HANDBOOK OF RESEARCH ON

ICTs and Management Systems for Improving Efficiency in Healthcare and Social Care

Maria Manuela Cruz-Cunha, Isabel Maria Miranda & Patrícia Gonçalves

Volume I

Handbook of Research on ICTs and Management Systems for Improving Efficiency in Healthcare and Social Care

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Preface

ABOUT THE SUBJECT

It is our belief that the pursuit to improve efficiency in healthcare and social care has become the main goal of policy makers within most health systems. Nowadays, there is a vast range of possible applications of Information and Communication Technologies (ICT) in the health sector. The technology of management systems has progressed considerably and ICT implementation can result in care that is both higher in quality, safer, and more responsive to patients' needs, and, at the same time, more efficient. Some specialists defend the potential reduction in medication errors as one of the critical advantages. In spite of the promise, implementing management systems in clinical care has proven to be a difficult undertaking. This is accompanied by a failure to achieve a widespread understanding of the benefits of electronic record keeping and information exchange.

The OECD has used lessons from case studies in six OECD countries (Australia, Canada, The Netherlands, Spain, Sweden, and the United States) to identify the opportunities offered by ICTs and to analyze under what conditions these technologies are most likely to result in increased efficiency and quality of health care improvements. The findings illustrate the potential benefits that can result from ICT implementation according to four broad, inter-related categories of objectives:

- Increasing quality of care and efficiency
- Reducing operating costs of clinical services
- Reducing administrative costs
- Enabling entirely new modes of care

Management systems may contribute to the increasing quality of care and efficiency by the efficient sharing of health information that is of extreme importance for the effective delivery of care. The centrality of information in health systems and the multiplicity of uses to which it can be put, means that management systems that ensure the timely and accurate collection and exchange of health data are likely to foster better care co-ordination, and the more efficient use of resources. Management systems can also make important fundamental contributions toward improving aspects of patient safety. Critical elements for providing safe care to patients include ready availability of individual patient medical information, online access to clinical guidelines or drug databases, monitoring the effects of disease and therapies on the patient over time, and detecting and preventing medication errors that could harm the patients.

Management systems can contribute the reduction of operating costs as well as administrative costs of clinical services through the improvement in the way tasks are performed by saving time with data processing and by reducing multiple handling of documents. The experience in other sectors indicates that these functional improvements can have a positive effect on staff productivity. The evidence in the health sector is, however, usually mixed depending on the context and the technology that is used.

ICTs and management systems can also generate value by enabling innovation and a wide range of changes in the process of care delivery, which may improve cost. ICTs have been defined as technologies with a transformative potential, since they can open up the possibility of entirely new ways of delivering healthcare and as well as social care.

ORGANIZATION OF THE HANDBOOK

This handbook aims to stimulate the discussion and research on Management Systems for Improving Efficiency in Healthcare and Social Care. An overwhelming response to the call for papers illustrates the level of interest in this particular topic. Sixty-four papers from savvy researchers worldwide were chosen for publication in this handbook representing an impressive sample of the ongoing activity in the domain.

The organization of this handbook is distributed into two different sections: Section 1 – Developments and Applications in Healthcare/E-Health and Section 2 – Studies on Adoption, Critical Success Factors, and Case Studies.

In Section 1, there are fifty-four chapters that address relevant research that has been accomplished concerning the Developments about Applications in Healthcare/E-Health. It reflects many authors' views on how applications in healthcare/e-health have come to a rise and have helped in the development of many health services worldwide.

In chapter one, Joseph Wood and his co-authors, discuss how Information and Communication Technology (ICT) have become distinguished from Information Technology in the sense that ICT extends specifically beyond technology to its use with critical organizational skills, the skills across a market segment, or across a system of organizations. In their chapter they begin to apply social interdependence theory to their interest in the technologies and techniques that increase both knowledge and social welfare (e.g., ICT), in particular the application of metrics to organizational performance. They address ICT in their research as it is applied to Telemedicine, eHealth, and e-Institutional Review Boards (eIRBs) for healthcare in Georgia.

The second chapter, by Fjorentina Angjellari-Dajci, William Lawless, Max Stachura, Elena Wood, and Caroline DiBattisto explains why comparative full economic evaluations are needed to evaluate whether telehealth-based systems can bring societal cost savings over the long run and economic benefits that exceed economic costs. Economic evaluations of telehealth-based interventions across different health care fields have focused primarily on cost analysis, rather than on full economic analysis, which captures both the economic costs and economic benefits of two or more competing interventions. The authors provide a framework for a Benefit-Cost Analysis that would render this more applied method. The authors are interested in the comparative economic evaluation of two categories of Autism Spectrum Disorders intervention programs: telehealth-based and in-person.

In chapter three, Mark Griffiths and his co-authors briefly examine videogames in therapeutic capacity areas including: (1) videogames as physiotherapy and occupational therapy, (2) videogames as distractors in the role of pain management, (3) videogames and cognitive rehabilitation, (4) videogames

and the development of social and communication skills among the learning disabled, (5) videogames and impulsivity/attention deficit disorders, (6) videogames and therapeutic benefits in the elderly, (7) videogames in psychotherapeutic settings, (8) videogames and health care, and (9) videogames and anxiety disorders.

