

Preface

Complex quality issues, within complex systems, rarely have one cause. As a result, random activities with one piece of a process can provoke unexpected results. For example, technology solutions may improve some patient safety factors but may also cause unexpected problems. Therefore, although the vigorous pursuit of technology advancements is essential, the emergence of new interactions cannot be overlooked.

In this context, it is crucial to realize that we still cannot capture all the multidimensional variables that run parallel to, intersect with, diverge from and converge with the evolution of e-health. Small deviations are being carried through the interaction and result in a magnified impact, which is amplified when the incompatible worlds of the patient, family, and visitor meet the world of healthcare professionals. On the other hand, the quality movement needs to advocate the free flow of information in order to fertilize organizational learning and nourish worker intelligence (Wheatley, 1999).

However, information cannot be disentangled from e-health initiatives. Information technology provides alternative methods for making health information accessible to consumers. Furthermore, research shows an improvement of health awareness, high user satisfaction, evidence of greater benefit for under-served people and beneficial impact on health behavior (Gaston & Mitchell, 2005; Murray et al., 2005; Santo et al., 2005; Wofford et al., 2005).

However, do all these translate into a quality linkage of e-health?

Understanding the linkage between e-health and quality is a complicated task because no definitional consensus exists for either of these terms. The lack of shared definition can present challenges from both practical and academic perspectives (Pate & Turner-Ferrier, 2010; Kastania, 2010). Academically, the lack of shared definition can serve as a motivating force for a meaningful dialogue to promote knowledge. From a pragmatic point of view, different conceptualizations held by various stakeholders can also lead to a serious dialogue with the intention of arriving at a definitional resolution. On the other hand, the lack of consensus can cause inter, and intra-organizational dysfunctions, as organizations adhere to and try to leverage their positions for self-gain (Pate & Turner-Ferrier, 2010). Therefore, establishing a common language may serve as a powerful platform that enables e-health help organizations to achieve quality improvement more effectively.

However, what is clear about healthcare is that the interdependent and complex nature of healthcare delivery calls for structured ways to analyze the strategic goals, processes, technologies, outcomes, and other features of the healthcare system. Systems theory is a theoretical framework that serves as a starting point for this analysis (Austin & Boxerman, 1998; Ginter et al., 1998).

In its essence, systems theory provides a straightforward way of viewing the relationship between inputs and outputs. In its most basic form, system inputs are converted to and drive outputs, which,

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in turn, provides a feedback mechanism to the size and amount of inputs needed. On the other hand, Donabedian's (2005) well-known structure-process-outcome (SPO) framework provides a meaningful way of viewing the concept of quality. In this context, e-health technologies and supporting equipment clearly fall under the domain of structural measures of quality, which constitute 'input measures of an organization's capacity to permit or promote effective work' (Flood et al., 2000).

On empirical grounds, in a systematic review of the relationship between health information technology and quality, Chaudhry et al. (2006) found two main topics about the relationship. First, health information technology has been shown to increase adherence to clinical guidelines, based on the associated decision-making processes and functions, which are inherently built into adherence. Second, health information technology has also increased the ability of organizations to improve the quality of care by increasing monitoring through 'large scale screening and aggregation of data'.

On the other hand, the quality linkage of e-health can be traced in the patient safety and patient-centered care thinking. Patient safety could be described as a discipline that applies safety science methods to achieve reliable health care delivery. However, it is also thought as an attribute of the health care system that minimizes the incidence and impact of adverse events. Preliminary evidence of interaction with e-health could be found in safety culture, data mining, and medical simulation. Specifically, a prerequisite for the realization of the key dimensions of patient safety culture (Ginsburg et al., 2009; Singer et al., 2008) is the collection, analysis, and dissemination of information deriving from:

- Incidents and near misses.
- The adoption of the reporting, just, flexible and learning cultures (Ruchlin et al. 2004).

