Acceptance of Telemedical Treatments – A Medical Professional Point of View

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Abstract. The demographic change has tremendous consequences for health care availability, with a growing mismatch between rising numbers of patients and the declining number of care personnel. As a consequence, considerable shortcomings in availability, accessibility, and quality of health care can be expected. Telemedicine and telemonitoring services are promising approaches to compensate this gap, especially for long-term monitoring, nevertheless also within the supply chain of health care. Despite the potential, the acceptance of telemedicine is quite low. In this paper we report on two studies focusing on acceptance of telemedical services. First, chronically ill persons were experimentally studied with respect to their acceptance of telemedical systems. Second, a survey was conducted to assess medical professionals' points of view. Findings reveal perceived benefits in the context of telemedical services, however, also considerable barriers, especially on the medical doctors' side. Outcomes may contribute to the development of a sensitive and transparent communication and information strategy for stakeholders, as well as a public awareness for the benefits and the drawbacks of telemedical services.

Keywords: Telemedical treatment, telemonitoring, electronic services, medical professional technology acceptance, biomedical engineering.

1 Introduction

As a consequence of the increasing graying of our societies, currently a vivid discussion examines how the consequences of the demographic change can be met [1] [2] [3] [4] [5]. This discussion is quite challenging as it touches sensible and serious topics: One of the challenges regards the economic shortcomings in the health insurance systems, connected with the question of how societies can care for the increasing number of seniors which need to be medically cared. Another challenge are the shortcomings regarding the availability of caregivers and facing a considerable lack in the medical supply chain with increasingly lower number of persons that are doing the caring jobs. In addition, traditional family structures are dissolving. In contrast to former societal structures, many old people live alone and have no children, who used

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to take over caring for the older parents [6]. Aggravating the situation, there is an enormous discrepancy between the availability of medical doctors in rural and urban regions [7]. In rural areas, predominately senior citizens are living, who – due to their lower mobility – will have serious problems to make visits to the doctor's office [8].

Concluding, there is an urgent need to develop new, innovative medical care concepts that are able to compensate for the bottlenecks in medical care [9][10].

1.1 Technology in the Doctors' Office

Technology in the doctor's office is not new. More than 20 years ago, computer systems have been installed in the majority of doc-tor's offices, mainly in order to help accelerate organizational work. This increased the number of patients treated and was accompanied by a higher efficiency and a reduced fallibility of data handling [1][11][12]. However, patients still have to come into the doctor's office. While this may be inevitable as a physical examination is required in some cases, in other cases a personal contact is not factually necessary from a medical point of view [2]. Thus, telemedical services could be an economically and organizationally interesting alternative or addendum to the traditional visit to the doctor's, for all persons involved [13][14]. Already in the 90s, studies considered the consequences of telemedicine for different stakeholders [9][11][12], addressing patients, providers, policy as well as societal structures.

The power of mobile technologies has improved dramatically and the possibilities are very different to earlier times [15] [16] [17]. Today, information and communication technology plays an integral part in emergency medicine [18] [19]. Additionally, mobile technology also enters private spaces and is increasingly incorporated in smart homes [20] [21]. Recently, there are research trends for more innovative technology supporting doctors [22] [23]. One example is the virtual doctor's visit, a telemedical scenario which enables remote virtual consultation hours between doctor and patient [24]. Here patients do not need to visit doctors in person in order to get medical advice, but instead they can choose to communicate with the doctor virtually and clarify routine problems or questions prior to a face-to face consultation.

