Preface

Healthcare and healthcare delivery are currently undergoing major changes worldwide as they are increasingly being transformed through the application of technology. Over the past several decades a wide variety of information technologies have been deployed within an ever increasing variety of healthcare settings (ranging from clinical to hospital, community and home settings) in an effort to streamline and modernize healthcare delivery. Much of this effort has been in response to the limitations of ways that healthcare information has traditionally been collected, retrieved and communicated. For example, the limitations of handwritten paper-based medical records, which have been the predominant form of recording patient and medical information for over a century, have been well documented (Shortliffe & Cimino, 2006). This includes difficulty in obtaining information stored in paper-based records, illegibility of handwritten notes and lack of ability to connect information in the paper-based record with other relevant data being stored in growing clinical, hospital, regional and national health databases and repositories. Conventional approaches to healthcare information management are not able to support advanced health information systems of the future that will be able to take advantage of the increasing amount of health data being generated in order to radically improve healthcare decision making and practice. Indeed, traditional approaches to managing healthcare information that met the needs of healthcare professionals and organizations in past decades have not scaled well to the current information needs of modern healthcare (Shortliffe & Cimino, 2006).

In response to this need, a wide range of information technologies have been designed and deployed, ranging from systems designed to support retrieval of basic patient data to physician order entry systems designed to support ordering of medications by healthcare workers (Borycki & Kushniruk, 2005). However, despite the promise of information technology for improving healthcare, much of the current healthcare system worldwide continues to be based on outmoded traditional models for information management and exchange. Furthermore, studies examining the potential benefits of the introduction of healthcare technology are mixed and some studies have indicated that information technology that is not designed or deployed properly may lead to little or no benefit (Chaudhry, Wang, Wu, Maglione, Mojica, Roth, et al., 2006). This is a consequence of a range of difficulties encountered in attempting to modernize healthcare using information technology, both technical and non-technical. From a technical perspective many advances have and continue to be made. However experience is indicating that integration of technological innovation with human work and social activity in healthcare is problematic.

Over the past several decades it has become increasingly recognized that perhaps the most serious barriers to achieving widespread improvement in healthcare using information technology are related to human and social aspects of healthcare information systems. These include issues related to understanding and optimizing the complex interaction between people (e.g. healthcare professionals, patients and laypeople) and computer systems, organizational issues surrounding understanding the impact of implementation of such systems in complex healthcare settings, as well as the legal, ethical and social

issues surrounding the use and potentially widespread sensitive electronic dissemination of healthcare information. In order to address these issues a wide variety of researchers and practitioners from many disciplines have contributed both theoretical and methodological approaches in order to improve our understanding of barriers to successful use of information technology in healthcare. In this book we gather multiple perspectives on human and social aspects of healthcare information technology. The contributors to this book describe a variety of models, frameworks and empirical approaches to considering human and social aspects of health information systems.

BACKGROUND: THE EMERGENCE OF HEALTHCARE INFORMATION TECHNOLOGY AND THE ELECTRONIC HEALTH RECORD (EHR)

Over the past several decades, great strides have been made in technological developments in healthcare information technology. These have included improvements in approaches to digitally storing and retrieving textual data (e.g. descriptions of patient illnesses), advances in imaging data (e.g. digital X-rays and imaging systems), as well as advances in database technologies, networking and communication technologies. Foremost among new and emerging information technologies in healthcare is the electronic health record (EHR), which can be considered a "cognitive artifact" (i.e. a tool that enables people to reason and communicate) that will ultimately serve an integrating role for patient records and other emerging healthcare electronic technologies. In this book we refer to the EHR as the repository of information about an individual's health (including relevant medical and health information) that can be stored and retrieved electronically and ideally will exist not only within physician practices and hospitals but ideally will be maintained over an individual's lifetime (Shortliffe & Cimino, 2006). Such systems are designed to be integrated with other forms of computer support for healthcare such as clinical decision support systems, alerting and remindering systems and disease surveillance systems. While this ideal has not been fully achieved yet, a wide range of more limited electronic records have appeared and are deployed increasingly routinely in healthcare – including the EMR (electronic medical record), which is maintained by the health professional to store and retrieve electronic data about an individual or patient, the EPR (electronic patient record) which is maintained by a particular healthcare organization about a patient, and the PHR (personal health record), which is meant to be maintained and accessed directly by patients and laypeople themselves (Nagle, 2007).

