problem. Asking questions that allow patients to present more information than yes-or-no answers, not interrupting, and anticipating that patients will have a reaction, possibly an emotional reaction such as crying, when they hear what they perceive to be bad news are common elements of each model. Each model emphasizes empathy and seeing the situation from the patient's perspective, and each uses the skill of briefly being silent when the patient displays emotion.

From the above picture and presented strategies, it is clear that, physician-patient communication is quiet complicated because it includes all elements of communicating act. However, those elements are more formalized, institutionalized and subordinated to achieving the goal, which is determining a patient's health condition and setting up of a diagnosis in case of a disease. The relationship between doctors and patients is being built from the moment of the first meeting (therapeutic contact). Thus the first contact is a basis of physician-patient communication and trust building. The pattern of doctor-patient relationship is also established during the first few minutes of the contact. This first contact includes the transferred verbal contents and non-verbal signals, demonstrating a momentary mood of the physician and patient, their personality and also patient - doctor schemes of reaction, emotions and physician's model of work.

Although the first two strategies already exist and are in use in various forms in different countries (Australian Council for Safety and Quality in Health Care, 2005), there is also another specific aspect of physician's model of work and communication with patients. This aspect is technology and communication with patients using this new trend.

Doctor–patient communication by e-mail is perhaps a more convenient form of communication as it does not require the time and effort spent by patient on traveling to meet the doctor and even before that, the difficulty of arranging the time of the meeting that would be convenient both for the patient and doctor. Experiences from Hershey Medical Center in United States (Leong, Gingrich, Lewis, Mauger & George, 2005) show that contact by e-mail has the potential to improve doctor-patient relationship as a result of better communication. Assessing indirect communication (phone, e-mail, short text messages) as a new trend, beginning with the invention of the telephone in 1876 to the more recent electronic mail, we can observe that these technologies revolutionized doctor - patient contact. The potential benefits are however tempered by concerns including privacy, security, and unwanted daily intrusions (Spielberg, 1998; Atkinson et al., 2008). Internet use (by both patients and the medical sector) is increasing dramatically and e-mail can prove itself a potential tool in improving doctor-patient communication (Liederman & Morefield, 2003; Baker, Wagner, Singer & Bundorf, 2003). The physicians need to be alerted and become sensitive to the use of modern technologies in improving doctor-patient communication both in developed as well as developing countries. Experiences from the United States and Sweeden last year (Suggs, 2006; Houston, Sands, Jenckes & Ford, 2004) show, that these special communication skills (i.e. using e-mail contact) can improve health care outcomes in people with intellectual disability, terminally ill patients, and chronic ill patients (Wullink, Veldhuijzen, Henny, Matsemakers & Dinant, 2009).

Other aspects of the doctor - patient communication, like patient's perceptions (Pandya, 2001), communication skills of the treating physician (Zoppi & Epstein, 2002), and physician's empathy

(Kim, Kaplowitz & Johnston, 2004) are also getting more important and are gaining more attention both from physicians and research scholars and because of this we can observe how communication strategies change currently.

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DOCTOR-PATIENT E-MAIL COMMUNICATION

To address the significance of e-mail contacts between physicians and patients as a newly recognized medium for improved patient care and satisfaction, it is important to review the recent history and development of this medium within the health care arena, examine the current trends emerging in health reimbursement systems and secured technology, and, in doing so, analyze what impact this medium had on the physician-patient relationship in modern medicine.

The United States Institute of Medicine (IOM) has produced several important documents that had substantial influence on healthcare patients. In the 2001 IOM in report "Crossing the Quality Chasm" indicated that respect for patient, his preferences, and patient's needs with a focus on information, communication, and education is important and valuable. Consistent and effective communication between patient and clinician has been associated in report not only with improved patient satisfaction and safety, but also ultimately with better health outcomes, and often with lower costs. The work was the basis of the Best Practices and Evidence Communication Innovation Collaboratives of the Institute of Medicine Roundtable on Value & Science-Driven Health Care. Medical Research Council in UK also provide a guidance for developing and evaluating complex intervention (Craig, Dieppe, MacIntyre, Michie, Nazareth & Petticrew, 2008). Both Institute of Medicine (in the document "Crossing the Quality Charms: A New Health Systems for the 21st Century") and Medical Research Council (MRC) indicated that a redesign of healthcare process by doctors (health professionals) and patients is needed. Those two guidance documents showed that patients should receive care whenever needed and in many forms, not only during face to face visits. This involves new healthcare systems which should encompass Internet and phone calls which should be available for patients 24 hours a day (flexibility time). Many authors assess that the use of electronical methods of communication not only helps managing the medical information for both groups and individuals (Woods, 2006) but can also improve the quality of care, and can help to deliver care for patients suffering from various ailments and diseases (Chaudchry et al., 2006).

This socio-technological perspective views e-mail as an interactive resource of legal, medical documents. Informatics and new technology can play a vital role in meeting patients' needs and in establishing new a better relations between physicians and patients. Medical side of information and communication with patients is as important as type of non–frontal care (Boukus, Grossman & O'Malley, 2010). It plays a useful role in meeting patient's needs, receiving updates, promoting quality of care and quality of patient's life. This non – frontal care also provides better service for patients and is much cheaper than traditional face to face consultation.

The communication by the e-mail is a social instrument of change in the physician-patient relationship. With the aid of current medical publications, this socio-informatics analysis seeks to illuminate the effect of e-mail on past, present, and future trends of communication in health care McLuhan (1962, 1964), Mumford (1934), Meyrowitz (1985), Marvin (1988), and Eisenstein (2005).

According to the American Medical Informatics Association (AMIA), the e-mail is a hybrid between letter writing and the spoken word with the spontaneity of oral expression and the permanence of written documentation. AMIA has defined patient healthcare provider electronic mail as "*computer-based communications between clinicians and patients within a contractual relationship in which the health-care provider has taken on an explicit measure of responsibility for the client's care*" (Kane & Sands, 1998, p. 104). This includes all medical advice, treatment, and information or data exchanged professionally between physicians and their patients through electronic interactions. In this form of communication words may be spoken in the fit of emotion by patients and, because of the "immediacy" of the medium,

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patients and doctor can be closer and such expression in fact can be more believable than the words of a written, speech or official letter.

E-Health as a Concept: Communication and Collaboration between a Doctor and a Patient

E-health and e-mail communication use interactive communication technologies, such as the Internet, computers and mobile devices, to help deliver health care services (Wilson, 2008).

The term e-health can be used to conveniently describe all means and actions involving healthcare services and new technologies. However "e-health" is also the name of the application used in dentistry. E-oral health is the application of e-health in dentistry and is used by large number of Americans who use the Internet. This tool is utilized in shared decision making and is thought to lead to better patient outcomes and adherence to treatment (Robinson, Callister, Berry & Dearing, 2008). E-health tool empowers patients who want to become more informed about their health and play a meaningful role in the decision-making process. E-health encompasses many areas, such as the healthcare provider's use of electronic health records, decision support tools and telehealth technologies. It also involves the use of web sites, personal health records and other information resources and tools by patients (Pagliari et al., 2005). The great driving factors for the increased use of e-health by providers and patients have been the development of Internet and the World Wide Web, coupled with the need to improve the quality of care.

The advent of the Internet and e-health platform has undoubtedly put all health information within the reach of nearly everyone, but it has introduced the strong potential for misinformation. Millions of Americans and Europeans search for health information online, and these patients routinely make decisions based on what they find online (Atkinson et al., 2008). Despite the benefits, health care providers remain concerned about the quality of information on the Internet (Bernstam et al., 2008; Ghoshal & Walji, 2006; Walji et al, 2004;). However as a global medium, the Internet allows patients with rare diseases to communicate with one other and receive opinions of healthcare providers from different countries. Patients become more comfortable reading content related to their health online, they also experiment with using this medium to engage in discussions with fellow patients as well as their healthcare providers. The increased ability to communicate via the Internet provides great advantages but also challenges for patients and healthcare units. Among the advantages and the facts that telemedicine and videoconferencing allow the diagnosis and subsequent recommendations for physical care (Harper, 2006; Karp et al., 2000; Rosiek & Leksowski, 2014). There is also the fact that the Internet allows for additional simultaneous communication among providers and for improved coordination of care with fewer physical trips to multiple clinics that a patient would have to make otherwise (Robinson, Seale, Tiernan & Berg, 2003; Cady, Kelly & Finkelstein, 2008) such consultation bridge also annihilates the geographical barrier, which is felt especially by patients from rural areas. In other words, telephone or videoconferencing between hospitals, specialists and patients is used to improve not only communication but also improve continuity of care.

E-Mail

Electronic mail, or e-mail, is one of the most popular and useful technologies on the Internet. E-mail is a convenient method to use for communication that can be answered at any time. It also affords many benefits for patient-physician communication. Patients may seek clarification by e-mail for questions

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they forget to ask during their hospital visits or a medical consultation. e-mail also allows the provider to answer the request at his or her own time and pace. On the other hand e-mail provides an opportunity to improve patient satisfaction and it is reimbursable in some instances. E-mail communication works best with established patients with whom a doctor already has a good relationship. Following a clinic visit, patients could automatically receive an e-mail summary of the visit with links (or an information prescription) to supporting material. This allows patients to review and contemplate information in the comfort of their homes and at their leisure. E-mail can also be tracked and archived in a patient's health record.

Of course those who start practicing medicine via e-mail with patients they don't know could be setting themselves up for malpractice suits (Houston, Sands, Jenckes & Ford, 2004). Despite the advantages of patient preference for communication by e-mail (Houston, Sands, Jenckes & Ford, 2004) many doctors resist the use of e-mail with their patients because of the expectation of receiving a flood of messages during their work. However in the right setting, e-mail can enhance patient care, could reduce the number of telephone calls made to a practice, and improve efficiency. In general practices, exchange of the information by e-mail between patients and doctors improves patients' satisfaction, outcomes and reduces face to face consultation. Those advantages are confirmed by many authors (Peleg & Nazarenko, 2012; Leong, Gingrich, Lewis, Mauger & George, 2005; Ye, Rust, Fry-Johnson & Strothers, 2010; Bergmo, Kummervold, Gammon & Dahl, 2005)

E-mail contact is also excellent for managing chronic diseases such as hypertension or diabetics. Patients could come in every 2 weeks for blood pressure checks or they could learn to monitor their own blood pressure at home and e-mail readings to the physician. The same goes for the diabetics patients. This group of patients can monitor the level of glucose in their blood, and results of the measurements can be sent by e-mail to the physician. This form of keeping contact with doctor forces provides patients to be self - disciplined and it helps the doctor monitor a patient health conditions.

Using e-mail communication in doctor-patient relation could also be used prior to patient's visits for history taking and for appointment reminders, or after a visit for reporting lab results. Establishing effective physician-patient e-mail communication requires a secure server. A platform with a Web site that allows patients to provide medical information, download medical data, schedule visits, or - in case of a private health care service or a system present in US - pay bills for visits. As we can see, this new form of communication (e-mail communication) is an easy way to improve doctor-patient communications and relationship in technological society. Dr Bachman's (expert in communication by e-mail) experiences show, that a physician could easily process 12 e-mails in an hour. In his experience, 85% of e-mails can be handled by staff, and e-mail communication reduces follow-up office visits by 50%, and all visits by 20% (Wercester, 2005).

When we compare e-mail communication with standard methods of communication with patients we can observe that doctors as well as patients prefer e-mail communication rather than phone or non urgent consultation (Liederman & Morefield, 2003). Patients who have a regular access to the Internet feel more comfortable with a healthcare system. Those factors influence the changes in the medical insurance systems which carry the economic consequences of reimbursement for e-mail consultation (Weiss, 2004).

People registering patient wanting to see a doctor are highly qualified practitioners who are also a part of health care delivery process as educators. They usually have a university – level education, and studies show they deliver cost - effective, high quality, and safe health care (AANP, 2010). A systematic review of advance practice doctor-patient communication by new form communication which is provided

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in public health shows a better outcomes from patients. Many studies show that health care delivered in that way may result in high level of patient satisfaction (Horrocks, Anderson, & Salisbury, 2002; Roblin, Becker, Adams, Howard & Roberts, 2004). Also physician–patient communication model by e-mail is able to provide health care at much lower litigation rates and resultant malpractice rates than their traditional physician counterparts (Hooker, Nicholson, & Li, 2009).

In the definition of e-mail communication evident is the importance of time, permanence, and control within the physician-patient relationship. Like the spoken word, e-mail allows for a freedom based on using natural means of communication. It encourages on immediate expression of thought without regard for the time of day or the physical presence of the receiver (doctors or patients). Spontaneity of message is both its benefit and its drawback, for a person may write a note in a moment of anger, trauma, or sentiment and then send that expression to a doctor.

In this form of communication words, may be spoken in the fit of emotion; and, because of this such expression can in fact be more believable than the words of a written speech or official letter. The e-mail, therefore, allows for natural, introspective, emotional, and spontaneous expressing of thoughts by patients but also the exchange of medical information between a doctor and a patient. The spontaneity, permanence, and information power characterizing e-mails between physicians and patients play a significant role in the decision of whether or not to use e-mails as part of doctor-patient relationship in communication process.

To understand the development and nature of the e-mail's popularity in physicians' practices today, a look at current medical research highlights the usage levels and applications of this new medium. In short, the fundamental goal of health promotion and disease prevention efforts is "to help health consumers and information seekers gain knowledge about health issues, maintain and improve health, and prevent disease and illness" and "to improve lifestyle behaviors, reduce risk factors for disease, increase compliance with a medication or treatment plan to, better self-manage a condition, provide social support, or provide help with making decisions about health" (Suggs, 2006, p. 62). Patient-centered care requires placing the concerns and needs of the patient ahead of any health care organization, insurance company, private practice, or personal agenda. A healthy trusting relationship between the patient and physician remains the paramount concern (Leong, Gingrich, Lewis, Mauger & George, 2005) and in this sense e-mails themselves must, of course, be handled with care (Terry, 2001) to assure such benefits.

As we can see, the modification of communication strategy is a necessity. Changing society and technological advances of our everyday life force the changes in healthcare organizations, change the communication model and form of information exchange between doctors and patients. Because of this authors propose new model of communication strategy in healthcare sector. This is a Five E's Strategy Model of Communication.

The Five E's Strategy: This model of communication strategy in health care, combines the variables (such as background, process and outcome) and refers to the existing two models of clinical communication. It takes into account assumptions about new technologies that accompany advances in medicine. This new model also assumes a thorough patient education about the disease and refers to the maximum involvement of a physician at every stage of the meeting with a patient. Apart from traditional form of communication this model places a special importance on electronic exchange of medical information (E-Exchange) and includes fives E's (Enlistment, Empathy, Education, Enlistment, E-Exchange).

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What the new strategy exactly means for doctors and patients is presented in five steps:

- **Engagement:** Engagement with a patient can begin with a clinician assuring that a patient is comfortable, asking open-ended questions also by Internet, e-mail or Web site. The doctor's engagement in the treatment process is more sophisticated in this model as it utilizes new and traditional forms of communication.
- **Empathy:** During this step clinicians indicate that they comprehend the problem from the patient's perspective and understand that the patient may have an emotional reaction to bad news, which a doctor may communicate via both in traditional way and in an e-mail. Doctor's answers to patient's e-mails build trust and give the feeling that the patient is treated with respect and empathy
- **Education:** Education, apart from being provided in the traditional form, can also be provided by Internet. It remains under full control of the doctor, because he or she decides which Web sites to recommend to their patients in order to raise awareness of the disease.
- **Enlistment:** Patients one active collaborators, not passive recipients of medical prescriptions. They are active seekers of knowledge on the methods of treatment and are open to communication with doctors via new media. Patients more often believe in the efficiency of treatment and in monitoring their health condition than they do with the use of traditional forms of communication.
- **E-Exchange:** During fifth step patient and doctor maintain regular contact by Internet using either a Web site or e-mail. Doctors are available for consultation 24-hours a day. Both doctors and patients can exchange important information regarding patient's health at flexible time. The new form of communication influences patient's satisfaction and provides high quality of patient's care. Figure 2 presents how a communication model changes with the development of new technologies in health care and where is the place of the Five E's model of communication.

PATIENT–CENTERED CARE IN MEDICAL COMMUNICATION

Health communication research began in response to physicians' frustration with patients who did not comply with physicians' orders or recommendations. Physicians wanted to know why this was so, and enlisted the assistance of medical sociologists to study what strategies would be most effective in persuading patients to obey physicians (Du Pre, 1999). Communication between physicians and patients continues to be one of the most researched topics within health communication. Traditionally, health communication research has focused on three main areas of research:

- Physician-patient communication,
- Health information dissemination (e.g., media campaigns to promote smoking cessation or to encourage early cancer screening),
- Social support (Sharf, 1999).

