Preface

INTRODUCTION

Over the last few decades, the proliferation of various forms of health information systems and informatics is challenging traditional patient care and, sometimes, even well-established clinical practice. Today, caregivers as well as patients are ever more eager and open to the idea of advocating, evaluating, redesigning, adopting and integrating advancing technologies and automated intelligence into health care applications so as to enhance current and new therapeutic procedures to improve the outcomes of patient health services in a variety of clinical environments. Indeed, many breakthroughs in medicine one can anticipate in the coming years will very likely rely on maturation and the further development of computerized tools, wireless communications and mobile-driven applications that have the potential and promise to realize improved patient care safety, privacy and confidentiality, more effective health services quality as well as greater administrative efficiencies and clinical productivity. Today, many such specialized tools and methods are rapidly evolving and simultaneously changing the landscape of the health information technology/information systems (IT/IS) field.

Clearly, the challenge in providing responsive care through applied health IT/IS tools and new methods within a framework of well-coordinated and productive clinical workflow is an increasingly complex and demanding task, given the growing number of medical specialties. Implementation success of these tools and methods requires the active participation and willing collaboration of multidisciplinary caregivers, researchers, health IT/IS vendors and various health informatics practitioners to form partnerships in evaluating the design, development and continuing enhancement of such tools. Given that health care costs have and are still rising above the rates of inflation worldwide, health IT/IS tools and systems have been touted as one of the most promising means to play a critical role in an effort to cost contain future health care services. Aside from paying attention to safeguard patient safety and privacy, testing of new health IT/IS tools and applications is difficult due to the complexity of the patient care process, the lack of well trained health informatics researchers and expert evaluators, and the wide variety of emerging vendor-driven technologies with high-speed networked information retrieval features that are yet to be tested. Sadly, health informatics technologies are evolving unceasingly to address patient care in new and more innovative ways, yet resources are lacking to properly and adequately evaluate their effectiveness and impacts.

Specifically, the content of this volume focuses on the need for understanding the structure of health and medical informatics in order to become familiar with many of its subfields. How to go about developing and applying innovative technologies and evaluate complex health IT/IS tools and applications in order to achieve breakthroughs in medical practice within evolving and intelligent clinical environments is central to any efforts to promote and diffuse the use of such technologies (Tan J. with Dimitry, 2011).
The trends contributing to transform health care services involve, among other things, understanding artificial intelligence and expert systems innovatively and appropriately, sustaining computerized technologies in traditional hospital environments to improve clinical decision making, measuring the effects of health IT/IS on operating room performance to increase organizational effectiveness and productivity, achieving data and mined knowledge interoperability in clinical decision support systems, evaluating the impact of new technologies such as neural networks and neuro-fuzzy model, applying advanced biomedical instrumentation and healthcare engineering approaches to aid interpretation and accurate prediction of various sourced medical data, improving home health care via web-based components and home telecare management systems, and planning for health IT/IS disaster recovery.

The opening piece of this volume therefore serves to provide an overview of the various themes presented and attempts to meaningfully connect the different contributions appearing within the cover of this research handbook. We first survey the different subfields of published works in the health and medical informatics discipline based on the intellectual structure of the area over the past several decades as contributed by the authors of the first chapter. Next, we discuss why health data and the use of electronic health records are essential to building value when implementing health IT/IS in any modern-day care environment, and what impacts these systems may have on health care organizations. One of the pillars to adopting health IT/IS in routine clinical practice lies in the application of data and knowledge mining and their support of various forms of decision making, especially decisions that are related to clinical processes and patient care outcomes. This is key to understanding how value can be extracted out of health IT/IS innovative applications. Extending the intelligence of computerized decision support is the application of artificial intelligence, fuzzy logic and neural networks. These specialized methodologies can provide us with clever ways of redesigning traditional medical processes, and even pinpoint us to key organizational motivational factors, that can ultimately improve workflow to impact performance of knowledge users of health IT/IS. Impacts of other emerging health IT/IS applications on patient care, in particular, the emerging field of biomedical instrumentation and health care engineering, will also be covered. Finally, we will take a look at the developments in tele-home care and related mobile applications.