Data mining is becoming an increasingly indispensable tool in mining a broad range of health records (Norén et al., 2008). It can maintain quality assurance, simplify the automation of data retrieval, facilitate physician quality improvement (Johnstone et al., 2008), and accurately represent patient outcomes if combined with simulation (Harper, 2005). Recently, there is interest in switching to algorithms and database development for microarray data mining (Cordero et al., 2007). Finally, medical simulation bridges the knowledge gap by representing certain key characteristics of a physical system. Quality improvement, patient safety, and the evaluation of clinical skills have impelled medical simulation into the clinical arena (Carroll & Messenger, 2008) while there is conclusive evidence that simulation training improves provider self-efficacy and effectiveness (Nishisaki et al., 2007) and increases patient safety. It is also accepted that the process of iterative learning creates a much stronger learning environment, and computer simulators are an ideal tool for the evaluation of students' clinical skills (Murphy et al., 2007). Finally, a great potential of interaction has to be established through the assessment of biobanking, biochips, disease modeling, genomics, molecular imaging, nanotechnology, ontologies, and proteomics (Moumtzoglou, 2010).

Taking into account the patient-doctor encounter, as an element of a good outcome, we turn to the idea of patient-centeredness. Although definitions of patient-centered care vary, patient-centered care is the provision of care that is 'respectful of and responsive to individual patient preferences, needs and values and ensuring that patient values guide all clinical decisions' (IOM, 2001). In this context, Kilbridge (2002) suggested that twelve information technology applications, which involve the management of health care information, empower patients. These include:

1. Technologies which provide access to general and specific medical information.
2. Technologies capable of handling data entry and tracking of self-management data.

The applications included:

- Personal health records.
- Patient access to hospital information systems.
- Patient access to general health information.
- Electronic medical records (EMRs).
- Pre-visit intake.
- Inter-hospital data sharing.
- Information for physicians to manage patient populations.
- Patient-physician electronic messaging.
- Patient access to tailored medical information.
- Online data entry and tracking.
- Online scheduling.
- Computer-assisted telephone triage and assistance.
- Online access to provider performance data.

Finally, a key way to think e-health and educational linkage relates to the ways in which e-health applications and technologies can be introduced into educational settings taking into account the missing foci of healthcare delivery education.

Overall, if we also take into account that IOM (2003) suggested all health professionals be educated to deliver patient-centered care, a theoretical interaction between e-health and quality might be established.

Having said that, we have to admit that there is relatively little empirical evidence to substantiate many of the theoretical claims made about the linkage of quality and e-health, and a lack of robust research on the risks of implementing e-health technology (Black et al., 2011). The reasons are multi-faceted, including lack of primary research, methodological limitations, the inappropriate timeframe of the study, failure to involve patients, and inadequate attention to socio-technical factors.

However, despite the substantial gap in evidence, due to the theoretical linkage of quality and e-health, an evaluation framework of e-health has to be established, taking into account the six dimensions of quality, namely, patient safety, effectiveness, timeliness, patient-centeredness, efficiency and equitability.

ORGANIZATION OF THE BOOK

In chapter 1, Anastasios Mourtoglou & Abraham Pouliakis argue that Population Health Management (PHM) aims to provide better health outcomes for preventing diseases, closing care gaps and providing more personalized care. Since the inception of the Pap test, cervical cancer (CxCa) decreased in countries applying screening programs, involving both prevention and treatment. In this chapter, the authors map a PHM roadmap to CxCa screening programs, examine the effect of supporting information technology systems, and propose a suitable architecture for implementation. Notwithstanding screening programs have a tight relation to PHM; the mapping reveals numerous interventions involving additional data sources, and timeless reconfiguration. They conclude that the use of open source platforms allows the

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implementation of IT systems supporting CxCa screening, when employed in a multitier web-based architecture.