In chapter four, Patrice Braun reports on the evaluation of Clever Health, an Australian e-health project. The evaluation took place from mid 2007 through 2010 and consisted of both qualitative and quantitative approaches to capture awareness, expectations, and use of Clever Health components—which included video-conferencing for patient care, professional development, and peer support—and compared initial perceptions and expectations to perceived changes in awareness and uptake of Clever Health components.

Jose Andonegui and his co-authors discuss, in chapter five, the application of e-Ophthalmology-based models in the diagnosis and follow-up of chronic glaucoma. The authors describe the current status of the use of e-Ophthalmology-based models in the screening and follow-up of chronic glaucoma, the main advantages of these models, the technologic requirements for their implementation, and future trends in this field.

Chapter six, written by António Teixeira and fellow researchers from the University of Aveiro, Portugal, presents and contextualizes work in progress in a new telerehabilitation service targeting the combined needs of the elderly to have professionally monitored exercises without leaving their homes with their need regarding interaction, directly related to age-related effects on, for example, vision, hearing and cognitive capabilities. After a brief general overview of the service, additional information on its two supporting applications are presented, including information on user interfaces. First results, from a preliminary evaluation, are also included.

In chapter seven, Tiago Oliveira, Mónica Oliveira, and Teresa Peña start by reviewing the literature on the costs and benefits of outpatient ePrescribing systems and find that the evidence is scattered. The review also shows that the evaluation of ePrescribing systems is complex and that most studies share limitations associated with the evaluation of other health information technologies and systems. They propose an evidence-based framework to inform post-implementation evaluations of outpatient ePrescribing systems to improve the quality and comparability of studies in the area.

In chapter eight, Milica Milutinovic and her co-authors describe the software architecture of a commercially run home assistance system that allows patients or elderly people to stay at home longer. Since such systems often have to handle sensitive medical information, the protection of the privacy is a major concern. In addition, legislation often restricts access to health information to qualified persons (i.e. medical personnel), who are not always available in a commercial setting. The home assistance system can offer several services, going from scheduling necessary tasks and following up their execution, to monitoring the patient's health status and responding promptly to requests for help or in case of emergency situations, and all this without the need to maintain personal medical data or identifying information about patients and caregivers in the home assistance centre.

In chapter nine, optical fiber technology is presented, referring the different types of optical fibers, its main characteristics, and advantages over other sensing methodologies. Optical fiber-based sensors and sensing techniques are also be discussed. Nélia Alberto and her co-authors show and report several works from the literature and their valuable techniques to improve healthcare service to the community and as a potential solution to answer different problems. The final section of the chapter consists in the description of three applications of optical sensors in healthcare, namely the monitoring of human joint movement, measuring the strain of biological tissues, and the characterization of medical materials.

In chapter ten, Maria José Lucena e Vale and Filipa Vale introduce "Geographic Information Management Approaches: Improvements in Health and Social Care." There are several health-related databases, covering different scales: World, Europe, or National; and including several datasets with different detail. In order to understand the relevance of these database infrastructures when integrated with Web-based, geographical information management tools and their utility when improving the knowledge of health issues, this chapter integrates examples related to enhancing the performance analysis of this collaborative spatial data infrastructure in three distinct areas: national health systems and health care, disease prevalence studies in different countries, and integrated analysis of environment quality and public health.

Chapter eleven, by Sílvia Frumento, Roberto Razzoli, and Francesco Cepolina, brings in surgical robotics, with focus on technology and design issues of the remote-mode operation assistants. The investigation leads to define the technical characteristics of a CRHA, co-robotic handling appliance, to be purposely developed, to support the duty-split approach surgical planner. The expected features are outlined, including analysis of operation potential of special-purpose contrivances (i.e., automatic changing device of the surgical tools) and of scope-driven enhancers (i.e., exploration of the intervention theatre, IT).

Martha Sabelli and her co-authors, within the framework of the implementation of the Integrated National Healthcare System (SNIS) along with national policies of information and communication at the República Oriental del Uruguay, conducted a study, focusing on adolescents and young people in vulnerable contexts in the city of Montevideo, taking them as both real and potential users of healthcare information. Chapter twelve is also centered in the description of mediators in the flow of communication and information, especially among healthcare staff. From a multi-interdisciplinary approach, this investigation aims at identifying the behaviors and needs of the target population in relation to the information and ICTs, the availability and access to personal technological resources, its context of use (the community, their everyday lives, the institutions), the process of interaction among the different social actors in the sector as well as in the communication flow within the organizational culture of these services. On this basis, it provides models to design electronic information resources according to the social needs, and which may contribute to the inclusion of all citizens in the so-called Information Society.

