ABSTRACT

Evolutions in information and communications technologies (ICT) have remarkably contributed to momentous advancements in the way healthcare practices are managed and delivered. This paper conceptually highlights eHealth contribution in bringing about better healthcare outcomes in terms of quality, access, and efficiency at the country level. Nevertheless, the eHealth impact is promoted or impeded by a myriad of challenges. Drawing on contextualist theories and the theory of light, a country-prism eHealth model is presented. The model portrays the relationship between eHealth and healthcare outcomes as could be influenced by various country-level factors. The proposed model is validated, and implications are discussed.

KEYWORDS: EHealth, Healthcare, Health Outcomes, Culture-centered Approach, ICT, Information and Communication Technologies, EHealth Model

INTRODUCTION

Advances in information and communication technologies (ICT) have provided innovative means, tools, and knowledge for improving health service functionality and health system application. ICT enables solutions that are of vital importance to healthcare professionals, patients, as well as institutions, both private and public. This will offer new opportunities to empower individuals in matters related to their health, enhance the quality of healthcare performance, and alleviate the gap in people’s access to health information and services. Termed as eHealth, the use of ICT in healthcare and public health practices has enhanced the availability of health information, and, thus, the opportunities for informed decision making processes.

Efficient and effective solutions enabled by eHealth have clearly demonstrated its value amid various global health challenges, such as mitigating the health consequences of natural disasters or facing emerging epidemics (European Commission, 2014; Jong-wook and Reding, 2005). It is this profound impact that eHealth has that highlights its vital role in the achievement of the United Nations Millennium Development Goals (UNMDG), at the heart of which is health (WHO, 2009). The UNMDG goals address human needs and represent basic rights that people
all over the globe should be able to fulfill and enjoy (Ki-Moon, 2010). Unarguably, good health is a basic need and right, and is thus pivotal to nations’ social and economic development.

While being a matter of utmost and common concern to all nations, healthcare is defined, viewed, and provided differently by various nations and communities. This could be attributed to the concept of health, which was defined by WHO (1946) as ‘a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity’. Accordingly, healthcare systems adopted by various societies will widely differ in their contribution to health as this is probably based on their perspectives about the state of well-being. Moreover, health status is also determined by access to appropriate healthcare, the policies and regulations within a given healthcare system, and decisions related to healthcare expenditure and priorities (Parker et al, 2009). Figure 1 depicts the determinants of health and shows that an individual’s health is a function of biological and behavioral factors, which are influenced by the surrounding environments (e.g. economic well-being, stress level…). The health status and the influencing factors are also affected and shaped by the availability of (and access to) quality healthcare and effective policies and interventions (Parker et al, 2009; Aday and Andersen, 1974).

Examining these various factors through the lens of ICT applications in healthcare, one can imagine the role that these technologies can play in promoting access to and quality of healthcare resources. Besides enabling self-health management (Osborne et al, 2007; Hess et al, 2007), the role of eHealth can even extend to effect changes in structural, regulatory, and policy factors (Grundy et al, 2009, Boddy et al, 2009). Research suggests that getting involved in the process of health information search enables individuals to know and apply preventive behaviors, investigate physician – patient relationships, and actively assess and identify policies that hinder the attainment of health outcomes (Bodie et al, 2009).

Although the primary sought benefit of eHealth is improved health outcomes for patients, further benefits would reach the healthcare providers and the greater health system. Overall,
gains in several aspects pertinent to the health system should be realized, including but not limited to: decreased hospital readmissions due to lower occurrences of errors and adverse events, better coordination and information availability, resulting in more time efficiency and reduced wait times, and improved planning and decision making processes in the health system (Sanagan, 2011). An example of such benefits was reported to be realized in Canada, where an estimated $8.6 billion in benefits accrued to Canadians and the health care system from 2007 to 2012. These benefits are attributed to investments in electronic medical records, telehealth, drug information systems and diagnostic imaging solutions alone (Strasbourg, 2014).

In fact, an illustration of the e-health technology can be made by referring to a distributed e-healthcare system (Thuemmler, 2012; Kart et al, 2009). The system is designed to be used by physicians, patients, pharmacists, and nurses, as well as by medical monitoring devices. Its user interface is user-friendly, convenient for the patients and the professional medical body, and can enhance effective communication amongst them (Shoniregun et al, 2010; Kart et al, 2009). With such system, a patient’s appointments with a physician can be made online. The patient can be referred to a specialist electronically. An e-prescription can be communicated from the physician to the pharmacist online, thereby reducing the probability of having incorrect or lost information.

At the individual usage level, previous models of e-health and health outcomes proposed that motivation and ability are key contributors to individuals’ use of e-health. E-health use involves health information searching and online social support, among other things, which eventually lead to the attainment of health outcomes (Knapp et al, 2011). These micro/individual indicators are influenced by macro/social level factors, such as race, education, and income. According to this model, the digital divide is represented by disparities in accessing healthcare infrastructure at the social level, and is highly reinforced by disparities in the individuals’ ability and motivation to access and use the available communication information (Lustria et al, 2011). Integrating the individual-level access factors with the underlying enabling social structure can contribute to the understanding of the digital divide, the health disparities, and the use of the Internet for healthcare (Lustria et al, 2011; Bodie et al, 2009).

At the community level, previous research discussed several types of e-health applications and their contributions to healthcare outcomes. For example, based on the service oriented architecture, a distributed e-healthcare system (e-prescription) was presented as a foundation for the design, development, deployment, management, and enhancement of e-healthcare services (Thuemmler, 2012; Kart et al, 2009). With its user-friendly and service-oriented structure, the system facilitates collaboration among physicians, patients, nurses, and pharmacists, and supports an open, networked ecosystem of healthcare providers and users. Previous research showed that using the internet to communicate wellness is less costly, more convenient, and more accessible than delivering it in a primary healthcare setting. Nevertheless, proper consideration should be given to the factors that may influence the outcomes, including infrastructure, user acceptance, perceived usefulness and ease of use, and users’ attitudes (Nuq & Aubert, 2013; Omar, 2008).

