In the first decade of the 21st century, we experienced exciting technological advancements in computing and decision sciences. As we are approaching the mid-point in the second decade, we are witnessing a radical transformation in healthcare administration and management. Healthcare is embracing computing technologies and decision analytics paradigms to deliver effective services. Remote care using information technologies has become a norm in medical practices. Ubiquitous technologies are facilitating the provision of healthcare services anywhere and anytime. This is causing an exponential proliferation of healthcare information that can be analyzed for effective management in various healthcare settings. As a result, healthcare informatics and analytics has been concerned not only with data management but also with predictive and prescriptive analytics, taking the healthcare sector to a higher degree of intelligence and effective advantages.

Health informatics and analytical methods have provided several advantages in the healthcare context. They have been contributing to the individual’s health and have provided comprehensive tools for representing, accessing, and visualizing health data. They have also enabled comprehensive measurement and visualization of the human body and applied formal models for better understanding the functions or workings of the human body. Furthermore, health informatics and analytics has contributed to health knowledge. For example, several data mining algorithms have been applied to analyze data from different perspectives and summarizing it into useful information. The recent advancements in health informatics have enabled individuals to access a wide range of credible health information and knowledge, as well as given patients the ability to monitor and manage their diseases by accessing their own health information. It has also increased the collaboration between patients with chronic illnesses and caregivers by using health informatics tools.

Medical error is one of the primary causes of death in the US. Between 44,000 and 98,000 American deaths are consequences of medical errors in the healthcare industry. The most important causes for these kinds of errors come from communication problems such as unreadable information because of poor handwriting, mislabeled laboratory specimens, loss of medical records, and inaccurate health information in medical records. Investing in computer technologies related to healthcare can radically improve the range and quality of care available to patients and medical specialists such as nurses, doctors, and clinicians. Health informatics can minimize the risk of medical errors and help the early detection of health problems. In-home tele-monitoring of patients with chronic problems such as heart diseases can improve survival rates, reduce hospital days, and save nursing costs. Moreover, e-prescriptions have been reported to decrease errors in drugs dosage.

Healthcare processes are highly collaborative, and professionals from different disciplines must work together to enhance the quality of care. Achievement of this goal has been revolutionized through
the use of computerized methods. For instance, Electronic Medical Records (EMRs) are commonly used, replacing paper medical records with digital ones. EMRs can be compared to their paper-based counterparts in three major perspectives: from the viewpoint of patients, General Practitioners (GPs), and health providers. For example, in paper-based systems, patients must physically transfer their health information from one provider to another, but in an electronic system all patient information is stored in the EMR database, and health providers have access to patients’ data. Additionally, in paper-based system, patients with chronic diseases cannot update their health progress frequently, but in electronic systems chronic care patients can easily update their medical records and play an active role in their treatment. Furthermore, in paper-based systems, health practitioners may have some difficulties in obtaining relevant patient treatment information, whereas in electronic systems, patient information is stored in an integrated health record database providing for better access, which can lead to improved quality of care. Finally, integrated electronic systems can give healthcare providers access to more reliable and accurate information.

Given these trends, it is obvious that information technologies and analytical methods have played a critical and significant role in enhancing healthcare practices. Despite massive progress in healthcare informatics and analytics research and practice, there is no book that provides a relatively comprehensive set of modern research and practice in the field. Thus, this book aims at providing a big picture of recent advancements in the area of healthcare informatics and analytics.

The principal objective of this book is to provide a collection of recent and state-of-the-art contributions for researchers, academics, healthcare practitioners, and healthcare professionals who are concerned with the novel applications of informatics and analytics in healthcare. The chapters in this book demonstrate cutting-edge scholarly or applied practice methodologies using a wide range of techniques and analytical models including both quantitative and qualitative approaches as well as case studies that describe the significant advances in healthcare informatics and analytics.

The chapters in this book highlight the current state-of-the-art and science of applying informatics and analytics in healthcare. We are beginning to see that these applications are in fact reshaping the daily practices in healthcare settings. In this context, informatics and analytics tools are doing more than simply storing, retrieving, organizing, and analyzing information. The 17 chapters in this book illustrate that healthcare informatics and analytics are transforming delivery as well as the substance practice of healthcare in four different areas, producing the four sections of this book.