1.2 Benefits and Drawbacks of Telemedicine

Within literature there is a vivid discussion and a growing interest in potential benefits of teleconsultations in different medical fields, e.g., ophthalmology [25], rehabilitation in stroke care [26], or orthopedics [27]. However, not all views - medical, sociological, economic or psychological - are positive regarding the real benefits but reveal also critical thoughts accompanied by a very sensible discussion about the overall usefulness of telemedicine. In addition, insufficient knowledge is present as to what extent individual beliefs, (social) trust in healthcare and technology as well as perceptions of potential benefits and risks are influencing telemedicine's acceptance [28] [29] [30]. This knowledge gap is due to the fact that traditional acceptance studies predominately concentrate on the technologies in the working context [31]. However, especially in the medical context, technology acceptance is influenced by many other factors [32] [33]. User diversity plays a prominent role: gender [34], age [35], technical upbringing and expertise [36], and cultural factors do considerably decrease technology acceptance [37]. Large impact on acceptance and the willingness to adopt medical technology also comes from the usage context: Technologies entering private spheres in the home context [20] and invasive medical technology that is close to [28] or even inside the body [32] are critical factors which are known to be fragile determinants of medical technology. Also, within the public perception, a broad reluctance prevails [21]. People are quite skeptical towards telemedicine regardless of its potential. Concerns about security and privacy are key issues [29] [21] as are fears such as doctors being afraid that a therapy mediated by technology might decrease care quality or even finally lead to their unemployment [24].

1.3 Questions Addressed

In most of the studies focusing on telemedical acceptance a quite generic view is examined. Only little is known regarding the stakeholder's view – meaning the patients and the medical doctors. This was undertaken in the present study. In a first, experimental approach, patients suffering from chronic heart disease evaluated the usability of a prototypic telemonitoring system (more details see [21]). In a second study, an exploratory survey was applied asking medical personnel about perceived benefits and drawbacks.

2 Study 1: Patients' Point of View

The first study focused the usability of prototypic telemedical application. Chronically ill persons (coronary heart disease) and healthy persons had to evaluate the perceived reliability of the data acquisition functionality. Participants had to carry out a telemedical task and then assess the usability and learnability of the prototype as well perceived privacy, trust, and data security. We assumed that patients would differ in their opinions from healthy persons due to their experience with the disease and their higher awareness for the importance of continuous monitoring.

2.1 The Lab Environment: The Future Care Lab

The lab environment used as an experimental space was the Future Care Lab at RWTH University, Germany, part of the European Network of Living Labs (ENoLL). The lab is conceptualized and technically realized as an intelligent living room, equipped with different medical assistive devices. A full-scale prototype room as a simulated home environment was built which enables to test experimental interfaces with persons of different ages and health states. Different parts of the room (walls, floor, furniture) are used as input and output modalities for medical services. The wall of the living room represents a huge multi touch display (4.8m x 2.4m) that allows to examine telemedical services in the home environment (Figure 1).

Fig. 1. Communication with the doctor (left) and telemedical systems (right) (® Kasugai)

2.2 Participants

28 persons (51% female) took part (24-85 years). 50% of the sample was chronically ill (different forms and degrees of coronary heart disease). Participants were recruited through advertisements in a local newspaper. Participants reported to have different professions and educational levels. They were not compensated for their participation.

2.3 Materials

In order to assess usability and learnability, we used the System Usability Scale (SUS, [39]). Participants had to answer ten questions (5-point Likert scale, from 1 (''strongly disagree'') to 5 (''strongly agree''). Overall, a maximum of 100 points could be reached. The following items were explored: (1) I think that I would like to use this system frequently. (2) I found the system unnecessarily complex. (3) I thought the system was easy to use. (4) I think that I would need the support of a technical person to be able to use this system. (5) I found the various functions in this system were well integrated. (6) I thought there was too much inconsistency in this system. (7) I would imagine that most people would learn to use this system very quickly. (8) I found the system very cumbersome to use. (9) I felt very confident using the system. (10) I needed to learn a lot of things before I could get started with this system.

2.4 Tasks and Procedure

First, participants were introduced to telemedicine and the possibility to have electronic applications at home, supporting persons regarding a continuous monitoring of vital data related to their disease. In a second step, the experimenter acted as a model and demonstrated participants how to interact with the system (using the scale which was implemented invisibly in the floor), as well as how to take their blood pressure. Participants then had to do the same, navigating through the system menu structure to measure their vital signs. Finally, participants filled in the usability questionnaire.