In an attempt to deal with health disparities in several countries and communities, previous researchers have identified various reasons behind the poor healthcare being delivered to racial and ethnic groups in the USA, including discrimination, poor physician-patient communication, healthcare system operations, and the provisions of fewer treatment options by healthcare providers (Roux, 2011; Len-Rios, 2009). Based on this, researchers emphasized a healthcare vision of affordable and accessible healthcare, which is information-driven, patient-centered, and enhanced with quality improvement systems (Ahem et al, 2011; Davis et al, 2005). Such vision requires effective information and communication systems allowing for digitized communication for appointment scheduling, electronic prescription refills, patients’ involvement in treatment options and plans, and patients’ access to their electronic medical
records as well as to information that could provide guidance, education, and behavioral change. The vision also encompasses accessible public information databases to enable consumers to select healthcare providers on the basis of certain performance and care standards (Hood & Flores, 2012).

Since the distribution of and access to technologies do not follow similar patterns across different communities and societies, previous research showed a triggered interest in the relationships between digital divide and healthcare inequities (Lorence et al, 2006; Robin et al, 2009; Ginossar & Nelson, 2010). According to their investigations, previous researchers found that lack of or poor access to needed health care services by individuals, groups, or communities was highly related to poor access of ICT infrastructures. More specifically, a digital divide in ICT access and use clearly mirrors healthcare structural disparities, the roots of which extend from social disparities (Zach et al, 2012; Dutta, 2007).

**STATEMENT OF PROBLEM**

The world has witnessed significant health improvements over the past five decades. For example, global indicators show that child mortality continues to fall in all WHO regions. In 2008, the annual mortality occurrences in children under five years of age dropped to 8.8 million from the estimated 12.4 million in 1990 (a 30% decline). Also, the global coverage for measles immunization significantly increased between 1990 and 2008 from 73 % to 83 % (WHO, 2010). This could be attributed to several factors, including advances in the medical, technological, and science fields, and more to better nutrition, sanitation, income, literacy, opportunities for women, and expanded infrastructures (WHO, 2005). Nevertheless, these health improvements have been accompanied by slow progress, lack of essential condition for health in several countries, and wide gaps in the health status between urban and rural areas as well as between the wealthy and poor population groups. The World Health Statistics Report (2010) indicates that the lowest densities for both physicians and nurses exist in the WHO African Region (< 5 and < 10 respectively per 10,000 populations). The highest density of physicians is in European countries (>30 per 10,000 populations), and the highest density of nurses (> 100 per 10,000 populations) exist in the more developed world regions. Moreover, the highest levels of per capita health expenditures are reported in the countries belonging to the WHO Regions of the Americas – and Europe. The lowest levels, however, were found in the WHO African Region (WHO, 2010).

Despite the shining picture that such statistics display about certain WHO regions and the less bright one about others, the prevailing fact is that the delivery of efficient and effective healthcare is a major challenge for all nations and cultures (Parker et al, 2009). For example, the Institute of Medicine estimated that about 800,000 adverse drug reactions occurred annually in the U.S. long-term health care facilities at a cost to hospitals of $3.5 billion a year (Puspitasari and Soegijoko, 2009; Brewin, 2007). Moreover, according to the National Association Boards of Pharmacy, 7,000 deaths each year in USA are attributed to incorrect prescriptions (Catizone, 2002 as adopted from Kart et al, 2009). But could these problems be attributed to low healthcare expenditures, or could it be the result of the low number of physicians in certain countries? The answer to this is negative as evidenced by world health statistics. To start with, assessments of the health of nations show that the amount of health expenditures is not necessarily the determinant of effective healthcare outcomes in nations. For example, Nolte and McKee (2008) compared the trends in amenable mortality in persons below 75 years old in USA with those in Canada, Australia, New Zealand, Japan, and 14 European countries between two periods of time: 1997-1998 and 2002-2003. The authors found that while these countries achieved an average decline of 16% in amenable mortality, the USA achieved only 4% decline, implying that the magnitude of financial
investments in US healthcare systems could not generate the desired outcomes achieved in other industrialized countries. The data set pertinent to preventable mortalities in 14 nations, along with their health expenditures and number of physicians and nurses is presented in Table 1.

The table clearly shows that while the total expenditure on healthcare as a percentage of GDP is the highest in the US, the number of preventable deaths is the highest amongst the examined countries. Also, the number of professionals has increased remarkably from 2007 to 2008 in many of these countries. Yet, this too could not result in a lower number of preventable deaths. This corroborates with the observation made by several researchers that more doctors will not necessarily translate into better healthcare outcomes for countries (Watson and McGrail, 2009).
Table 1: Health Expenditures and Preventable Mortalities in 14 Nations

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1 Source: Nolte and McKee, 2008
2 Source: OECD Health Data, 2010
While an increase in total healthcare expenditures and a higher number of professionals do not necessarily contribute to better health outcomes, compelling evidence shows that properly designed and developed ICT-based healthcare can play a key role in enhancing the access, quality, and efficiency / effectiveness of the healthcare system (Parker et al, 2009). In examining medical error reports, these researchers found that 67% of these death cases were mainly caused by inadequate clinical information systems that impede access to patient information in a timely and complete manner. Healthcare systems throughout the world are deploying various e-health initiatives (electronic medical records, in an attempt to gain efficiencies in healthcare delivery and management, improve quality of care, reduce costs and medical errors, and provide more patient-centric healthcare (Zwicker et al. 2011).

Previous research examined the relationship between ICT deployment in healthcare (e-health) and health outcomes, namely access (Lasser et al, 2006), quality (Eysenbach et al, 2002), and economy (Chaudhry et al, 2006). Also, previous research discussed the factors leading to eHealth usage by examining the antecedents of consumer satisfaction and repeated search behavior for eHealth information (Lee et al, 2009).