INTELLECTUAL STRUCTURE OF HEALTH AND MEDICAL INFORMATICS

A fundamental insight of the intellectual structure of health and medical informatics is critical for readers interested in the healthcare information systems and informatics discipline. As a health or medical informatics researchers and/or practitioners, it is sometimes easy to confuse what constitutes the field or discipline of Health & Medical Informatics given its many sub-fields of studies that are almost always interdisciplinary and somewhat overlapping. It is also difficult to pinpoint specific domains of the field and how these relate to one another, providing the foundational thinking and perspectives for building new ones. A key question remains in the minds of many health and medical informatics researchers and practitioners, that is, what are the primary sub-fields of this discipline, including those that are known and those that are emerging?

In seeking answers to this complex question, Raghupathi and Nerur attempted an author co-citation analysis of the health and medical informatics discipline and identified a taxonomy of various sub-fields drawn from the current and growing health and medical informatics literature. Much like a scoping review, their analysis covered sub-fields found within the health and medical informatics discipline that
encompassed the years of 1988 to 2006 – the period in which knowledge of healthcare and medical informatics and associated educational programs proliferated among major research universities. Extending previous research, Raghupathi and Nerur have chosen to reflect the current state of knowledge in the health and medical informatics discipline among the works of the key editorial board members of the following notable journals: *IEEE Transactions on Information Technology in Biomedicine (ITBM)*, *the International Journal of Electronic Healthcare (IJEH)*, *the International Journal of Healthcare Information Systems & Informatics (IJHISI)*, *the International Journal of Medical Informatics (IJM)*, *the Journal of the American Medical Informatics Association (JAMIA)*, *the Journal of Biomedical Informatics (JBI)*, *the Journal of Medical Internet Research (JMIR)*, and *the Medical Informatics & The Internet in Medicine (MIIM)*.

Interestingly, these authors were able to separate the more established subfields from the emerging ones. In general, among the more dominant subfields include: (1) AI/DSS (Fox, Greenes, Shortliffe, Stefanelli, Tu); (2) Quality & User Acceptance (Ammenwerth, Hasman, Haux, Kuhn, Sands, VanBemmel); (3) Clinical Information Systems (Ash, Kuperman, Overhage, Payne); and (4) Ontology & medical terminology (Bakken, Chapman, Chute, Cimino, Huff, Humphreys, Rector). Among the emerging subfields they found were: (1) Communication (Jadad, Eysenbach); (2) Bioinformatics (Altman, Troyanskaya); (3) Health Care Informatics (Young); (4) Medical Imaging Terminology (Carter, Dewey, Hu, Schwartz); (5) Computational Genomics & Genome Sciences (Boguski, Califano, Rzhetsky, Slonim); (6) E-Health (Tan, J.); (7) User Interface (Miller, McGowan, Roux); and (7) Mobile Computing & Remote Monitoring (Bakker, Finkelstein, Jordan).

Building on the Raghupathi-Nerur insightful work, it is clear that the discipline of health and medical informatics is ever evolving. Indeed, this all-encompassing discipline is attracting more and more researchers and practitioners from all walks of life interested in the relationships among multiple sub-specialty areas. This is the starting point for breakthroughs in health and medical informatics to be realized as new data, tools and technologies are being envisioned based on previous efforts to generate interdisciplinary collaborations. Ultimately, with more interdisciplinary research and the cross-pollination of knowledge, health and medical informatics researchers will be able to develop more sustainable technologies for changing clinical practice in the long run.

**ELECTRONIC HEALTH AND PATIENT RECORDS**

No breakthroughs in health informatics and/or health information systems can be achieved without, first, having some means of capturing, verifying, storing, transferring, retrieving and using data, especially those in the forms of meaning patient health records. In order for any health or medical informatics researchers and/or practitioners to advocate a change to any traditionally accepted treatment procedures or systems, evidence is clearly needed to show that such changes will either improve the efficiencies or effectiveness of the existing treatment systems.