2.5 Results

The evaluations of the system usability were analyzed by univariate and multivariate analysis of variance. The level of significance was set at 5%. In Figure 2, outcomes are visualized. As can be seen, the general usability is very high. Out of a maximum score of 100 points, the mean usability score reached 91 points (SD = 12.3 points). As expected though, differences appeared between healthy and chronically ill persons ($F(1,26) = 7.7$, $p<0.05$). People suffering from heart disease perceived the usability of the system higher than healthy persons (93 respective 85 out of 100 points max).

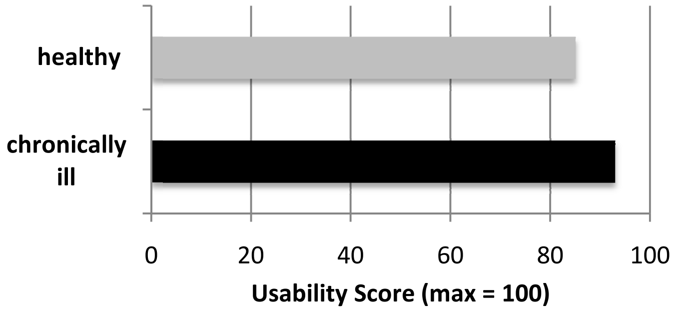

Fig. 2. Usability scores in chronically ill and healthy persons

Patients value telemedical systems more than those who are unaware of the disease-related implications. The high evaluation of the systems' usability was found to be independent of age and gender, hinting at a generic (positive) outcome. When looking at the findings regarding the perceived trust in data security and the system's reliability we also found high scores. From the 5 points to be reached as a maximum, data security received, on average, 4.1 points (SD = 0.8) and system reliability 4.3 points (SD = 0.7). Again, outcomes did not vary with gender and age of participants. Separate correlation analyses for persons suffering from chronic heart disease and healthy persons did not show significant differences regarding trust, privacy, and reliability.

Overall, it could be found that the requirements with respect to perceived trust and security are universal demands for sensitive technology environments.

3 Study 2: Medical Doctors' Point of View

This Study Focuses on Medical Care Personnel and Their Acceptance of Telemedicine.

3.1 Survey Instrument and Measures

The survey assessed general attitudes towards telemedical systems. This includes spontaneous associations with telemedicine as well as the willingness to use telemedical systems in the working environment. Then two scenarios for monitoring a cardiac patient were described: (a) the use of telemedical systems and (b) conventional treatment. Participants were instructed to take the role of the attending physician of a patient with heart disease who has to record his/her vitals daily. In the first scenario the patient is equipped with a telemedical system to automatically record his/her vitals and transfer them to the doctor. Only in case of emergency and irregularity, the patient would have to consult the doctor. The second scenario introduces the conventional way of documenting the vitals on a daily basis, noting them in a diary and consulting the physician once a month to check the data.

Participants had to evaluate 13 different criteria regarding both treatments: time efficiency, treatment quality, cost efficiency, false alarms, convenience, compliance, data analysis, data security, privacy, legal protection, emergency adequacy, long term adequacy. The criteria had been identified as most important in focus groups with medical professionals prior to the study (Mennicken et al., 2011). Finally, an overall decision for one of the two treatment options was asked for.

3.2 Participants

The sample consisted of 39 medical professionals (doctors and professional care persons) and 44 control persons (different professional background). 51% were female. The age range was from 21-72 years of age. Participants were recruited through advertisements in a newspaper (non-medical control) and in medical practices, hospitals (medical group). Participants were not compensated for participation. The level of technical self-confidence was about the same within the two groups (doctors: M=70.3/100 points max, SD=15.6; control group: M=72.2/100 points max, SD=13.7).

3.3 Results

Here, the evaluation of the different criteria in the telemedical compared to conventional treatment is reported for both groups (medical professionals vs. control group). In Figure 3, the results are presented. Bars on the left hand side represent preferences of the conventional treatment, bars on the right hand side depict preferences of the telemedical treatment in both groups. What can be seen there is that the telemedical approach is regarded as more advantageous than the conventional treatment regarding data analysis, long term adequacy, emergency adequacy, and treatment quality, but is also perceived as more susceptible to false alarms. Problems are seen – therefore favoring the conventional approach – within cost efficiency, data security, privacy protection, and time efficiency. Nevertheless, participants of both groups report an overall preference of the telemedical approach, basically ascribing a high usefulness of telemedicine as addendum to the face-to face consultation hour.