Over time, the field developed a broader focus. The focus of the health communication field is now large and varied, and, in addition to traditional topics, includes research on health care teams, collaboration within health care, the organization of health care institutions, the communication effects of managed care, communication between health care institutions and members of disenfranchised groups, and

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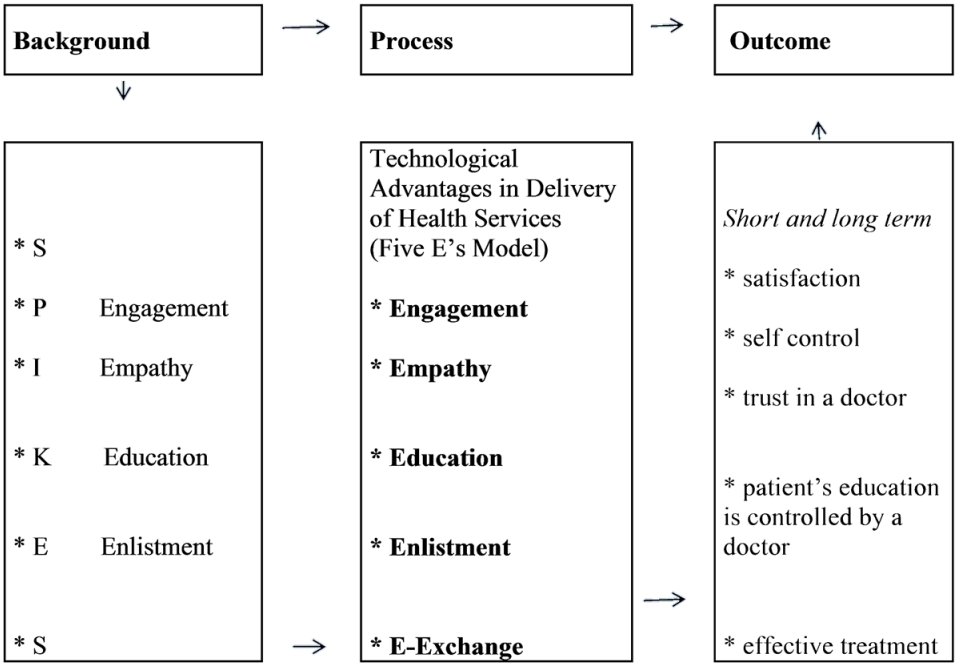
Figure 2. Communication model
Sources: Author's own study based on Buckman (2005), Breaking bad news: the S-P-I-K-E-S strategy. Commun. Oncol. 2005;2:138–142, with author's owns modifications



transnational comparative studies of health care systems. Health communication research has been, and continues to be, interdisciplinary, with researchers located in the fields of medicine, sociology, psychology, communication, anthropology, public health, social work, and nursing (Du Pre, 1999)

The environment for communicating health has changed significantly in the 21st century as a result of the availability of various communication channels, including the Internet and mobile phones, the complexity of health issues, and consumers' demands for more and better quality health information. Our challenge is to identify the optimal content, channel, and context whereby communication strategies can be implemented to create awareness and engage in recommended behavior. To meet this challenge, scholarly research is needed as well as evidence based on practice. Previous research indicates that effective health promotion and communication initiatives often adopt an audience-centred perspective, which means that promotion and communication activities reflect the audience's culture and contexts (Dutta, 2008). Specific knowledge of the cultural characteristics is necessary as our society is becoming increasingly multicultural.

Health messages need to take into account the language, culture, and socioeconomic situations of the target audience (Kreuter, Strecher, & Glassman, 1999). Examples of recent studies tailoring to specific segments of audiences include dissemination of the risk of tobacco smoking among youth in the US (Davis, Farrelly, Messeri, & Duke, 2009), tobacco control policies in Korea (Levy et al., 2010), and the role of mass media in attitudes and behavioral changes associated with HIV/AIDS in China (Li et al., 2009). Diverse research that increases the existing knowledge will contribute to the development of strategies and theories to facilitate disease prevention, health restoration and promote public health (Pacquiano, 2007). These activities also promote patient satisfaction and greater equality of care (Pacquiano, 2007).

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Patient-centered care is premised on the idea that clinicians and patients share a common human experience, even though their roles may exaggerate the distance in their positions. This fact demonstrates that relational communication (observed in verbal and nonverbal messages) from physicians can minimize that distance between doctors and patients (Cissna & Sieburg, 1981). Patient-centered care can only be achieved if patients rise up to the opportunity to discuss how they want to work together with their doctors. These ideas are negotiated and renegotiated by the interaction (doctor-patients), creating a relationship in the process of treatment. Patient-centered approach is important in any medical discipline but takes a special function in oncology where patient-doctors communication during therapeutic process is of paramount importance. Effective communication may help these patients to reduce barriers that stand in the way of optimal health outcome. Because of that, training in communication is an essential and effective component of doctors' medical education. This special training should be focusing on verbal and nonverbal communication (Cegala & Lenzmeier Broz, 2002), and also affective (psychosocial) and task-oriented behavior (Rao, Anderson, Inui & Frankel, 2007; Haskard et al., 2008) and on creation of opportunities for active patient involvement. Improvement of the doctors' skills to communicate with oncologist patients after such a training should be evaluated and by measuring how those activities, taken by organization and doctors, affect patient outcomes and patient's satisfaction.

Patient-centered care takes the practitioner beyond the basic legal and educational requirements. It requires an orientation of service, diligence, humility, and a lifelong commitment to a good, caring practice and communication skills.

Does Doctor-Patient Communication Affect Patient's Satisfaction with Hospital Care

Patients' satisfaction with their hospital care is important to payers, hospital administrators, physicians, and patients themselves. It is important because it captures the patients' experience of health care outside of direct effects on health and acknowledges the role of the patient as partner in health care, and as such reflects the patient-centeredness of care (Institute of Medicine, 2001). It also offers insight into patients' perceptions of interpersonal relations and amenities. In addition, it is a goal toward which considerable resources are directed (Dranove et al., 1999). Physicians' communication behaviors are important contributors to patients' satisfaction in the outpatient setting (Stewart 1995; Williams, Weinman & Dale 1998). In the inpatient setting, several studies have indicated that the quality of aspects of communication with physicians is important to hospitalized patients (Rubin et al., 1993; Hall, Elliott & Stiles 1993; Moller-Leimkuhler et al., 2002).

Determining whether physicians' communication behaviors have a direct effect on patients' satisfaction ratings is not straightforward, however, because their association may be confounded in several ways. For example, an association between ratings of communication behaviors and overall satisfaction could reflect reverse causation in which patients who are more satisfied with their care are also more likely to rate their physicians' communication behaviors highly (Morath, 2003; Godbold & Diesfeld, 2006). In addition, patients who have heard good news, or who have had a good health outcome, may give high ratings for the physician's communication behaviors and report greater satisfaction, producing an association not due to any effects of communication on overall satisfaction. Similarly, patients who are generally unhappy or more difficult to please might give lower ratings to both their physician's communication behaviors and their satisfaction, again producing a false association.

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Physicians' communication behaviors causally influence patients' care ratings. Other studies have established that physicians' communication behaviors, such as lack of physician's dominance, physician's questions about psychosocial issues, information giving, positive affect and friendliness, discussing options, and encouraging patients to ask questions, are associated with patient satisfaction in the outpatient setting (Stewart, 1995; Williams, Weinman & Dale, 1998). Some other studies have shown that physicians' technical and communication behaviors are important to hospitalized patients (Matthews & Feinstein, 1989; Cleary et al., 1991; Minnick, Roberts, Young, Kleinpell & Marcantonio, 1997). Experiences from Polish hospitals are consistent with those, and there is significant association between elements of inpatient physicians' communication behaviors, (such as treatment with respect and dignity, respect for patients' preferences regarding and involving patients in decision making) and satisfaction with health care. This tendency can be observed all around the world (Jenkinson, Coulter, Bruster, Richards & Chandola, 2002; Moller-Leimkuhler et al., 2002; Joffe, Manocchia, Weeks & Cleary, 2003; Gesell, Clark & Williams, 2004). Data analyzed by these authors focuses in particular on the relationship between the patient and the physician, not the overall hospital experience, and focuses on a group of patients than is usually not well studied.

The detailed study of doctor-patient communication suggests that physicians' communication behaviors are associated with overall ratings of satisfaction. This suggests that simple changes that physicians can make when talking to patients, such as asking patients for their opinions, letting them tell their stories, and encouraging them to ask questions, may have a substantial impact on patients' quality of care ratings. Advice given by the doctors to patients, which includes, the physician's advice about lifestyle (monitoring the blood pressure level, BMI, and generally leading a healthy life) was also associated with patient's satisfaction.

Patient communication is not a top assessment in health care when evaluating e.g. radiology (Gilmore, 1940; Basu et al., 2011; Brown, 2010) residents in training. Also it's not a top assessment when hiring a radiologist. However patient communication is at the core of medical practice. Good patient communication builds trust, helps to control patients' expectations, reduces errors, and helps patients make appropriate health care decisions.

In the past there was a clearer delineation in discipline such as cardiology, surgery and radiology in regards to the responsibilities of communicating with a patient. Typically those doctors did not need to talk to patients. Results of patients' examinations were reported directly to the referring physician. In many ways this was the most effective method of relaying information. Results could be complex and confusing and require understanding of anatomy, pathology, and physiology knowledge that most patients do not have. Referring physicians often had long-term professional relationships with their patients and could put the results into context with regard to the patient's entire health history. As can be seen here there are many reasons of not talking to patients directly - cost, efficiency, and referring physician's preference, but despite those there are many more compelling reasons to encourage communication with patients.

The public should understand that the radiologists' role in delivery of excellent health care is the same as surgeons' and cardiologists'. Direct radiologist-patient discussion can improve patient care by providing timely, accurate interpretations and by providing a method for patients to ask questions. It is the right thing to do in health services. However, in the era of social networking and personal health records, patients will have more direct access to imaging data and reports. Patient access will increase with the implementation of patient portals and personal health records (Brady, Kinn & Stuart, 2003). As practices get busier, efficiency becomes the priority, and less time is allotted per patient visit. Referring

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specialists may not be aware of the entire health history of the patient and not have a long-term relationship with the family. Patients will value any physician who spends time communicating with them.

In a recent study by Basu et al., patients were surveyed for their preferences on how they receive results, from whom they receive them, and when they receive them. The majority wanted results communicated within a few hours of the examination. Patients did not show a strong preference regarding which physician communicated the results, but speed was the most important factor for patient's (Basu et al., 2011). Time is valuable for patients and communication with the use of new distribution channel such as Internet starts to become increasingly popular because of its time-saving quality. Sonologists, fluoroscopists, interventional radiologists, and pediatric radiologists often communicate directly with their patients before, during, and after examinations. These procedures typically include face-to-face contact, which strengthens the physician-patient relationship. We observe those trends especially in a fetal imager. Most doctors regularly counsel families following fetal magnetic resonance imaging exams (MRI) and sonograms even though it takes time and may involve communicating potentially devastating. This face to face communication is of the most rewarding aspects of work for many specialists in medicine. A study by Brown et al. on the intersection of ethics and communication in prenatal imaging found that fetal imagers were often the best qualified to provide consultation with parents (Pagliari et al., 2005; Brown, 2010). Reviewing images with the families served as a critical function in increasing the autonomy of these vulnerable parents. By visually demonstrating anomalies that may be difficult to appreciate by ultrasound, radiologists empower families to understand subtle, yet potentially overwhelming diagnostic findings.

Those studies (in radiology and in other fields of medicine) show, how important are such factor as full, through diagnosis, consultation and explanation of the health condition. All those elements are assessed by patients during the course of health delivery services process and they decide if a patient is satisfied or not.

As we can conclude, patient satisfaction is an important measure of health care quality because it includes also information on how doctors communicate with their patients (Scott & Marfell-Jones, 2004). However, patients and physicians may have different views on what constitutes good care. (Yule, Flin, Paterson-Brown & Maran., 2006; Woodhouse, 2006) The doctor-patient relationship and the professional competence of the physician are the most valued aspects of the physician's skills in the eyes of patients. (Crenshaw & Winslow, 2002) Knowing the patient's view on the consultation is an essential part of the assessment of the medical encounter. Such knowledge may help health care authorities prioritize the measures needed to be taken to better respond to patients' needs and desires (Firth-Cozens & Mowbray, 2001). Improving patient satisfaction from medical consultation can reduce the risk of malpractice claims (Cho & Choi, 2010). Such satisfaction can also enhance the compliance of the patient to medical care.

Physician's communication skills also have a strong connection with patient's satisfaction from the medical consultation. This is confirmed by Bertakis et al. who found a number of significant relationships between communication during the visit and the various dimensions of patient satisfaction. Patients were less satisfied when physicians dominated the interview by talking more or when the emotional tone was characterized by physician dominance. Patients were most satisfied when they were encouraged to talk about psychosocial issues in an atmosphere that was characterized by the absence of physician domination. Observation of patients' and doctors' behaviors can conclude, that gender can be an important element in communication process with patients and can make a difference when the doctor and his or her ability to communicate is evaluated.

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Gender Differences in the Application of Communication Skills among Physicians

People often change physicians because they don't like the way their physician acts. The main reasons for changing physicians were related to the style or personality of the physician. The most consistent finding in the satisfaction literature is that characteristics of the health care provider or organization that make care more 'personal' are associated with higher levels of patients satisfaction. Good communication skills, empathy, and caring appear to be the strongest predictors of how patient will evaluate the care received (Cleary & McNeil, 1988);

Physicians who can get and keep patients have good communication skills as well as technical expertise. When patients, nurses, or colleagues see a physician yell, throw things, or slam the phone down in disgust, they get uneasy. In this situation patients, think that they may be the next target of the physician's anger or that the bad mood.

The differences between doctor and patient communication style are individual for each group. Usually patients' perceptions of the quality of care are different from physicians' perceptions. Physicians think about scientific matters - patients want to feel cared for first because they can more easily measure with illness during the process of treatment. Patients do not tolerate physicians who talk using difficult medical language or talk inexactly.

Patients also don't think about the degrees and fellowships hanging on the doctor's wall. Patients cannot be sure of physicians' technical competence, because they don't know how to evaluate the doctor's knowledge. Because of that they concentrate on whether physicians are nice to them or not. If physicians don't look them in the eyes, if they don't lean forward a little when they talk to patients, if they use jargon that makes patients feel dumb (or use the language which is completely incomprehensible to patient's), patients do not like them, even if they believe a doctor knows what he or she is doing.

Patients want a doctor who:

- Shows warmth and concern
- Gives them enough time to say what they want to say.
- Demonstrates that he or she understands what the patient has said.
- Speaks simply to them
- Tells them what is wrong and what to do (how to change a life style and how to exist with illness)

Making the effort to use good communication skills and showing warmth lets patients know doctors as human beings who care about them and want them to be cured. These behaviors can help doctors get new patients and keep the old patients coming back. In the building of doctor-patient communication model it is important to not only connect emotionally but also develop a strategy to get to know and subsequently provide what the patients really want. To that end it is important to let them talk for at least a minute about themselves and their problem the beginning of sessions. Then the doctor can take control of the interview by asking open-ended questions to get more information about patient and his or her health.

If the doctor is also willing to speak to a patient in a simple way (slowly and not too loudly or not too softly using vocabulary that will be understandable to a patient unfamiliar with medical jargon) the doctor is on a good way to build correct doctor-patient relationship and communication style which will provide assistance in treatment process.

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Experiences from many countries and literature reviewed show that gender of doctor has a strong impact on physician's communication skills. Comparing how male and female physicians differ in their use of communication skills with patients, emotion work, how they cope with burnout, strain, and how they use stress-coping strategies, it can concluded that female physicians have been found to be more sensitive to the doctor-patient relationship, more accepting of patients' feelings, and more open to the social and humanistic aspects of patient care (Maheux, Dufort, Beland, Jacques & Levesque, 1990; Brink –Muinen, Dulmen, Messerli-Rohrbach & Bensing, 2002) Literature review shows that female physicians offer more options and spend more time to negotiate treatment possibilities both with female and male patients. (Brink –Muinen, Dulmen, Messerli-Rohrbach & Bensing, 2002). Female doctors also spend more time building rapport and ask more open-ended questions. Thanks to that, female physicians on average spend more time with their patients. (Uskul & Abroad, 2003; Bernzweig, Takayama, Phibbs, Lewis & Parnell, 1997; Roter & Hall, 2004, Roter &Hall, 1998, Roter, 1989).