Perhaps the greatest potential of modernizing healthcare through use of information technology will come from new functionality and capabilities that will emerge based on the initial conversion of paper-based records and data to electronic forms. For example, decision support systems will be capable of alerting physicians about problems in entering a medication due to a patient's drug allergies (or provide public health warnings about potential epidemics) and will also be capable of integrating data about a patient's genetic makeup to support physician selection of medications (Shortliffe & Cimino, 2006). Such systems are expected to become routinely integrated in future healthcare practice once healthcare data is widely stored and integrated in digital form. Such systems are envisaged to become commonly used to improve healthcare across a range of settings, including hospitals, clinics, health professional offices as well as home care. Other emergent benefits and potential functions resulting from widespread encoding, storage and retrieval of interchangeable healthcare data (both textual and image-based data) will likely emerge in an opportunistic manner and will in turn shape new functionality in repeated cycles of innovation (Patel & Kushniruk, 1998).

Despite these technological advances associated with EHRs and related information technologies (and their potential to shape modern healthcare), the penetration and success of information technologies
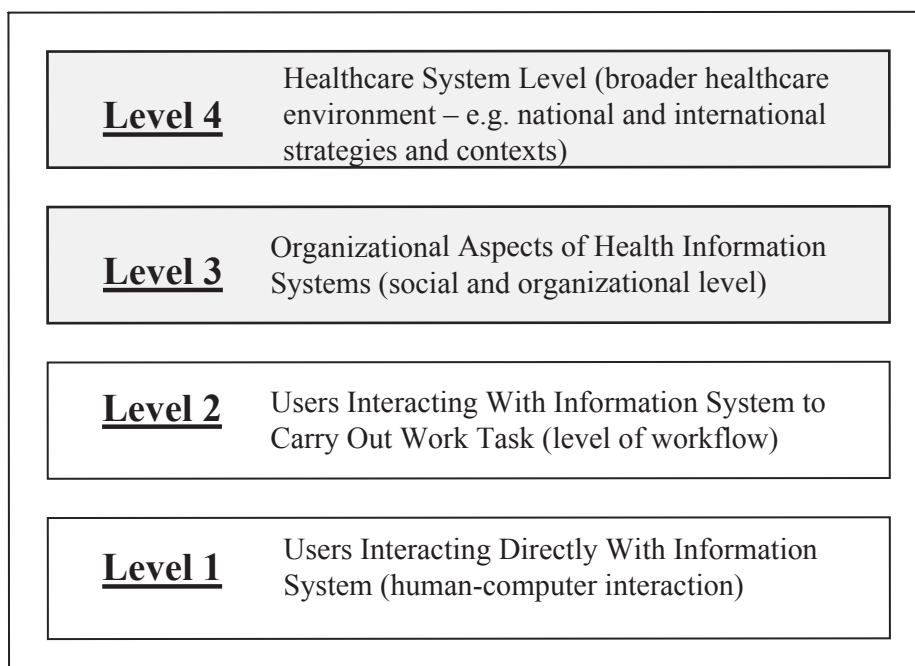
in healthcare to date has be less than expected and efforts at implementing regional, national and international initiatives are currently facing numerous problems. For example, estimates of use of electronic health records within North America have remained relatively low (for example in Canada such system are used by considerably fewer than half of practicing physicians) and in countries reporting highest usage of such technology, a wide range of issues related to adoption and integration of these technologies remain (Protti, 2007). Indeed, the literature contains many examples of healthcare information system implementations that have failed to be implemented, have ended up not improving healthcare and in some cases that were completely abandoned (Chaudhry, Wang, Wu, Maglione, Mojica, Roth, et al., 2006). The issues surrounding problems in successful implementation of healthcare system are many and are complex. While technological developments and advances in healthcare information systems are by no means complete and work along these lines is ongoing, human and social aspects of developing and implementing healthcare information technology are proving to be perhaps the most challenging factors in the successful deployment of healthcare information technology. The objective of this book is to provide the reader with multiple perspectives on major human and social issues and possible solutions that are emerging in an attempt to improve healthcare using information technologies.

HUMAN AND SOCIAL ISSUES IN SUCCESSFUL DEPLOYMENT OF HEALTHCARE INFORMATION TECHNOLOGY

To address the challenges noted above a range of theories and methodologies emerging from a wide variety of disciplines have appeared and are embedded in health informatics. The field of health informatics can be defined as the interdisciplinary study of how information is processed, managed and communicated in healthcare and stands at the intersection among disciplines such as medicine, nursing, computer science, psychology and management (Shortliffe & Cimino, 2006). Health informatics is an evolving field that considers healthcare information technology at multiple levels of abstraction and complexity, ranging from analysis of the impact of healthcare information systems at the individual, organizational and the regional level.