In chapter thirteen, by Guido van Os, Vincent Homberg, and Victor Bekkers, the authors start by viewing ICT-enabled integration as a technological and managerial "practice" and analyzing ICT coordination in various institutional regimes (in a decentralized regime like Denmark, a decentralized unity state like The Netherlands, and in a federal state like Austria). By comparative case study, they investigate whether ICT coordination adapts to the institutional context in which it is shaped (contingency-approach), or whether in various institutional contexts coordination practices more or less resemble each other (convergence-approach). Two methods were used to gather data. First, for each country policy documents and strategy papers were analyzed by using a structured code list. Second, in each country five key respondents at ministerial level and five respondents at local/regional level were interviewed. The authors reflect on the findings by discussing the role of ICTs in providing coordinated and integrated services in various welfare state regimes.

In chapter fourteen, George Jamil and his co-authors defend that marketing data and information must be provided from a variety of sources to produce knowledge, in a process that can be characterized as "organizational intelligence." Collected contents from healthcare associated industrial sectors, such as chemical and pharmaceutical, have the potential to produce integrated value chain knowledge, improving analysis and decision processes. Approaching the healthcare market, a framework for an intelligence system for marketing decisions is discussed. Initially reviewing the literature, a conceptual base is formed

which delimits the evaluation of the intended framework. As an exam of the practical marketing intelligence system application, case studies of real decisions observed in the Brazilian market are done at the end of the chapter, to evaluate how intelligence and knowledge, as conceptualized in the literature review, serve in typical healthcare marketing competition, as managerial support for problem solutions.

The Web 2.0 Applications has gained much power and usability in the last years. We can observe a particular case in medicine Websites like forums, wikis and others. In the most cases these sites provide general information and they not allow making contact with the physicians. On the other side, the CDSS (Clinical Decision Support Systems) are very useful applications and many of them are ontology-based. In chapter fifteen, Gandhi Hernandez and his co-authors propose a Social Web application which allows the patients make contact with their physicians and send them thought a CDSS a list of signs. This application combines social Web, CDSS, and Web services.

During the last decade, modern hospitals have witnessed a growth in the amount of information acquired, stored, and retrieved more than ever before. While aimed at helping healthcare personnel in providing care to patients, this high stream of data can also have a negative impact if not delivered in a simple and organized way. In chapter sixteen, Andre Fialho and his co-authors explore the current opportunities and challenges that soft computing predictive tools face in healthcare delivery, and then present an example of how some of these tools may contribute to the decision-making of health care providers for an important critical condition in Intensive Care Units (ICU) – septic shock. Despite current challenges, such as the availability of clean clinical data, accuracy, or interpretability, these systems will likely act to enhance the performance of a human expert and permit healthcare resources to be used more efficiently while maintaining or improving the outcomes.

In chapter seventeen, Ricardo Santos and Jorge Bernardino present a solution for continuous motorization and prediction of HT episodes, using Heart Rate (HR) and mean Blood Pressure (BP) biosignals. They propose an architecture for a HT Predictor (HTP) Tool, presenting a set of applications and a real-time database capable of continuously storing and real-time monitoring all patients' historical HR and BP data. The tool is able to efficiently alert both probable and detected occurrences of HT episodes for each patient for the following sixty minutes. Additionally, the system promotes medical staff mobility, by taking advantage of mobile personal devices such as mobile phones and PDAs, optimizing human resources. Finally, an experimental evaluation on real-life data from the well-known Physionet database shows the efficiency of the tool, outperforming the winning proposal of the Physionet 2009 Challenge.

Chapter eighteen discusses the development and implementation methodology of a real-time biomedical telemetry system for ambulances. Comparable systems, together with their authors' claimed improvements, are evaluated and analyzed in this chapter. Novas Castellano, Ja Gázquez Parra, and Marina Noguerol Gutierrez start by providing an overview of the most relevant systems, and then introduce the reader to the methodology used to develop and implement a real-time communications system that allows low-cost data transmission from a medical monitor and haematology analyser installed in an ambulance. This system was evaluated in terms of how well it can provide health assistance within a 50 km radius of the Torrecardenas Hospital (part of the public health-care system in southern Spain). Results have been technically and medically validated, and encourage further implementation of this technology, since it was proved to be reliable, while the transmitted data allow a correct and thorough patient evaluation throughout the patient's transportation to the hospital.

Chapter nineteen outlines the advantages and disadvantages of one type of SST, namely self-service hospital kiosks, and presents results of an empirical study carried out into the willingness of patients to use them. Data was collected from 192 patients attending two private healthcare clinics in Johannesburg,

South Africa. Results show that patients are most willing to use kiosk technologies for administrative rather than diagnostic or treatment-related services. Moreover, Jason Cohen and his co-authors find that technology anxiety, self-efficacy beliefs, trust, and need for interaction are important antecedents to the formulation of performance and effort expectancies and the willingness of patients to use kiosk technology. Results have implications for healthcare providers looking to improve the success of their SST applications.

