Due to increased life expectancy and improved general health states of citizens, more and more old and frail people will need medical care in the near future. At the same time, considerable bottlenecks arise from the fact that increasingly fewer people are present, who may take over the nursing. In order to master the requirements of an aging society, innovations in information and communication as well as medical engineering technologies come to the forefront, which offer novel or improved medical diagnosis, therapy, treatments and rehabilitation possibilities. Nevertheless, recent research shows that acceptance barriers are prevalent, which might be due to the fact that current development praxis predominately focuses on technical feasibility, while the “human factor” in these systems is fairly underdeveloped. In order to fully exploit the potential of future healthcare applications, acceptance and usability issues of assistive technologies need to be considered, especially for older users, who have specific needs and requirements regarding usability and acceptance issues. As the knowledge about the antecedents of acceptance and utilization behavior is restricted, it is necessary to explore acceptance and the fit of emerging healthcare technology within homes and private spheres. In order to meet the needs of future patients and caregivers, an integrative and multidisciplinary approach is required, which combines engineering and medical knowledge with theoretical and methodological contributions from the social sciences and humanities. This book will address these challenges by providing an in-depth introduction into medical, social, psychological, and technical aspects of assistive e-health technologies as well as their consequences for the design, use and acceptance of future systems.

The knowledge and insights provided in this book will help students as well as systems designers to understand the fundamental social and technical requirements future healthcare technologies have to meet. By providing a well-rounded introduction within one single volume, this book is equally suited as a library reference and upper-level course supplement, but also represents a first-class resource for independent study.

The book “E-Health, Assistive Technologies and Applications for Assisted Living: Challenges and Solutions” consists of 13 chapters, which are clustered in three sections: (1) Challenges of Future E-Health Systems, (2) User-Centered Design of Assistive Technologies, and (3) Applications for Assisted Living.

The first section on Challenges of Future E-Health Systems provides an introduction in the field of e-health and assistive technologies and illustrates the design challenges of future healthcare systems. In Chapter 1, “Patient Centered Medicine and Technology Adaptation”, by Brett Harnett from the University of Cincinnati, USA, the concept of “patient centeredness” in healthcare is discussed. Healthcare across the globe varies in capability and complexity. In some parts of the world healthcare is seen as an inalienable right, in other areas it is a privilege. Despite how medical expertise is allocated, there are
logical processes that dictate an intervention. To accurately diagnose and treat a condition, many factors are considered. These include information about the patient’s history, allergies, current medications and surroundings, in other words, data. The more that is known about a patient, the more quickly and efficiently an accurate diagnosis can be rendered as well as an appropriate treatment plan. In many locations throughout the world, the optimal process is non-existent or has broken down. The situation has become inefficient because of poorly coordinated, acute-focused, episodic care. The solution lies in the most basic role of the healthcare continuum, primary care. However, to achieve maximum effectiveness and efficiency, adoption of various technologies need to be embraced. While it is referenced by different terms, the concept is often termed “patient centered medicine”.

Chapter 2 on “Privacy and Security in E-Health Applications”, authored by Milan Petković and Luan Ibraimi from Philips Research Europe, The Netherlands, analyzes privacy and security requirements in healthcare and reviews both classical and novel security technologies that could fulfill these requirements. The introduction of e-health and extramural applications in the personal healthcare domain has raised serious concerns about security and privacy of health data. Novel digital technologies require other security approaches in addition to the traditional “purely physical” approach. Furthermore, privacy is becoming an increasing concern in domains that deal with sensitive information such as healthcare, which cannot absorb the costs of security abuses in the system. Once sensitive information about an individual’s health is uncovered and social damage is done, there is no way to revoke the information or to restitute the individual. Therefore, in addition to legal means, it is very important to provide and enforce privacy and security in healthcare by technological means. In this chapter, the authors analyze privacy and security requirements in healthcare, explain their importance and review both classical and novel security technologies that could fulfill these requirements.

In Chapter 3 entitled “Foundations of Trust for E-Health”, Cynthia L. Corritore and colleagues from Creighton University, USA, explore the nature of trust in e-health systems. Trust has always been an important element of healthcare. As healthcare evolves into e-health, a question arises: What will the nature of trust be in e-health? In this chapter the authors provide the reader with a foundation for considering this question from a research perspective. They focus on one e-health domain: online websites. The chapter begins with a high-level overview of the body of offline trust research. Next, findings related to online trust are presented, along with a working definition. Trust research in the context of online healthcare is then examined, although this body of work is in its infancy. A detailed discussion of our research in the area of online trust is then presented. Finally, with this background, the authors take the reader through some possible research questions that are interesting candidates for future research on the nature of trust in e-health.

