Foreword

With this edited volume, IGI Global continues its tradition of publishing high quality titles that address the range of current issues in information technology utilization and management that arise in today's knowledge society. This book, edited by researchers with well-established credentials in ubiquitous systems, computer science, and medical informatics, includes contributions from a number of scholars on a wide range of topics that are relevant to the complex considerations of ubiquitous eHealth/ medical informatics. These topics touch on many issues of burning interest to the healthcare community, as the search continues for innovative ways in which healthcare quality can be improved, while at the same time realizing benefits to healthcare provider productivity and effectiveness.

It is difficult to over-emphasize the complexities involved in providing healthcare. Many of the issues to be addressed are non-technical and they interact in many ways with technical solutions, requiring careful consideration of these interactions. The reader will find in this book a good indication of the strong multidisciplinary links that result among computer and communications engineering, computer science, the health disciplines, business, and social sciences that support eHealth. When it comes to developing innovative and lasting contributions to this field, it is essential to take into account the broad scope of the underpinnings of this research.

There is a large disparity among nations in the ubiquity, depth, and expenditures, and the technology supporting healthcare, ranging from the most advanced, in Europe, to nations that still are building an appropriate infrastructure (U.S. and Canada), to developing nations such as China and India that have islands of expertise, but are far from offering ubiquitous health to their populations, to the many less developed nations. Each nation faces questions of cost, infrastructure, privacy, network infrastructure, adoption by the healthcare community, and embedded cultural beliefs in the appropriate levels of healthcare to be offered. Developing nations in particular are moving ahead rapidly with communications systems that use wireless systems to leapfrog over the fixed landline systems typical of Western nations.

We are becoming accustomed to the rapid developments in Web 2.0, the second generation of Web development and design. This has grown out of cumulative changes in how developers and end-user utilize the Web to facilitate information sharing and collaboration. Web 2.0 includes the development and evolution of Web-based communities, hosted services, and Web applications such as social networking, video-sharing, wikis (websites using wiki software for the creation and editing of interlinked Web pages using a simplified markup language to create collaborative websites, community websites, and note taking); blogs (weblogs -a type of website, containing regular commentaries, event descriptions, or other material, often allowing comments by readers); mashups (Web pages or applications that combine data or functionality from two or more external sources to create a new service, using open APIs and data sources); and folksonomies (non-hierarchical classifications generated by user-based tagging). Investments in Web 2.0 eHealth applications are becoming increasingly significant, in a way that is distinguished from previous eHealth trends. This technology has a value in its access by non-traditional participants,

novel forms of social interaction, and cost-effective improvements to existing methods through social networking, community synthesis, and collaborative content generation.

Ubiquity is the property of being everywhere at once. As you will see in Chapter 1, the first generation of ubiquity, dubbed Ubiquity 1.0, is supported by the widespread adoption of XML in both syntactic and semantic communication layers, thus enhancing interoperability among heterogeneous systems. Heterogeneous systems are a characteristic of the role that eHealth plays in the healthcare system, so interoperability is essential for eHealth ubiquity. Ubiquity 2.0 derives from Web 2.0 tools and all the innovations it has generated, to enable better support that can empower both providers and consumers of healthcare. However, the specialized and innovative applications that are supported by these tools require a substantial rethinking of how they can be implemented ubiquitously. Hence the reason for this volume, which explores many of the relevant research and management issues, and demonstrates some relevant applications. The following touches briefly on the flavor of many of the works that are presented.

Interoperability is one of the most important aspects of ubiquitous solutions, since healthcare is characterized by multiple heterogeneous systems that may not support access to all the relevant information about a patient in one view within the network. Lack of interoperability in turn causes issues with continuity of care, safety, and the assessment of program delivery. An appropriate interoperability framework will lead to an improvement in understanding of the need to move towards a high performing healthcare system that can make use of some of the Web 2.0 methodologies and tools. The semantic Web, related common languages, and semantic Web services architectures that are upgrades to existing physical architectures can help provide eHealth content and services to users. Semantic interoperability that allows clinical data sharing to multiple users, with the potential for improved patient safety, better healthcare, improved outcomes, and higher quality of life may result. Before this can be achieved, there are many issues relating to terminologies that define, describe, and document healthcare. One way these can be addressed is through terminology sets with a global master meta-dictionary of data elements that have precise definitions to remove ambiguity in use.