However, as the above literature demonstrates, there’s a lack of substantive and adequate research that analyzes holistically the effect of country-related factors on ICT-health outcomes relationship. This is important since eHealth is a globally pervasive tool (Scott & Mars, 2013). The need for such research stems from the fact that observations by experts in the field show that differences in the health care quality are sometimes not attributed to access-related factors (The National Academy of Sciences, 2002). Also previous research showed that seldom have health institutions, countries, or geographic regions had a proper eHealth strategy (Scott & Mars, 2013) to guide implementation and achieve sustainable healthcare systems. Based on this, it is prudent to identify and assess the factors that could be associated to eHealth effective operation.

This study attempts to fill this research gap: it proposes a holistic and dynamic eHealth framework that highlights the role that eHealth plays in bringing about sustainable healthcare outcomes in terms of quality, access, and efficiency, while examining the impact that contextual factors have on this implementation. In addition, the paper emphasizes a socio-technical approach which serves to emphasize the importance of several interrelated elements in healthcare management.

**STATEMENT OF OBJECTIVE**

Using the integrated perspectives of the Delone and McLean (2003) information systems (IS) success model, the diffusion of innovation theory (Rogers, 1995), the culture-centered approach to health care (Airhihenbuwa, 1995), and Newton’s theory of light (Newton, 1672), this study has three primary objectives. The first is to present an integrated synthesis of the ICT dimensions related to eHealth as well as the socio-economic and cultural dimensions related to a country or community. This will be drawn upon a review of both theoretical and empirical research related to the two areas. The second is to propose a model relating ICT used in healthcare to the desired health outcomes. This is important as the advancements in the medicine field and the developments of new communication links between healthcare providers and patients are getting increasingly linked to their ICT advancements. The third is to pave the way for an empirical research through the provision of a conceptual foundation that helps in investigating the factors that would significantly impact the relationship between eHealth and outcomes. For example, empirical researchers can use the dimensions presented in the proposed model to compare and contrast differences in eHealth diffusion and utilization patterns across countries/cultures and to examine the mediating effect that country-related factors may have in the eHealth-outcomes relationship.
Emphasizing a holistic and dynamic eHealth framework is anticipated to make this paper mission critical to scholars, health care policy makers, government analysts, and ICT developers and strategists. To start with, scholars can use the framework as a foundation for assessing the contribution level of eHealth technologies in promoting better health care access points, quality service, and efficient use of resources. This could be done through a thorough examination of all the factors (eHealth and country-related) encompassed in the model. Moreover, the model is flexible in that it can be used as an integrated tool, and can also be used to deal with the effect of each of the mentioned dimensions. In addition to this, the study can help in understanding how different countries are placed along the eHealth innovation diffusion curve and, in turn, how they are overcoming existing challenges to achieve better health objectives. As for government analysts, they will find in this framework a powerful means to identify, based on a country’s set of economic and socio-technical resources, the factors that should be emphasized to mitigate the effects of certain structural barriers toward the achievement of better health and well-being to citizens. This could be reflected onto the interventions they make, which should be based on the contextual factors existing in the community. Policy makers will also benefit from the relationships that the proposed model suggests. EHealth will not only enhance the physician-patient relationship, but will also empower the patient to actively participate in defining and supporting needed and effective policies. Finally, ICT designers and developers can find the model useful as it allows them to define the factors that would lead to the development of country-specific eHealth solutions to support the country strategy-technology fit but with an eye on the global scale that a country intends to achieve.

Proposed Model: The Ehealth-Country Prism Model

The eHealth-Country Prism Model is a depiction of the role that eHealth plays in the achievement of a community’s health objectives and desired outcomes. The model synthesizes the theoretical perspectives of several theoretical frameworks derived from the IS/IT (information systems/information technology) field, the healthcare field, and the optics field. The eHealth-country prism model is depicted in Figure 2, and it has the following characteristics:

1. The model is holistic and integrated. It incorporates the e-health technology components and depicts their potential impact on healthcare desirable outcomes with a lens focusing on the facilitators / challenges shaping this impact.

2. The model suggests that the question of e-health implementation and usage success goes beyond simple technology access/no-access to the realm of patterns that define a country’s social, economic, cultural, governance, healthcare system, and e-health education / training. The economic aspect in the model represents the ‘efficiency’ outcome that eHealth provides. In this respect, the model is also dynamic and flexible. It allows the examination of the impact of each factor as well as the interaction of several factors on the derivation of optimal health outcomes from the eHealth technology used.

3. It incorporates elements from the ecological model of social determinants (Golden & Earp, 2012; Northridge et al, 2003). According to this model, macro level factors influence meso level factors, which in turn influence health well-being at the personal and community level through the interpersonal factors. Northridge et al (2009) argue that it is at the meso / community level that interventions are the most effective to improve the health and well-being of marginalized groups affected by the social and economic inequalities. Also, interventions at this level typically involve organizations belonging to various sectors, hence enhancing the collaboration between the planners of the health sector and those of other sectors, thus resulting in sustained and effective outcomes (i.e. health outcomes).
ICT-based Healthcare (eHealth) Challenges

- Infrastructure
- Policies & regulatory framework
- Standardization
- Access & use
- Security & Privacy

Figure 2: The e-health country prism model
The reason behind an ecological approach to the study of e-health diffusion in countries or communities is the fact that the participants in the healthcare processes cannot be viewed in isolation from their social milieu. In fact, it is this interaction between participants and their social context that brings to the picture the aspects of participation and empowerment. Communities with actively participating members are more apt to get engaged in behaviors, such as seeking out health information and other resources (Dutta, 2009) which will contribute to the realization of positive and sustainable health outcomes. Incorporating such approach is not new in the IS/IT research streams. Previously, factors linked to the country preparedness or Macro-Environment have been consistent themes through varied research, in particular, Wyatt & Sullivan (2005), Doupi et al. (2005), Jones et al. (2005), and Ahern et al. (2006). The analyses undertake perspectives at a country level with national strategies related to economic, collaborative, and cultural characteristics. In addition, previous researchers (e.g. Dutta, 2009) suggested that in an ICT-based healthcare service environment, attention should be paid not only to the interpersonal context of the provider-patient relationship, but also to other broader contexts. These include the mediated context (e.g. Internet, telemedicine), cultural context, and the organizational context (e.g. services offered and standards of care adopted). The proposed model addresses this need.