Figure 1 presents a conceptual framework for considering the interaction between humans and healthcare information technologies. Starting at Level 1 the focus is on aspects of the interaction of users (e.g. health professionals, patients and others) directly with information systems. Here cognitive psychology and related disciplines can help improve the design of healthcare systems by providing knowledge about what users can and cannot be expected to do, identifying the nature and causes of problems users encounter in using healthcare information technology, as well as supplying modeling tools and methods to help build more effective healthcare information systems from the perspective of different types of users (e.g. physicians, nurses, healthcare professionals and patients). At this level human issues include the critical need for developing healthcare information systems that are "usable" – i.e. systems that efficient, effective and enjoyable to use from the perspective of the human user of such systems (Sharp, Rogers & Preece, 2007). The healthcare literature contains considerable research that indicates that one of the major problems (that has been implicated for the low adoption rate of many healthcare information technologies) is the lack of usability of healthcare systems (Kushniruk & Patel, 2004). There is no doubt that many of the EHR and related information technologies produced to data have had poor usability and users of such systems have not been able to adequately take advantage of system technical capabilities due to usability issues related problems experienced by users in attempting to interact with such systems.

Figure 1. Layers of human and social aspects of health information systems

Level 4	Healthcare System Level (broader healthcare environment – e.g. national and international strategies and contexts)
Level 3	Organizational Aspects of Health Information Systems (social and organizational level)
Level 2	Users Interacting With Information System to Carry Out Work Task (level of workflow)
Level 1	Users Interacting Directly With Information System (human-computer interaction)

At the second level (Level 2) depicted in Figure 1 we consider issues in using and adopting healthcare information technology in the context of how such systems fit within the actual healthcare work activities and workflow they are designed to support. At this level systems can be considered in the context of how well they support complex human work activities, such as support of patient care by nurses or diagnosis of a patient's illness by a physician. One of the major criticisms of current healthcare information systems is a lack of appropriate integration of such technology within the routine work practices, decision making and reasoning processes of the users they are designed to support (Borycki & Kushniruk, 2005). Further work in understanding the complex interaction among humans, computers and collaborative healthcare work activity are explored at this level.

The third level (Level 3) in Figure 1 represents the organizational and social layer when considering health information technologies and their use by humans. At this level, application of knowledge from areas such as social psychology, organizational psychology and management science, as well as other related disciplines, can be brought to bear on improving healthcare information systems (Ash, Gorman, Lavelle, Lyman & Fournier, 2001; Kaplan, Dowling, Friedman & Peel, 2001). This includes providing improved knowledge about the context of use of such technology in complex social and organizational settings, identifying and explaining how healthcare professionals can work together to best support collaborative practice, as well as providing frameworks for modeling and evaluating the impact of health information technology. Such knowledge can be used to improve the design of healthcare information systems by identifying trouble spots in organizational and social processes, providing models for improved design of social and organizational structures and processes, and for supplying methods to support improved design and evaluation of technologies.

Moving up the next level of abstraction - Level 4, the impact of the broader environment and overall healthcare system (e.g. regional health authorities, national strategies, and international context) is

brought to bear in considering health information technologies. Here strategic decisions that guide the deployment of such technology must take into account a range of social and political aspects of healthcare when for example deciding how to best deploy health information systems at the national level across regions (Protti. 2007). In addition, ethical issues begin to come to the fore when considering the complex interaction among individuals within the healthcare system as a whole, and dissemination of sensitive healthcare data using information technology. Finally, the dissemination of knowledge about health and healthcare practices across national and international boundaries (as well as across society from health professionals to patients to the general lay population) is becoming increasingly important through work in the area of knowledge translation, focusing on translating research knowledge to practical information to inform healthcare practice.

ORGANIZATION OF THE BOOK

The organization of this book reflects the multiple layers and varied interdisciplinary perspectives on human and social aspects of healthcare information systems described above. The perspectives span research that includes the consideration of human interaction with healthcare information systems from the level of individual user to the social, ethical and even the economic impact of health information systems on healthcare.

In Section I of this book we begin by considering issues around human-computer interaction, starting with a focus on the individual user of the system interacting with healthcare information systems (corresponding to Level 1 of the framework described in the previous section, focusing on users' interactions with systems). In Chapter I, Kushniruk, Borycki, Kuwata and Ho describe emerging approaches to evaluating the usability of healthcare information systems. The approaches discussed are aimed at providing feedback and input to designers and implementers to help improve the usability, effectiveness and adoption of health information systems by users, who may range from healthcare professionals to patients and lay people. In Chapter II, Price provides and overview of models of human-computer interaction, that have evolved historically from descriptions of individual user interactions with healthcare systems and analysis of cognitive aspects of computer use, to analysis of how healthcare information systems can be modeled in terms of cognition that is "distributed" amongst multiple healthcare professionals and computer systems.