The purpose of chapter twenty, written by Helena Blazun and her fellow co-authors, is to present up-to-date knowledge on elderly people's use of Information Communication Technology (ICT), online social networks, and eventual positive effects of advanced technology on the quality of life of elderly people. The chapter is based on two previous literature reviews and a new integrated literature review focusing on three main criteria: Use of ICT, attitudes of elderly people toward ICT, and benefits of and barriers to the use of ICT. A comparison of the literature reviews will show the level of currently known facts about computer use among the elderly and present the necessary steps for future research on how to increase the computer engagement of elderly people toward a better quality of life.

In the recent years, a great advance in technology for wireless communication may be seen. There is a great availability of devices using Bluetooth and Wi-Fi that allows other devices to exchange information and actions. Consequently, the paradigm of pervasive computing is increasingly present in several areas assisting to conduct various types of activities. Healthcare is one of the important sectors that are benefiting from this paradigm. In chapter twenty-one, Álvaro Sobrinho and his co-authors conduct a study about the use of the pervasive computing paradigm for health care through the development of a multiplatform tool for mobile devices is presented.

The primary objective of chapter twenty-two is to introduce a socio-technical approach called the Activity-Driven (AD) approach to Information Systems Development (ISD) in healthcare and social services. The approach is based on the application of Activity Theory in ISD and on participatory and cooperative design principles. It has been studied and developed for over a decade in cooperation between IS researchers and healthcare professionals within around twenty practice-oriented research cases, hosted by the participating health facilities. Irmeli Luukkonena and her co-authors define the AD approach and describe the characteristics of the AD approach and the continuum of the interrelated research projects since 1998. They also provide a glance at the business utilisation of the approach and discuss the tentative educational experiences of the approach. The aim is to contribute to the knowledge of socio-technical ISD by providing a versatile description of the AD approach, the characteristics, and the long-term cooperative multidisciplinary research efforts, and show the interplay between the AD approach that was developed and the conditions under which it was elaborated.

Gustavo Salcido and Eduardo Delgado present in chapter twenty-three a didactic tool that enables general practitioners to identify medical disorders in the area of rheumatology. Didactic software is based on the application of an intelligent agent based on goals that contains enough information to identify seven of the most common inflammatory rheumatic diseases and fourteen non-inflammatory. The purpose of this tool is that a general practitioner can get an early diagnosis in a rheumatic patient and subsequently send that patient to rheumatologist in order to prevent damage. The presented prototype can be useful for professors and students of the computation area to solve similar problems.

Chapter twenty-four describes the evolution of Nursing Information Systems (NIS). Fernando Petronilho and his co-authors reflect upon the impact of reformulation and implementation of the NIS in Portugal in the development of the nursing practice and reflect upon the impact of the NIS reformulation in the quality of care as well as in Education and Training in the nursing area.

In chapter twenty-five, "Using Global Shape Descriptors for Content Medical-Based Image Retrieval," Saïd Mahmoudi and Mohammed Benjelloun, propose a new method belonging to content medical based image retrieval approaches that use a set of region-based shape descriptors. The search engine discussed in this work allows the classification of new acquired medical images into some well-known categories and also to get the images that are more similar to a query image. The final goal is to help the medical staff to annotate these images. To achieve this task the authors propose a set of three descriptors that are based on: (1) Hu, (2) Zernike moments, and (3) Fourier transform-based signature, which are considered region descriptors. The advantage of using this kind of global descriptor is that they are very fast, real time, and they do not need any segmentation step. The search engines were tested by using a database composed of 75 images which have different sizes, and that are classified into five classes. The results provided by the proposed retrieval approaches are given with high precision. The comparison between the three approaches was achieved using classification matrices and the recall/precision curves. The three proposed retrieval approaches produce accurate results in real time. This proves the advantage of using global shape features as preliminary classification step in an automated aided diagnosis system.

The current growth of mobile data usage and emergence of new applications have greatly motivated the Third Generation Partnership Project (3GPP) to work on Long Term Evolution (LTE). LTE is the most recent standard in the mobile network technology to be developed based on GSM/EDGE and UMTS/HSPA network technologies with the aim of optimizing the capacity and speed of 3G mobile communication networks. In chapter twenty-six, Aini Zain and fellow researchers investigate the structures and features of fourth generation (4G) LTE at the early stages of telemedical research. The chapter also provides a comparison of WiMAX and LTE standards on various aspects, as well as the potential of technology in healthcare applications. Issues and challenges of wireless technologies in healthcare applications and services are finally presented.

Surgical units of hospitals are generally the most costly and least utilized units of hospitals. In order to provide higher utilization rates of surgical units, scheduling of operating rooms should be done effectively. Inefficient or inaccurate scheduling of operating room time often results in delays of surgery or cancellations of procedures, which are costly to the patient and the hospital. Therefore, operating room scheduling and management problem has been an important area of research both for operations researchers and artificial intelligence researchers since 1960s. In chapter twenty-seven, the operations research and artificial intelligence solutions developed for operating room scheduling problem in the operational level are examined and discussed. The studies are classified according to the approaches employed. By this way, it is aimed to be helpful for researchers who are willing to make contributions in this area as well as the practitioners who are looking for efficient and effective ways to handle the operating room management problem of their own.