Based on this, the model proposes that the levels at which e-health solutions can contribute to health outcomes and to the mitigation of health disparities in a certain society are highly contingent upon the contexts in which e-health is developed or adopted. For example, the patient-physician communication typically takes the doctor’s office or examination room into consideration. In contrast, e-prescription or e-consultation emphasizes the context of communities or sub communities (i.e. local, national, or international) from and to which messages are sent and received. As a matter of fact, understanding the context within which healthcare problems occur is crucial to the devising and development of appropriate e-health solutions to address these problems. This highlights the importance of developing the e-health prism model with an ecological perspective in mind. The need for such perspective stems from the fact that it helps in depicting the health information exchange within the broader environment in which healthcare systems, institutions, processes, and structures are situated (Rippen et al, 2013; Dutta, 2007). It also emerges out of the growing necessity for developing digitized health solutions that are culture-centered and culturally sensitive for local as well as global communities and sub communities.

In the e-health prism model, the e-health technology penetrates the country prism, which encompasses the healthcare systems, communities/sub-communities, cultures/subcultures, economic/social systems, legal/policy structures, and the healthcare organizations where the physician-patient communication typically takes place. Depending on the lens used to examine a health problem or to assess an e-health solution, different contexts could be referred to or emphasized.

**Components of the Model**

Although the e-Health-country prism model components have been discussed above, this section will address each of the elements by itself. The e-Health elements provide the tools or the means, while the prism elements present the medium through which e-Health will permeate the country/community paths and outlets to deliver the desired health outcomes.

**e-Health ICT**
The effectiveness of mass media in health outcomes is well established (McAfee et al, 2013; Cho and McLead, 2007), and could be extended to digital communication media such as ICT. E-Health technologies can play a key role in alleviating racial and cultural healthcare disparities by allowing and enabling, for example, the reporting of instances of discrimination responsible for unequal healthcare. They also empower underserved patients to question the healthcare policies that are not introducing effective changes to the practices performed and delivered. In addition, they provide medications and prevention treatments, thus affecting people’s attitudes and behaviors and contributing to better health and well-being. These technologies should be based on high quality levels of competence and performance (Delone and McLean, 2003).

e-Health Infrastructure

Infrastructure is a common element in mostly all the research work that deals with ICT adoption and diffusion, including e-government, ERP, e-commerce, and e-learning. This study refers to infrastructure as comprising internet connectivity, high bandwidth for accessing the network, and sufficiency and competence of national power grid (Sherry & Ratzan, 2012; Mutula and Brakel, 2006). This is so important in eHealth since it will contribute to the technology access and quality of information exchange.

e-Health Security

Security is a critical issue for all information systems. Adherence to clearly defined security policies based upon legal requirements, regulations, and ethical standards is pivotal for effective eHealth projects and sustained outcomes (Barua et al, 2011). Efforts should be made at the healthcare organizational level to set security policies that not only conform to compliance standards, but also take into consideration the dynamic nature of IS security management. In addition, these policies should be continuously updated, monitored, and enforced (Fernando, 2010; Narasimhan and Croll, 2008). Moreover, to avoid security vulnerabilities in healthcare, it is recommended that security be integrated to system engineering rather than considering it after system definition (Sabnis et al, 2012; Mouratidis et al, 2003).

e-Health Policy

Health researchers have emphasized the significant role that healthcare policies play in influencing healthcare practices and outcomes (Rossi Mori et al, 2012; Dutta, 2007; Zoller, 2005), with the influence being either constructive or destructive. The spectrum of this influence calls for communication strategies that would change the policies that (1) limit individuals’/groups’ access for healthcare; (2) cause/promote healthcare inequities; and (3) support unhealthy social structures. These strategies should aim at promoting public awareness of the negative impact such policies have. They should also aim at influencing health care policy makers and strategies to change these policies and policy structures (Bertolino et al, 2013; Dutta, 2009). Of course, the role that ICT plays in this regard cannot be underestimated.

e-Health Standards

Building e-health systems should be based on some relevant standards. This is important to have a common understanding of health information exchange processes and operations. Based on this, standards are vital for enhancing coordination and collaboration amongst administrative, governmental, technical, medical, and policy-making groups for developing health initiatives across communities and nations (Kay et al, 2011; Chavez et al, 2010). In
China, the standardization of EHRs (electronic health records) was enforced by governmental and regulatory frameworks in order to achieve integration of different sources of information and enhance accessibility and information sharing. These, of course, are necessary requirements to enhance sharing and deliver better outcomes (Yun et al, 2010).

Country-Prism Components

As mentioned above, the country prism represents the channel within which eHealth tools will diverge to deliver the desired outcomes. In the process, the various country factors and dimensions will, separately and jointly, affect the eHealth path, and consequently, affect the achievement of outcomes. Following is a discussion of these factors.

Economy

The economic level of a country can have a significant impact on the adoption and usage of e-health technologies as well as on the healthcare system practices, policies, and outcomes. This is because individuals living in poor communities are more prone to suffer from a lack of basic infrastructures (e.g. transportation, internet access, access to health care services / facilities) which pose an extra threat to their health. Researchers contend that poorer communities have lower standards of health practices, lower health capacity, less command of healthcare resources, and thus lower health outcomes than communities with higher levels of income (Basu et al, 2012; Dutta, 2009). In fact, poverty imposes a critical risk factor for health in nations, especially in cases of chronic diseases. In fact, economic deprivation limits people’s access to the vital essentials for a healthy life. Preventive care, timely diagnostic services, access to medications, and transport to health facilities are usually limited in poverty-stricken environments. Additionally, in such environments, wide healthcare disparities would prevail, with low-income people marginalized and unable to receive timely and responsive healthcare services (Parker et al, 2009).