Very often physicians feel that communication difficulties can be attributed to a lack of resources, high patient volume, and patient's inability to understand physician difficulties (Uskul & Abroad, 2003). Believing that building relationship with patients is important can result in empathic concern towards patients, enacted through deep acting (Pembroke, 2007). Use of deep acting allows for genuine self-expression (Larson & Yao, 2005) and feelings of authenticity (Brotheridge & Lee, 2002), and partly accounts for why females feel more self-authentic than males. The core of medical practice in this aspect is the relationship between patient and physician. Satisfaction with this relationship is directly related to the quality of communication that occurs which in turn may be impacted by the gender of a physician. Of particular interest are findings regarding the interpersonal aspects of care, and their link to the use of emotions as an inherent component of the bio-psychosocial model of health care which influences communication skills and doctor-patient relationship (Borrell-Carrio, Suchman & Epstein, 2004).

Let's try to briefly explain, why the communication skills among physicians are so highly -acclaimed.

Key points in the communication for physicians can be described as:

- Physician's communication skills is the number one factor most highly correlated with patients' likelihood of returning to a hospital or physician,
- Effective patient-centered communication improves adherence to recommended treatment and improves patient outcomes for example in diabetes, hypertension, after surgery or during cancer treatment.
- Physicians who communicate well with their patients find their work less stressful.
- Communication problems cause the vast majority of malpractice lawsuits and medical errors.

Although the sex of physician may influence communication with a patient, it regardless of gender unknown language skillful adjustment to the patient can generate losses in general. Lack of good communication contributes to more stress in the medical profession, the loss of patients and to make matters worse to the lack of positive results of treatment. This sometimes can lead to a lack of agreement with co-workers and medical errors.

Communication Skills and Medical Errors

According to the Institute of Medicine (IOM), a health care error is "a problem in the process of care itself or failure of a planned action to be completed as intended or the use of a wrong plan to achieve an

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aim" (IOM, 1999). Thus, while some refer to medical error as any act, or failure to act, which results in harm to a patient, others refer to medical error as any action within the process of care that may have the potential to cause harm. A lack of clinical communication is also classified as a factor which can contribute to medical errors in treatment process. Clinical communication not only provides better patient outcome but also has a direct impact on influence patients' safety during hospital stay.

Leape in his research in 1993, has provided a brief and practical typology of all medical errors that includes four main domains:

1. Diagnostics
2. Treatment
3. Preventive behavior
4. Other

This typology with author's own modification is presented in Table 1.

Clinical communication and lack of communication skills contribute to medical errors. Failure of communication both traditional and with the use of new technology (Internet etc.) with patients contributes to inadequate treatment monitoring and inadequate prophylactic treatment. This is a reason why doctors should attend a special training which can help them to better understand patients' needs and implement a patient - centered care. Studies conducted during the past three decades show that the clinician's ability to explain, listen and empathize can have a profound effect on biological and functional health outcomes as well as patient satisfaction and experience of care. Research evidence also indicates that there are strong positive relationships between a health care team member's communication skills and a patient's capacity to follow through with medical recommendations, self manage a chronic medical condition, and adopt preventive health behaviors. In other words, patients are able to more often monitor themselves and provide feedback to their doctors when all elements of communication (explaining, educating, listening, and empathy) are in balance. This guarantees success in providing monitoring and prophylactic treatment process and results in fewer medical errors in health care system.

Table 1. Medical error classification by Leape

Diagnosis	1. Error or delay in diagnosis 2. Failure to employ indicated tests 3. Use of outmoded tests or therapy 4. Failure to act on the results of monitoring or testing
Treatment	5. Technical error in the performance of a procedure 6. Error in administering treatment. 7. Error in dose or method of use of a drug 8. Avoidable delay in treatment or in response to an abnormal test 9. Inappropriate care
Preventive & Other (Medical Errors resulting from the lack of communication skills)	10. Failure to provide indicated prophylactic treatment 11. Inadequate treatment monitoring or follow up
	12. Failure in communication 13. Equipment failure 14. Other systems failure

Sources: Bases on Leape, Lawthers, Brennan & Johnson, 1993. Preventing medical injury. Qual. Rev Bull 1993; 19: 144-149 with author's own modifications.

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Other failures in communication can also contribute to dysfunction in health care organization and influence patient's safety in hospital. Medical mistakes can be caused by latent errors, such as similar sounding drug names or delays in treatment due to lack of staff, or misunderstandings among medical staff or lack of teamwork. There is much interest in the area of communication and teamwork within the operating room environment. Awad et al., in 2005 showed that improved anesthetist and surgeon communication was achieved after a period of medical team training focusing on communication issues which might in turn decrease adverse events. These results suggest that good communication is perceived as beneficial in resolving a crisis of teamwork in operating room where the probability of medical errors is very high. Experiences from United States show that the medical errors in the operating room are admitted to more readily by doctors to other doctors (within their professional environment) rather than to patients. Lack of communication can lead to mistakes such as operating on the wrong side of the body or even operating on a wrong patient. In two thousand four hospitals and surgical offices in the United States doctors reported twenty-five cases involving the wrong patients between 2004 and 2008 (Denver Health Medical Center, 2008). Five patients suffered serious harm. Surgeons and other doctors also reported one hundred seven cases involving the wrong site. More than one third of patients suffered serious harm (Aggarwal, Undre, Moorthy, Vincent & Darzi, 2004). Such problems reported by Denver Health Medical Center only on a small scale, show how serious is the lack of clinical communication.

We postulate that poor communication during a crisis is less well remembered or reported because both surgeon and anesthetist are involved in efforts to resolve the crisis and clinical success (the most frequent outcome) takes the focus away from the nature of the communication. On the other hand, when individuals work well together, everyone wins. Good teamwork creates a positive environment, fosters good relationships among coworkers, and lightens the load on all individuals. Most importantly, teamwork provides consistent quality of care to clients.

An issue within the operating room environment is that healthcare workers may create a professional group in addition to 'operating room team' allegiances, but favour the former to the detriment of the latter. Theatre nurses may share important information with other nurses but not with doctors, or surgeons may communicate with fellow surgeons but not with anesthetists, nurses or technicians. Whole team communication is vital regarding information that may later feature within the context of a crisis. Failure to convey such information may actually cause a crisis, increasing morbidity and mortality.

What Is Important Is To Look At Factors Underlying Why the Lack of Communication in the Particular Circumstances Exists and Try to Identify and Correct Problems

Sexton, Thomas & Helmreich in 2000, showed "teamwork climate" to be a recognized marker of performance and the existence of a relationship between perceptions of teamwork and status in the team and communication in teamwrok. Surgeons were most supportive of steep hierarchies within teams where junior staff do not question senior staff. Surgeons also perceived teamwork and communication within the team as better compared to how the rest of the team perceived teamwork and communication. Experiences from aviation, show that highly effective cockpit crews used one-third of their communications discussing threats and errors (high vigilance) compared to 5% for poorly performing crews (low vigilance) (Sexton, 1999). Sexton has developed the Safety Attitudes Questionnaire (Sexton et al., 2006), a tool which attempts to assess teamwork climate and communication skills using six items - difficulty

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in speaking up, conflict resolution, physician-nurse collaboration, feeling supported by others, asking questions and heeding nurse input.

Somewhat different considerations led Lingard. Lingard (Lingard et al. 2004) has studied operating room teamwork and factors contributing to communication failure. Amongst the findings were lower tension levels in operating room teams in smaller hospitals compared with larger ones (Lingard, Garwood & Poenaru, 2004) and that approximately 30% of documented "communications" within operating rooms resulted in failure (Lingard et al., 2004). One-third of these affected patient safety, increased inefficiency, increased team tension, caused delay, procedural error or patient inconvenience. Lingard further categorised failures into four distinct types; "occasion"- poor timing, "content"-missing information, "purpose"- unresolved issues and "audience"- key individuals excluded (Lingard et al., 2004). Also a large proportion of anesthetists reported that they are informed of major emergency situations too late in the chain of communication, leaving too little time to prepare for intervention.

Diagnostic errors are among the most difficult to address because despite system changes, they remain devastating in terms of their overall high frequency of occurrence and potential. This type error can harm patients.

Some types of medical errors lend themselves to direct observation and feedback. Many complicated surgical procedures, which are problematic in terms of frequency and severity such as: operating on the wrong site, on the wrong patient or removing a different organ than required, provide a clear opportunity for observation and eventual peer-to-peer training which can help to eliminate the observed errors.

As indicated above, ineffective communication is a common root cause of medical errors. Communication which is too late or incomplete makes up the bulk of communication failures in health care (Lingard et al., 2004). Because of that, Lingard has developed a preoperative check list to avoid such communication failures. This checklist is widely used in hospital practices in operating rooms as a protocol of surgical time – out. This protocol is a gold standard which helps both doctors and hospitals managers to reduce medical errors and improve patient safety by correct communication and teamwork in the operating room.

FIVE STEPS TO IMPROVE COMMUNICATION

Developments in medical and psychological care influence the way of delivery of care by physicians and organizations. Doctors and medical organizations can deal with psychosocial aspects of patients' during normal work (Nederlands Huisartsen Genootschap, 1959). Already in 1959, physicians of the Dutch College of General Practitioners stated that patients' care had to be continuous, integrative and personal. With this agreement, doctors and also hospital care were explicitly placed in a broader societal and emotional context and not limited to biomedical framework. Physicians started to emphasize the importance of understanding the meaning of illness for patients rather than merely diagnosing medical diseases (McWhinney, 1986; Nederlands Huisartsen Genootschap, 1959). Problem behavior of patients (behavior related to psychosocial aspects of patients' life) was considered as starting point for doctors to deal with patients' health complaints (Lamberts, 1979). During a doctor's visit, physician should get a clear and complete idea of patient's reasons to seek doctors care. We also know that disregard of the patient's symptoms provides excellent opportunity for medical errors and suboptimal continuity of patient care (Bates & Kaelber, 2007). These data are available from medical intensive care unit studies and hospital

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care. The Harvard Work Hours, Health and Safety Study reported a 22% higher total rate of serious errors and 5.6 times as many serious diagnostic errors for physicians, while working a traditional schedule (24 hours or more) in the medical Intensive Care Unit (ICU) (Landrigan et al., 2004). As we can see both doctors and hospital stakeholders demand that a safer, effective and more cost effective care is provided for patients as a priority. These arguments are important for doctors, and hospital managers alike. All of them, concentrate on eliminating medical errors and providing cost effective care and also patient's satisfaction. Finding new methods to improve healthcare conditions, was also discussed extensively. All interested parties began to listen to the voice of patients and started adapting the medical market to customer needs. Commercialization of medical services undoubtedly had a major impact on the ongoing changes in the medical sector. In answer to the needs of the market, it has become widely understood that there is a need for telemedicine services and their ethical use, as well as for assessments of psychosocial aspects related to patient's health problems and physicians-patients medical communication style. The market has attempted to conform patient's expectations and adjust to a severe manpower shortage by creating telemedicine ventures designed to increase coverage of patient's care by trained doctors working in medical organization. There is some evidence that telemedicine programs are safe and effective and no more costly than increased staffing protocols (Breslow et al., 2004). Breslow et al demonstrated that a remote patient's traditional care program integrated with new information technology and a delivery network improved patient outcomes (Breslow et al., 2004). Mortality, medical errors, length of stay, and variable costs per case all were lower during the uses of telemedicine both by a hospital as an single ward, for example intensive care units. In addition the standard of patient care as assessed by a patient was higher than the one using only traditional methods in treatment process.

Traditional communication seems basic enough, but few other areas in medicine remain as cantankerous and potentially damaging for a company or organization because of lack of balance. No matter what the size of organization (hospital), any facility is likely to suffer from communication issues, but there are ways to nip challenges before they grow into full blown problems.

Gary Collins, owner and operator of Garden City Healthcare Center (GCHC) in Modesto, California U.S.A offered ideas to improve communication in the workplace and with family and residents. Those ideas can be used in all hospitals and with respect to medical staff who want to improve communication with patients. Using new technology as a method of communication is one way of solving problems. According to Gary and our Five E's model of communication, we propose steps for day-by-day assessment of the condition of communication in health organization.

1. Being available and Engagement

The managerial staff keeps all things in health organization running smoothly. They are responsible for positive communication, both traditional and electronical, and also for all innovation in health organization

Collins said - "It's very important for the administrator and director of nurses to be very accessible". This attitude indicates management commitment and the assumption of responsibility by the directors of hospitals for the communication processes that occur at each stage in the hospital. Adoption of this effort has become a necessity in the light of changes in health care. Involvement in clinical communication process is moving in a straight line from the management, the head of department to subordinate employees (from top down). It is a good practice, which shows that if a hospital wants to improve process of communication, it should be conducted in this manner.

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2. Follow up, Empathy and Feedback

The department head helps reinforce the sense that patients are under watchful care. The department heads should also make sure that patients understand their health situation, and that they are accepting of the method of treatment which doctor applies both in short term and in the long term. This is a very important part of doctor-patient communication, which helps to provide feedback about the skills of doctors in communication on the ward or lack of those skills.

The effective transfer of information (handover) between healthcare practitioners is a fundamental element of patient care and is an "important consideration in maintaining patient safety, work flow and quality care." (Ottewill, Urben & Elson, 2007).

3. Daily morning staff meetings and Education (if necessary).

Collins emphasized necessity of daily meetings, where department heads articulate what they need from the hospital administrator. Doctors and nurses in the department will often see things that affect residents or patients directly before the hospital manager does. It is therefore crucial to have open lines of communication: both between medical staff and hospital managers and medical staff and patients and their families. In the cases of reported issues with staff, those are the types of things which may be address directly to managerial staff. The role of the director is to educate the employee to change his or her behavior and to show best practice methods. However, the role of the director is also to argue and explain, for example, what attitude should be presented to the patient during performance of activities related to the treatment and why empathy should be an integral part of them. This is also the time to discuss employees' needs and trends among residents or patients being admitted (e.g. for which kind of medical procedure there is more need) or to discuss new policies, procedures or the need for new equipment.

4. Evaluation of the communication and causes of confusion, E-Exchange

Collins emphasized the importance of responding to any complaint within 24 hours. He said "If a family member calls with a complaint," staff don't need my permission to respond, but I want to know about it during next 24 hours ." Quick reply to concerns about patient care and regular analysis of claims reported by patients can eliminate errors in a hospital organization which could give rise to communication problems. The responses can be provided in traditional way – during face to face contact – but also sent electronically to patient/family making the complaint and to the hospital manager.

5. Creation of a care plan and Enlistment.

By the end of the first week of patient's treatment, medical staff should meet with family members to review the care plan and answer any questions that may still exist or explain any concepts that may have been misunderstood. Also if problems with patient's care warrant quick action, doctors should be back in contact with the family member right away. Compliance with these rules allows medical personnel to ensure good cooperation between them and the patient's family, especially in the case of terminally ill patients, stroke patients or those residing in the intensive care unit. Good collaboration with the patient

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and his family lowers patient's demanding attitude, minimizes the risk of medical errors, and builds good doctor-patient relationship (which increases confidence in the doctor and the proposed treatment).

Implementation of these steps is an easy way to help improve all communication process in a hospital and also improve the organizational culture.

In this section we focused on the communicative behavior of physicians and managers in hospital practices and not strictly on the communication between a doctor and a patient. A rationale for this choice is that developments such as the implementation of clinical communication skills guidelines influence physicians' behavior primarily in the direction from top to down (from hospital managers to physicians). The implementation of those guidelines will have direct effect on the way doctors communicate with patients during consultations in a hospital ward. This form of implementation of clinical communication skills guidelines may also have a strong impact on improving quality of hospital care.

CONCLUSION

The core of medical practice is the relationship between patient and physician. Good relationship between patients and physicians is in large part dependent on the level of interpersonal communication which significantly influences patient's satisfaction with hospital care. Satisfaction with this relationship is directly related to the quality of communication that occurs during health care process, a factor which may directly influence and improve this relationship.

Of particular interest are our findings regarding the interpersonal aspects of care, and their link to the use of emotions as an inherent component of the bio-psychosocial model of health care and also all aspects of new technology which are becoming more and more popular in medical sector (Wilson & Lankton, 2003). Fast progress of new technologies and new media such as Internet and e-mail, resulted in changes in the model of communication between physicians and patients. Taking into account new media has become a necessity for the physician and health care facility. We must also remember that effective clinical practice must not focus only on technological system issues, but also on the human factor. As shown in this chapter, good communication encourages collaboration and helps prevent errors. It is important for health care organizations to assess possible setups for poor communication and be diligent about offering programs and outlets to help foster team collaboration. By addressing this issue, health care organizations have an opportunity to greatly enhance their clinical outcomes.

The studies presented in this chapter have analyzed how physician's gender impacts upon communications, stress, and stress coping. Experiences form many countries and different cultures also show that improving communication leads to better outcome of care. As leaders of a multidisciplinary health care team, physicians need to recognize the importance of their role in being able to lead, direct, coordinate, and follow through on care decisions and treatment recommendations that require efficient communication flow and task accountabilities for all participants in the process.