One of the most fundamental themes of health and medical informatics is the application of electronic health and patient records within a modern-day care environment to support patient care and treatments. In the past, most of these systems were large-scale, expensive data systems, which took many years and man-hours to develop; such legacy systems were also mostly available only in major hospitals or large hospital networks. Today, with rapid advances in technological breakthroughs, many smaller hospitals, and even outpatient clinics, are able and ready to implement automated patient records. Many patients
are now even empowered to access their own health records in the form of web-based Patient Health Records (PHRs), which will not be discussed here due to space limitation. In this volume, two key studies related to hospital-based electronic health and patient records provide guidance to how such systems can affect both the caregivers who use the systems and the patients. These studies tell the story of how electronic health records (EHR) can impact the outcomes of patient care quality.

As in many other disciplines, the field of health and medical informatics rely on valid and reliable studies to pinpoint specific areas in which computerized systems such as electronic health records can contribute to improved patient care or other patient care related procedures. In one of the EHR study reported, Bourgeois and Yaylacicegi, for example, concluded that there is sufficient evidence, to date, to support its use and implementation in hospitals for safeguarding patient safety and for guiding hospital surgical procedures. Specifically, their results showed positive significant relationships between the use of the EHR technology and patient safety as well as such technology use and the quality of care, particularly in terms of surgical procedures. Their findings were based on data sourced from multiple avenues, including nonfederal acute care hospitals in the state of Texas, AHA (American Hospital Association), the Dallas Fort Worth Hospital Council and the American Hospital Directory.

In one of the other EHR-related studies reported in this volume, Wallance, Friesen, White, Gilmour and Lemaire discussed the impact of implementing an electronic Patient Care IS (PCIS) relating to the perceptions of health care providers in Canada on computer use, job stress, and patient care quality. The researchers cleverly divided the reporting of their results into: (1) Short-term vs. (2) Long-term results. In comparing the two sets of findings, first and not surprisingly, the use of the PCIS over the short-term (three months follow up results) was significantly less efficient in varying degrees in regards to time spent entering (p = 0.2), retrieving (p = 0.3) and searching for places to enter (p = .01) patient information/orders, than over the long-term (twenty months follow up results). The rationale for this is that healthcare providers become more familiar with how to better navigate the system over time. Second, while more care providers surveyed had expressed higher initial job stress with the use of the new PCIS system in the short-term, the average level of job stress significantly dropped in the long-term (p =.01). The rationale, again, is the longer term familiarity with the product and its use. Finally, long-term use of PCIS also led the care providers to feel significantly more assured and confident in not making a patient care related error (p =.01), in providing better quality of patient care (p =.14) and safer care (p =.03). While these results generally supported the use of PCIS over the long term, there was a surprising finding on what factors precisely related to the negative impact of PCIS over the short and long term. Readers interested in the complexity of such caregiver perceptions with health IT/IS implementation should read their work more carefully.

Broadly speaking, the study of health IT/IS should revolve around understanding impact of health IT/IS and how data captured in the system will yield valuable information and knowledge to aid health care decisions performed routinely by the knowledge users, including physicians, nurses, administrators, policymakers and other health care practitioners in the different care environments. We therefore move on to the important subject of health IT/IS evaluation, decision making and clinical decision support systems.
HEALTH IS/IT EVALUATION, DECISION MAKING AND CLINICAL DECISION SUPPORT SYSTEMS

A major emphasis in the acceptance of health IT/IS is the concept of its impact on organizational performance and the value of the health information systems and clinical decision support systems to aid human decisions as well as educate knowledge workers. These systems are built not only to educate users who lack specific knowledge and/or skills, but, more important, to facilitate decisions made by healthcare providers in the clinics, in hospitals, in multi-provider hospital or institutional networks, in public healthcare systems, in other healthcare agencies and institutions such as for specialty treatment areas (e.g., Cancer) and chronic illnesses (e.g., diabetes, inflammatory bowel disease – IBD), home care, and decisions made during the interactions of caregivers with the various patient communities at large.