In chapter 2, David Mendes, Manuel Lopes, Artur Romao & Irene Pimenta Rodrigues present a proposal to develop intelligent assisted living environments for home based healthcare. These environments unite the patient clinical history sematic representation with the ability to monitor the conditions of life and events recurring to a fully managed Semantic Web of Things (SWoT). Several levels of acquired knowledge and the case based reasoning that is possible by knowledge representation of the health-disease history and acquisition of the scientific evidence will deliver, through various voice based natural interfaces, the adequate support systems for disease auto management but prominently by activating the less differentiated caregiver for any specific need. With these capabilities at hand, home-based healthcare providing becomes a viable possibility reducing the institutionalization needs. The resulting integrated healthcare framework provides significant savings while improving the generality of health and satisfaction indicators.

In chapter 3, Wayne Usher identifies how Australian university students access and use various forms of technology (Web 1.0 – Internet, Web 2.0 – social media - SM) to retrieve personal health information. This chapter moves beyond Web 1.0, to present a theoretical basis for the claim, concerning the extent to which other forms of technology (e.g. Web 2.0 and wireless monitoring devices) have impacted on youth. What is more, attention will be directed towards outlining to what degree this has shaped their patterns of health information retrieval. Importantly, this chapter aligns with contemporary literature that suggests a need for further studies into the area of human - technology interactions, which promotes sustainable action plans and strategies that will create and encourage reform throughout e-health programs and interactive communication platforms. Given that Australian university students are prolific users of modern forms of communication technology and that youth, in general, characteristically undertake relatively high levels of risky health behaviors and unhealthy lifestyle choices, such a chapter would seem warranted.

In chapter 4, Athanasios Anastasiou, Kostas Giokas, Georgia Koutsouri & Dimitra Iliopoulou present the architecture and implementation of an automatic medication dispenser specifically for users who take medications without close professional supervision. By relieving the users from the error-prone tasks of interpreting medication directions and administering medications accordingly, the device can improve the required level in compliance and prevent serious medication errors. By taking advantage of the scheduling flexibility provided by medication directions, the device makes the user's medication schedule easy to adhere and tolerant to tardiness whenever possible. This work is done collaboratively by the medication scheduler and dispenser controller in an action-oriented manner. An advantage of the action-oriented interface, between the components, is extensibility, as new functions can be added and existing ones removed with little or no need to modify the dispenser control structure. This chapter first describes the action-oriented design, principal components and hardware structures of the smart device. It then provides an overview of the heuristic algorithms used by the medication scheduler and their relative merits. The different available user options are presented depicting the user-specific operating modes of the device/service. The scope of the chapter is to describe the development of a smart electronic drug dispenser unit for the pharmaceutical adherence of patients.

In chapter 5, Vassilia Costarides, Apollon Zygomalas, Kostas Giokas & Dimitris Koutsouris argue that healthcare robotic applications are a growing trend due to rapid demographic changes that affect healthcare systems, professionals and quality of life indicators, for the elderly, the injured and the physically challenged. Current technological advances in robotic systems offer an exciting field for medical

research, as the interdisciplinary approach of robotics in healthcare and specifically in surgery is continuously gaining ground. The chapter features a review of current applications, from external large scale robotic devices to nanoscale swarm robots programmed to interact on a cellular level.

In chapter 6, Konstantinos Bougoulas, Ioannis Kouris, Marios Prasinos, Kostas Giokas & Dimitris Koutsouris analyze the development of an Ob/Gyn EMR software for small Obstetrics and Gynecology organizations. The necessary gynecological information was gathered via research concerning the needs of the practice and was organized and categorized according to its importance to the clinicians. The user interface of the developed software provides access to obstetrics, gynecological, surgical, sterilization and PAP test data, along with video and image file storage capabilities. An integrated appointment scheduling module, as well as an expected labor day prediction module are also part of the application. The developed software is self-contained so that it can be installed on the clinician's computer or accessed within the clinic.