In this chapter we postulate that all presented thesis boil down to certain behavior that can be learned by doctors of various disciplines and which aim at skillful communication with the patient. These behaviors are known to everyone, the doctor and the nurse or other health professionals, but they are not always fully and conscious by employed. Often in everyday work, especially when it comes to saving human lives, they are forgotten, so training in this area and the education of the medical community is necessary. Numerous reports in the literature on various aspects of communication, show how great is

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its importance. Poor clinical communication skills bring a whole range of problems both for the physician, the patient and the organization.

The most important of them include:

- Medical errors
- Lack of patient compliance with physician which leads to failure of treatment.
- Lack of cooperation between doctors (e.g. surgeon and anesthesiologist in the operating room) in the team;
- Use of language not understood by the patient and lack of empathy

These problems not only translate into poor quality of health services which are being provided but also contribute to the lack of patient satisfaction with treatment. All these aspects are discussed in detail in this chapter.

In addition we present how the model of communicating with the patient should change with expectations of patients (public). Experience shows that the traditional form of communication is no longer sufficient and should be replaced by a new model of Five E, which involves communication with the use of the new media (Internet, e-mail, Web sites). This approach forces a greater involvement of the doctor not only in the treatment process but also in building interpersonal relationships with patients. Additionally, doctors can also provide patients with the knowledge about specific diseases and that can help to restore the authority of the doctor, as the information that can be found on the Internet is not always expert knowledge or even correct. To effectively utilize Five E's model in everyday medical practice and an organization such as a hospital, we have proposed an easy way to assess the state of communication in the organization of health care, and we have also shown, how such an organization or people working in it can strive to improve the communication every day.

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Chapter 70
Advanced Intervention Strategies for Suicide in Patients with Chronic Mental Illness

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ABSTRACT

Chronic mental illnesses are common to find in routine clinical practice and suicide is one of the dreaded outcomes. The concept under defining chronic mental illness has evolved in few decades as now the critical elements for defining the chronic mental illness are psychiatric diagnosis, functional disability, and illness duration. There are various studies on prevalence of suicide and especially in patients with CMI. There is rising trend of research on suicide in patient with psychiatric illness in last decade and found ever over thousand published article in year 2014. This chapter will include literature based on various aspect of suicide including neurobiological factors like neurotransmitters, neural circuits, genetic and epigenetic factors, response on pharmacotherapy and newer generation novel treatment strategies and various psychosocial factors.

INTRODUCTION

Chronic Mental Illnesses (CMI) are common to find in routine clinical practice. The concept for defining chronic mental illness has evolved in few decades. The three critical elements for defining the chronic mental illness are psychiatric diagnosis, functional disability and illness duration. Based on these elements there will be different understanding regarding outcome of CMI. Among various outcomes based on psychiatric diagnosis and associated disability, the most dreaded one is suicide. The great majority of

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people who experience a mental illness do not die by suicide. However, of those who die from suicide, more than 90 percent have a diagnosable mental disorder. Suicide has been studied in various populations and attempts were made to understand these above factors mentioned. Based on the projected rising trend of diagnosable psychiatric illness in general population and undoubtedly more indulgence of stressful life, the trend of suicide seems to be reciprocative. This concern has been acknowledged and appreciated by service providers since long back but still seems unmatched with current need. There are various Intervention Strategies brought into practice which are broadly grouped as pharmacological, non-pharmacological and novel techniques but two extreme aspects of spectrum which required specific intervention are early detection of suicide risk and intervention in suicide rescued victims. These have been the area of research not only for mental health professionals but also for other medical disciplines like forensic medicine, internal medicine, emergency and trauma etc. This chapter will detail about suicide in CMI, prevalence, burden, factors related to suicide and different advanced interventional strategies as part of management.

Prevalence

There are various studies on prevalence of suicide and especially in patients with CMI. According to calculations based on data reported to World Health Organization [WHO] (2015), by its Member States, in 1998 suicide represented 1.8% of the global burden of disease and it is expected to increase to 2.4% by the year 2020. Suicide is among the 10 leading causes of death for all ages in most of the countries for which information is available. There may be differences in statistical data among various dependent variables like age, gender, ethnicity and other sociodemographic profile in suicide epidemiology but at same time it is difficult to draw qualitative analogy among the same. In some countries, it is among the top three causes of death for people aged 15-34 years. Suicide does not just occur in high-income countries, but in fact, 75% of global suicides occurred in low and middle income countries in 2012. In the year 2020, approximately 1.53 million people will die from suicide based on current trends and according to WHO estimates. Ten to twenty times more people will attempt suicide worldwide. This represents on average one death every 20 seconds and one attempt every 1-2 seconds. In India (based on National Crime Records Bureau [NCBR] report, 2014), more than one lakh persons commit suicides every year in the country during the decadal period from 2004 to 2014. The number of suicides in the country during the decade (2004–2014) has recorded an increase of 15.8% (1,31,666 in 2014 from 1,13,697 in 2004). The increase in incidence of suicides was reported each year till 2011 thereafter a declining trend was noticed. The population has increased by 14.6% during the decade while the rate of suicides has slightly increased by 1.0% (from 10.5 in 2004 to 10.6 in 2014).

Burden

Mental health conditions are the leading cause of Disability-Adjusted Life Years (DALYs) worldwide and account for 37% of healthy life years lost from Non-Communicable Diseases (NCD). By disease, mental illness will account for the largest share of the economic burden in both 2010 and 2030, just slightly greater than cardiovascular diseases (figure-1). They are followed by cancer, chronic respiratory disease and diabetes.

Among these conditions, unipolar depressive disorder, alcohol use disorders and schizophrenia constitute the greatest global burden in terms of disability (see the Table 1).

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Figure 1. Mental health and cardiovascular diseases are top drivers of lost output breakdown of NCD cost by disease type, based on EPIC model
Source: The Global Economic Burden of Non Communicable Diseases. Geneva: World Economic Forum (Bloom et al., 2011)

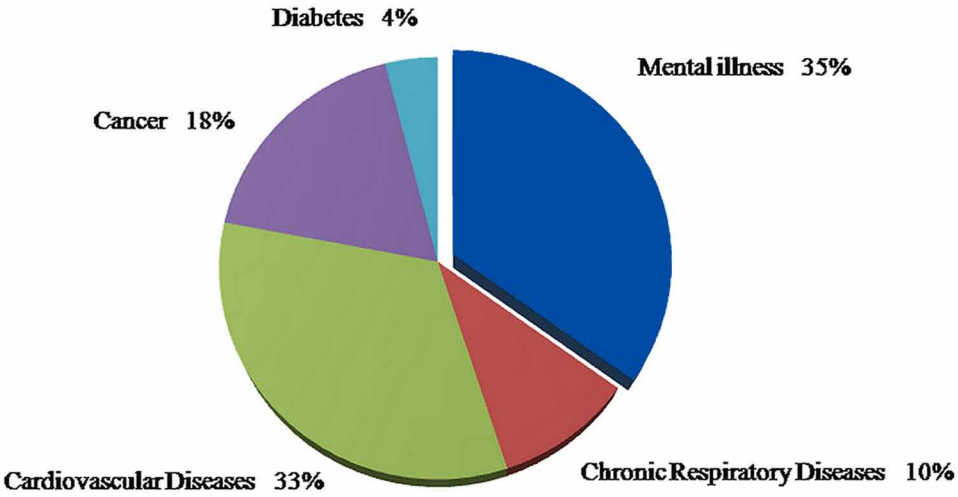

Table 1. Disability-Adjusted life years associated with mental health conditions

Types of Disorders	DALYs (Millions)	% Mental Health DALYs, World
All Neuropsychiatric disorders	**199**	
Unipolar depressive disorders	65	32.9
Bipolar affective disorder	14	7.2
Schizophrenia	17	8.4
Epilepsy	8	3.9
Alcohol use disorders	24	11.9
Alzheimer and other dementias	11	5.6
Parkinson disease	2	0.9
Multiple sclerosis	2	0.8
Drug use disorders	8	4.2
Post-traumatic stress disorder	3	1.7
Obsessive-compulsive disorder	5	2.6
Panic disorder	7	3.5
Insomnia (primary)	4	1.8
Migraine	8	3.9

Source: The Global Economic Burden of Noncommunicable Diseases. Geneva: World Economic Forum (Bloom et al., 2011).

In a study by Greenberg et al. (2015), the economic burden of individuals with chronic psychiatric illness with high suicide rate especially in major depressive disorder has increased by 21.5% from 2005 to 2010. The composition of these costs remained stable, with approximately 45% attributable to direct costs, 5% to suicide-related costs, and 50% to workplace costs. The global cost of mental health condi-

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tions in 2010 was estimated at US$ 2.5 trillion, with the cost projected to surge to US$ 6.0 trillion by 2030. The nationwide attempts to curtail health expenditures have resulted in pressure to demonstrate treatment effectiveness in most areas of health. However according to Atkinson, Zibin and Chuang (1997) as psychiatry deal with chronic illness with complex etiology and pervasive psychosocial effects on disorders leading to serious challenges to those who endeavor to assess program effectiveness in terms of economic burden.

FACTORS FOR SUICIDE RISK

Many risk factors and their relationship with underlying mental disorders and suicides have come from "psychological autopsy" studies (Cavanagh, Carson, Sharpe., & Lawrie, 2003). It is detailed investigations rely on interviews with family, close friends, and others who were in close contact with the person who died by suicide, in order to identify factors that likely contributed to the death (Table 2). Such studies have consistently found that the overwhelming majority of people who die by suicide i.e. 90% or more had a mental disorder at the time of their deaths. Often, however, these disorders had not been recognized, diagnosed, or adequately treated. While nearly all mental disorders have the potential to increase the risk for suicide, Bertolote and Fleischmann (2002) have shown that the most common disorders among people who die by suicide are major depression or with other mood disorders, substance use disorders, schizophrenia and personality disorders.

The various risk factors for suicide has been discussed which are as follows.

Table 2. Risk Factors for suicide

Primary Diagnosis	Sociodemographic and Miscellaneous Factors	Personality	Co-Morbidities	Social Factors	Other Factors
Bipolar	Male	Borderline	Substance abuse/ dependence	Divorced	Means available
Schizophrenia	Older age	Narcissistic	Alcohol abuse/ dependence	Widower	abuse
Major Depressive Episode	White race	Antisocial	Anxiety	Lives alone	Few reasons
Dysthymia	Prior depression or Suicide attempts	Conduct Disorder	Axis III Diagnosis	Isolated	To live
Adjustment Disorder with Depression	Family history of Depression/attempts	Impulsive	Panic	Financial Worries	Adverse events
Delirium or Dementia	Homosexuality			Other losses	Change of grades
Any psychosis	Suicidal Ideation			No religion	Change of friends
Hallucinations/ delusions: especially poverty	Hopeless/Helpless				Giving away possessions
	Agitation/ desperation				Guns in home

Source: Kaplan and Sadock's Comprehensive Textbook of Psychiatry, 9th Ed.

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Previous Suicide Attempt

According to Tidemalm, Langstrom, Lichtenstein, and Runeson (2008) about 20% of people who die by suicide have made a prior suicide attempt and clinical studies have confirmed that such prior attempts increase a person's risk for subsequent suicide death. Suicide risk appears to be especially elevated during the days and weeks following hospitalization for a suicide attempt, especially in people with diagnoses of major depression, bipolar disorder, and schizophrenia.

The majority of people who make a suicide attempt, however, do not ultimately die by suicide. There are studies that have followed suicide attempters identified in hospital emergency rooms have found that just 7–10% died by suicide over the next two decades (Carter, Child, Page, Clover, & Taylor, 2007).

Family History of Suicide

There are systematic reviews by Thelma Beatriz, Isela, Alma, María Lilia, and Carlos Alfonso, (2014) which have shown that the risk for suicide can be inherited. Pandey (2013) has reported that among the most studied genes are the ones that codify tryptophan hydroxylase 1 and 2 (TPH-1 and TPH-2), the serotonin transporter (5-HTT or SLC6A4) and the serotonin receptors (5-HTR1A, 5-HTR1B, 5-HTR2A, 5-HTR2C, etc.). Identical twins, for example, have been found to have stronger concordance for suicide than fraternal twins, even when they are raised separately. Study by de Leo and Heller (2008) on people who were adopted and subsequently died by suicide have found suicide to be more common among these individuals' biological parents than their adopted parents. Exposure to completed and attempted suicide in the family has also been found to increase suicide risk among family members by providing a "social model" of self-harm behavior. While these studies indicate that a family history of suicide can be a risk factor for suicide, they do not suggest that a suicide in the family automatically heightens suicide risk for all family members. Family history is one among many factors that can contribute to a person's vulnerability or resilience. As with other genetically-linked illnesses and conditions, awareness of possible risk and attention to early signs of problems in oneself or a loved one can be protective if it leads those who have lost a relative to suicide to seek timely treatment or intervention.

Relationship between Sociodemographic Factors and Suicide Risk

One of the major challenges of suicide research is determining how mental disorders and sociodemographic factors with certain environmental stressors interact to create a pathway to suicide. Data collected by the Centers for Disease Control and Prevention showed clear differences in the gender and age patterns in those who die by suicide or even suicide attempters. For example, young women are estimated to make 100 or more suicide attempts for every completed suicide, but yet they have a low rate of completed suicide. In contrast, the elderly have a suicide rate that is twice the rate among youth, but make relatively few non-fatal suicide attempts. Greater frailty and increased likelihood of physical illnesses are the factors which contribute to the lethality of suicide attempts in older adults.

Suicide Contagion

That imitative behavior ("contagion") plays a role in suicide has long been observed. Recent studies have concluded that media coverage of suicide is connected to the increase or decrease in subsequent

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suicides, particularly among adolescents (Sisask &Varnik, 2012). High volume, prominent, repetitive coverage that glorifies, sensationalizes or romanticizes suicide has been found to be associated with an increase in suicides (Bohanna & Wang, 2012). There is also evidence that when coverage includes detailed description of specific means used, the use of that method may increase in the population as a whole (Yip et al., 2012).

In recent years, the internet has become a particular concern because of its reach and potential to communicate information about notorious suicides and those that occur among celebrities. However, when media follows appropriate reporting recommendations, studies show that the risk of suicide contagion can be decreased (Bohanna & Wang, 2012).

Access to Lethal Methods of Suicide

There is strong evidence that the availability and use of different modes of suicide impacts suicide rates among different population and different geographical areas. In the U.S., the most common method of suicide is firearms, used in 51% of all suicides. Currently, firearms are involved in 56% of male suicides and 30% of female suicides. Among U.S. women, the most common suicide method involves poisonous substances, especially overdoses of medications. Poisoning accounts for 37% of female suicides, compared to only 12% of male suicides. Hanging or other means of suffocation are used in about 25% of both male and female suicides. The difference in death rates among the most common suicide methods estimated at 80-90% for firearms and 1.5-4% for overdoses helps to account for the roughly 4: 1 ratio of male-to-female suicides (Yip et al., 2012). The greater availability of firearms in rural parts of the country also contributes to higher suicide rates in the more rural Western states. Studies have shown that many suicide attempts are unplanned and occur during an acute period of ambivalence (Bohanna & Wang, 2012). Therefore, restricting access to lethal methods is a key suicide prevention strategy.

Biological Factors

Postmortem studies of the brains of people who have died by suicide have shown a number of visible differences in the brains of people who died by suicide, compare to those who died from other causes, suicide is a result of a disease of the brain (Mann & Currier, 2012). There is possible strong association with neuroplastic effect due to chronic mental illness and prolonged drug exposure leading to suicidality. The brain systems that have been most frequently studied as factors in suicide are the serotonergic system, adrenergic system and the Hypothalamic-Pituitary Axis (HPA), which relate to mood, thinking and stress response, respectively. This research has also identified neurobiological impairments related to depression and other underlying mental disorders, as well as to acute or prolonged stressors. One of the key challenges of neurobiological studies is to determine the abnormalities in genes, brain structures or brain function that differentiate patients from CMI who died by suicide from who died by other causes.

ADVANCE INTERVENTION STRATEGIES

It can be as a part of preventive strategies, treatment and rehabilitative strategies. There have been several reviews of interventions that may be considered effective in reducing suicides. Under the framework of universal, selective, and indicated interventions (Mrazek & Haggerty, 1994) the general population is

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targeted by universal interventions (e.g. restricting access to means of suicide) and selective interventions focus on high-risk subgroups (e.g. people with mental disorders), whereas those who have attempted suicide are considered high-risk individuals and are therefore addressed with indicated interventions, which include a range of pharmacotherapy, non-pharmacotherapy like behavioral therapies and approaches such as cognitive therapy (Brown et al., 2005) including mindfulness based cognitive behavior therapy and novel treatment approaches particularly in active suicidal or in rescued cases as a part of rehabilitation. As it is indicated in the first report in WHO Preventing suicide: a global imperative (2014), many universal, selected and indicated strategies have been implemented worldwide to improve the knowledge about suicide, increase the access to health care professionals, train the gatekeepers and therefore lead to an improvement in identification and management of people at risk.