Clearly, clinical decision support systems and a wide range of specialized health information systems are critical to the patients, the knowledge users, particularly, the clinical decision makers, as well as administrators and policymakers because facilitating the efficiency and effectiveness of the decision process of key stakeholders within the health care system will ultimately impact on the timeliness and costs of running such a system. Note that administrative decisions can be distinguished more appropriately and specifically from specialized clinical decision making in that health administrative and policymaking will often entail the process of making decisions regarding resource allocation, costing related to paperflow and administrative processes as well as how various organizational workflow is to be supported and coordinated whereas clinical decision making often pertains solely to the making of decisions that will directly impact on the outcomes of patient care.

As one reads through the volume, one should become better informed as to how health IT/IS studies are complex in terms of its interdisciplinarity, and how these studies need to bring to focus the perspectives of the different stakeholders, including scientists, researchers and administrative thinkers or knowledge users. It is, therefore, important when evaluating any health IT/IS projects for all stakeholders to be considered, that they be encouraged to participate or the system may or will likely not be successfully implemented without critical support contributed from all angles. Health scientists, the government, vendors and expert clinicians, librarians and information sciences experts, computing engineers, health technologists and operation management researchers should all have a say on how the health IT/IS system work or should work. Simply stated, the successful implementation of health IT/IS often retells the stories of how beneficial it is to bring all stakeholders together. The complexity of using health IT/IS, therefore, lies in how the decisions of the health professionals will be ultimately impacted and how their behaviors may change via the use of these systems.

In this volume, McDermid, Kristjanson, and Spry explored issues and barriers related to generating a sustainable system for gathering quality of life data in hospitals via tablet computers as opposed to the traditional paper-based system. Their health IT/IS evaluation results showed that the tablet system was rated significantly higher than the paper-based system in terms of benefiting clinicians; it was also considered to be easier to use, more flexible, less costly to transcribe, more efficient, more secure and provided better accuracy although the paper-based system was thought to be more reliable. Clearly, physicians and other health decision makers benefited significantly from the use of a tablet system, encouraging its acceptance and adoption. Yet, its success or failure should not and cannot be just attributed solely to the users – the other stakeholders such as developers, engineers, administrators and educators will all have to share in that success or failure. A key lesson learned is that not all constructs used for health IT/IS evaluation were easy to assess, for instance, cost-effectiveness.
Harison and Berghout also studied the effects of health IT/IS on operating room (OR) performance. They adopted a mixed quantitative-qualitative method in their study and found that the appropriate performance indicators are critical to tell the true story of success or failure. Five major categories of performance indicators were identified in their study, namely, efficiency, productivity, cost savings, quality, and employee satisfaction. An important observation noted by the researchers is that the integration of a successful OR unit system with other existing organizational unit systems such as admission, finance and billing, and preoperative research will go a long way to further reduce costs and increase efficiencies of the system – a point that policymakers should especially note for achieving the longer term effects and the need to see “the larger picture”.

In a different contribution, Kazemzadeh, Sartipi, and Jayaratna focused on developing a novel framework for translating the analysis of mined data and knowledge of disparate health information systems to influence decision making, specifically, within a clinical decision support system (CDSS) environment. Essentially, they built a prototype to demonstrate how data mining results captured using various forms of data mining techniques can be integrated interoperably into a CDSS “to provide an environment for clinical guideline authoring and executive.” The feasibility of such a data and mined knowledge interoperability CDSS architecture was further illustrated in their work via walkthroughs of relevant scenarios in three different but relevant case studies.

Beyond statistical data mining and knowledge abstraction techniques, more specialized decision support and facilitating tools and methodologies include the application of artificial intelligence (AI), expert systems (ES), fuzzy logic and neural networks (NNs), all of which constitutes the theme to be discussed next.

