The MobiHealth Usability Evaluation Questionnaire

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Abstract

There is a need for high quality evaluation instruments when testing new mobile devices and services. The aim of this study was to describe the development of the MobiHealth Usability Evaluation Questionnaire. It was developed in a step-wise consensus process with close interaction between researchers, technology developers and end-users. The questionnaire ten dimensions: functionality, user interface, effectiveness, efficiency, satisfaction, safety, functional and aspirational needs, mastery and empowerment, mobility and activity, quality of life and ethical considerations. These dimensions are defined and their usage as parameters in an evaluation instrument is discussed. The conclusion is that the MobiHealth Evaluation Questionnaire can be used as a basis for method development when evaluating mobile care and rehabilitative devices, but it should be tested for reliability before actual use.

Introduction

The development of guidelines and standards in rehabilitation medicine and technology is on-going. These guidelines can be used to access the quality of rehabilitation systems, services and products.¹ The standards should be evidence-based, and their development should be based on a systematic review of the available literature to assess the weight of the available evidence. The strengths of the evidence ranges from Level 1 (meta-analysis of randomized trials) to Level 4 (consensus between professionals in the field). Because rehabilitation is a multi-disciplinary and complex process and the small numbers and heterogeneity of patients, it may be inappropriate or impractical to conduct randomized controlled trials in this field, particularly when testing new mobile devices and services. Therefore, instruments for evaluations of mobile rehabilitation devices and services need to be developed in a step-wise consensus process with close interaction between researchers, technology developers and end-users. So far, we have yet to reach total agreement on the “best way” to evaluate new information systems or services.² Consequently, different projects tend to develop their own evaluation methodology. Telehealth is often perceived as a medical or rehabilitation technology or medical treatment and this has to be reflected in the content and the methods of evaluation.

The MobiHealth project was performed within the framework of the EU’s “Information Society Technologies” Programme during 2002 and 2003. Its overall objective was to develop new services and applications in the area of mobile health, promoting the use and deployment of GPRS and UMTS mobile services and technologies. Its main task was to deliver a flexible and dynamic service to patients and health care providers with a focus on optimal utility and usability.
Utility related the functionality of a system or service in terms of what it can do, whereas usability related to how well users can use that functionality. Usability applies to all aspects of a system or service with which a human might interact, including installation and maintenance. It is not uni-dimensional. Instead, it is associated with several dimensions, including learnability (easy to learn), efficiency (efficient to use), memorability (easy to remember), permitting a low error rate so that users make few errors during its use, and satisfaction (pleasant to use). “Usable” is an adjective synonymous with “fit to use, functioning, operational, serviceable, valid and working”. Within the MobiHealth project usability was defined according to ISO 9241-11: Guidance on Usability as:

“the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”.

Usability includes accessibility aspects as well as prerequisites for performing daily activities in the designated environment targeted. It also includes subjective perceptions of how well the design of a system or service enables functioning and well-being from the user’s perspective.

Usability testing is a reliable way to estimate quantitatively users’ performance as well as subjective satisfaction with products. There are four major trends in usability testing: common reporting formats and methods for industry; Internet application and Website testing; testing of mobile handheld devices; and testing in naturalistic environments such as simulated homes and classrooms. It has been suggested that “quick and clean” usability testing methods are needed to provide valid and reliable data on how people use products and systems and how they like using them.

The MobiHealth system consists of a Body Area Network (BAN), a small box with sensors that register and transmit physiological data. These data are sent by Bluetooth to a handheld computer (MBU) and the MBU sends the data by means of GPRS or UMTS to the hospital/primary care centre where the data are reviewed on line by the medical staff (see Fig. 1).

A total of 9 trials within healthcare were performed: Telemonitoring of patients with arrhythmia; The Lighthouse Alarm and Locator; Physical Activity and Impediments to Activity in Women with Rheumatoid Arthritis (RA); Monitoring of Vital Parameters in Patients with Respiratory Insufficiency; Home Care and Remote Consultation for Recently-
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Released Patients in a Rural Area; Support of Home-based Healthcare Services & Outdoor Patients’ Rehabilitation; Tele Trauma Team; Integrated Home Care for Women with High-risk Pregnancies.