In chapter 7, Pedro Miguel Rodrigues, Diamantino Freitas, João Paulo Teixeira, Dílio Alves & Carolina Garrett present a new approach to detect early Alzheimer's disease Electroencephalogram temporal events to improve Alzheimer's disease (AD) early diagnosis. Using Self-Organized Maps (SOM), it was found that there are sequences of EEG energy variation, characteristic of AD, which appears with high incidence in Mild Cognitive Impairment (MCI) patients. Those AD events are related to the first cognitive changes in patients that interfere with the normal EEG signal pattern. Moreover, there are significant differences concerning the propagation time of those events between the study groups ($p=0.0082<0.05$). That means as AD progresses, the brain dynamics are progressively affected because AD causes brain atrophy.

In chapter 8, João Paulo Teixeira, Maria Goreti Fernandes & Rita Alexandra Costa present an algorithm to identify segments of silence or speech automatically. The algorithm was developed to measure the silence periods in spontaneous and read speech. These silence periods are one of the parameters used to know the degree of severity of stuttered speech. For this purpose, the three longer disfluent events (pauses or other disfluent events) and also the percentage of silence are useful. The algorithm is based on the evaluation of the energy and the zero crossing rate of the signal compared to the threshold values previously determined in silence. One experiment with eight subjects is described using the Stuttering Severity Instrument for Children and Adults – SSI and the percentage of silence in speech. It was concluded that the proportion of silence is good enough to separate stuttered from the normal speech but alone is not capable of measuring the degree of severity of the stuttered speech.

In chapter 9, Stelios Zimeras argues that segmentation is a powerful procedure that could be used to extract relevant information of the images based on advanced techniques (like active contours, region growing, Markov random fields, and medical atlas analysis). For the procedures, the main task is the contour, or volume or surface representation of specific parts of the organs that could be used for the benefit of the patients under doctor evaluation. So, in real cases, the proposed process must be quick, accurate and easy to implement. The segmentation of the organ is another problem that must be considered. In bronchus segmentation, a quick, efficient and easy to implement procedure is proposed based on the combination of boundary tracking and region growing techniques.

In chapter 10, Paula Estrella & Nikos Tsourakis acknowledge that when it comes to the evaluation of natural language systems, there is a lack of common evaluation methodologies, making the fair comparison of such systems a difficult task. Many attempts to standardize this process have used a quality model based on the ISO/IEC 9126 standards. The authors have used these standards for the definition of a weighted quality model for the evaluation of a medical speech translator, showing the relative im-

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portance of the system's features depending on the potential user (patient or doctor, developer). More recently, ISO/IEC 9126 has been replaced by a new series of standards, the 25000 or SQuaRE series, indicating that the model should be migrated to the new series to maintain compliance adherence to current standards. The chapter demonstrates how to migrate from ISO/IEC 9126 to ISO 25000 by using the authors' previous work as a use case.

In chapter 11, Anastasius Moutzoglou argues that individualizing care must take into account the diversity of patient values and perspectives while attending to the specific needs of people must take into account the multifaceted nature of culture. Digital medicine enables digital proximity and self-care, challenges the traditional paternal model of medicine, reshapes the nature and expectations of health care delivery, emphasizes the active involvement of patients and has an enormous potential to empower patients. Moreover, the concepts of bio-objects, cultural competence, and patient-centered care could be apparently thought on a continuum with one pole representing the bio-objects and the other representing one of the health care quality dimensions, patient-centered care. All-embracing, digital medicine affects the core values of cultural competence, which are shared by patient-centered care, one of the health care quality dimensions.