Chapter twenty-eight by Jean-Luc Hainaut, Anne-France Brogneaux, and Anthony Cleve studies the requirements for a wide range of healthcare information systems, including but not limited to clinical pathways management, patient record management, home care management, and medical personnel and resource management. The analysis concentrates on the description and management of medical activities, leaving aside the standard management processes common to all enterprises. It develops a generic architecture for these information systems comprising four central sub models devoted to the description, respectively, of organizational structures, care processes, information, and resources. Each sub model is analyzed independently of the others then integrated into a consistent global model. Extensions of this model to other facets of healthcare information system are discussed and some practical applications are suggested.

Chapter twenty-nine, by Iulian Furdu and Bogdan Pătruţ describes and discusses the applications and solutions under development or implemented in the e-Health care systems, in terms of their technological, social, and organizational dimensions. A survey of the present status in relation with e-Government covers the leading countries (and not only) in ICT-based developments in these sectors. The authors present the most important solutions regarding the actual implementation and administration of a wide range of applications. Certain issues concerning EHR (Electronic Healthcare Record Systems), pharmacy and electronic prescription systems, patient administration and financial systems, intensive care unit systems, laboratory information systems, homecare and telecare applications, radiology information systems, and bioinformatics are outlined.

Chapter thirty, by César Benavente-Peces and co-authors Ander Garcia-Gangoiti, José Manuel Pardo-Martín, Francisco Javier Ortega-González, and Javier Franco-Arroyo is aimed at the analysis and description of various wireless technologies and methods for indoor location of mobile/portable devices in order to provide support services to elderly and handicapped people as well as to care and medical services. Indoor location is an open problem that has been analyzed in the last years in order to provide location-based positioning services which can improve the quality of life of end users. GPS location is not possible in these environments due to the lack of satellite coverage. Satellites' signals are absorbed by building elements and cannot reach GPS receivers. As consequence, no location is obtained. We must take into account that many elderly and handicapped people are most of the time in an indoor location. Thus, new technologies and techniques have to be investigated in order to provide additional location services in indoor environment that complement those provided in outdoor situations by the GPS system.

Chapter thirty-one, "Image Based Classification Platform: Application to Breast Cancer Diagnosis," by Paulo Gonçalves and his co-researchers, proposes an Image-Based Classification Platform suitable to help Medical Doctors diagnosing breast cancer, based in mammograms, i.e., to detect if a tumor is present in the image. The Platform is twofold, i.e., in the first part the image descriptors are extracted from the image using image-processing algorithms. The obtained descriptors are used in the second part. The second part is related to classification, where computational intelligence methods are used to classify a given image, based on the descriptors obtained in the first phase. Texture analysis based on co-occurrence matrices were applied to obtain the descriptors from the MIAS database of mammograms. From these descriptors, fuzzy models, neural networks, and support vector machines were successfully used to classify the mammograms and obtain a diagnosis.

Cloud computing is one of the emerging technologies that has an increasing impact on both private and public sectors. It represents an on-demand service model for delivering computing resources ranging from storage and data access, via computation to software provisioning. Chapter thirty-two, by Mina Deng, Mialn Petkovic, Marco Nalin, and Ilanria Baroni describes an application of Cloud Computing in home healthcare by introducing several use cases and application architecture based on the cloud. A comprehensive methodology is used to integrate security and privacy engineering process into the development lifecycle and to identify challenges for building security and privacy in the proposed cloud-based home healthcare system. Moreover, a functional infrastructure plan is provided to demonstrate the integration between the proposed application architecture with the cloud infrastructure. Finally, this chapter discusses several mitigation techniques putting the focus on patient-centric control and policy enforcement via cryptographic technologies, and consequently on digital rights management and attribute-based encryption technologies.

Chapter thirty-three, by Leonor Teixeira, Vasco Saavedra, Carlos Ferreira, and Beatriz Sousa Santos outlines a study that examines the role of Information and Communication Technologies (ICTs) in the management of a rare and chronic disease, hemophilia. Evidences in literature show how the adoption of ICTs can improve the management of chronic conditions. Furthermore, the authors believe that these tools may also give response to rare diseases needs, while greatly improving the quality of life of those patients. A Web-based application that was developed to facilitate the communication between Healthcare Professionals (HCPs) and patients in a specific Hemophilia Treatment Center (HTC) to improve the utility and quality of clinical data and treatment information, as well as to help the management of resources involved in a specific rare chronic disease, represents a practical case presented in this chapter. This technological solution allows the management of inherited bleeding disorders, integrating, diffusing, and archiving large sets of data relating to the clinical practice of hemophilia care, more specifically the clinical practice at the Hematology Service of Coimbra Hospital Center.