To move towards a secure and trusted network that manages patient health record identity and ensures patient privacy is a major challenge. Ensuring patient privacy has been found to be one of the most critical factors of system success. Thus, care for the security of the health record system must always be considered, including both basic and enhanced security methods that balance privacy needs with the need for access to the system by the patient's circle of care. One way of providing the needed privacy is through a multi-agent brokering architecture that supports different degrees of privacy. Implementing new functionalities that are accessible anywhere may be supported through different types and classes of agents through a flexible distributed architecture. Experimental agent-based applications have been designed and tested to help medical practitioners deliver home care services securely and efficiently.

To ensure an affordable healthcare system, it is necessary to move towards ubiquitous patient-centered and self-managed care. This provides patient empowerment through private personal health records (PHRs) with access that is under the control of patients themselves. Development and adoption of PHRs can be accelerated by the development of open source software that uses a standardized format and controlled vocabulary. The resulting benefits for patients include improved access to information, communication with providers, medication tracking, prescription renewals, and so on. Organizational benefits include improved patient satisfaction, continuity of care, improved standardization of care, and improved costing models. However, there are many challenges before such advantages can be realized, including privacy issues, change management issues among providers and patients, and the lack of suitable support infrastructures.

Advances in interoperable systems that support access to relevant patient health records from all available sources also create opportunities for ubiquitous knowledge discovery that monitors, analyzes,

and manages the health of individual patients, and potentially to enhance public health management in the face of epidemiological threats. Such knowledge discovery requires a well-crafted architecture for the patient's circle of trust that shares data while protecting identity and personal information. Knowledge discovery and management has also been used in supporting dynamic learning capabilities in telemedicine. Lifelong learning in the healthcare sector requires specialized knowledge that must be renewed frequently. The dissemination of updated medication information can be supported by keyword search, ontology-based search, and by automatic integration of instructions into regular daily tasks. An integrated system is preferable since updates are just-in-time and tailored to the specific needs of users.

Human resources management (HRM) organizations are typically responsible for employee training. As innovation continues at a rapid pace, training medical personnel can directly support the provision of superior care. Technology can maximize communication, collaboration, and support among professionals separated by distance and at the same time be used for distance training and continuing education for geographically isolated individuals. Healthcare specialists working in remote areas face many challenges that can be addressed by Computer Supported Collaborative Work (CSCW) wireless technologies that are adapted to suit medical applications. Mobile technologies can be used to develop virtual communities to help patients to self-manage chronic diseases, typically enhancing healthcare delivery at a reduced cost. Common procedures and software tools can benefit from Web 2.0, with ubiquitous remote data access for point of care decision making supported by integrating Web services, mobile devices, and multi-stream communications. Web 2.0 social networks provide a wide range of possibilities in eHealth, offering many research opportunities. These include the formulation of healthcare questions by users that can be automatically classified semantically through medical ontologies, for answers by expert physicians.

Computer architectures can support many innovations in treatment. For example, psychological disorders can be addressed through virtual online worlds that link the virtual and the real world, taking care at the same time to protect against the risks of privacy and personal safety. Care process management can describe the way information and communication can support active patient management principles, with positive effects on cost efficiency and quality of care, applied for example to an environment to support treatment of patients with depression. Clinical simulation is a tool that can be used to assess issues of information, workflow, and cognitive needs arising from proposed ubiquitous computing devices and to evaluate their impact on supporting systems and the work of health professionals.

One class of diagnostic tools involves the generation of digital images. The current trend is towards tools that generate far more high quality images (e.g. Magnetic Resonance Imaging or MRI machines) than were thought possible just a few years ago. The flood of such images has created an overwhelming load on radiologists who must read and interpret these images. The trend is towards regionalized image repositories that can be accessed, queried, and/or matched by physicians or radiologists for first or second opinions through remote high speed links, and the use of computerized detection and diagnosis of lesions (e.g. mammography), involving applications of machine learning, computer vision, and clinical decision support. Digital pathology is closely related to these technologies, through the use of virtual microscopy and digital slides. Grid computing is one solution for the massive computing power needed to support the collaborative computing environment resulting from the growing overlay of Web 2.0 technologies on healthcare architectures. At the same time, high data quality and security, computing resource availability and reliability in an open source format can be best provided by Service Oriented Architectures (SOA).

Healthcare reforms are urgently needed to address the rising costs of providing quality healthcare to aging populations. These reforms must consider how to overcome barriers linked to historical processes that have not used interoperable and collaborative information technology solutions effectively. Ubiquitous eHealth, with its Web 2.0 innovations, has great promise in catalyzing significant improvements that will help overcome the deficits in healthcare delivery.

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