SECTION 1: APPLICATIONS OF ONLINE SOCIAL MEDIA IN HEALTHCARE

This section consists of four chapters and presents the applications of online social media in healthcare. Social scientists have been studying the inter-personal relationships and their impacts in health and health-related settings for a long time. Following the advancements in the Web technology, the past decade has observed a growing interest in how social networks influence healthcare. In recent years, the rapid development of new informatics and tools, such as Web 2.0, has facilitated healthcare participants to utilize social networks. Healthcare organizations can use social media to reach aggregate information and leverage collaboration. As more patients use social networks and Web 2.0 technologies to track their health conditions and care, industry organizations have an opportunity to interact with the members of these online communities and to leverage real world data sets into new treatments and care pathways. This section presents techniques that can be utilized in several healthcare processes.
Chapter 1

In the first chapter, titled “Twitter and its Role in Health Information Dissemination: Analysis of the Micro-Blog Posts of Health-Related Organisations,” Dumbrell and Steele have provided an analysis of the use of a micro-blog system, namely Twitter, in terms of its nationwide use by health-related organizations. This is both novel and challenging as typical Twitter-related studies have concentrated on a more narrowly defined topic given the large volume of micro-blog posts. In addition, a more semantically deep analysis of this content has been carried out considering both the content of the micro-blog posts and the contents of Web pages linked to those micro-blog posts.

Chapter 2

The aim of the chapter of Kuusisto-Niemi, Saranto, and Rissanen is to describe and analyse the conception of ICTs for social services on the basis of previous international and national research and a case study of Finnish experiences. The theme of their chapter is the development of social services informatics and the importance of special characteristics of it in ICT development. These issues are analysed in the light of national and international research. The chapter also opens a new perspective in ICT research. In the first part, the international research literature is analyzed by a paradigm that has been developed in a Finnish master’s degree program for health and human services informatics for the purposes of directing research and teaching in the most significant areas of informatics. It facilitates the study of previous research and places it in a systematic framework.

Chapter 3

In the chapter titled “A Social Network Framework to Explore Healthcare Collaboration,” Srinivasan and Uddin take a new approach that explores the impact of collaboration among physicians when treating hospital patients admitted for acute care. They utilize principles of two social network theories to offer insights into different types of collaboration patterns among healthcare professionals and explore the impact of different collaboration structures on healthcare cost and quality of care. The proposed collaboration framework is based on network theories of centralization and centrality that can explain how network structure and collaboration patterns affect group and individual performance. This framework is explained using illustrative examples of collaboration that evolves among physicians, while treating hospital patients undergoing hip replacement surgery. This practical application reveals network structures that are not favorable to cost and a quality of care parameter such as readmission rate. Finally, the authors offer some insights into various collaboration models that can provide cost effective and efficient healthcare service to chronic and acute care patients.

Chapter 4

In their chapter titled “Privacy Perceptions of Older Adults when using Social Media Technologies,” Dumbrell and Steele have investigated an important issue in relation to the increasing utilization of social media technologies by older adults for accessing health-related and other types of information. That is, the perceptions of older adults in relation to privacy when using social media. Whilst social media technologies can offer a novel medium for accessing up-to-date and relevant information and
such technologies have seen a rapid consumer uptake globally, further understanding of any barriers to adoption particularly for older adults requires better understanding. Dumbrell and Steele have identified privacy concerns as one of the key issues for older adult adoption of social media as has been reported in a number of previous studies. In this chapter, the authors describe that the perceptions of older adults in relation to this issue are multi-faceted and complex. Moreover, Dumbrell and Steele identify and discuss that there were quite different privacy perceptions in relation to the different individual social technologies trialed—Facebook, Twitter, and Skype—and that these perceptions related to the different characteristics of these technologies.

SECTION 2: USER ACCEPTANCE OF HEALTH INFORMATION SYSTEMS

This section is composed of three chapters and investigates user and usage aspects of health information systems. Complex regulatory concerns and patient-care priorities affect the pace at which technology can be adopted and deployed in the healthcare segment. Poor healthcare outcomes lead to increased levels of morbidity and mortality and obstruct countries’ prosperity and business profitability. While there has been considerable interest in healthcare information systems, the uptake and acceptance rates for these systems have not been high enough for healthcare providers to experience the maximum benefits that these system have to offer. Past experiences of health information system adoption have indicated that the low adoption rate could be attributed to both macro-level factors (e.g., supportive policies) from the perspective of the public, healthcare organizations, and the system, and micro-level barriers from the perspective of healthcare providers (e.g., physicians’ perception about technological complexity). Overall, uptake of healthcare information systems has been shown to be a very complex issue relating to organizational, people and technological challenges. Section 2 seeks to address these challenges by providing three state-of-the-art chapters.