Even though both groups show the same preference and non-preference patterns, it is obvious that the medical professionals are much more reluctant and show a higher aloofness towards the telemedical treatment. Throughout, medical professionals' votes are less positive and more negative in comparison to the non-medical group. Beyond usability and privacy concerns, which were reported by all, medical personnel specifically complained about missing technical competence that was not trained during education. They feared not being able to meet the requirements when using novel technology in combination with the responsibility for a safe patient care.

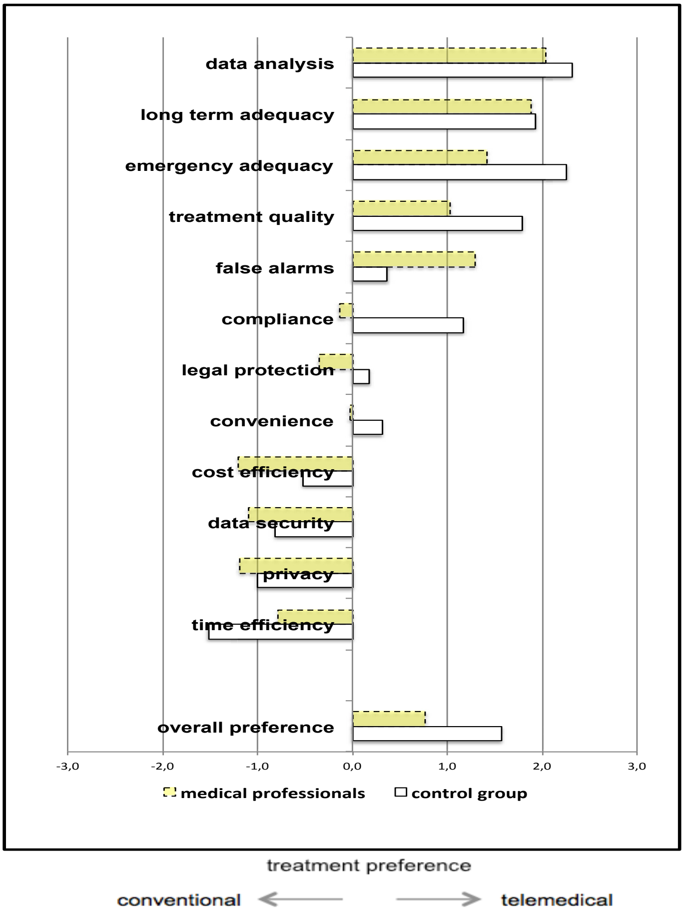

Fig. 3. Preference ratings of the telemedical vs. conventional treatments in both groups (medical professional colored bars vs. non-medical control persons)

4 Discussion and Conclusion

Overall, the two studies focusing on the acceptance of telemedicine for patients (Study 1) and medical care personnel (Study 2) revealed interesting insights. The findings provide support for our hypothesis that patients – as experts for their disease – show a higher acceptance for telemedicine and the usability of the telemedical approach, in contrast to healthy persons who, however, also ascribe a high usability to the system. Medical personnel – including both doctors and care personnel – are much more reluctant and address different aspects which need to be considered. While there is a positive attitude toward the perceived adequacy of the telemedical approach, especially for emergency situations, and also toward the accuracy and quality of the data required for monitoring vital parameters, the perceived drawbacks include not only the higher probability of false alarms, but also data security and privacy issues that are reported to be more problematic in telemedical treatments. Doctors' barriers are low usability of technical devices, assumed difficulties in handling the devices, and low technical competence which might be the reason for their view that telemedicine is more time-consuming in contrast to the conventional approach.

Overall, the findings show that medical professionals should be especially included into the development of future telemedical systems. Not only because they do have the most critical perspective, but also because their professional view could represent a highly useful information source with respect to three information and communication duties. Medical professionals' views could reveal (1) to technical designers what should be considered regarding the usability of the devices, (2) what should be discussed in the public communication policy and (3) what should be integrated in future education programs of medical professionals.

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