ARTIFICIAL INTELLIGENCE (AI), EXPERT SYSTEMS, FUZZY LOGIC AND NEURAL NETWORKS (NNS)

A good number of contributions in this volume relate generally to the subfield of AI, expert systems (ES), fuzzy logic and neural networks (NNs). To overcome the “sharp boundary” problem that often limits the usefulness of recommendations produced from traditional rule-based expert systems, Olufunke, Charles (Uwadia) and Charles (Ayo), for example, reported on the application of an expert-driven approach to examine the effectiveness of a fuzzy ES in determining risk associated with CHD (coronary heart disease). Briefly, the “sharp boundary” problem often results in either underestimating or overestimating of boundary cases, which correspondingly constraints the resulting accuracy of a rule based ES. The authors, here, applied fuzzy logic to improve the performance of their ES.

In an innovative demonstration of an artificial NN application, Hanafizadeh, Paydar and Aliabadi showed how the NN methodology could be applied to evaluate the effect of hospital employees’ motivation on patients’ satisfaction, instead of applying the usual statistical approaches of regression and correlation analysis. Their findings revealed that key among various motivating factors affecting hospital employees, that could in turn, affect the level of satisfaction among patients, is the awarding of monetary bonuses as an acknowledgement of meritorious performance. Also, many employees were generally anxious over the lack of adequate job security, affecting their daily performance.

In a more classical application of the NN methodology, Kalpana, Muttan and Agrawala reported on the training and application of a Back Propagation Neural Network (BPNN) methodology to evaluate accurately the age related changes in brain fiber tracts, thereby aiding physicians in further understanding
of age-related changes in brain white matter. These researchers claimed that such work would eventually contribute to a greater understanding among caregivers of the “miscorrelation in motor activities and relevant causes” in elderly patients. In contrast, Hemanth, Selvathi and Anitha presented a specialized NN methodology for brain tumor image classification. They termed this methodology as the adaptive resonance theory (ART2) neural network. When compared to classical NN classifier methodologies such as the kohonen NN, or, the back propagation NN, Hemanth et al. experimental analysis proved that the ART2 NN methodology was able to produce a more accurate classification for abnormal brain tumor images.

As well, Mashhour Bani Amer also applied a novel neuro-fuzzy model to assess liver function based on predicting the level of blood albumin (BA). Essentially, the BA model uses four inputs as measured in any routine liver function test for calibration and prediction of the liver function: asparate aminotransferase, alkaline phosphate, total bilirubin, and total protein. Accordingly, the author argued that the diagnosis of liver disease is complex and the key benefit of using this model is to enhance the clinical assessment capabilities of the clinicians besides having the model to be easily integrated into any medical ES diagnostic tools for assessing liver disorders.

Finally, an interesting human-computer interface study which bridges the application of NNs to the emerging field of biomedical instrumentation was reported by Rajesh and Kumar. They employed a surface electromyography (SEMG) to detect the muscle activities of hand gestures and use the back propagation NNs to separately analyze and classify the different movements needed in human-computer interactions, including wrist and finger flexion as well as a combination of the two - all of which would be applicable - when one has to navigate a wheel chair. This brings us to the next section, which focuses specifically on studies related to the biomedical instrumentation and healthcare engineering subfield.

**BIOMEDICAL INSTRUMENTATION AND HEALTHCARE ENGINEERING: AN EMERGING SUBFIELD**

An emerging theme of health and medical informatics featured in this particular volume is research in the various domains of biomedical instrumentation and healthcare engineering. Whereas biomedical instrumentation research is often concerned with signal processing techniques applicable to the interpretation of physiological measurements, healthcare engineering is more or less focused on the application of engineering principles to build such technology that models the human physiological systems, including the development of different electromedical equipment. Together, this emerging subfield contributes richly to our knowledge of recording and monitoring human physiological signals, our understanding of precise measurement and analysis techniques needed to operate therapeutic equipment and other technological innovations, and our use of modern imaging systems, with the application of new and improved methods of medical diagnosis, treatment and rehabilitation.