Chapter 4, “A Multi-Disciplinary Approach to Ambient Assisted Living”, authored by Martina Ziefle et al. from RWTH Aachen University, Germany, illustrates the different disciplinary design challenges of smart healthcare systems and presents an interdisciplinary approach toward the development of an integrative Ambient Assisted Living environment. Within the last years a variety of new healthcare concepts for supporting and assisting users in technology-enhanced environments emerged. While such smart healthcare systems can help to minimize hospital stays and in so doing enable patients an independent life in a domestic environment, the complexity such systems raises fundamental questions of behavior, communication and technology acceptance. The first part of the chapter describes the research challenges encountered in the fields of medical engineering, computer science, psychology, communication science, and architecture as well as their consequences for the design, use and acceptance of smart healthcare
systems. The second part of the paper shows how these disciplinary challenges were addressed within the eHealth project, an interdisciplinary research project at RWTH Aachen University.

In Chapter 5, “Security in E-Health Applications”, Victor Pomponiu from the University of Torino in Italy presents an analysis of wireless sensor networks (WSN) security techniques in the context of healthcare applications. Wireless sensor networks in e-health applications are acquiring an increasing importance due to the widespread diffusion of wearable vital sign sensors and location tags, which can track both healthcare personnel and patient status location continuously in real-time mode. Despite the increased range of potential application frameworks the security breach between existing sensor network characteristics and the requirements of medical applications remains unresolved. Devising a sensor network architecture, which complies with the security mechanisms is not a trivial task since the WSN devices are extremely limited in terms of power, computation and communication. This chapter presents an analysis of various WSN security techniques from the perspective of healthcare applications, and takes into consideration the significance of security to the efficient distribution of ubiquitous computing solutions.

The second section on User-Centered Design of Assistive Technologies comprises four chapters illustrating user studies, conceptual frameworks and novel design approaches in the field of assistive technologies. In Chapter 6, “An Approach to Participative Personal Health Record System Development,” Vasso Koufi and colleagues from the University of Piraeus in Greece present a new concept for supporting the adoption of personal health record systems. Healthcare delivery is undergoing radical change in an attempt to meet increasing demands in the face of rising costs. Among the most intriguing concepts in this effort is shifting the focus of care management to patients by means of Personal Health Record (PHR) systems, which can integrate care delivery across the continuum of services and also coordinate care across all settings. However, a number of organizational and behavioral issues can delay PHR adoption. This chapter presents a general approach to breaking down barriers that exist at the level of individual healthcare professionals and consumers. According to this approach, user participation in PHR system development is considered essential for achieving successful system implementations. Realizing a participative PHR system development, where users are full members of the development team, requires not only choosing an appropriate methodology, but also organizing the participation process in a way that is tailored to the particular situation in order to achieve the desired results.

Chapter 7 entitled “How Knowing Who, Where and When Can Change Health Care Delivery” by William D. Kearns et al. from the University of South Florida, USA, illustrates a novel technique for studying the relationship of movement to health changes. Everything that happens to a person during their lifetime happens in the context of place, and the movements made by the person through and within that place. Persons begin life with a birthplace, they remember exactly where they were when they first laid eyes on their true love, the street address of their first home, etc. New research suggests that changes in movement patterns, which occur in home and public spaces, may be significant indicators of declining mental and physical health. In this chapter, the authors discuss efforts to measure natural human movement and present a novel technique that uses a referential grid system to study the relationship of movement to health changes. The authors then present several syndromes, whose understanding may be increased by a more thorough analysis of movement. They conclude with a discussion of how location-aware technologies can play a role in identifying problems and solutions in the design of living spaces for the elderly.

In Chapter 8, “Integrating Tele-Health into the Organization’s Work System”, Joachim Jean-Jules and Alain O. Villeneuve from the Université de Sherbrooke, Canada, report on the development of a
multi-level model for understanding assimilation of e-health systems. With increased use of tele-health
to provide healthcare services, bringing tele-health technology out of experimental settings into real-life
settings, it is imperative to gain a deeper understanding of the mechanisms underlying the assimilation
of tele-heath systems. Yet, there is little understanding of how information systems are assimilated by
organizations, more work is then warranted to understand how tele-health can be integrated into admin-
istrative and clinical practices and to identify factors that may impinge onto tele-health integration.
Borrowing from institutional, structuration and organizational learning theories, the authors develop a
multi-level model for understanding assimilation of tele-health systems. Their study addresses limita-
tions of past work and will be helpful for guiding research and managerial actions while integrating
tele-health in the workplace.