How to Assess Suicidality

The rising trend of suicide in community has other way raised the concern of unidentified underlying psychiatric illness possibly of chronic nature. Over the past several decades our knowledge about suicidal behavior has greatly increased. Research could prove the importance of the interplay between neurobiological, social, psychological, cultural and environmental factors for the development of suicidal behavior. Epidemiological studies have led to more information about risk and protective factors in general population and in patients with psychiatric diseases. Apart from various tools available for suicide risk assessment, there are various recent advances and research in developing easy accessible tools for assessment of suicide. One of the larger initiativeshas been taken by Substance Abuse and Mental Health Services Administration (SAMHSA) and the Health Resources and Services Administration (HRSA). The Center for Integrated Health Solutions (CIHS) promotes the development of integrated primary and behavioral health services to better address the needs of individuals with mental health and substance use conditions, whether seen in specialty behavioral health or primary care provider settings. CIHS is funded jointly by SAMHSA and HRSA and run by the National Council for Behavioral Health.

The various screening tools for suicide assessment are:

- Columbia Classification Algorithm of Suicide Assessment (C-CASA) by Posner, Oquendo and Gould (2007).
- Substance Abuse and Mental Health Services Administration (SAMHSA) Suicide Assessment Five-Step Evaluation and Triage (SAFE-T): Pocket Card for Clinicians which is a Suicide Safe mobile app (based on the SAFE-T is available on the app stores).
- The Columbia-Suicide Severity Rating Scale (C-SSRS) by Posner, Brown and Stanley, (2011), is a questionnaire used for suicide assessment. It is available in 114 country-specific languages.
- PHQ-9 and SBQ-R and other regular screenings by Bluml et al. (2013) in primary care and other healthcare settings enable earlier identification of suicide risk and mental health disorders.
- QPR Institute's risk audit can help in your organization's current operational and training approach to suicidal patient safety.
- Stories of Hope and Recovery, is a video guide for Suicide Attempt Survivors and features inspiring stories from three people who survived an attempted suicide.
- The MacArthur Depression Toolkit assists primary care clinicians with recognizing and managing depression. This toolkit includes user-friendly instruments to assist with recognizing, diagnosing, treating, and monitoring depression (Han, Voils, & Williams, 2011).

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- A Discussion Guide for Primary Health Care Providers is an online guide to equip primary health care providers with questions to begin discussions with their patients about alcohol, illicit drug, and mental health problems, as well as co-occurring disorders. This brief guide also includes resources for patients who need an evaluation based on positive screening results.

What Are the Preventive Strategies?

Among indicated interventions, various approaches have been tested to prevent subsequent suicidal behavior by suicide attempters; extensive review articles are available. Usually, the primary outcome measure used for these interventions was repeated suicide attempts. Previously, completed suicides were used as an outcome measure in a study that investigated the maintenance of long-term contact (i.e. a total of 5 years and 24 contacts) with high suicide-risk psychiatric patients refusing further treatment (Motto, 1976; Motto, Heilbron, Juster., & Bostrom, 1981; Motto & Bostrom, 2001). The contact comprised regular short letters expressing concern for the person's well-being and inviting them to respond. This was associated with a significant reduction in suicide rates for at least 2 years after discharge from the in-patient setting.

The Crisis Intervention and Suicide Prevention Centre of BC (Crisis Centre) is a non-profit, volunteer organization committed to helping people help themselves and others deal with crisis. The Crisis Centre has been providing emotional support to youth, adults and seniors in distress since 1969. As a safe place to turn when there seems to be no hope, the Crisis Centre is operated by 450+ frontline volunteers and a small team of professional staff who support and empower individuals to see their own strengths and options, 24 hours a day in 7 days a week. We work at the community level to provide education and training aimed at fostering resiliency and building capacity to respond to crisis and suicide. In 2014, the Crisis Centre impacted more than 127,000 lives across BC through its three core services: 24/7 Distress Phone Services, Online Distress Services (YouthInBC.com, CrisisCentreChat.ca) and Community Education.

In addition, in the elderly who typically have an elevated risk of suicide compared with an age-adjusted number for the general population, a "tele-help/tele-check" service (i.e. an alarm system that can be activated to call for help and a service that contacts a person twice a week for assessment of their needs and to provide emotional support) could significantly reduce the number of suicide deaths (De Leo, Carollo., & DelloBuono, 1995; De Leo, DelloBuono., & Dwyer, 2002).

The multisite intervention study on suicidal behaviours (SUPRE-MISS), launched by WHO in 2000, evaluated an innovative intervention in a large randomized controlled trial, that brought together the elements of information, education, and practical advice from brief interventions with the maintenance of long-term follow-up contact on a regular basis. It used completed suicides as the primary outcome measure because the reduction in suicide mortality is the most convincing evidence for the effectiveness of suicide prevention (Moller, 1989). The multisite randomized controlled trial of different treatment strategies for suicide attempters represented one component of SUPRE-MISS, which, overall, aimed at increasing knowledge about suicidal behaviours and effective interventions for suicide attempters (Bertolote et al., 2005).

The main crucial factor for prevention of suicide is the time of contact. In an analysis of separate 40 postmortem studies found that 45% of those had seen a primary care provider within the month before their death, and 77% had such contact within the past year (Luoma, Martin, & Pearson, 2002). Older adults who died by suicide were even more likely to have had recent contact with a primary care provider. By contrast, only about 30% of all those who died by suicide had received mental health services during

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the last year of life, and only 19% in the last month. These findings suggest that suicides may be reduced if primary care providers and their staffs were better able to recognize and treat (or refer for specialty care) patients who show signs of the mental disorders that are most commonly associated with suicide. In a recent meta-analysis (Inagaki et al., 2015), the interventions of active contact and follow-up have been recommended to reduce the risk of a repeat suicide attempt.

Substance Abuse and Mental Health Services Administration (SAMHSA) and the Health Resources and Services Administration (HRSA) have come up with general resources for suicide prevention strategies keeping view on recent technological advances like:

- An edition of solutions which focuses on Suicide Prevention in Primary Care, common suicide warning signs, featured resources, etc.
- The Suicide Resource Prevention Center, funded by SAMHSA, provides technical assistance, training, and materials to increase the knowledge of professionals serving people at risk for suicide.
- The 2012 National Strategy for Suicide Prevention: Goals and Objectives for Action is a joint effort by the U.S. Surgeon General and the National Action Alliance for Suicide Prevention.
- Suicide Prevention Toolkit for Rural Primary Care, developed by Western Interstate Commission for Higher Education (WICHE) Mental Health Program, in collaboration with the Suicide Prevention Resource Center, assists rural primary care providers in effectively identifying and intervening with individuals who are suicidal.
- Suicide Prevention: Not Another Life to Lose, the most recent edition of National Council Magazine, provides insights from leaders in the field, extensive community resources, and inspiring, poignant stories of survival, resiliency, and courage.
- Suicide Safe: a suicide prevention, mobile-learning tool to help providers integrate suicide prevention strategies into their practice and reduce suicide risk among their patients. SAMHSA'S free app is available for Android and iOS operating systems.

There are attempts to curtail health expenditures which have resulted in pressure to demonstrate most effective treatment outcome models in practice. However, as psychiatry deal with chronic illness with complex etiology hassled to serious challenges to those who endeavor to assess program effectiveness in terms of economic burden. Such difficulties include: Disease states of a chronic nature, multi determinant treatment outcome indicators and lack clear causal specificity, indicators of effectiveness that involve complex psychosocial systems, and treatment approaches that often focus on the prevention or maintenance of psychosocial function as opposed to circumscribed curative goals. One of the major factors which prevent patients to seek treatment is perceived stigma. This underlies even when such subjects do not have any CMI but are only under severe emotional crises. There are some policies and programs in match with current advancement for its early detection and interventions like online suicide helpline etc.

Treatment

Suicidality represents trans-diagnostic issue, so matter of the fact is to make the correct diagnosis. There have not been a large number of programs and practices identified that can be said to be truly "evidence based" in terms of suicide prediction or treatment because first, completed suicide is relatively uncommon and researchers have become ethically constrained. This has led deficit in methodological consideration in studying suicide or suicidality even in general populations (Till, Strauss, Sonneck., &

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Table 3. Selected suicide risk factors and interventions: individual, family, and community levels

Risk Factors	Interventions
Individual Level: • Sex/gender • Occupation • History of suicide attempts • Mental disorder (anxiety, mood) • Addictions • Physical illness • Financial stress • Personality disorders/impulsivity/aggression • Legal problems • Lack of religious affiliation	• Timely access to evidence-based interventions in various settings: college,workplace, justice, primary care, organized faith settings, specialty care (S/I) • Postdischarge follow-up contact for patients hospitalized for suicidal behavior (I)
Family Level: • Childhood maltreatment • Intimate partner violence • Addictions, mental disorders, suicide in family members	• Positive parenting programs (U/S) • Family-based interventions (U/S) • Peer support for young mothers (S) • Support for the bereaved (S)
Community Level: • Suicide in peers • Sensational media reporting of suicide • Specific cultural factors (e.g., Native Americans, immigrants, refugees) • Access to lethal means: guns, pesticides	• School-based evidence based programs (U) • Media education of safe reporting (U) • Culturally grounded interventions (U/I/S) • Means restriction (U) • Crisis lines (U)

Source: Promising Strategies for Advancement in Knowledge of Suicide Risk Factors and Prevention (Sareen et al., 2014)

Note: Institute of Medicine [IOM] -defined prevention programs: I, indicated; S, selective; U, universal.

I programs target groups that have already developed the disease and aim to reduce severe problems. S programs target groups at high risk for the outcome or disease.

U programs include all people in a certain community in the intervention.

Table 4. Strengths and limitations of proposed research pathways

Research Pathways	Strengths	Limitations
Analysis of existing epidemiologic samples and clinical trial databases	• Data already collected • Inexpensive to conduct analysis • Large sample size	• Limited by what is already collected in data sets • Observational studies, causal inferences cannot be made
Networks and consortia of researchers	• Multi-site prospective cohorts (history of suicide attempts, family history of suicide) • Sufficient sample sizes to examine biomarkers, genetics, and imaging work to understand biological factors related to suicide • Understand the natural trajectory of suicidal behavior	• Large infrastructure support required • Observational studies • Substantial effort to create the network and develop partnerships
Evaluation of current or new policies and programs	• Creates partnerships between policymakers and researchers in suicide • Bidirectional knowledge exchange leads to rapid uptake of new knowledge in suicide • Prevention • Careful evaluation of large-scale policies leads to an understanding of which suicide policies have an impact on suicide • Multi-site clinical trials with high-risk	• Large-scale policies are heterogeneous and it may be difficult to discern which parts of the policies are associated with reductions in suicide • Quasi-experimental designs preclude causal inferences • Ethical issues of conducting RCTs in high-risk groups samples

Source: Promising Strategies for Advancement in Knowledge of Suicide Risk Factors and Prevention (Sareen et al., 2014).

Note: IOM-defined prevention programs: I, indicated; S, selective; U, universal.

I programs target groups that have already developed the disease and aim to reduce severe problems. S programs target groups at high risk for the outcome or disease.

U programs include all people in a certain community in the intervention (see the Table 3 & 4)

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Niederkrotenthaler, 2015; Jha & Kumar, 2015). Treated versus treatment as usual (TAU) rather than randomized, treated versus untreated controls and the utilization of suicide attempt data as a proxy for completed suicides are not entirely satisfactory substitutes. Of the handful of evidence-based programs or practices, the use of clozapine in schizophrenia, lithium in bipolar patients, dialectical behavioral therapy (DBT) in patients with borderline personality disorder, and cognitive behavioral therapy (CBT) in depressed patients stand out as providing strong evidence of their effectiveness in diminishing suicide attempts or completions (Kaplan & Sadock, pp. 2717–2732). Other interventions and programs have lesser degrees of proven efficacy. With advent of newer interventions in terms of pharmacotherapy, psychotherapy and novel treatments like Transcranial Magnetic Stimulation (TMS), transcranial Direct Current Stimulation (tDCS) along with gold standard modified Electro-Convulsive Therapy (ECT), has led path for promising outcome.

Pharmacotherapy

The primary determinant of the pharmacotherapy is the underlying disorder like antidepressants for patients with depressions, mood stabilizers in bipolar patients, atypical antipsychotics for psychotic patients and substance use disorder patients may receive methadone, naltrexone or disulfiram, etc. Based on various researches on biological basis of suicide and its implications in understanding treatments strategies have helped in formulating different pharmacotherapuetic regimes for preventing suicide. The genetic and epigenetic factors, dysfunction of neurotransmitter, neuroendocrine system and stress response system has been determining for neurobiology of suicidality. Therefore, pharmacotherapeutic approach should be focused, not only on prevention and reduction of suicidality, but adjusted for general and diagnosis-specific risk factors.

The serotoninergic drugs have neutral or mildly protective effect on potential suicidal behaviour while noradrenergic drugs may have activating effect or could even worsen suicidal ideation in certain phase of the illness. There is perennial debate regarding the use of antidepressant medications themselves may induce suicidal behavior in youths. But based on research it was reported that there were no completed suicides occurred in children treated with SSRI medications. However, about four percent of those taking SSRI medications experienced suicidal thinking or behavior, including actual suicide attempts-twice the rate of those taking placebo, or sugar pills. In response, the U.S. Food and Drug Administration (FDA) adopted a "black box" label warning indicating that antidepressants may increase the risk of suicidal thinking and behavior in some children and adolescents with major depressive disorder. When given in appropriate dose and the right time, dual or noradrenergic antidepressants, could also have good protective impact on specific patient. There is emergence of four new antidepressants among two are essentially old wines in new bottles i.e. trazodone extended-release and doxepin, one is a reissue of as is ocarboxazid and one is actually a new molecule vilazodone (Rickels et al., 2009). However, their efficacy comparing with existing antidepressant in management of suicide risk is yet to be studied.

Psychotherapy

The psychopathological dynamics in suicidality overcomes actual diagnostic distribution therefore pharmacotherapy has restricted role in overall prevention of suicidal behaviour among mentally ill and is demanding for clinician. Searches for relevant literatures were carried out using electronic databases. Pubmed (including Pubmed Central) and Google Scholar were used to identify published studies. Searches

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were carried out using Medical Subject Headings (MeSH) terms "psychotherapy" and "Suicide". Additional searches were carried out using related keywords of "suicidal behaviors" and "psychotherapy". There were studies on specific therapies providing evidence of their effectiveness directed towards preventing suicidal behavior or suicide in respective disorders like unguided online self-help to reduce suicidal thoughts, an adjunctive Emotion Regulation Group Therapy (ERGT) for Deliberate Self-Harm among women with BPD, Interpersonal Psychotherapy (IPT) adapted for older depressive patients at risk for suicide, Internet-delivered CBT programs, MIDSHIPS: multi-centre intervention designed for self-harm using interpersonal problem-solving, Mindfulness-based stress reduction, Dialectical Behavioral Therapy (DBT) and DBT Prolonged Exposure in patients with borderline personality disorder and PTSD, and Cognitive Behavioral Therapy (CBT) in depressed patients.

Based on recent systematic review and meta-analysis (Cuijpers et al., 2013), there is insufficient evidence for making assumption that the suicidality in depressed patients can be reduced with psychotherapy. Although psychotherapy of depression may have small positive effects on suicidality, available data suggest that psychotherapy for depression cannot be considered to be a sufficient treatment.

Novel Treatments

Apart from above mentioned therapeutic interventions, there are few novel techniques like Electro-Convulsive Therapy (ECT), Triple Chronotherapy, Transcranial Magnetic Stimulation (TMS), Transcranial Direct Current Stimulation (tDCS) and Vagal Nerve Stimulation (VNS). Among these techniques, ECT has proven its efficacy over the time in improving depressive symptom and subsequently in suicide prevention. The rapid relief of severe depression, mania and psychosis by electroconvulsive therapy (ECT) is accompanied by the rapid reduction in suicide drive. These have led to the consideration of ECT in treatment algorithms to reduce suicide rates. The benefit of ECT in reducing suicide risk is widely acknowledged by National Psychiatric Associations (NPA) in Great Britain and the United States although supporting studies are few (Fink, Kellner, & McCall, 2014). Studies have demonstrated that combined total sleep deprivation (Wake therapy), sleep phase advance, and bright light therapy (Triple Chronotherapy) produce a rapid and sustained antidepressant effect in acutely depressed individuals. The results of this small pilot trial demonstrate that adjunctive Triple Chronotherapy is feasible and tolerable in acutely suicidal and depressed inpatients (Sahlem et al., 2014).