In chapter 12, Alexandra Pomares-Quimbaya, Rafael A. González, Alejandro Sierra, Julián Camilo Daza, Oscar Muñoz, Angel García, Alvaro Bustamante, Olga Milena García & Wilson Ricardo Bohórquez contend that medical practice, monitoring and control guidelines enable standardization, assessment and quality improvement in healthcare. That often implies collecting and analyzing electronic medical records (EMRs) to calculate compliance metrics and support evidence-based decision-making. However, for these benefits to materialize, a set of challenges must be overcome, including the complexity required to represent guidelines in such a way that compliance can be automatically determined with the aid of software; the combination of both structured and unstructured (narrative text) data; and cultural or political barriers. In this chapter, the authors present a strategy to overcome these challenges using three case studies, in chronic diseases, for a developing country. As such, this work contributes to the use of ICT-supported medical guideline evaluation and a more reliable and context-dependent way of improving healthcare in developing countries.

In chapter 13, Bo Yu, Duminda Wijsekera & Paulo Costa argue that informed consents, either for treatment or sensitive information use/disclosure, that protect the privacy of patient/participant information subject to law that in certain circumstances may override patient wishes, are mandatory practice in healthcare. Similarly, for protecting and respecting research participants, informed consents are also a prerequisite for human subjects research. Although the healthcare industry has widely adopted Electronic Medical Record (EMR) systems, consents are still obtained and stored primarily on paper or scanned electronic documents. Integrating a consent management system for different purposes into an EMR system involves various implementation challenges. A case study, informed consent for genetic services, is used to show how genetic informed consents placed new challenges on the traditional ethical standards of informed consent, and how appropriate consents can be electronically obtained and automatically enforced using a system that combines medical workflows and hierarchically, ontologically motivated rule enforcement. Finally, the chapter describes an implementation that uses the open-source software-based addition of these components to an open-source EMR system, so that existing systems do not need to be scrapped or otherwise rendered obsolete.

In chapter 14, Priscilla A. Arling, Edward J. Miech & Greg W. Arling examine the outcomes of a specific QI collaborative, the Empira Falls Prevention Project in Minnesota, USA. Levels of electronic communication between collaborative members were found to be associated with a positive patient outcome, specifically a reduction in falls. Electronic and face-to-face communication differed in their association with success measures for the collaborative. The findings suggest that the two modes of communication can be leverage to attain maximum benefits from participating in a quality improvement collaborative.

In chapter 15, Vahé A. Kazandjian argues that traditional expectations about healthcare continue to be challenged by the umbrella concerns about accountability and trust. The core of this challenge is two-fold: healthcare providers have seen the absolute trust placed into their intentions and practices erode through the quantification of quality and safety of care, and, the recipients of care have been empowered with timely and specific data to demand accountability rather than unquestionably trust providers.

The chapter reviews the key dimensions of the operationalization of performance measurement and the translation of its findings to statements about quality and safety of care. The past four decades have seen the continuous discovery and refining of analytical tools to quantify what once was taken for granted: that patients always receive the best care possible. These tools have uncovered the probabilistic nature of medicine and the resulting nature of the relationships, outcomes have to processes. Hence the expectations of patients, payors of care and policy makers require being continuously modified to reflect the limitations of medicine and healthcare.

The education of various audiences as to what the measures mean not only is a necessary requisite for sound project design but also will determine how the accountability model is shaped in each environment based on the generic measurement tools results, local traditions of care and caring, and expectations about outcomes.

In chapter 16, Aleš Bourek predicts that future health systems, besides traditional areas defined and addressed since 1980, will face the advent of Proactive, Predictive, Prospective, Preventive, Participative and Personalized health care (HC). Reliable e-health platforms can help with these challenges. They should be designed and implemented in a way to help ordinary people achieve extraordinary results. Even the best projects addressing HC systems improvement are not automatically qualified for implementation unless adopted by policy makers. The introduction of strategies with a potential for healthcare systems improvement to policy makers is necessary but difficult because of the complexity of the addressed issue. Illustrated on four projects, selected from the 25 the author participated in, from 1993 to 2016, principles, processes and attitudes found beneficial for successful policy implementation in various healthcare environments are presented, to help with the integration of reliable electronic healthcare platforms into coming healthcare systems.

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