Some common examples of applied biomedical instrumentation and healthcare engineering research include the application of engineering methods to enhance the diagnosis of obstructive sleep apnea, innovative and intelligent signal monitoring for predicting cardiac arrhythmias, the development of electromedical systems for detecting respiratory irregularities and other physiological and neurological disorders. Several related contributions in this volume explore the theme of biomedical instrumentation. For example, the application of appropriate diagnostic tools via specialized methods such as a Random Forest classifier based diagnostic system to enhance electrocardiogram or electrocardiography record
ECG or EKG) is a work contributed by Mahesh, Kandaswamy, Vimal and Sathish. They argued that developing a diagnostic tool, which combines certain features of ECG with the heart rate variability signal, could meaningfully aid physicians in the analysis of various types of cardiac arrhythmias. In contrast, Gautam, Lee and Chung concentrated their efforts in developing a new algorithm for ECG signal de-noising. Their Asynchronous Averaging and Filtering (AAF) algorithm essentially reduces random noise from ECG signal and provides accurate R-wave detection, which can also be adversely affected by Baseline wander noise embedded in the ECG signal. Along the same line, Chatterjee, Ganguly and Bhattacharya found Pointcare Plot (PP) to serve as a key marker for characterizing both short-term and long-term heart rate variability (HRV). Their HRV characterization study was conducted among the female tea garden workers of the Northern Hilly Regions of West Bengal, India.

Another stream of noteworthy contributions in this subfield include brain image manipulation. Here, Gopinath and Gupta investigated an image classification methodology to differentiate effectively between benign or malignant state of thyroid carcinoma. Their medical image analysis was based on thyroid samples extracted via the non-surgical means known as fine-needle aspiration biopsy (FNAB). Through the application of k-nearest neighbor (kNN) algorithm to classify images that have undergone segmentation on region of interest, followed by the use of appropriate feature extraction, the researchers were able to achieve a low error rate in tested images. Similarly, Selvathi, Selvi and Malar demonstrated how the application of the SURE-LET approach could more meaningfully reduce the Rician noise in brain MRI (magnetic resonance images), compared to the use of Curvelet transform via Wrapping reported in previous research.

Lastly, in his article, “Assessment of Anti-angiogenic Drug in Cancer Therapy,” Pan advocated the development of a clinically relevant analytical model that could effectively simulate “angiogenesis” and trace tumor growth. In this context, “angiogenesis” refers to the generation of micro-vessel surrounding solid tumor. Following a series of experiments, Pan concluded that the quantitative-based “time distance model” which he had developed would be useful in tracing the behavior of the tumor system during varying time course of disease progression.

OTHER EMERGING AREAS

Other emerging areas in health IT/IS that are also transforming healthcare practice and encouraging previously unanticipated innovations in research translations to practice include designing appropriate architecture for distributed and wireless networks, telehome care management systems, mobile applications for maternal and child care, as well as health IT/IS disaster recovery. Such new innovations of health IT/IS domains will enhance sharing, storing and retrieval of patient-related information, knowledge mobilization and exchange, learning, automated decision support, use of intelligent medical devices and sensors, convenient networking and communications, use of social media, all for the promotion of a “caring” environment. Intelligent use of health IT/IS affects both the practitioner and the patient and is critical in motivating and nurturing a healthy care environment, thereby encouraging even further innovations and implementation of intelligent health IT/IS.