ECT is an intervention for which its role in suicide prevention is not based on any robust, formalized study, but rather relies on a long clinical history of successful use in the treatment of depression associated with suicidal thoughts and behaviors. Despite expert consensus that ECT is effective, it has a limited role in the general prevention of suicide given its cost, limited availability, and procedural logistics with associated stigma. Each treatment requires several hours for administration of anesthesia and recovery in a monitored medical setting, and it is generally given 3 times per week for 2–4 weeks, making it a very involved process for patients, clinicians, and family members. Unlike the pharmacotherapies discussed above, convulsive treatments can work rather quickly to reduce suicidal ideation, but their long-term impact is not as clear, and the potential for cognitive side effects can be limiting.

TMS is a newer neurostimulatory technique that is less invasive than ECT and does not require sedation. It utilizes alternating magnetic fields to induce neuronal firing in targeted brain regions. There are studies on efficacy of perfusional imaging assisted TMS in treatment resistant depression (Jha, Chadda, Kumar, & Bal, 2013) which alleviates risk of suicide. In a clinical trial (Ferrucci et al., 2009) that included some patients with a history of suicide attempt, tDCS was shown to have an effect on depressive

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symptoms, including suicidal ideation, comparable to that of a 6-week course of standard antidepressant medications. One weakness of the study was it did not take into account the proximity of attempts to the treatment. Direct evaluation of this novel therapy with regard to suicide has not been conducted.

There are studies on suicide rescued patient (Kumar & Jha, 2013) particularly post hanging that soon or later manifest with some neuropsychiatric deficit like amnesia, orbitofrontal syndromes or based on extent and area of brain insult. The brain SPECT assisted TMS has shown some evidence in such rescued patient in overcoming those residual deficits though it requires further research.

SPECIAL TOPICS

Extended Suicide

Extended suicide is a dramatic event in which an individual commits suicide shortly after homicide. In German-speaking countries Nacke first introduced the term "extended suicide". In extended suicide the person sees the murdered person as an extension of self (Cooke, 2013). Extended suicide is the most tragic associations between depression and criminality. In a study on Austrian females who committed a serious extended suicide attempt, it was found that factor associated were first, chronic severe depression with or without psychotic features, anxious-avoidant personality disorder, committed at least one suicide attempt in the past, long standing overstrain, marital or financial problems. An altruistic, hypernomic motive for killing and psychotic identification with the victim were found to be the basic understanding behind extended suicide (Meszaros & Fischer-Danzinger, 2000).

Suicide Victim

The majority of patients who make a suicide attempt, however, do not ultimately die by suicide. Studies that have followed suicide attempters identified in hospital emergency rooms have found that just 7–10% died by suicide over the next two decades (Jenkins, Hale, Papanastassiou, Crawford, & Tyrer, 2002). In rescued cases of suicide by hanging, there are hypoxic or anoxic changes occur in brain which may later lead to behavioral abnormality and personality change (Kumar & Jha, 2013). Single-Photon Emission Computed Tomography (SPECT) is a valuable tool to investigate regional cerebral blood flow (rCBF) deficits in such patients especially correlating the stable neuropsychiatric deficits. The perfusion studies have shown diffusely scattered area of hypoperfusion involving various cortical and subcortical structures. These neuropsychiatric deficits do add up to the existing burden of chronic psychiatric illness and subsequently requires intensive interventions (Kumar & Jha, 2013) with rehabilitation plan.

WHO Response

WHO is recognized suicide as a priority in public health perspective. The first WHO World Suicide Report "Preventing suicide: a global imperative" published in 2014. It was aimed to increase the awareness of the public health significance of suicide and suicide attempts and to make suicide prevention a high priority on the global public health agenda. It also aimed to encourage and support countries to develop or strengthen comprehensive suicide prevention strategies in a multisectoral public health approach. Suicide is one of the priority conditions in the WHO Mental Health Gap Action Programme (mhGAP)

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launched in 2008, which provides evidence-based technical guidance to scale up service provision and care in countries for mental, neurological and substance use disorders. In the WHO Mental Health Action Plan 2013-2020, WHO Member States have committed themselves to working towards the global target of reducing the suicide rate in countries by 10% by 2020.

Indian Scenario

The suicide rate in India is comparable to that of developed countries and the increasing rate during recent decades is consistent with the global trend. More than one lakh lives are lost every year due to suicide in India. There had been a gradual increasing trend of suicide rate in the past decades (from 1975 to 2005), the suicide rate increased by 43%. The rates were approximately the same in 1975 and 1985; from 1985 to 1995 there was an increase of 35% and from 1995 to 2005, the increase was 5%. In the NCRB report the rate in 2010 rose to 11.4 per 100,000 population; an increase of 5.9% in the number of suicides (Radhakrishnan & Andrade, 2012). Based on NCRB report, 2014 the number of Suicides in 2013 was 1,34,799 i.e. 11.0 per one lakh persons and in 2014 was 1,31,666 i.e. 10.6 per one lakh persons. The problem is however a difficult one as expressed by Gajalakshmi and Peto (2007) as "a complex array of factors such as poverty, low literacy level, unemployment, family violence, breakdown of the joint family system, unfulfilled romantic ideals, inter-generational conflicts, loss of job or loved one, failure of crops, growing costs of cultivation, huge debt burden, unhappy marriages, harassment by in-laws and husbands, dowry disputes, depression, chronic physical illness, alcoholism/drug addiction, and easy access to means of suicide."47 the prevention is being the main intervention and based on same there are various crisis intervention centers came into existence. There had been research on suicide which are categorized under (1) Incidence and prevalence studies (2) Profiling and identification of risk factors (3) Suicide and suicidal behavior in specific communities (4)Studies on Non-Fatal Deliberate Self Harm (DSH) (5) Suicide prevention strategies.

Nandi, Banarjee and Boral, (1978) and Hegde, (1980) studied incidence rates in Bengal and patterns of suicide in a rural community in northern Karnataka respectively using data available in the public domain across a hundred-year period (1872-1972) and reported increasing incidence of suicide rate with male preponderance along with the most common method identified was poisoning. Regarding clinical profile and factors associated, Rao, (1965) in his hospital based study on suicide attempts reported a male preponderance and vulnerable age group as being from 15 to 25 years. 20% of the attempters had a family history of mental illness/suicidal attempts. He also recommended that education of general physicians, limiting access to availability of antidepressants, paracetemol and pesticides would lower the rates of suicide (Rao, 1999).

Vijayakumar, (2007) in an editorial expresses the urgent need for suicide prevention in India and stresses that suicide is a multifaceted problem and hence suicide prevention programs should also be multidimensional. Collaboration, coordination, cooperation and commitment are needed to develop and implement a national plan, which is cost-effective, appropriate and relevant to the needs of the community. For the suicide risk assessment, Gupta, Anand, and Trivedi (1983) published an article on the development of a 10 item suicidal intent questionnaire. The article established that the questionnaire was fairly valid but stated that further work was necessary to establish its statistical validity and reliability.

Based on the research evidences (Vijayakumar, 2010), a social and public health approach acknowledged that suicide is preventable, and initiated a framework to be made in integrated system of interventions across multiple levels within society including the individual, the family, the community and the health

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care system. A key step in such an approach involves modifying attitudes toward suicide via educational efforts and legal levers (e.g. decriminalizing suicide).

Moving ahead on policy level, the landmark initiative had been taken by the government of India indecriminalizing the "attempt to suicide" by deleting Section 309 of the Indian Penal Code (IPC) from the statute book after 18 states and 4 Union territories backed the recommendation of the Law Commission of India in this regard.

Further in an attempt to make crisis intervention accessible to every people in crisis, the initiatives taken by SAMHSA and manyonline crisis intervention sites like IMAlive: An Online Crisis Network, Crisis Chat, National Suicide Prevention Lifeline and others. Similarly, in India such center is "AASRA". It is a crisis intervention center for the lonely, distressed and suicidal. Aasra functions as a unit of Befrienders Worldwide/Samaritans and is a non-religious, non-political and non-sectarian organization, registered as a Public Charity under the Bombay Charity Act, 1960. There are many such reforms required even at the level of policy making for some population specific crisis or suicide like farmers' suicide in India.

Few Facts about NCRB Report, 2014:

- 15 Suicides take place every one hour in the year 2014.
- Like previous years, more than one lakh persons (1,31,666) in the country lost their lives by committing suicide during the year 2014.
- Maximum suicides were reported in Maharashtra (16,307) followed by Tamil Nadu (16,122) and West Bengal (14,310) accounting for 12.4%, 12.2% and 10.9% respectively of total suicides reported in the country during 2014. Puducherry reported the highest rate of suicides (40.4) followed by Sikkim (38.4) during 2014.
- Like previous year, 'Hanging' (41.8%), Consuming 'Poison' (26.0%), 'Self-Immolation' (6.9%) and 'Drowning' (5.6%) were the prominent means of committing suicides during 2014.
- 1 suicide out of every 6 suicides was committed by a 'homemaker'; nearly 67.0% of the male victims were married while 63.6% of female victims were married.
- 69.7% of victims having income of less than 1 lakh have committed suicides during 2014. 26.9% of suicides victims belong to income group of 1 lakh and above to less than 5 lakh. 20.2% of the suicide victims were educated up to middle level, 19.0% of the suicide victims were educated up to primary level and 14.3% of victims of suicide were illiterate.
- Family problem (other than marriage related issues) was the major cause of suicide in cities in 2014 which accounted for 25.0% (5,157 out of 20,621) of total suicides followed by 'Illness' which accounted for 19.0% (3,920 victim out of 20,621 victim)
- Out of total 20,621 suicides in cities during 2014, 23.6% were educated up to matriculate/secondary level (4,867) The highest number of mass/family suicide deaths were reported from Uttar Pradesh (66) followed by Karnataka (52), Andhra Pradesh (33), Maharashtra (23), Kerala and Telangana (22 each) out of 275 deaths during the year 2014.

CONCLUSION

Suicide is major public health issue. Mental illness is a risk factor for suicide and uniformly studied all across the globe. With such rising trend, it requires specific attention in all domains among public service providers along with specific targeted population of patients suffering from psychiatric illness. A

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social and public health response to suicide is crucial and should complement a mental health response. However, additional risk factors are prominent in India. These tend to relate to societal structures and specific stressors. Among people who die by suicide, identifiable psychiatric diagnosis either independent or comorbid are common. Therefore, efforts to educate primary care providers about the diagnosis and treatment of such condition including referral to specialized center are especially important. However, the enormity of the problem has led to several major public health initiatives and a growth in research funding for suicide prevention and specific interventions. The national strategy should focus on promoting awareness that suicide is public health problem and it is preventable, to develop support for suicide prevention, implement strategies to reduce the stigma, implement suicide prevention programs, efforts to reduce access to lethal means and methods, implement training for recognition of at-risk behavior and delivery of effective treatment, improve access to and community linkages with mental health and substance abuse services, promote and support research on suicide and suicide prevention, improve and expand surveillance systems. Twenty-eight countries have established national suicide prevention programs dedicated to suicide research and prevention. However, there is still a need to expand suicide prevention research and anti-suicidal strategies. With vigorousness in research methodology and in era of technological advancement, there have been various treatment alternatives now available which has emerged and hold great promises in future prospect. But due to limited resources especially in underdevelop or developing nation, the accessibility to all is still a concern by service providers. Besides all the commitment perceived at all sections including community, professional bodies and policy makers, it is yet not impossible to provide helping hand to the person in crisis.

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KEY TERMS AND DEFINITIONS

Novel Treatments in Suicide: There are few novel techniques, what we call as an advance treatment modalities like Electro-Convulsive Therapy (ECT), Triple Chronotherapy, Transcranial Magnetic Stimulation (TMS), Transcranial Direct Current Stimulation (tDCS) and Vagal Nerve Stimulation (VNS). Among these techniques, ECT has proven its efficacy over the time in improving depressive symptom and subsequently in suicide prevention.

Suicide: The act of intentionally causing one's own death. Suicide is often carried out as a result of despair, the cause of which is frequently attributed to a mental disorder such as depression, bipolar disorder, schizophrenia, borderline personality disorder, alcoholism, or drug abuse, as well as stress factors such as financial difficulties, troubles with interpersonal relationships, and bullying.

Suicide in Bipolar Disorder: Bipolar disorder (manic-depressive illness) is a neurobiological disorder that severely affects patients with depression. Individuals diagnosed with this disease have mood swings that alternate from periods of severe highs (mania) to extreme lows (depression). Suicide is the number one cause of premature death among people with bipolar disorder.

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Suicide in Depression: A morbidity associated with depression is difficult to quantify, but the lethality of depression takes the measurable form of completed suicide.

Suicide in Schizophrenia: A chronic disabling mental illness, characterized by a wide range of symptoms including abnormal thinking, loss of contact with the reality and hallucinations. It is strongly linked to an increased risk of suicideattempts and completed suicides.

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Chapter 71
The Future of Healthcare:
Political Participation of Nursing and Public Health Students

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ABSTRACT

The U.S. healthcare environment is undergoing rapid change. New policies have reshaped healthcare through reimbursement models focused on access and quality. Advocating for policies that improve population health is important for health professionals and students. For this reason, educators need to know how to prepare students to be active in the political process. Using the Civic Volunteerism Model, factors influencing nursing and public health students' political participation were examined. Both groups had relatively low levels of political participation and differences in types of political activities. The best predictor of political participation was found to be psychological engagement (e.g., political efficacy, partisanship, political interest). Students were more politically active if they attended school part-time, employed more than part-time, and were non-traditional students. Suggested educational strategies and use of social media were discussed. Further exploration of social media as a source of political information and recruitment is recommended.

INTRODUCTION

A continuing decline in political involvement among young adults has been shown (Levine, 2007). An opportunity exists for students to be prepared for social responsibilities, including political participation, through college courses and education. Students can gain knowledge and skills through a college education during a time at which they are forming a political identity. This is especially important in

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health related fields during a time when health policy is being reformed and substantially changed to improve access and health outcomes. By strengthening their political acumen, they are better equipped to affect public policy both personally and as future health professionals. The purpose of this study was to determine the level of political participation in undergraduate nursing and public health (PH) students in one Midwestern university along with factors influencing that participation. Verba's Civic Volunteerism Model (CVM) was used as a model for predicting political participation. Using a descriptive, predictive design, the study examined differences in political participation, demographic variables, and effect factors by major. The study also determined the extent to which the CVM predicted political participation in this population.

LITERATURE REVIEW

Nursing, as one of the largest health professions with three million registered nurses across the United States, has the potential to drive policies that influence health. This large and trusted professional group accounts for one in every 44 voters (Spenceley et al., 2013; Phillips, 2012). The public expects nurses to provide compassionate and ethical care and advocate for clients and issues that are relevant. A recent Gallup poll found nurses rated highest in honesty and ethical standards compared to numerous other professional groups (Gallup, 2014). Despite the profession's potential to influence policy, advocacy by nurses has sometimes been characterized as invisible (Spenceley et al., 2013).

Exploration of the level and types of political participation among nurses and nursing students has been addressed in recent literature. Using Verba and colleagues' (1995) Civic Volunteerism Model (CVM), the authors identified political engagement in primarily "low cost" activities (e.g., voting, conversations about politics, contacting elected officials) among Midwestern RN to BSN students and RNs (Vandenhouten, Malakar, Kubsch, Block, & Gallagher-Lepak, 2011). Psychological engagement was found to be most predictive of political participation which was consistent with previous research by Ritter (2008) and Cramer (2002). Specific dimensions of psychological engagement most strongly associated with political participation were political interest, political efficacy and family influences. Resources (i.e., time/money, civic skills) significantly contributed to political participation as well (Vandenhouten et al., 2011). Social networking as a form of political participation was not addressed in this study (Vandenhouten et al., 2011).

Numerous barriers have been cited as reasons for low political participation by nurses and nursing students. Rains & Barton-Kriese (2001) identified in a qualitative study that nursing students had a "disconnect among personal, political, and professional expectations" and a "hesitancy in talking about themselves as political beings" (p. 222). Spenceley et al. (2006) cited the following barriers for political participation by nurses 1) lack of preparation from nursing education, 2) heavy workloads and lack of time, 3) professional silos and fragmentation, 4) risk averse personal qualities, and 5) tendency to view policy as removed from their scope of interest.

The level of political participation among other health professions is of interest as well. Disciplines such as social work and PH, similar to nursing, are oriented toward the publics good and this may impact their political engagement to some degree. Social workers, for example, have been shown to be more politically active than the general public (Hamilton & Fauri, 2001). Comparisons between nursing students and students from other disciplines have been performed to a small extent. Rains and Barton-Kriese (2001), for example, compared undergraduate nursing and political science students using qualitative

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methods. Interestingly political science students were able to "talk the talk" but were less active than nursing students in community service; nursing students, however, did not refer to their social action in the community as "political". Spenceley et al. (2006) found that the importance of policy advocacy was recognized among community health nurses. Thus, consideration of the political participation of those in the discipline of PH appears warranted.