Information and communication technologies are radically changing the way that healthcare is delivered with the development of e-Health among the most remarkable changes. It plays an increasingly important role in delivering healthcare. Information and communication technology has the potential to effectively support the complexities involved in the communication that takes place both amongst healthcare professionals and their patients in the developed and developing countries. The aim of chapter thirty-four is to analyze the recent situation in healthcare management and information communication technology applications in the health industry. This chapter, by Asli Suder and Murat Durucu, examines the challenges involved in human interaction and a clinical information system; it allows for richer communication between the patient and those involved in their health.

Chapter thirty-five, by Maria Teresa Borges Tiago and Flavio Tiago acts as both a review and an empirical framework analysis piece. It argues that technological acceptance and adoption by healthcare firms still suffers from oversimplification of its development and specially it measurement processes. There is a common thought both in business and academia that the technology adoption process is a key component of success and allows firms to achieve and sustain competitive advantages. In a digital era, these advantages arise from the potential of information and communication technology to improve firms' daily activities. This research tries to reinforce the assessment of ICT impacts on healthcare firm performance, presenting a set of induced and intangible benefits besides the traditional financial benefits, as well as measuring IS integration impact. To do so, a structural equation model was applied to a large database sample covering firms from seventeen European countries. The results reinforce the importance of induce and structural benefits in firms overall performance.

Chapter thirty-six, by Guillermo Lopez Cala, Yolanda de la Fuente Robles, and Rosa Fernandez Alcala, deals with accessibility, a specially relevant and important concept for every citizen in the improvement of their quality of life in any environment or daily situation. Specifically, an empirical study about accessibility in the public health centers of a Basic Health Area (BHA) of Jaén is carried out. From this study, accessibility deficiencies in health buildings are revealed and explicit proposals are provided with the aim of improving accessibility in different scopes such as information and communications. Our improvement plans based on the use of Technology, Information, and Communication (TIC) tools help sensory disabled users that attend to the Health Center.

The use of Information and Communication Technologies (ICT) to support and facilitate interactions on the Web has increased in the amount of users, communities, and organizations. Computer-Mediated Communications (CMC) is among the most frequently studied and used ICT. Online communities—where individuals with similar interests and/or experiences come together to interact—can benefit from CMC as

a tool for seeking, gaining, and sharing knowledge and experiences. It is these communities—groups of individuals with similar interests and experiences who are connected through the use of ICTs and whose conversations are facilitated through CMC use—that makes these ICTs a valuable tool for social support. In chapter thirty-seven, Bolanle Olaniran and Natasha Rodriguez explore the use of ICTs; specifically, the role of CMC as a support medium for victims/survivors of Domestic Violence (DV). DV is a topic germane to healthcare and the overall general well-being of females, their families, and societies at large.

Geographical Information Systems (GIS) are a relatively new tool in health care services and organizations. However, health-care professionals who know how to utilize GIS and other spatial tools get a powerful decision support tool. Chapter thirty-eight, by Eilon Blanc and Iris Reychav, presents an overview of the GIS and spatial simulation in the health care environment. In the first section, an introduction to the situation is provided. Then, in the second section, the key terms are introduced: access in health care, GIS, and spatial simulation. In the third section, different cases where GIS supports decision making in the health care services are shown. In the fourth section, two examples of spatial simulation are shown. Finally, future research directions and conclusions are discussed.

Chapter thirty-nine, by Emilia Mendes, aims to describe a case study where Bayesian Networks (BNs) were used to construct an expert-based software effort and risk prediction model for use by a large Healthcare organization in Auckland (New Zealand) to manage healthcare software projects delivered on the Web. This model was solely elicited from expert knowledge, with the participation of seven project managers, and was validated using data from twenty-two past finished projects. The model led to numerous changes in process and also in business. The company adapted their existing effort and risk management process to be in line with the model that was created, and the use of a mathematically based model also led to an increase in the number of projects being outsourced to this company by other company branches worldwide. Their predictions improved significantly too. Our results suggest that the use of a model that allows the representation of uncertainty, inherent in effort estimation, can outperform expert-based estimates.

A residential care home is a suitable environment to implement a software system providing users the functionality and the information required at any time, whichever place and circumstance. The advances of technology in the last few years have made the design of the system possible; the system will imply features regarding collaboration, ubiquity, and context-awareness. Firstly, defining the architecture of the system is necessary to guarantee a proper design and implementation. Chapter forty deals with those subjects. The architectural proposal is described from the hardware and software perspectives. The hardware architecture shows the distribution of the hardware components to be used: mobile devices, servers, communications, etc.; on the other hand, the software architecture shows the distribution of the system components by layers based on the functionality and information processing. Awareness is a key issue to be considered in the design of the proposed system from the point of view of collaboration; therefore, an analysis about how to handle and consider this feature on both architectures is also depicted.