Moreover, income disparities amongst countries’ communities, groups, and sub groups are also manifested in disparities in access to policies frames of reference as well as to regulatory agencies or institutional bodies that assess policies and how they are implemented in organizations. Examining health and health outcome disparities from the lens of people’s socioeconomic status, previous research found that low socioeconomic levels along with adverse health behaviors pave the way for racial / ethnic disparities to play out in the field of healthcare (Brodie et al, 2000). Based on this, race-based differences may cause disparities in access to medical care. Even after controlling or adjustment for economic status of patients, several studies indicate that some ethnic groups (Whites) are more likely than others to access a wider range of certain medical procedures (Williams, 1999 as adapted from Dutta, 2009).

Social Factors

The social determinants (Golden & Earp, 2012; Northridge et al, 2003) of health can be adapted to include e-health tools and technologies at various levels of influence within a community. These levels of influence include the natural environment, the built environment (e.g. transportation system, health care facilities); the macro / social factors (e.g. historical conditions, political and economic orders, and ideologies); inequalities; social context (e.g. cultural identity, policies, enforcement of regulations, and quality of education); as well as interpersonal / micro level factors (e.g. discrimination, social participation, type of social networks, and social support).
Human Factors

The human factors include both human literacy and the physician-patient communication. Health literacy is a pivotal factor in empowering people to understand their medical benefits, prescription usage and side effects, the impact that certain lifestyles or behaviors have on their health, and even the policies and regulations that govern their healthcare system. Accordingly, it is essential for reducing healthcare disparities. Research shows that people suffering from health inequities are, in general, more likely to have low health literacy levels (Mackert et al, 2009; Davis et al, 2002). Needless to say, with the vast array of health information that it provides, ICT, if properly designed, diffused, and used, can contribute effectively in raising health literacy levels amongst various groups and subgroups in a community.

Coming to the provider-patient relationship, researchers suggest that a patient involvement in the health information exchange process varies across a myriad of demographics, including, but not limited to, age, income, race, education, and gender. Based on this, different patients will more express themselves and will get more involved in the process than other patients (Duggan, 2006). Moreover, communication skills are needed by both physicians and patients, hence the need for training programs (Cegala and Broz, 2005) that equip the physician with culturally-sensitive skills for communicating with diverse patients locally and globally. Training interventions designed for patients would mostly emphasize information exchange skills, including information seeking, provision, and verification (Cagela and Broz, 2005). Here also, the cultural, economic, and social context of participants should be taken into consideration.

Collaboration

Increasing eHealth implementation in developing countries is vital for the achievement of efficient and quality healthcare and public health in these areas. To achieve this, the main barrier is not financial or technical. This challenge is rather the ability to design, develop, and implement an e-health plan that has a global vision, while addressing local problems. Of course, such initiatives are so enormous that they cannot be achieved except through effective global collaborations and partnerships (Bohm et al, 2011; Jong-wook and Reding, 2005). This is especially important after the global economic crisis which has decelerated progress towards the achievement of the MDG-2015 goals (United Nations, 2010), including probably the global-health related goals. As with the other MDG goals, good health and effective health care are achievable when development policies, strategies and programs that emerge at eh national level are espoused by international development collaborations and partnerships (Ki-Moon, 2010).

Existing Health Care (HC) System

The characteristics of the operating health care system can have a strong effect on how the eHealth technologies will be adopted and utilized. Such characteristics may include, among other things, flexibility, response to customer needs, and quality standards. If current healthcare systems, however, are fragmented, this fragmentation would result in inefficiency, high costs, avoidable errors, and poor healthcare quality (Halamka et al, 2005). Accordingly, collaborative efforts are needed to establish a decentralized health information exchange model that is based on uniform policies and standards. Previous research reported a profound gap between current
healthcare systems and the desired patient-centered care (Parker et al, 2009). Reducing this gap requires disruptive innovation, which can make possible simpler and less costly alternatives to the existing costly and low quality care ones. In fact, advancements in ICT have facilitated the availability and direct access of information by people (e.g. with diabetes) for making important health-relation decisions. This is proved to result in improved and more efficient healthcare outcomes. In fact, even a well-designed healthcare website can promote better health behaviors, especially if it is tailored to the users’ needs, or as expected in the future, if it personalizes healthcare through the deployment of bioinformatics technology (Giustini, 2007).

Culture

Efforts to reach the underserved may be thwarted since this group typically does not have the same economic, social, and educational resources available to the higher socio-economic groups. This means that health communication should take place via channels that take into consideration cultural relevance and differences. Unfortunately, however, not all professionals have been trained to be culturally aware (Len-Rios, 2009). In fact, culture’s impact on any national or international related strategy cannot be underestimated. This is because global operations have to take into consideration cultural diversity. A huge body of research work investigated and emphasized the significant relationship between culture or cross-cultural differences and the differences in the levels of ICT adoption, diffusion, and use along countries (Gallivan and Srite, 2005; Srite, 2006). As it is well known, the most common reference about culture in a cross-country research work is Hofstede’s cultural dimensions (Hofstede, 1980).

Using these and other cultural dimensions, one can relate eHealth applications to a community’s cultural factors, and assess that impact of the various cultural dimensions, roots, and origins on eHealth adoption and utilization as well as on health outcomes. In fact, examining the health care disparities causing ‘unequal burden of pain’ amongst racial and ethnic groups in a community, Green al (2003) highlighted two sources of these inequities:

1. The nature, quality, and characteristics of existing healthcare systems as well as the prevailing regulatory framework; and
2. Discrimination, including stereotyping and biases in clinical decision making and physician-patient communication.

Health Outcomes

The eHealth impact has typically been examined in reference to efficiency, access, and quality. The huge and unjustifiable rise in healthcare costs has drawn attention for the urgent need of having a new healthcare paradigm. For this need, several researchers suggest that e-Health may be the solution (Moullec and Ray, 2009). Moreover, access to and equity in healthcare are vital outcomes that can draw the difference between effective and ineffective e-health systems. Although these issues are typically discussed under the umbrella of the digital divide research stream, they have really yet to be incorporated within any theoretical framework (Bodie et al, 2009) involving the impact of ICT deployment on outcomes in various areas or sectors. Access is a key and essential issue of healthcare. Unless all groups and subgroups in a certain community have access to the basic aspects of healthcare, this matter should be interrogated by all the groups and entities concerned.