Public health professionals, prepared with undergraduate or graduate degrees, work in government, nonprofit, and advocacy organizations. Little research has been reported on PH professionals' political participation. No literature was found on the level and types of political participation of PH students although McFarlane and Gordon (1992) asserted that the nature of their future work as professionals requires working within the political system as a result of public health's heavy reliance on government funding. For example, a study by Thompson, Boardley, Kerr, Greene, and Jenkins (2009), evaluated public policy involvement by health officials and found 31% of commissioners involved in influencing health policy in the last four years. Primary methods used included voting and providing political information and reports.

Education has predominantly been viewed as a method to inform individuals about the importance of political engagement. Coverage of PH policy, advocacy, and regulatory aspects of health care in curricula is important in that it provides the education and training in nursing and PH. In the U.S., over 140,000 nursing students graduate and take the nursing licensure exam each year (Hines & Jernigan, 2012). Similar to undergraduate nursing programs, the number of undergraduate PH programs has grown in the past two decades. Almost 6500 students graduated from undergraduate PH programs in 2012, up from 759 in 1992 (Leider et al., 2014).

Yet, in the Vandenhouten et al. (2011) study, most nurses (80%) indicated their nursing courses lacked political content and did not prepare them for political participation. Political participation scores were higher for nurses who completed a non-nursing course with content on political process. Courses that involve active learning experiences involving politics activities (e.g., public policy learning activities, serving as a legislative intern) have been shown to enhance political astuteness and engagement (Byrd et al., 2012). Primomo and Bjorling (2013) demonstrated that political astuteness scores increased after nursing students participated in a legislative day.

Similarly in PH, Hines and Jernigan (2012) cited a lack of content on advocacy skills in PH curricula and proposed a new curriculum on this topic. Gebbie, Rosenstock, & Hernandez (2003) identified that schools of PH need to "better prepare their graduates to understand, study, and participate in policy related activities". Although model curricula have been proposed to prepare PH graduates with the advocacy skills they need to succeed in the political arena (Coulter, Allbrecht, Gulitz, Figg, & Mahan, 1999; Hines & Jernigan, 2012), the degree to which these curricula have been adopted or the effect of the curricula on students' political participation is not well understood.

Both nursing and PH have professional organizations that recommend the inclusion of health policy content in the curriculum as a way to strengthen political acumen. The American Association of Colleges of Nursing (AACN) *Essentials of Baccalaureate Education for Nursing Practice* consider content on healthcare policy, finance, and regulatory environments to be essential to baccalaureate curricula (AACN, 2008). Based on academic and practice expert panels, the Association of Schools of Public Health (ASPH), as of 2012, recommends that critical elements of an undergraduate major in PH include content on health policy, law, and ethics (ASPH, 2014). Similarly, accreditation criteria for PH Programs by the Council on Education for Public Health (CEPH), require undergraduate PH programs include instruction on basic concepts in PH policy and the roles, influences and responsibilities of agencies

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and government (Council on Education for Public Health, 2014). While both fields have accreditation standards, not all university programs are accredited.

College students are highly engaged in social media and this method needs to be considered in research on political participation of young adults. The internet provides new options for individuals to engage in "clickstream activism" through social media such as Facebook, Twitter, YouTube, blogs, listservs, and email action alerts (Karpf, 2010). Online forms of political participation are preferred by some individuals (Oser, Hooghe, & Marien, 2013). The use of social media, however, is related to generational differences and digital literacy. Social media was used in the 2008 Presidential campaign and its use has been studied to determine the impact of social media on political activity. Vitak, Zube, Smock, Carr, Ellison, and Lampe (2011) found that political activity on Facebook by college students (e.g., mentioning political information in a Facebook message, posting a wall comment about politics) is a significant predictor of other types of political participation.

Advocacy groups are using the internet heavily to "organize, mobilize, and effect change" (Obar, Zube, Lampe, 2012, p.5). Social media technologies used to encourage civic engagement include Facebook, Twitter, electronic mailing lists, and email (Karpf, 2010; Obar, Zube, & Lampe, 2012). These methods are cost effective ways to mobilize a campaign. There is a dearth of literature on the use of social media by health professionals (or health professions students) as a political tool to address health issues and health policy advocacy. In summary, it was found that nurses' political participation is marginal and social workers were found to be more active politically than nurses. There was little to no evidence of public health students' political participation in the literature. Both disciplines lacked sufficient curricular content on politics however both disciplines have professional organizations that encourage political participation.

CONCEPTUAL FRAMEWORK

The Civic Voluntarism Model (CVM) has been used to evaluate factors impacting political participation (Figure 1) (Verba, Schlozman & Brady, 1995). Verba and colleagues identified three factors (resources, psychological engagement, and recruitment networks) related to the level of political participation of U.S. citizens. The first factor, resources, includes the dimensions time, money, and civic skills. The second factor, psychological engagement, involves motivation for involvement in political activities and includes the dimensions political interest, political efficacy, political information, partisanship, and family influences. While the original CVM did not include education, Vandenhouten and colleagues (2011) added the dimension of education to the psychological engagement construct because of the assumption that educational influences (i.e., previous courses or content on the political process) could influence political participation among students. The third factor, recruitment networks, including civic, religious, and professional organizations, involves exposure to direct and indirect requests for political action.

The CVM variables have been found to be useful in predicting health professionals' political participation. Cramer (2002) found that resources and psychological engagement were more important predictors of political participation than networks of recruitment among nurses. Ritter (2008) found psychological engagement and professional networks of recruitment most predictive of political participation in a study of licensed social workers. Further, Hamilton and Fauri (2001) determined that professional association membership and interest in political affairs were significant predictors of political participation among certified social workers.

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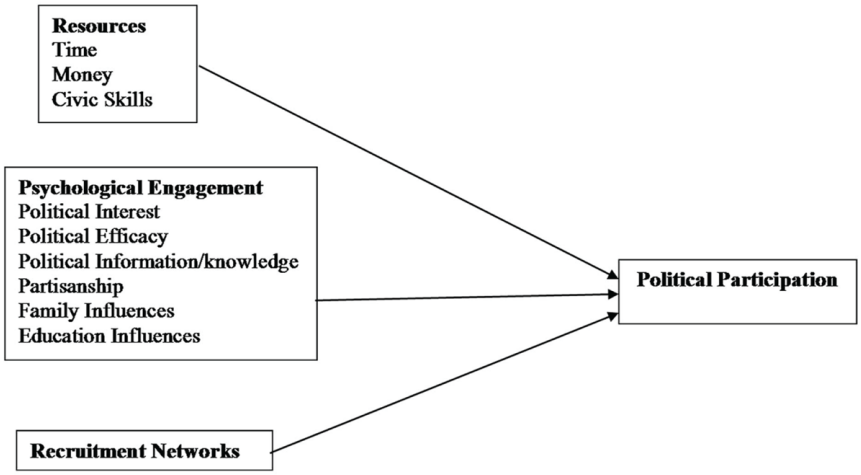
Figure 1. Civic voluntarism model adapted with addition of education influences (Source: Verba, Schlozman & Brady (1995))



METHOD

This study used a descriptive, predictive design. A 77-item questionnaire, based on the CVM (Verba, Schlozman, & Brady, 1995) and modified from a previously developed and validated instrument (Vandenhouten et al., 2011), was used to assess the political participation of undergraduate PH and nursing students. For this study, an item related to the use of social media as a source of political information and/or a means of political of participation was added under the dimension of Recruitment Networks. The tool also included a political information subscale comprised of select knowledge questions from the Intercollegiate Studies Institute (ISI) American Civic Literacy Program Civic Literacy Test (ISI, 2008) and demographic items. The survey was distributed via e-mail using Qualtrics©, an online survey software application.

Study Variables

The following operational definitions were used and are consistent with the study by Vandenhouten and colleagues (2011). The dependent variable was political participation, and independent variables included resources, psychological engagement, and recruitment networks:

- **Political participation:** Political participation was defined as involvement in activities for political purposes such as voting, campaigning, attending rallies, volunteering, contacting elected officials, working with others on local problems or issues, and being a member of nursing or non-nursing organizations that take stands on political issues;
- **Resources:** Resources were defined as time/money and civic skills that facilitate engagement in political process. The time/money that an individual is willing to devote or contribute to political purposes was measured by five items. Civic skills was defined as knowledge and abilities related to political activities that allow individuals to participate effectively in politics. The resource score was the sum of the time/money and civic skills subscale scores;

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- **Psychological engagement:** Psychological engagement was defined as a feeling of connection to political stimuli. Dimensions of psychological engagement included political interest, political efficacy, political information/knowledge, partisanship, family influences, and education influences. The psychological engagement score was calculated from 24 items:
  - *Political interest* was defined as curiosity, concern, and information seeking about political issues and elections. Scores were calculated from responses to five items such as "How often do you seek information about politics from social media, internet, newspapers, magazines, television, and/or radio. Social as a source political information was added to the item. Given temporal changes in information sources, this study added social media as a source of information about politics;
  - *Family influences* was defined as exposure to politically relevant stimuli while growing up. Family influences scores were calculated from three items such as, "When you were growing up, how frequent were political discussions in your home?"
  - *Political efficacy* was defined as perceived ability to influence governmental decisions. Scores were calculated from responses to six items such as "I believe I have power to influence political affairs;"
  - *Partisanship* was defined as strength of party affiliation. An item used to calculate the partisanship score was, "How strongly are you affiliated with a political party?"
  - *Political information/knowledge* was defined as knowledge about the theory and practice of government. Items were selected from the 2008 Civic Literacy test (ISI, 2008) and fell into one of two categories, political history and foreign relations. Examples of items include, "What part of the government has the power to declare war?"
  - *Education influences* was defined as exposure to politically relevant stimuli during formal education. An item from the four item subscale testing educational influences was, "To what extent have courses in your major included content, discussion, or activities on the political process?"
- **Recruitment networks:** Recruitment networks were defined as sources that encourage individuals to become politically active. A score was computed from responses to seven items. An example item was, "Has someone at your job, past or present, ever asked or suggested that you become politically active (ex. attend a meeting, vote, contact a public official)?" Similar questions addressed recruitment from educational programs, friends, organizations (religious, student, volunteer), and social media.

Reliability of the instrument was established using Cronbach's Alpha (Table 1).

Procedure

A convenience sample of junior and senior nursing and PH students at a large, Midwestern public university was used. Following institutional review board approval, students were sent an electronic invitation to participate in the study. The invitation contained a link to the consent form and anonymous online survey. Consent was implied by completion of the survey. A series of e-invitations were sent over a five-month period. Of a possible 480 nursing students and 235 PH students (N= 715), 168 (23%) completed the survey. As an incentive, students were offered the opportunity to enter a drawing for one of three $50

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Table 1. Scores by civic voluntarism model

Dimension (Possible Range of Scores)	Mean (*SD*)	Cronbach's Alpha
Political Participation (0-17)	5.34 (3.60)	.833
Resources (0-19)	7.23 (3.06)	.722
Time/Money (0-12)	2.49 (2.17)	.793
Civic Skills (0-7)	4.73 (1.84)	.720
Psychological Engagement (0-82)	40.89 (11.63)	.865
Political Interest (0-16)	11.21 (3.37)	.811
Political Efficacy (0-24)	11.51 (4.49)	.808
Political Information/Knowledge (0-8)	5.55 (1.90)	.666
Partisanship (0-9)	5.32 (2.52)	.737
Family Influences (0-9)	3.07 (2.24)	.712
Education Influences (0-16)	4.23 (2.80)	.586
Recruitment Networks (0-7)	2.38 (1.85)	.684

Note: SD = Standard Deviation

prepaid gift cards. Following completion of the survey, students were redirected to a separate online site where they could enter their contact information, if they wanted to be in the drawing.

RESULTS

Sample

Of the 163 respondents, 99 were nursing students and 64 were PH students. Subjects were predominantly female (89%), white (69%), and never married (67%). More than one in ten reported their race as Black/African-American (13%) or Asian (13%). Most respondents were18-22 years old (44%) or 23-27 years old (28%). A fifth of the participants had children under 18 years of age living at home (20%) and one in ten (10%) had significant responsibilities for a family member other than children. Four out of ten (44%) respondents reported annual household income of less than $30,000.

Over half of respondents held additional degrees (45% associate degrees and 10% baccalaureate degrees). Most respondents were juniors (64%) and the remainder were seniors (36%). Four out of five were full time students (80%). Two-thirds of the respondents reported working (64%), with 32% working more than 21 hours/week.

Regarding parental education, over a third of respondents (36%) were first generation college students. A third (39%) had at least one parent who had completed a baccalaureate degree or higher.

Level of Political Participation

The mean political participation score of participants was 5.34 (Table 1). While the mean political participation scores of nursing (mean = 5.30) and PH (mean = 5.41) student groups were not significantly

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different (p = .86). However, public health students reported that they voted in the last presidential election, participated in campaigning, and worked as a volunteer for a political candidate significantly more than nursing students (see Table 2).

Political Participation and Select Demographic Characteristics

T-tests were conducted to investigate differences in political participation scores related to gender, race, student status (full or part time), employment status, additional degree other than nursing or PH, marital status (married or not), having children under 18 years of age, and having significant caretaking responsibilities for a family member. Results showed significant differences for full time versus part time students (t = -2.4, df = 166, p = .02) with part-time students being more politically active than full-time students. Likewise, students who were married were significantly more politically active than those who were not married (t = -2.2, df = 166, p = .03). Students who had children under the age of 18 reported significantly more political participation than those who did not (t = 2.4, df = 165, p = .02). There was no significant differences in political participation according to gender, race, employment status, additional degree, and having significant family caretaking responsibilities.

One-way analysis of variance (ANOVA) tests were computed for differences in political participation scores and categories of age, parental education level, hours employed, and household income. There was a significant difference in political participation by age with students age 28 and older significantly more politically active (F (3, 164) = 4.96, p = .003). Likewise, there was a significant difference in political participation by number of hours employed with those employed 31 to 40 hours per week re-

Table 2. Participation in various political activities by major

Political Activity	% Nursing Students (n = 99)	% PH Students (n = 64)
Vote in last presidential election*	57	73
Frequency of voting in Presidential elections	54	64
Discuss political issues	56	44
Talked to someone about how to vote	63	58
Vote in last state/local election	37	30
Wore campaign button, T-shirt, sticker *	24	39
Frequency of voting in State local election	27	23
Contacted elected official	26	22
Community/local committee	25	22
Attended political meeting, rally, speech, dinner	11	17
Boycott, march, demonstration	17	9
Served on student government	15	13
Member of student org that takes political stands	15	5
Monetary donation	13	14
Volunteer for campaign *	4	13

Note. * p < 0.05

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porting greater amounts of political participation ($F(4,163) = 2.58$, $p = .04$). No difference in political participation was found by parental education or household income.

In addition to demographic characteristics, one-way ANOVA tests were conducted to investigate differences in political participation scores regarding strength of political affiliation and political views. Those with strong party affiliation were nearly twice as politically active as those with no to moderate party affiliation ($p < .001$). Similarly, those with moderate to extreme views (either conservative or liberal) were nearly twice as active as those who identified themselves as "middle of the road" ($p < .001$).