Chapter 5

The chapter titled “Perceived Importance of User Expectations from Healthcare Information Systems” by Gürsel is the continuation study of the work “A New Approach in the Evaluation of Hospital Information Systems,” which presents an evaluation framework for the Hospital Information Systems (HIS) that evaluates the expectation meeting ratio of the HISs. This chapter represents the next step in this study. In this study, the variables of the framework are rank ordered according to the perceived importance of the users. This study gives important clues for the Healthcare Information System (HCIS) designers and developers. In addition, it gives insight into the research on HCIS, and its success factors and failure reasons. Although the HCIS developing industry is in close contact with the academic developments and studies, the high ratio of failure in health sector Information Technology (IT) projects indicates that they must be more careful in planning and management. Expectation management in an IT project is a critical issue that must be addressed. This item is always ignored in the project management phase of HCISs. Although there is a great deal of work done and remarkable results have already been gained, it seems there are still issues to be resolved and developed further.
Chapter 6

In their chapter titled “Don’t Leave Me Untouched: Considering Emotions in Personal Alarm Use and Development,” Pedell, Lopez-Lorca, Miller, and Sterling present a novel approach for including the emotional needs of users in the development of systems and services. The authors illustrate their process with a compelling case study in the area of wellbeing in old age, tackling a truly current problem as the aged population grows as well as aged care costs. Personal alarm systems, usually in the form of a pendant worn around the neck or as a wristband, can be activated if seniors need help. Service providers often bundle the alarms with “check-in” systems, which require the older person to press a button on a daily basis during a specified interval. Pressing this button sends an “I’m OK” signal. If older adults do not press the button, the service provider contacts them and, eventually, their family if the older person cannot be contacted. Despite their technical soundness, these alarm systems often fail in their goal, that is, to provide support in an emergency. In many cases, relatives of older people insist on the installation of these systems, and the result is that the older people reject them. Pedell, Lopez-Lorca, Miller, and Sterling argue that the reasons behind this rejection are in the lack of catering for the non-functional needs of older people. This seems to be a common issue in many assistive systems, where the emotional needs of the intended users are overlooked in favor of specific physical needs dominating the design.

Chapter 7

The goal of the chapter written by Keikhosrokian, Mustaffa, Zakaria, and Baharudin is the introduction of the Mobile Healthcare System (MHS) followed by exploring the behavior intention of Smartphone users in Penang, Malaysia to use MHS. For this reason, a survey was conducted by distributing a questionnaire to Smartphone users as respondents in Penang, Malaysia. Partial Least Squares (PLS) was used to analyze the proposed measurement model. The results indicate which factors have significant effect on Smartphone user’s behavioral intentions and which factors are not significant. The results assist the researchers in assessing whether MHS is highly demanded by users or not, as well as assist them in the development of the system for the future.

SECTION 3: EMERGING TECHNOLOGIES FOR HEALTHCARE

This section consists of six chapters and presents emerging technologies for healthcare. New technologies are constantly in development to help people stay healthy, better diagnose disease, treat illness, and provide a better quality of life. While the rapid changes in routines, practices, and regulations push the contemporary healthcare forward, one could argue that nothing is changing the healthcare practices as much as technological advancements. Here, emerging technologies are advancements that can utilize and change the way that healthcare workers conduct their daily duties or the way that patients benefit from healthcare services. Section 3 seeks to address this by providing six interesting chapters.

Chapter 8

In their chapter titled “Sleep Disorder Diagnosis: An Analytical Approach,” Blake and Kerr demonstrate the development and evaluation of online tools to support the diagnosis of a chronic condition, sleep
disorders. One of the outputs of this application is the automatic collection of good quality patient history data from every patient that completes the form. Decision analytics has the ability to uncover unknown patterns of patient characteristics, which might be used to develop a low-cost screening tool. To develop targeted instruments that might be used by primary physicians, this chapter proposes to access enough good quality data, which might be analyzed. However, the primary goal of sleep clinics currently is to efficiently diagnose sleep disorders rather than research or the collection of data. This chapter presents a tool that works by collecting the data as a by-product of diagnosis support.