Regarding the aspect of quality as a healthcare system outcome of eHealth is salient and prominent across countries and communities all over the globe. Such outcome manifests itself in health information, health services, and preventive measures (Dutta, 2009). Working towards enhancing healthcare quality incorporates: (1) patient / provider communication; (2) healthcare
organization quality; (3) trust, comprehensibility, and accuracy of information; (4) the competence of technologies used; and (5) the infrastructure distribution across the community.

MODEL VALIDATION

Besides the literature review from which the model is drawn, this section will discuss the theoretical support for the model. This will be done in three steps. First, the theories used as a basis for the E-health prism model will be presented. Second, the relevance of the model to real global cases will be discussed. Finally, a practical validation of the model through relating it to a well-established theory will be depicted and analyzed.

Theoretical Validation

Being an integrated model, the E-health-Country Prism Model derives its components from several models. Following is a description and a discussion of the four major theories that the proposed model is built upon.

1. The Theory of Light and Color. According to Newton (1672), light is declared to be not similar or ‘homogeneal’, but rather consists of ‘difform’, irregular, or dissimilar rays, with some of them more refrangible (refractable) than others. When a beam of sunlight (or simply white light) goes through a prism, the light will bend at its characteristics angle in the prism. The result will be a spectrum of colors that are determined by the refractability of the rays. This is one aspect of the theory, which will be related to the ehealth-country prism model later in this section. Another aspect of the theory is based on its extension and the different perspective with which the contemporary scientists of the day, such as Hook and Descartes, analyzed the color spectrum emerging from the prism (Shapiro, 1980). According to these scientists, the white light is pure and ‘homogeneal’, and that the colors are produced by distortions caused somehow from within the prism. Interestingly enough, this color explanation is also pertinent to this study proposed model.

Examining Newton’s perspective about the beam light refractability characteristics and the colors produced, one can find that it is pertinent to the ICT-ehealth technologies being adopted and diffused in a certain community. In fact, it is logical to assume that the ehealth technologies are various, with different features, capacities, and performance levels (impact). These variations will surely be reflected onto various health outcomes (the different wave lengths). For example, the quality of the IS / IT (Delone and McLean, 2003), the security level of the communication lines (Fernando, 2010; Naraimhan and Croll, 2008). In fact, an assessment of the contingency theory applied to IS by Weil and Olson (1989) supports the idea that particular variables of information systems affect its performance. This implies that establishing a better “fit” of these factors with the adoption, implementation, and usage of the systems within communities (as in organizations) will lead to higher performance and better outcomes.

As for the second perspective, it is related to the prism part of the model. Also here, the role that social, economic, cultural and other specific community / country characteristics play in determining the success or failure of an ICT-based diffusion such as ehealth cannot be underestimated. The impact of such factors on any ICT diffusion has been an area of interest to many researchers (e.g. Fife and Pereira, 2005; Manley, 2002; Clark and Guy, 1998). Based on this, even with the hypothetical assumption that the ehealth technologies adopted by the various communities are similar, the characteristics of communities’ environments and contexts can never be similar. Accordingly, the distinct characteristics of each community will, separately and interactively with each other as
well as with other communities’ factors, promote or distort the e-health performance and consequently the health outcomes.

2. The Diffusion of Innovation theory. Presented by Rogers (1995), this theory views innovation adoption and diffusion as a process by which an innovation is conducted to the members of a social unit (organization, community, country, …). The transmission takes place through communication channels over a period of time. As a result, few communities will be categorized as innovators, while others will be early adopters, early majority, late majority, or laggards. In a global context, the earlier the adoption and diffusion of a technology, the more benefits will a community or country likely reap. Referring to the health-Country Prism Model, communities that enable an early and well planned e-health technologies are more likely to have higher e-health ranks, and to ultimately reap better health outcomes.

3. The Contextualist-Worldview Approach. This approach was originally presented by Vygotsky (1978) as the cultural-historical theory. The theory focuses on knowledge as rooted in events, history, and culture (Hickey and Zuiker, 2005). The Contextualist Worldview views systems definition and transmission as tightly related to the culture of the communities where they are used. The signs and codes which a culture attributes to systems get reflected in many ways, including the ways people develop, maintain, change or transfer social institutions and relationships from one generation to another. Based on this, advocates of this approach argue that there are no universal laws of development; rather factors leading to development are specific to the history and social characteristics of the place. This perspective is strongly emphasized in the e-health-Country Prism model. As mentioned earlier, the model adopts the ecological model perspective in that the contextual characteristics of a community, including the social, cultural, and regulatory characteristics will play a significant role in e-health diffusion as well as its contribution to health outcomes. The model underscores the importance of examining these contextual factors, the interactions amongst them, and their influence on the e-health – health outcomes relationship.

Based on the discussion above, one can conclude that the e-health-Country Prism model is theoretically supported. The components of the model represent a set of integrated components derived from commonly known and widely used theories, the validities of which were demonstrated by a vast array of scholarly and practical research. The integration of such important components makes the model a holistic and integrated one with a supportive theoretical foundation.

Model Relevance to Real Cases: A look at France and Oman

The dynamic nature of the e-health-Country Prism model is important helps in envisioning the potential mediating effect that a community’s economic, cultural, social, legal, and other factors may have in the e-health – health outcomes relationship. This type of analysis that the model provides is essential for a careful investigation of the root causal factors behind e-health contribution to the success or failure of healthcare systems in various countries and communities. Given similar e-health technologies, different communities will not realize the same outcomes, even with high investment budgets (Nolte and McKee, 2008). Based on this, it is interesting to explore the e-health experiences of two countries, one belonging to the group of developed countries and another to the emerging economies. The two countries are France and Oman.

