Chapter 4
A Multi-Disciplinary Approach to Ambient Assisted Living

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ABSTRACT

This chapter 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 of 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 chapter shows how these disciplinary challenges were addressed within the eHealth project, an interdisciplinary research project at RWTH Aachen University.

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INTRODUCTION

The increased life expectancy and improved general health states of citizens in most western countries will inevitably result in more and more elderly people requiring medical care in the near future (Wittenberg et al., 2006). At the same time, considerable bottlenecks arise from the fact that increasingly fewer people are present, who may take over the nursing (Leonhardt, 2005). In order to master the requirements of an aging society, innovations in information and communication as well as medical engineering technologies come to the fore, which offer novel or improved medical diagnosis, therapy, treatments and rehabilitation possibilities (Weiner et al., 2003; Warren & Craft, 1999). Though, recent research shows that acceptance barriers are prevalent, which might be due to the fact that 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 e-health applications, acceptance and usability issues of e-health applications need to be considered, especially for older users, who have specific needs and requirements regarding usability and acceptance issues (Melenhorst et al., 2006; Arning & Ziefle, 2009; Zimmer & Chappell, 1999). As the knowledge about the antecedents of e-health acceptance and utilization behavior is restricted, it is necessary to explore the acceptance and fit of e-health technologies within homes and private spheres (Wilkowska & Ziefle, 2009; Gaul & Ziefle, 2009; Röcker & Feith, 2009).

DISCIPLINARY CHALLENGES

The following sections outline 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.

Medical Engineering

Major changes in the demographic and social structure of most western countries bring up new challenges, not only for the health care systems in general, but also for the development of new medical technologies. In such an aging society, where medical progress leads to a considerably increased life expectancy, age-related chronic diseases require constant medical assistance by a new generation of medical care equipment (Röcker et al., 2010). In situations, where patients cannot be treated in institutional setting alone anymore, individual and personalized care in the patients' home environment plays a more and more important role (Ziefle et al., 2009).

Those technologies and devices have to provide the essential, established attributes of today's medical devices, to be *functional, safe and reliable*, but furthermore in the future they also have to be *mobile* (can be used in professional and home environments), *adaptive* (can be run by patients and professionals) and *ergonomic* (easy to use and accepted by users). To implement those new aspects in medicine technology is a great challenge because most medical devices influence the patients´ health in a direct way and are highly critical in terms of patient safety. The decentralized application of such devices puts users in the centre of attention and it will give them a high degree of independency and self-control of the therapy, but also a high degree of responsibility.

The most important modification in the development approaches in the field of medical engineering is to include the user actively in the design process. A coherent user-centered design of medical devices will result in a medical technology, which is not only functional in an engineering way of thinking, but also addresses fundamental user needs in terms of appearance, ease of use and privacy.

Especially medical assistance devices for the elderly are often perceived to be stigmatizing and therefore not used efficiently. One example is the