Chapter 9

In their chapter titled “Supporting Physicians in the Detection of the Interactions between Treatments of Co-Morbid Patients,” Piovesan, Molino, and Terenziani address one of the most challenging emerging issues in Healthcare Informatics: the treatment of co-morbid patients (i.e., patients affected by multiple diseases). Nowadays, the number of co-morbid patients is rapidly increasing, due to the aging of population and the increase of chronic diseases (e.g., hypertension, diabetes mellitus, and heart failure). Clinical guidelines are widely used in the clinical practice as a way to implement evidence-based medicine and to provide both the quality and the standardization of healthcare services. However, “clinical practice guidelines provide evidence-based information of interventions, but only on individual pathologies. This sets up the urgent need of developing ways of merging multiple single-disease interventions to provide professionals’ assistance to co-morbid patients.” In this chapter, Piovesan et al. address such a crucial need by proposing a new computer-assisted methodology to support physicians in the detection of interactions between two or more different guidelines. The central and innovative idea of Piovesan et al.’s approach is that, to provide an adequate support to user-physicians, interaction detection must be interactive, flexible, and more importantly, must consider different levels of abstraction.

Chapter 10

In their chapter titled “Radio Frequency Identification Technology as an Analytical Lens and Solution in Hospitals: A Novel Approach in BPR/BPM,” Unnithan and Fraunholz contribute to the literature by presenting a novel way of using Radio Frequency Identification Technology as not only a technology solution for hospitals but also as an analytical lens to reveal inconsistencies in existing processes. The standard way of deploying a technology by redesigning processes and plugging in the technology may not work with hospitals that are hectic by nature. In the Australian context, while hospitals have discovered the utility value of RFID, there seem to be a certain reluctance in deployment. This chapter is timely in that it explains the way in which RFID can not only be a piece of technology that is useful to enhance processes, but it may also be an analytical tool that helps hospitals reassess their processes and address inconsistencies.

Chapter 11

Ceruti, Geninatti, and Siliquini present a chapter titled “Use and Reuse of Electronic Health Records: Building Information Systems for Improvement of Health Services” that provides a clear and interesting overview of Electronic Health Records (EHRs), a description of their challenging evolution within the recent expansion of e-health, and of the emerging opportunities through EHR data reuse for the
improvement of healthcare services. According to Ceruti, Geninatti, and Siliquini, all professionals in the field of public health should be provided a definition of EHR with respect to the disambiguation of the different health-related electronic records. The authors provide authoritative definitions. However, theoretical explanations are not always translated into practice by clear and distinct means. That is why the authors, while rigorously highlighting such differences among e-health data, direct their efforts to clarify why and how these data are intrinsically linked to each other. Personal Healthcare Records might be increasingly used with the advances in telemedicine, mHealth, and Health 2.0.

Chapter 12
In their chapter, “The E-Learning Experience in Medical School of Casablanca,” Ihssane, Diouny, Serhier, and Othmani bring into focus the current state of medical education, which is facing big advances in knowledge and less time for teaching. The authors point out the role of e-learning in improving the efficiency and effectiveness of educational materials through the description of two projects held by Hassan II University of Casablanca, Morocco, namely (1) the “Digital Environment Work” (DEW), a protected digital space which allows medical students, faculty, and administrators to access information and online services, and (2) “@U-PEL 2010 program,” which was launched with a view to supporting holders of a comprehensive strategy for the development of e-learning institutions on the basis of clearly identified projects.

Chapter 13
The next chapter titled “Knowledge Discovery and Data Mining Applications in the Healthcare Industry: A Comprehensive Study” is presented by Barazandeh and Gholamian. Databases are growing in hospitals, clinics, medical research centers, pharmaceutical companies, and other related businesses. This chapter proposes a well-structured classification that works as a road map for researchers to find their interest areas and conduct their studies in those areas. Research areas and challenges in each area are clearly discussed. The chapter studies recent studies on knowledge discovery and data mining applications in the healthcare industry and proposes a new classification of these applications. This classification is based on main healthcare industry pillars. These pillars includes the patient as the most important pillar, information and knowledge of healthcare activities, practitioners including managers, physicians, nurses, and other personnel, and business issues that cause the industry to survive and establish the relationships between all the pillars.