There are currently over 15,000 applications on the iPhone and iPad alone for practitioners, patients, and family members related to these patients, not to mention applications on administration, learning, and for more traditional chores such as scheduling. As of late 2009, it has been estimated that there are more than 10 million people using iPhones for health information in the US alone (Wagner, 2009) - by
providing convenient and ready access to relevant health information anytime, anywhere, these applications are being employed in a variety of channels and rapidly changing the landscape of health care for both the caregivers and the consumers (Sarasohn-Kahn, 2010). To use a typical illustration, neither a physician nor a pharmacist can be expected to remember all the names of appropriate medication that can simply be made available for treating a certain illness and they cannot also be expected to be able to have on hold physically all the available published journal articles related even to just a small area of their practice specialization, but a mobile device could easily capture, store and be available for easy retrieval of such information to these practitioners.

One of the emerging areas of research for healthcare engineering is the design of network architecture to support distributed services for medical applications. Logeswaran and Chen contributed to this thinking when they compared the performance of two open and flexible load balancing algorithms against previously used baseline methodologies for object-oriented distributed service architecture (DSA) to ease development of different hardware-software platforms supporting telecommunications and distributed medical applications. In heavy loaded condition, both of these open and flexible load balancing algorithms, namely, the Node Status algorithm and the Random Sender Initiated algorithm were found to perform significantly better than the baseline methodologies, namely, the Random algorithm and the Shortest Queue algorithm in terms of “throughput” and “mean setup time per session”. This led them to conclude that there is room to deploy new strategies to enhance network performance for distributed service architecture geared towards medical applications.

Another emerging theme of research for health and medical informatics is in the domain of mobile applications to improve maternal and child healthcare (MCH) management. Here, Romsaiyud and Premchaiswadi contributed insights on an adaptive multi-services system that is capable of providing fully integrated and comprehensive web-based and mobile healthcare services that also incorporates emergency services and alerts. Their application, known as AM-Care, comprises three mechanisms: (1) the control centre that stores and supervises all MCH information in a single depository; (2) the web-based mechanism that supports convenient Internet-based connectivity and web services; and (3) the mobile component that allows easy and ready access of personalized information via GPS technology.

Closely linked to these emerging technologies would be the development, acceptance and implementation of telehome care management systems. Here, Chen and Chou studied the adoption and acceptance of the Home Telecare Management System (HTMS) with a set of testable hypothesis that was generated on the basis of extending Davis’ (1989) Technology Acceptance Model (TAM) with a link to the Kelman’s (1958) Social Influence Theory (SIT) along the noted processes of compliance, identification and internalization. Generally in agreement with earlier findings except in a few instances, these researchers noted that whereas internalization and identification will impact on both behavioral intention (directly) and attitude (indirectly), compliance would only impact on attitude, but not on behavioral intention. This has eventually led them to note that the population they tested may be differently based, and they also concluded that in order for HTMS to be accepted, users’ perceived value is critical, that is, the system must be seen as capable of enhancing health management functions and easy to use. In this respect, patients can be educated on the use of the system.

Finally, a key challenge in the maintenance of any health IT/IS is an organization’s compliance with the Joint Commission’s mandate for disaster preparedness when implementing health IT/IS. Along this line, Lee and Guster presented a virtualized disaster recovery model for a typical healthcare system and large-scale hospitals. This model is clearly applicable and can be extended to cover multi-provider networks. In this model, steps are outlined on how to set up the environment conducive to recovery in the
face of a disaster and how to put a virtualized plan in place that would encompass a system of multiple networks. Although this model is less efficient in terms of workload performance than the traditional physical set up, results of a simulated scenario showed that it is viable and can be significant in terms of cost and time savings.

Altogether, the organized chapters of this volume provides rich insights into the evolving discipline of health and medical informatics. Research in this multi-disciplinary field is complex and challenging. The contributions in this volume expanded our knowledge of this area and given the growing number of published studies in its various subfields in recent years, these contributions are timely, relevant and valuable. Indeed, it is hope that readers of this volume will be encouraged to further add to the many established as well as emerging subfields of health and medical informatics. As health information systems and informatics gain further attention of the wider research communities due to ongoing and continued efforts of contributors such as those listed in this volume, all of us will share in the benefits that can be derived from the adoption, use and proliferation of these systems.

REFERENCES