To start with, France can be considered a country with effective policies supporting the quality of their health system. Nevertheless, this is the result of deep changes of 1980s and
1990s unwanted events in health care services. As part of these events, the infection of thousands of people with HIV through contaminated blood products. The government started a series of reforms creating new national organizations to lead the change. Important mandatory actions were established such as the assessment of care, together with the dissemination of practice guidelines, the extension of general practice training periods, the development of medical information systems, and initial networks of health care providers to improve coordination and continuity of care. Diverse government players were involved starting with the Ministry of Health. Although independent scientific public organizations like HAS (Haute Autorité de Santé – or French National Authority for Health) and HAT (Health Technology Assessment) were also engaged to assist with actions like evaluations, accreditation, development and dissemination of clinical guidelines (Legido-Quigley et al., 2008). The complete health system was overhauled including the pharmaceutical area, of course hospitals, and medical unions which provided help with actions like evaluating professional standards of practice, or facilitating evaluation in physicians’ surgery.

All these changes have brought France to be considered by the WHO as the country with the best overall health care, and to the top list by varied researchers such as Nolte & McKee (2008) who placed France as top country in preventable deaths. Anderson & Frogner (2008) located France in the top countries under the comparison of health spending and the value obtained from this spending, obtaining a classification as country in the quadrant of more-than-expected spending, and more-than-expected life expectancy. As has been studied, countries with a developed health care system that has been producing good results, usually continue to improve their systems. However, is not easy to make a change from a deficient health system, to a system that can provide a quality service, reachable to most of the population, and within a reachable cost (Berwick et al., 2008).

As for Oman, it is an example of a country which has evolved from a health care system not performing adequately, to a health care system where all performing measures are greatly improved is the Sultanate of Oman. The population of Oman in 2006 was about 2.5 million, and the number of hospital beds grew from 12 beds in 1970 to 5,200 beds and 120 health centers in 2000 (Dorvlo et al., 2006). The WHO placed Oman in the eighth position in the overall-health-system-performance metric, among 191 countries in their world health report of 2000. This achievement is in high contrast to its previous situation not more than forty years earlier.

During 35 years, Oman has undergone a rapid socioeconomic transformation, accompanied by a stable governance, and with a leadership and strong commitment to provide universal coverage to all its citizens without any charge (Ganguly et al., 2009). This country has evolved from an undeveloped country to a modern state, with a series of improvements in the medical fields. Most transmissible diseases have had steep declines supported by effective implementation of national health initiatives. Since 1976, the Sultanate of Oman have been putting in place 5-year health development plans, obtaining quick improvements in public health and at individual health as well (Sulaiman et al., 1995). Nevertheless, the country faces new health threats developed along the socioeconomic improvements, such as the obesity, smoking and sedentary habits. Men is the segment of the population facing the highest impact of obesity, which brings cardiovascular and metabolic complications (Al-Lawati & Jousilahti, 2004). Also, persistent underweight among children has been studied, and associated to low birth-weight, which in turn is linked to health and height of the mother, reflecting an intergenerational cycle. An additional factor was the quality of water at home, which is factor related to infrastructure in a country with a scarce rain (Alasfoor et al., 2007).

Practical Model Validation: The Culture-Centered Approach to health Communication (CCAHC)
So far, the validity of the model has been examined by portraying the theoretical foundation from which the model derived its components, as well as by attempting to test the proposed relationships through a very simple examination of e-health applications in France and Oman. A further step will now be taken by trying to conduct a practical validation of the model, using the culture-centered approach to health communication (Airhihenbuwa, 1995, 2000). Presented by Airhihenbuwa (1995), the culture-centered approach to health communication (CCAHC) provides a theoretical foundation for addressing the major challenges facing health information exchange nowadays. The approach suggests that health communication is entrenched into the context where it takes place. The emphasis here is on establishing sustainable key infrastructures that pave the way for health solutions articulated by the local community (Dutta, 2009; Airhehenbuwa and Obregan, 2000).

The CCAHC consists of three major elements that lay the grounds for understanding the context within which e-health would operate in order to enhance the health information exchange process between the healthcare providers and the patients. These elements are: (i) the structure, which represents the institutions, policies, processes, rules, and control that enhance or restrict the community’s access to alternative health choices and solutions; (ii) the culture, which reflects the myriad of factors originating from an intertwined web of communities and sub communities; and (iii) the agency, which refers to the ability and capacity of the local community to make choices and demonstrate activism towards changing structures and policies maintaining and supporting inefficient and poor quality health systems.

Applying the CCAHC to the e-health implementation in different country settings makes it crucial to mention that: (i) technology exists at the intersection between structure, culture, and agency (Dutta, 2009); (ii) the three elements of the CCAHC are interdependent; (iii) the elements are pertinent to countries, communities, and sub communities, and thus each element could be thought of as linked to the other elements (horizontally) and to the same element at higher or lower levels depending on the context in perspective; and (iv) the coordination efforts along the elements within the same context and across different contexts can add to the value derived in terms of sustaining health outcomes.

In a similar vein, the e-health-Country Prism model components are also interrelated, and all of them can contribute to (or limit) better health outcomes. Just like technology lies at the intersection center of all the components of the CCAHC, ICT (represented by e-health) can permeate the country at the various community levels, but this penetration is highly contingent upon the facilitation (or lack of) obtained by the various community social, economic, cultural, and existing healthcare characteristics.

Figure 3 depicts the e-health-Country Prism model components in relation to the CCAHC components. The figure clearly shows that the contribution of e-health to the attainment and maintenance of desired health outcomes is never direct. Unless a community’s preparedness level becomes high, in terms of its contextual factors (that are distinct from those of other communities), eHealth will remain a wasted effort, i.e., a cost rather than an investment. As figure 3 clearly illustrates, the e-health-Country Prism model elements can, if the country prism comprises the right types of factors and interactions, generate high levels of healthcare quality, access, and efficiency. A country’s social, cultural, economic, healthcare, human, and collaboration factors can be well assimilated into all of the components of the culture-centered approach to health communication. To illustrate, the regulatory environment may endorse certain policies and allocate investment budgets to lower the digital divide in the community and to increase access to health information.