Resources, Psychological Engagement, and Recruitment Networks

- **Resources:** Resources did not differ by major. With regard to time, both PH and nursing students felt they had little to no time (78% and 80% respectively) and little or no money (98% and 96% respectively) to devote to political activities. Regarding civic skills, both groups felt confident in their ability to register to vote (PH= 94%; Nsg= 92%), obtain an absentee ballot (PH= 64%; Nsg= 58%), and contact their elected officials and representatives (PH= 72%; Nsg= 65%). Both groups felt confident in their ability to give effective presentations (PH= 77%; Nsg= 83%) yet few felt they knew how to testify at a public hearing (PH= 34%; Nsg 30%).
- **Psychological engagement - Political Interest:** There were no statistically significant differences in PH and nursing students' political interest scores ($p = .07$). Nine out of ten PH (91%) versus seven out of ten nursing students (74%) cared about local, state, or national political issues. Additionally, only one item, concern about who wins or loses elections (PH= 89%; Nsg= 82%) ($p = 0.05$), showed a statistically significant difference between the two groups. Public health students tended to seek out political information from a variety of sources slightly more than nursing students. There were no differences between PH and nursing students in the importance of citizens knowing about political issues (PH= 96%; Nsg= 93%), students in their major knowing about political issues (PH= 97%; Nsg= 96%).
- **Psychological engagement - Family Influences:** There was a significant difference between the two groups regarding family influences ($p < 0.05$). Differences were noted regarding how active their parent(s) or guardian(s) were when working on community issues (PH= 33%; Nsg= 15%) ($p = .02$). Both student groups reported similar results regarding frequency of political discussions in their home while growing up (PH = 47%; Nsg= 41%).
- **Psychological engagement - Educational Influences:** There was a statistically significant difference between PH and nursing students' educational influences score ($p = .03$). A significant difference was noted in the percent of students who reported not having taken a college course that emphasized the political process (PH= 59%; Nsg= 85%) ($p = 0.004$). A larger percentage of PH students (16%) indicated courses in their major included discussion on the political process than nursing students (5%) ($p = .001$).
- **Psychological engagement - Political efficacy:** There was no statistically significant difference in PH and nursing students' overall political efficacy scores ($p = .53$). However, there was a statistically significant difference (PH= 35%; Nsg = 28%) ($p = .04$) in feeling informed about politics and government than most people.
- **Psychological engagement – Partisanship:** There was no statistically significant difference in PH and nursing students' overall partisanship score ($p = .20$). Likewise, there were no differences in specific party affiliation by major (χ^2 (2) =4.16, $p = .13$). Overall, more subjects were

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affiliated with the Democratic Party (PH=59%; Nsg= 46%) than the Republican Party (PH=17%; Nsg= 19%). One third (32%) of nursing students reported no party affiliation compared to 17% of PH students (p=.08). The percentage of participants identifying their political views as liberal, conservative, or middle-of-the-road did not differ by major (χ^2 (2) =1.97, p = .37). Overall, 41% of students self-identified as liberal, 41% middle of the road, and 18% identified themselves as conservative.

- **Psychological engagement - Political information/knowledge:** There was no statistically significant difference in the political information/knowledge scores of nursing and PH students (p =.16). Scores were generally high with a mean of 5.5 out of a possible eight.
- **Recruitment Networks:** There was no statistically significant difference in PH and nursing students' overall recruitment score (p = .74). Overall, important recruitment networks included Facebook, twitter, or other social media (56%), faculty or staff from the major (53%), and friends/acquaintances or neighbors (49%). Less important recruitment networks were student organizations (25%), voluntary organizations (22%), someone at a past or present job (20%), and someone from a church or other religious institution (17%). There were statistically significant differences between majors in two specific items. First, nursing students were more likely than PH students to identify that faculty or staff from their major asked or suggested they become politically active (PH= 36%; Nsg= 65%) (p < .000). Second, PH students were more likely than nursing students to identify that someone from their church or other religious institution asked or suggested they become politically active (PH= 23%; Nsg= 13%) (p = .04).

Relationship between CVM Factors and Level of Political Participation

Significant correlations (p < .01) were found between nursing and PH students' political participation scores and dimensions of the CVM (Table 3). Psychological engagement was most strongly correlated for

Table 3. Pearson product moment correlation for political participation scores and other civic voluntarism model variables

	Political Participation Both Groups	Political Participation Nursing Students	Political Participation PH Students
Psychologic Engagement	.67**	.74**	.54**
Political Interest	.58**	.64**	.48**
Political Efficacy	.52**	.60**	.38**
Political Information/Knowledge	.39**	.47**	.30*
Partisanship	.50**	.57**	.37**
Family Influences	.34**	.33**	.40**
Education Influences	.24**	.36**	.04
Resources	.56**	.63**	.42**
Time/Money	.43**	.48**	.35**
Civic Skills	.43**	.53**	.24
Recruitment Networks	.39**	.40**	.38**

Note: * p = 0.05, two-tailed. ** p = 0.01, two-tailed

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nursing (r =.74) and PH (r = .54) students followed by resources (PH r = .42; Nsg r = .63) and recruitment networks (PH r = .38; Nsg r = .40). Regarding subscales of the CVM dimensions most strongly correlated with political participation for nursing students were political interest followed by political efficacy, partisanship, civic skills, and time/money. In contrast, for PH students' political participation scores were strongly associated with political interest, family influences, political efficacy, partisanship, and time/money.

Political Participation and Academic Content

One-way ANOVA demonstrated no significant difference in nursing and PH students' political participation scores by inclusion of course content, discussion, or activities regarding the political process. Likewise, there was no difference in political participation scores by the perceived extent to which courses in the major prepared them for political participation.

Predictors of Political Participation among Nursing and Public Health Students

A multiple linear regression was calculated to predict political participation scores based on other elements of the CVM. Major factors of the CVM (psychological engagement, resources, and recruitment networks) were entered into a linear regression model for all participants. The model was significant, $F(3,164) = 52.29$, $p<.001$, and accounted for 49% of the variance in political participation scores ($R^2 = .49$). Psychological engagement contributed the most ($\beta= .48$; $p<.001$), followed by resources ($\beta= .24$; $p= .001$), and recruitment networks ($\beta= .09$; $p= 14$). Each of the dimensions of the psychological engagement score (i.e., political interest, political efficacy, partisanship, family influences, and political information/knowledge) were significant and positively correlated with higher levels of political participation. Education influences, an author-added dimension to the factor psychological engagement, did not significantly contribute to the regression model. Dimensions of resources (i.e., time/money and civic skills) were significant and positively correlated with higher levels of political participation.

Further, results for nursing and public health students were entered into separate linear regression models (Table 4). Models were significant with the model for nursing students ($F(3, 95) = 45.70$, $p<.001$) accounting for 58% of the variance ($R2 = .578$) while the PH student model ($F(3, 60) = 10.58$, $p<.001$) accounted for less variance at 35% ($R2 = .346$). As noted with the combined group, the factor psychological engagement (N β=.556; PH β= .348) contributed the most followed by resources (N β=.253; PH β= .209), and recruitment networks (N β=.044; PH β= .180) (Table 5).

DISCUSSION

Overall, the CVM was determined to be a good predictor of political participation. The single best predictor of political participation was the psychological engagement factor. Within that factor the dimensions of political knowledge/information, political efficacy, partisanship, political interest and family influences (in order of magnitude) were significant predictors. Educational influences, a dimension developed and added to the psychological engagement factor by the researchers, was not a significant predictor of political participation. The second most useful predictor of political participation was the

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Table 4. Regression analysis predicting all students' (nursing & public health) political participation on the factors and dimensions of the CVM

	df	*SS*	*MS*	*F*	*p*
Regression	3	1058.72	352.91	52.29	0.000
Residual	164	1106.95	6.75		
Variable		*B*	*SE B*	*β*	*p*
Psychological Engagement		.148	.023	.478	0.000
Political Interest		.214	.090	.200	.019
Political Efficacy		.188	.058	.235	.002
Political Information/Knowledge		.433	.117	.228	.000
Partisanship		.272	.100	.191	.007
Family Influences		.231	.101	.144	.023
Education Influences		.023	.080	.018	.770
Resources		.282	.083	.240	0.001
Time/Money		.613	.108	.370	.000
Civic Skills		.722	.128	.369	.000
Recruitment Networks		.183	.122	.094	.135

Table 5. Regression analysis comparing nursing to public health students' political participation on the factors and dimensions of the CVM

Variable	***B***		***SE B***		***β***		***p***	
	Nsg	***PH***	***Nsg***	***PH***	***Nsg***	***PH***	***Nsg***	***PH***
Psychological Engagement	**.169**	**.120**	**.027**	**.048**	**.556**	**.348**	**.000**	**.014**
Political Interest	.185	.251	.115	.166	.175	.208	.109	.137
Political Efficacy	.183	.179	.079	.096	.229	.213	.022	.068
Political Information/Knowledge	.447	.483	.150	.215	.225	.262	.004	.028
Partisanship	.363	.081	.117	.204	.258	.051	.003	.694
Family Influences	.140	.423	.134	.169	.077	.303	.299	.015
Education Influences	.179	-.147	.107	.128	.126	-.125	.098	.254
Resources	**.291**	**.264**	**.101**	**.048**	**.253**	**.209**	**.005**	**.094**
Time/Money	.638	.562	.141	.185	.368	.352	.000	.004
Civic Skills	.838	.486	.158	.239	.433	.236	.000	.047
Recruitment Networks	**.091**	**.325**	**.154**	**.216**	**.044**	**.180**	**.555**	**.137**

resources factor. Within the resources factor, both time/money and civic skills were highly significant predictors. The third factor of the CVM, recruitment networks, was not a significant predictor.

The political participation score (range 0-17) of nursing (mean = 5.30) and PH (mean= 5.41) students indicated that both groups had relatively low political participation. These findings are consistent with

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a previous study of nurses (Vandenhouten et al., 2011) and offer new information about PH students. However, both groups reported caring about political issues and considered it important for professionals in their disciplines to know about political issues. Public health students (91%) cared more about political issues than nursing students (74%). These results are contrary to PEW research findings, which found there is a general perception that millennials as a group are less interested in politics than older generations (Swanson, 2015). Most of the students (72%) in the study fell into the category of "millennials" born after 1980 and before 1997 (18-27 years).

Although there were no differences between groups in the overall level of political participation, there were significant differences in some types of activities. As seen in Table 2, more public health students voted in the last presidential election, displayed political views (i.e., campaign button, T-shirt, sticker) and volunteered for campaigns. In contrast, more nursing students reported conversing about politics and voting in an election.

Reasons for low participation levels relate to time and money. Four out of five nursing (80%) and PH (78%) students reported having little to no time, and almost all (96% of Nsg; 98% of PH students) reported having little to no money for political purposes. Two-thirds of the respondents reported being employed (64%), with almost one third (31.6%) working more than 21 hours/week. Interestingly, students were more politically active if they were part time students, employed 31 to 40 hours a week, 28 years of age or older, married, or had children under the age of 18. Along with these findings, both groups had confidence in their civic skills (e.g., contacting a politician) and basic knowledge of government, negating these as possible reasons for low participation.

The CVM is useful in that all factors (psychological engagement, resources and recruitment networks) were strongly correlated with political participation as were the subscales (Table 3). Dimensions of the CVM most strongly correlated with political activity were political interest, political efficacy, and partisanship. Regarding partisanship, those students with strong party affiliations and/or moderate to extreme political views were much more active politically. In a previous study of nurses, partisanship was not as strongly correlated with political participation (Vandenhouten, et al, 2011). Increasing political interest along with political efficacy, the feeling that individual political action makes a difference, might increase political activity. Given the high level of political interest reported in this study, students seem eager to learn about political citizenship.

A review of nursing and public health curricula at the study site revealed that there is content on policy and political process in both programs (e.g. communicating with legislators, finance of health care and its relation to health outcomes, organization of healthcare delivery). Additionally, many nursing students elect to attend events at the state capitol designed specifically for students to learn about political process and to meet their legislators.

Despite the fact that both curricula include relevant content, half or more of participants in both groups (PH= 50%; Nsg= 70%) reported that courses in their major did not include content on political process or feel that courses in their major prepared them for political participation (PH= 57%; Nsg= 77%). Additionally, very few students completed a specific college course on the political process. These findings put in question the degree to which college students in these professional programs see the linkage between course content and political skills, knowledge and efficacy. Given recent changes to health policy, an understanding of the political process among health professions students has never been more important.

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RECOMMENDATIONS

This research informs educators about ways they can increase civic knowledge and potentially civic engagement of health professions students. Because the findings show that students perceive they have little time or money for political activities, educators can create opportunities for engagement through the curriculum. The most direct strategy is to develop course assignments that build students' psychological engagement in political issues such as involvement in areas where they can make a difference. The CVM provides faculty with an excellent framework on which to guide development of course content. Faculty can benefit from knowledge of CVM factors and dimensions such as political interest, political efficacy, and political knowledge and how these variables contribute to more actively engaged students. Knowledge of political history, structure and process, for example, can be emphasized early in the major.

Several dimensions of the psychological engagement variable in the CVM (e.g., political interest, political efficacy) reflect Bloom's affective domain of learning and may be considered in developing teaching/learning strategies and in development of content on political process and skills. This refers to creating "aha moments" in which students realize they can be influential and impact change. One way is to highlight how individuals and/or groups changed policies affecting individual, community or population health. For example, including a talk or podcast of a guest speaker whose research or advocacy influenced child passenger safety laws may help engage students in this area. Another way to foster political interest is to follow political leaders and experts through news and social media. Today's students are highly connected via social media. Activities that engage them through social media may feel more relevant to students and raise their awareness and curiosity. In further, applying affective aspects of learning, students can be encouraged to self-reflect on values and interest in politics and political issues as part of a professionalism assignment. Students may be excited to be involved in service learning opportunities related to the legislative process, such as campaign activities and attending political meetings, which are higher investment political activities and have a greater influence on the political process. Another strategy is to encourage submission and publication of student opinion papers in a newsletter or other appropriate outlet, related to the impact of current legislation on practice. Lastly, bringing politically active health professionals and or legislators to the classroom to share stories about the power of the vote in impacting policy brings this content to life. The actual process of voting not only increases efficacy, but reminds oneself that he/she has participated in one of America's most important expressions of liberty. Each of these strategies engages students on health policy with emphasis on the impact each has on their own professional practice. This is an area for further exploration and research with the aim of incorporating curricula that use both cognitive and affective learning strategies in teaching political content.

Social media has been a "game changer" in politics as a way to engage voters. New in this study was the addition of a social media item. In this study, social media was an important recruitment tool, more important than friends, neighbors, coworkers, church, or student organizations. Newer ways to be politically active include responding to emails from politicians, using "contact us" forms on websites, webinars, and virtual town hall meetings. Educators need to consider these as sources of political information when creating assignments and activities. Students may engage to a larger extent, if asked to search for or share political information received via social media. For example, students could conduct informal polls about political topics via Twitter or Facebook by asking followers or friends to respond using the "follow" or "like" features.

Instructors can introduce students to the role that professional organizations play in advocating for their profession via lobbying and other political activities through the websites and social media sites

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of professional organizations (Catallo, Spalding, & Haghiri-Vijeh, 2014). Professional organizations (e.g., American Nursing Association, American Public Health Association) are an important source of political information and take positions on key political issues that affect professionals. Such exposure to professional organizations may increase political participation and professional activism, and also encourage membership.

Future Research

Because the study involved a relatively small sample and low response rate (25%) from one Midwestern institution, generalization of results is limited. Further study in this area using a larger array of health professional programs and multi-setting recruitment to increase the sample size are recommended. Additionally, further research using the CVM could explore levels of psychological engagement, resources and recruitment networks and political participation at entry into and at the end of programs to look at the impact of education. In the regression model, educational influences (as a dimension of the factor psychological engagement) was not a significant predictor of political participation for either nursing or PH students. Given that the education dimension had the lowest reliability of the subscales, this author-developed dimension requires further refinement regarding the construct validity of the items. The CVM can also be used to plan and evaluate educational strategies to increase political participation through increasing psychological engagement and a sense of political efficacy.

In this study social media was important as a method of recruitment. Additional survey items related to social media need to be developed in future research. In addition to using social media as a recruitment tool, it is recommended to expand items regarding social media as a form of political activity, source of political information, and as educational strategy.

CONCLUSION

This study investigated the level of political participation of nursing and PH students in one institution as well as CVM factors correlated with that participation. The majority of the factors and dimensions of the CVM were strongly correlated with political participation levels. Both groups had low political participation suggesting the study findings can be useful for creating opportunities to improve civic engagement. Psychological engagement was found to be a key factor related to political participation for nursing and PH students. Three dimensions of psychological engagement (i.e., political interest, family influences, and political knowledge) were correlated with political participation. Political interest and political efficacy were most strongly correlated with political participation scores. The areas of political interest and political efficacy appear to be particularly valuable in moving individuals toward civic engagement. While study participants were in programs that included some content related to political participation, this did not appear to be sufficient. Educators of health profession students need to develop more robust curricula and teaching methods that advocate for greater political participation, teach civic skills, and create psychological engagement. The areas of political interest and political efficacy (perception that one can make a difference), appear to be particularly valuable in moving individuals toward political engagement. Knowledge of the political process is not enough. It is essential to integrate emotionally laden or affective strategies about issues that directly impact their everyday life. Examples could include issues such as water quality and sustainable food practices.

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Further research about intervention strategies to enhance political participation of students in health programs is necessary. In particular, attention needs to focus on social media use as a vehicle for political information, calls to action, and as a recruitment tool. Click stream activism is now part of many political campaigns but the degree to which this approach is used to advocate for health issues is less known. How much health professionals are using these strategies to engage their colleagues is also not known.

Engaging students, the future pipeline of health professionals, early is critical to the future of healthcare and healthcare policy. Framing curricula around the CVM factors such as increased political knowledge, civic skills, and especially enhanced psychological engagement may translate into greater political activity both now and into the future. Enhanced civic knowledge and skills will assist students to assert their voices in the complex political arena.

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