SECTION 4: APPLICATIONS OF INFORMATICS FOR AGED CARE AND CHRONIC DISEASES

This section is formed by four chapters and highlights the applications of informatics for aged care and chronic diseases. The world’s population is aging rapidly, and the cost of caring for older people is also rising. In 2012, 6.9% of the world population were more than 65 years old, and this is estimated to increase to around 20% by 2050. In addition, the chance for the aged population to suffer from chronic diseases is higher than young ones. This has increased the necessity for innovative approaches in the aged care sector in order to reduce the cost of care. One approach could be the use of technologies to provide
efficiencies in patient care and lower costs. There are two main arguments for this. First, seniors traditionally like to live independently and preferably in their own homes. Second, it is commonly believed that the aged care sector will soon face a huge shortage in qualified workers. In addition, remote and regional areas, even basic healthcare services, require patients to travel long distances to get treatment, and this is further exacerbated as the elderly often have transport issues such as restricted movement and an inability to drive. Recent advancements in Information Technology (IT) have resulted in technological products that have potential to assist older people in their daily life activities at their homes. Section 4 addresses these issues through four state-of-the-art chapters.

Chapter 14

The next chapter is titled “Using Narrative with Avatars and Robots to Enhance Elder Care” and is written by Lundy Lewis. Socialization through narrative and storytelling is important for elder care and quality of life. The elderly enjoy reminiscing and communicating. They enjoy being reminded of past experiences and having conversations with other interested parties such as family and friends about their life history or particular life events. However, there are common reports of frustration, such as caregivers who are around on a daily basis and who do not know the elderly person in the way that families do and thus cannot engage in such meaningful conversation. Lewis’s chapter aims to alleviate the common problem of loneliness and depression in the elderly by developing a social companion in the form of an avatar or humanoid robot.

Chapter 15

The chapter written by Hume, Hume, Johnston, and Whitty is titled “The Role of Knowledge Management (KM) in Aged Care Informatics: Crafting the Knowledge Organization.” Aged care is becoming more diverse and complex advancing from residential care to incorporate community-directed care and require practices that enable efficiency and growth. This chapter introduces the concepts of knowledge management, decision support systems, and big data management in aged care, and focuses on the importance of diffusion of knowledge to those in need. This chapter focuses on informing the development of an analytics-driven operational system and advanced KM hub for aged care management and patient care services.

Chapter 16

In the chapter by Alireza Rahimi and colleagues, they learn current expressions of specification of data quality and the role of ontology-based approaches to develop data quality based on “fitness for purpose” within the health context. They have sighted different mechanisms, including ontologies, to specify DQ in integrated CDM and whether improved DQ will better measure health outcomes. This chapter presents a literature review that suggests that, compared to non-hierarchical data models, there may be more advantages and benefits in the use of ontologies to solve semantic clinical data quality issues and improve the validity and reliability of data retrieval, collection, storage, extraction, and linkage algorithms and tools.
Chapter 17

The last chapter is titled “A Reconfigurable Supporting Connected Health Environment for People with Chronic Diseases” and is written by Amira, Ramzan, Grecos, Wang, Casaseca-de-la-Higuera, Pervez, Wang, and Luo. The number of elderly and people diagnosed specifically with chronic diseases is increasing dramatically in all regions in the world. This has a huge impact on the cost, quality, and delivery of healthcare services, which are changing from the traditional approach to the connected model. This book chapter discusses the recent advances in connected health technologies and applications. A thorough review of the existing information and communications technologies and challenges in the area of connected health, including embedded medical devices, sensors, social networking, knowledge management, data fusion, and cloud computing, is presented. Finally, future directions and ongoing research in the area of connected health are presented.

All in all, this book will help to simplify the seemingly inexorable complexity involved in development of healthcare informatics and analytics tools, methods, and models that have come to characterize today’s world.

Madjid Tavana
La Salle University, USA

Amir Hossein Ghabanchi
Griffith University, Australia

Amir Talaei-Khoei
University of Technology, Sydney, Australia