Healthcare applications involve complex structures of interacting processes and professionals that need to exchange information to provide the care services. In this kind of system, many different professional competencies, ethical and sensibility requirements as well a legal frameworks coexist and because of that the information managed inside the system should not be freely accessed, on the contrary it must be subject to very complex privacy restrictions. In chapter forty-one, Lenka Lhotska and Jaromir Dolezal describe a case study of a knowledge-based distributed system the fundamental issues that must be considered in the design of a distributed healthcare application. The K4CARE system is an example of an application to the medical domain of homecare assistance. Homecare involves professionals from

different institutions (hospital, social work organisms, etc.) structurally independent, that must interact around any particular patient, and that use to be located in different physical places having their own and independent information systems.

Hospital information systems operating within internal computer networks have drastically helped hospitals to improve the efficiency of providing services. They have allowed an immediate sharing of medical information in digital form between hospital employees in order to undertake clinical decisions in a quicker and better way, and to eliminate errors caused by lower quality paper information. The equivalent to these systems in exchanging information between distant medical professionals has become telemedicine. Telemedicine has created opportunities for a smooth cooperation between disperse medical units and for automating the management of healthcare processes at the regional and national levels. In Chapter forty-two, Jerzy Brzezinski and his co-authors discuss an emerging trend towards developing and maintaining telemedical centers at the institutional and regional/national levels. They present functional and organizational requirements for such centers, as well as technical conditions relating to their implementation. Recommendations and statements presented herewith are based on the authors' collective experience in building teleinformation systems for healthcare which led to the development of the Wielkopolska Center of Telemedicine.

The automatic drug infusion in medical care environment remains an elusive goal due to the inherent specificities of the biological systems under control and to subtle shortcomings of the current models. The central aim of chapter forty-three, by Paulo Fazendeiro and his fellow researchers, is to present an overview of soft computing techniques and systems that can be used to ameliorate those problems. The applications of control systems in modern Medicine are discussed along with several enabling methodologies. The advantages and limitations of automatic drug infusion systems are analyzed. In order to comprehend the evolution of these systems and identify recent advances and research trends, a survey on the hypertension control problem is provided. For illustration, a state-of-the-art automatic drug infusion controller of Sodium Nitroprusside for the mean arterial pressure is described in detail. The chapter ends with final remarks on future research directions towards a fully automated drug infusion system.

In chapter forty-four, Frederico Della Croce and Fabio Salassa discuss the technological aspects of solutions and applications in staff rostering by means of ICT techniques. Three different applications are presented related to nurse rostering in a public hospital ward, nurse rostering in a private hospital ward, and physician rostering in a public hospital intensive care unit. For all applications, the use of efficient operations research techniques, models, and related solvers guided by the suggestions of the health-care staff are introduced. The peculiarity of this work is the combination of mathematical programming techniques and solvers under the classical neighborhood search framework.

In chapter forty-five Crescenzio Gallo examines the technical background behind the general problem of multimedia content deployment, and the architectural and technical choices and legal implications to be considered in order to build an effective client/server multimedia content deployment platform. This platform is suited for the implementation and spreading of a series of services, integrated with the Health Information System and the related educational and recreational facilities and support activities. Such infrastructure requires a strong convergence of expertise and innovative technologies to integrate system components and guarantee security, usability, and interoperability as recommended by IHE.

Calin Ciufudean, Otilia Ciufudean, and Constantin Filote's work in chapter forty-six is focused on the evaluation of the links between physiology of human body and human emotional states, in order to help specialists to perform a correct diagnosis correlated to patient's expectations and emotional states, as they denoted here "the Trust Diagnose" (TD). Their approaches in these techniques are different from

the previous ones. Instead of observing and classifying the people's responses to external stimuli or internal emotional factors, they are interested in developing a mechanism that appropriately describes the interaction doctor-patient via emotional states caused by disease and/or by doctor's examination, and that can lead to a TD. They develop this approach in two stages: the first stage is focused on emotion models expressed in a qualitative formalism capable to link analytic tools to emotion expressions and deliver significant information for both laboratory analysis methods and doctors' diagnose. The second stage is focused on the improvement of the automated medical diagnosis based on biological feature selection and classification, as we know that biological features represent patterns of important information.

Next-Generation-Sequencing (NGS) Techniques are currently on the rise. This is seen as a revolution by (most of) the human geneticists. The wealth of data stemming from Next-Generation-Sequencing will without doubt lead to significant advances in the field of molecular diagnostics. On the clinical side, this will be higher detection rates of the genetic cause of the particular disease in patients. On the scientific side, NGS techniques did lead to the discovering of new gene related to certain diseases and will do so in the future. However, these advances come at a price: Human geneticists will be confronted with different and new ICT issues related to NGS. Because of the so far unknown amount of data stemming from NGS, these ICT issues need to be taken seriously. The purpose of chapter forty-seven, by Saskia Biskup, is to give an overview on the different ICT aspects that come with the introduction of Next-Generation-Sequencing in molecular diagnostics.

The use of a methodology for the evaluation, comparison, and quality improvement of health Websites is justified by its widespread adoption and visibility to Internet users. Due to the sensitiveness of their content and impact on users, health related sites should be evaluated. Chapter forty-eight proposes three different dimensions for the development of quality evaluation methodologies of Health Websites: contents, services, and technical. Álvaro Rocha, Avelino Victor, and Patrícia Leite Brandão consider that these dimensions should be addressed transversally, providing an integrated and better overall evaluation.