Chapter 9 on the “Acceptance of Ambient Assisted Living Solutions in Everyday Life.” authored by
Annette Spellerberg and Lynn Schelisch from the Technical University of Kaiserslautern in Germany,
presents a user study exploring the acceptance of mobile home automation devices by elderly people.
The aim of so-called Ambient Assisted Living devices is to increase comfort and safety and to provide
support for elderly people in their homes. In a housing estate in Kaiserslautern, Germany, a touch-screen
tablet PC called PAUL (Personal Assistive Unit for Living), sensors and an EIB/KNX-Bus were installed
in 20 apartments. Within the framework of the project Assisted Living, urban sociologists from the
Technical University of Kaiserslautern analyzed the elderly peoples’ experiences and acceptance of the
implemented home automation devices, especially of the tablet PC over a period of two years of usage.
Besides technical aspects social issues like community building are focused in the project. The main
results of the project are presented in the paper.

In the third section on Applications for Assisted Living, several examples of prototypes and applica-
tions of Ambient Assisted Living systems are presented. Chapter 10 entitled “Iterative User Involv-
ment in Ambient Assisted Living Research and Development Processes: Does It Really Make a Difference?”
authored by Sonja Müller and colleagues from empirica - Gesellschaft für Kommunikations- und Tech-
nologieforschung in Germany, reports on the research project SOPRANO, which aims at developing
supportive environments for elderly people. The chapter is based on results from the European research
project SOPRANO, which is developing supportive environments for older people based on the concept
of Ambient Assisted Living (AAL). The project adapts and applies Experience and Application Research
methods involving active participation of older users throughout an iterative development and design
process. Innovative participatory methods enable developers to thoroughly focus on the users when
defining the system requirements, generating design solutions and evaluating these design solutions in
both lab and real-life settings. The example chosen to best demonstrate how the character and detail of
user ideas changed in the different stages of the research and development process is the design of an
exercise support system, which uses an avatar showing exercises on TV in the home of an older person.

In Chapter 11, “Wearable Systems for Monitoring Mobility Related Activities: From Technology to
Application for Healthcare Services,” Wiebren Zijlstra et al. from the University Medical Center Gron-
ingen, The Netherlands, discuss the applicability of wearable motion-sensing technologies for mobility
assessment and monitoring in clinical contexts. Monitoring the performance of daily life mobility-related
activities, such as rising from a chair, standing and walking may be used to support healthcare services.
This chapter identifies available wearable motion-sensing technologies, discusses their potential clinical
application for mobility assessment and monitoring, and addresses the need to assess user perspectives
on wearable monitoring systems. Given the basic requirements for application under real-life conditions,
this chapter emphasizes methods based on single sensor locations. A number of relevant clinical appli-
cations in specific older populations are discussed, including risk assessment, evaluation of changes in functioning, and monitoring as an essential part of exercise-based interventions. Since the application of mobility monitoring as part of existing healthcare services for older populations is rather limited, this chapter ends with issues that need to be addressed to effectively implement techniques for mobility monitoring in healthcare.

In Chapter 12, “Med-on-@ix: Real-time Tele-Consultation in Emergency Medical Services – Promising or Unnecessary?” a new emergency tele-medical service system is presented by In-Sik Na and colleagues from the University Hospital in Aachen, Germany. The aim of the illustrated project Med-on-@ix is to increase the quality of care for emergency patients by operationalizing rescue processes. Currently available technologies will be integrated into a new emergency tele-medical service system. The aim is to capture all necessary information including electrocardiograms, vital signs, clinical findings, images and necessary personal data of patients at an emergency scene and transmit these data in real time to a centre of competence. This would enable a “virtual presence” at the site of an Emergency Medical Services (EMS) physician. Thus, it would be possible to raise the quality of EMS in total and counteract the growing problem of EMS physician shortage by exploiting the existing medical resources. In addition, this system offers EMS physicians and paramedics the possibility of consulting a centre of competence.

The section closes with Chapter 13, “The Smart Condo Project: Services for Independent Living,” in which Nicholas M. Boers et al. from the University of Alberta, Canada, present the Smart Condo project, an environment for supporting seniors and rehabilitating patients. Providing affordable, high-quality healthcare to older adults, while enabling them to live independently longer, is critical. To this end, Ambient Assisted Living environments have been developed that are able to non-intrusively monitor the health of people at home and to provide them with improved care. The authors have designed an environment, the Smart Condo, to support seniors and rehabilitating patients. They embedded a wireless sensor network into a model living space, which was developed according to Universal Design principles. Information from the sensor network is archived in a server, which supports a range of views via APIs. One such view is a virtual world, which is realistic and intuitive, while remaining non-intrusive. The authors begin this chapter by examining computing technologies for smart healthcare-related environments as well as the needs of elderly patients. They then discuss the Smart Condo architecture and review key research challenges. Finally, they present lessons learned through the project.

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