In Section II of the book the impact of healthcare information systems on clinical work and practice is considered (corresponding to Level 2 of the framework described in the previous section, focusing on use of information technology to support healthcare workflow). In Chapter III Kuziemsky describes how the 'fit' (i.e. degree of match) of health information systems with the needs and information requirements of healthcare professionals can be enhanced through process supports and provides a case study of how this can be achieved. Nohr and Boye (Chapter IV) describe their work in monitoring the implementation process of electronic health records (EHRs) in Denmark and describe the development of a common conceptual model to support clinical processes when implementing healthcare information technologies. This is followed in Chapter V with a discussion by Boye of the vision of pervasive computing in healthcare whereby computer services are made widely available across varied settings and users, providing health information "anywhere and anytime". Issues and considerations associated with this vision are discussed from a human-societal perspective.

Section III of the book focuses on organizational and social aspects of healthcare information technology involving change management, best practices evaluation (corresponding to Level 3 – the organizational level, in the framework described in the previous section). In Chapter VI Day and Norris consider human

aspects of change in healthcare information technology projects. They discuss how change management can be used to intervene and assist in the transition to health information technology. In Chapter VII Kucukyazici, Keshavjee, Bosomworth, Copen and Lai discuss best practices for implementing electronic health records and information systems. They introduce a multi-level, multi-dimensional meta-framework for successful implementations of electronic health records (EHRs) within organizations and discuss implications of the framework for improving the chance of effective implementation. In Chapter VIII Vimarlund introduces a framework to identify the areas within an organization that will be affected by use of health information systems and to provide a structure to evaluate how changes will affect key actors and the organization.

Safety and the reduction of error in healthcare are also becoming major issues as it is now recognized that healthcare information technologies have the potential to decrease human error in healthcare (through advanced features and capabilities such as alerting and remaindering) but may also introduce new errors if not appropriately designed. In Chapter IX Borycki and Kushniruk describe how "technology-induced" errors (i.e. unintended errors that occur as a consequence of introduction of technology) can be reduced through appropriate information gathering, diagnosis and system design processes. Anderson in Chapter X describes how regional patient safety initiatives involving use of information technology can be designed to reduce error and streamline healthcare processes at multiple levels. In Chapter XI Brender provides a description of range of evaluation methods that have appeared to monitor the success and failure of health information systems.

Section IV of the book discusses strategic approaches being implemented at the healthcare system level (corresponding to Level 4 in the framework described in the previous section). In Chapter XII Protti considers national and organizational strategies for implementation of electronic health records (EHRs) in three different countries – Canada, England and Denmark. The importance of this work is considerable given that huge monetary investments are being made by such countries in order to modernize their healthcare systems using information technology. Major roadblocks have been encountered by countries attempting to implement large-scale strategies for this type of change and much can be learned by comparing the journeys taken and lessons learned in different countries around the world. In Chapter XIII Kannry discusses the need to "operationalize" the science of health informatics within healthcare organizations in order to bridge the gap between academic work in the field of health informatics and real-life healthcare implementations. The benefits of this bridging will be considerable both for informing practical implementations with the latest research in order to improve chances of success, as well as to feedback lessons and experience learned from organizational implementations back to field of health informatics. In Chapter XVI Eisenstein discusses the important area of assessing the economic impact of health information systems and describes a framework for conducting economic analyses of health information systems. As Eisenstein argues, this is an area that is not yet well developed in healthcare but that will be essential in order to ensure the systems that are introduced do indeed have positive economic benefits for the healthcare system.

As information technology becomes a more central part of healthcare worldwide a number of complex legal, ethical and professional issues have come to the fore, which is the focus of Section V of the book. These include legal issues around ownership, privacy and confidentiality of electronic health data with the potential for widespread availability of health data using electronic health records. In Chapter XV Ries describes legal aspects in health information and electronic health records and argues that the reduction in patient control over personal information ought to be augmented with stronger security protections to minimize the risks of unauthorized access and fulfill legal obligations. Sarryeddine in Chapter XVI considers the potential for ethical benefits of health information systems in asking the questions "can health information systems make organizations more accountable, beneficent and more

responsive to a patient's right to self determination?" Kluge extends this discussion in Chapter XVII by exploring why ethics matters in development of electronic health records and explores ethical implications of widespread use of health information systems.

In order to deploy information systems in healthcare that will provide users with information at the right time and place, the appropriate "translation" of knowledge via electronic media will become essential, which is the focus of Part 6. In Chapter XVIII Ho describes the rapidly emerging field of knowledge translation in healthcare. Given the rapid growth of health evidence and knowledge through research, health information technology will be key in integrating this knowledge and bringing it bear on health related decision making. Along these lines in Chapter XIX Doran and Di Pietro describe use of mobile computing technologies to improve knowledge translation in nursing practice through providing nurses decision support at the point-of-care. Finally, in Chapter XX Arocha and Hoffman-Goetz discuss improvement of Internet-based health knowledge through attention to literacy. This is an important area for improving the dissemination and uptake of useful healthcare information and evidence not only by health care professionals but also by patients and other consumers of health information.

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