Chapter forty-nine, by Alberto Carneiro discusses the issues and choices that researchers and technicians should consider when adapting maturity models to healthcare organization's needs. It discusses the practical utilization of maturity models, including different manners of exploring model's usefulness. For a more complete understanding of maturity models and their applicability, the selection of criteria and processes of measurement, called metrics, is briefly reviewed in terms of indicators and daily procedures. Finally, some issues of management information systems security are briefly addressed, along with a note on measuring security assessment.

Improved 4G communication technologies in conjunction to Web 2.0 technologies are contributing to design and implement new and exciting Healthcare services for citizens that can be accessed anytime and anyplace. Tobacco is a risk factor causing increased morbidity and mortality in developed countries. Smoking cessation is a hard challenge for several people that can be achieved with the help of Web 2.0 and wireless access technologies to multimedia information. There are a lot of basic Web 1.0 portals for smoking cessation. In chapter fifty, authors Alvaro Suarez and Elsa Macias present an overview of serious damages or even death provoked by nicotine poisoning, an overview of on-line group therapies and our user-centric Web 2.0 Portal intended for smoking cessation. Authors demonstrate innovative and effective facts of our Web 2.0 portal: Wireless access, scheduled agendas, and video on demand services.

Over the past sixty years, developed countries have registered high growth of total expenditure on health, which have attracted the attention of health economists, organizations, and policymakers alike. At the same time, we have observed the increasingly important role of the Information and Communication Technologies (ICTs), not only in improving diagnosis and treatment and the quality of information but

also in the growth of these expenditures. According to this scenario, Ana Borges and Erika Laranjeira focus in chapter fifty-one on the development of Health Economics as an autonomous branch within Economics, highlighting not only its origin and the leading authors that began to write about it but also the impact and the role of the development of ICTs on Health Economics and healthcare.

The goal of chapter fifty-two, by Nuno Martins, Heitor Alvelos, and Rita Espanha, is mapping the nature of possible contributions of participatory online platforms in citizen actions that may contribute in the fight against cancer and its associated consequences. The research is based on the analysis of online solidarity networks, namely the ones residing on Facebook and the blogosphere that citizens have been gradually resorting to. The research is also based on the development of newer and more efficient solutions that provide the individual (directly or indirectly affected by issues of oncology) with the means to overcome feelings of impotence and fatality. In this chapter, authors aim at summarizing the processes of usage of these decentralized, freer participatory platforms by citizens and institutions, while attempting to unravel existing hype and stigma; the authors also provide a first survey of the importance and the role of institutions in this kind of endeavor; lastly, they present a prototype, developed in the context of the present study, that is, specifically dedicated to addressing oncology through social media.

Chapter fifty-three, by Luiz Goncalves, Samuel Azevedo, and Rummenigge Dantas, introduces the use of middleware tools in applications for healthcare and social services, specially focusing on solutions designed for Interactive Digital Television (IDTV), and discusses its implications to modern roles for easing patient and caretaker relations. The authors explore the capacities of such solutions to assist the patients in their personal needs, optimizing the time and tasks of the caretaker. The authors discuss the limits of the use of Internet in satisfying the needs of communication of elderly and other patients and then propose new roles for caretaking based on this new reality. They also present an architecture that allows the remote use and control of electronic devices via IDTV set-top boxes for the middleware Ginga. They show applications based on this architecture that promote healthcare and social services, as a set of infrared lights coupled to a hat that can be used as input for impaired patients, and how an accelerometer can be used with IDTV applications for treatment and entertainment. Before concluding, the authors point out research directions on the topics discussed in this work.

In Portugal the Health Ministry's family planning programmes have traditionally focused on women. However, the involvement of men in family planning is crucial to the promotion of equal opportunities in health. Recent advances in technology and the means of communication that support Sexual and Reproductive Health seemed to mark the beginning of a new era in family planning in which men and women could be equal partners in the decision making processes, but these hopes have not been realised. In chapter fifty-four, Paula Remoaldo, Fátima Martins, and Ana Paula Remoaldo present semi-structured interviews conducted with 66 men from the Northwest of Portugal between May and June 2010. The results show that 90% of the respondents consider their involvement in the vigilance of Sexual and Reproductive Health important. However, 83.3% have not, to date, participated in any kind of consultation for family planning. The results identify a need to create new strategies for the promotion of Sexual and Reproductive Health among men, employing for example social marketing strategies, in which new technologies and certain means of communication could have an important role.

The prevailing system for diagnosis, treatment, and management of Autism Spectrum Disorders (ASDs) in the US—the in-person service delivery—has been unable to address the increase in the demand for services and societal costs for those served, and the unattained societal benefits for those not diagnosed early enough or not offered early and intensive behavioral interventions. In chapter fifty-five, Fjorentina Angjellari-Dajci and her co-authors discuss new developments in telehealth for diagnostic evaluation