This action will most likely enhance the health literacy of customers; get them involved in information seeking processes for health solutions and healthcare provider alternatives; enable them to access social networks for health discussions; and empower them to assess policies and reach policy making entities for policy changes and better healthcare structures. Of course,
this can lower the impact of racial disparities, enhance collaboration between the professional medical body and the patients, and highly contribute to realization of the desired health outcomes. Moreover, e-health technologies can enhance collaboration amongst communities and regions, thus allowing for health knowledge transfer across countries as well as capacity enhancement in countries with less command of resources. The above discussion shows that the e-health-country prism model has adequate theoretical validity.

CONCLUSIONS, IMPLICATIONS, LIMITATIONS, AND RECOMMENDATIONS

There is no doubt that the proliferation of the internet has brought about new and wide possibilities of accessing, exchanging, and promoting health information. ICT has manifested its ability to play a key role in the facilitation of healthcare operations as well as in the delivery of healthcare information and services (Murero and Rice, 2006 as adopted from Dutta, 2009). The percentage of internet users who are using the internet to search for, send, receive, and share health information is increasingly growing, thus introducing a difference in how health-related
decisions are made. Moreover, a difference has also been made in the quality, access, and efficiency levels attributed to health information.

Nevertheless, examining the existing healthcare systems and practices in most of the countries worldwide, one can spot a multitude of cases illustrating inequities and disparities. In fact, while certain segments of the population have access to healthcare resources, services, and preventive resources to promote health and well-being, other are rather marginalized through their lack of access to these vital health resources. With the powerful influence that healthcare policies have on the healthcare status in a country, it is imperative to seek and adopt communication strategies that would enhance people’s awareness of such practices and policies.

Presented as a new arena for health communication and information exchange, eHealth adoption and diffusion strategies do, and will, play a crucial strategic role in the achievement of optimal health outcomes. This, however, is contingent upon the contextual factors of the community adopting and implementing eHealth. Consequently, it is prudent for healthcare organizations, health care policy makers, and for countries’ governments to understand the factors that are associated with an effective eHealth adoption, diffusion, and use.

Probing these factors and their potential mediating impact on eHealth success is of key importance to decision makers of countries aiming at attaining better health outcomes at the community and global levels. The main contribution of this study lies in developing a holistic, dynamic, and culture-centered mode that helps in setting global eHealth initiatives, but with a focus on the local context. The concept of the light theory was adopted mainly to show the effect of the country factors (the prism) on the achievement of outcomes intended by eHealth solutions. Depending on the impact level of the community factors, various outcomes (colors) will result, with the possibility that some countries will reap no benefit and be in the ‘invisible’ zone where no desired outcome at the community level will be achieved. Using robust theoretical frameworks and a quantitative technique, the model was both validated and assessed.

As a result, the eHealth-Country Prism Model proposed in this study is mission critical and has a strong potential to be useful to many groups. For example, scholars can use the framework as a foundation for assessing the contribution level of ehealth technologies in promoting better health care access points, quality service, and efficient use of resources. As for government analysts, they will find in this framework a powerful means to identify, based on a country’s set of economic and socio-technical resources and dynamic capabilities, the interventions they should introduce, and which should be based on the contextual factors existing in the community. ICT designers and developers can find the model useful as it allows them to attain a country strategy-technology fit that will help the community reach the desired outcomes, but with an eye on the global scale. Finally, Policy makers will also benefit from the relationships that the proposed model suggests. Policy making should take into consideration the community needs vs. the eHealth capacity as well as the advocacy and the activism with which customers are empowered nowadays. Needless to say, such factors vary across cultures in various communities.

Besides its contribution, this study has certain limitations. For example, individual behavioral factors were not incorporated in the model. This will also enable an assessment of the interaction between micro level factors and e-health technology (such as technology acceptance, motivation to learn, and intention to change health behavior). For instance, the aging of the population in USA may have an impact on the user (age) friendliness levels that a healthcare technology or communication system should incorporate (Northridge et al 2009). It will also add to the understanding of the relationships between micro level individual factors and macro level context (including, but not limited to, culture, social aspects, economy, and policies, interventions, and regulations). This will build a wider lens through which the impact of e-health
technologies on the health outcomes in nations with different cultural, social, economic, and regulatory / political profiles could be examined. Another limitation is that the model did not investigate the antecedents for standards needed to establish a universal language for healthcare. Finally, the study did not elaborately discuss the relationships between the various Prism factors, which would clearly show the intertwined effect resulting from the interdependencies of these factors on eHealth implementation.

Furthermore, looking at the health information exchange within the global context has raised questions related to the concept of health, illness (Dutta, 2007), healthcare quality, effectiveness, and efficiency. This makes it imperative on healthcare strategists and policy makers to jointly work on establishing a global language of healthcare along with universal standards that would promote collaboration for better health outcomes at the global level. In a similar vein, local contexts should be thoroughly and thoughtfully examined to better understand the various perceptions attributed to healthcare across communities and sub communities within a nation. Also, it is imperative to have efforts put by healthcare agencies, policy designers, decision makers, and ehealth technology developers towards (1) investigating and setting the strategies needed to develop healthcare infrastructures to enable and promote access by the underserved group; (2) enhancing the communication skills of healthcare providers with an emphasis on cultural sensitivity and situational awareness; and (3) working on enhancing the health as well as the ICT literacy amongst various groups. Future research is recommended to conduct further tests on the proposed model. It is also recommended to build on the model by taking the aforementioned points into consideration.

Finally, e-Health can equip individuals with the means to seek information about healthcare practices and policies. It empowers them to have advocacy and activism that effect changes towards the wellness of not only the individuals but also the whole community at the local and global levels. This implies that e-health can make a difference in the health-related decision making processes at all levels: individuals, groups, subgroups, community, national, and global. Clearly, to enhance the health care outcomes to improve quality, efficiency and access, policy reforms are vital. This is anticipated to lead to improved uniformity of health information, thus increasing healthcare equity levels and promoting effective health information exchange and collaboration.
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