The trials had unique designs in terms of number of patients, the type of care given and by whom and the purpose of using the MobiHealth system. Generally, the partners used a participatory approach, i.e. the end-users were involved in the development and testing of the MobiHealth services. Two field pre-trials were conducted in order to create an interactive process between technicians and end-users. The purpose of each pre-trial was to gather information from the trial owners and to determine their experiences gathered with the BAN. This information was used as a basis for the technicians to further develop and design the BAN. Also, the pre-trials enabled the trial owners to get acquainted with, and test, the BANs and the user manual. Throughout December 2003 and January 2004, the MobiHealth system prototype was tested in pre-trials in Barcelona, Moenchengladbach, Enschede, Luleå and Boden. The purpose of these pre-trials was to evaluate the performance and user-friendliness of the equipment; and to provide data to the system providers for the final trials of the MobiHealth system in January and February 2004.

The MobiHealth system was meant to serve as a decision support tool for the caregivers. Hence, the evaluation methods needed to reflect a wide spectrum of different rehabilitation contexts, and both qualitative and quantitative methods were considered. The aim of the end-user evaluation was to describe to what extent user needs were satisfied.

In the remainder of this paper, we focus on the development of the MobiHealth usability evaluation questionnaire.

Development of the MobiHealth Usability Evaluation Questionnaire

Initially the different trial owners wanted to have their own evaluation forms, including questionnaires, logbooks, field notes and diaries. After some discussion they agreed to develop one standard questionnaire. Subsequently, the questionnaire was developed in cooperation between trial owners and researchers for use by both patients and professionals in all trials. It was done in three steps: 1) identification of the relevant dimensions of the questionnaire 2); literature search about the relevance and importance of these dimensions; 3) development of questions covering these dimensions; 4) final selection of the questions by consensus.

The dimensions included functionality, user interface and ease of use, effectiveness, satisfaction and safety, functional needs, mastery and empowerment, activity, mobility, quality of life, life satisfaction and ethical considerations. Consensus about the relevance of these dimensions was reached in workshops involving all trial owners. A literature search was performed to confirm the relevance and importance of these dimensions. All trial owners were asked to contribute relevant questions covering each dimension for their specific trial. Subsequently, the questions were put together in one standard questionnaire. It was translated to English and back to Swedish again to verify the face validity of the questions. Responses to questions used a five-point ordinal scale where 1 = do not agree at all with the statement and 5 = agree totally with this opinion. In the final step, all trial owners had the opportunity to add and/or eliminate irrelevant questions until consensus was reached the final form.

The literature search included Medline, Cinahl and Psychlit to identify the relevant dimensions for the questionnaire. The following dimensions were found to be relevant.

Functionality or Usability

Three types of user needs were found to be relevant; functional, aspiration and physical:

- **Functional needs include;** the requirements of the system to perform the specific tasks required by the users in a specific situation. Health care professionals were asked whether the system was accurate, valid, robust, fast enough and whether the service was available when they needed.
- **Aspirational need;** represent the requirement to support the personal goals of the user, ranging from the basic need for security to desires for interpersonal affiliation.
• Physical needs include; the suitability of the MobiHealth solution for the physical characteristics of the user. Did the unit and the service carried out in the trial affect the user’s environment in terms of ergonomic conditions?

User Interface and Ease of Use
The user interface consists of the hardware and software provided for the user to interact with the product. The user manipulates some type of control device and outputs (the product’s responses to the users inputs) are usually presented on some type of display. The product’s software logic defines the relationships between user inputs, system states and product outputs. The design and testing of user interfaces and ease of use are very important for products controlled by microprocessors. It should be user-centred.

Effectiveness
Quantitative evaluation of user’s performance such as effectiveness is an important dimension of usability evaluation.

Satisfaction and Safety
Subjective satisfaction with a product is a relevant dimension of usability evaluation. Safety is also an obvious criterion for a usable product. An unsafe product is neither effective, efficient nor satisfying. An evaluation of safety can be used to ensure 1) that a product is reasonably safe for its intended use, 2) extending such safety to include foreseeable misuse, including use by unintended users, especially children and the elderly, 3) identify those at risk, 4) identify the likelihood of injury and 5) highlight possible design improvements.

Mastery and Empowerment:
Mastery refers to the perception of the results of one’s own behaviour, i.e. the perception of having produced a successful outcome. Mastery depends on the perception of and evaluation of the results of the individual’s own behaviour (performance) and emotions.

Empowerment is a process of giving official or legal power or moral authority. It transfers power from one individual or group to another. It is clearly linked with individual self-responsibility, self-determination, self-care, and personal control. Empowerment can be seen as a process of providing people with opportunities and resources needed to understand and change their condition. Positive self-esteem may enable the individual to set and reach goals; give a sense of control over life and change processes; and provide a sense of hope for the future.

Activity and Mobility
Activity and mobility measures can be applied for different actors: patient, caregiver, health care professional etc. In terms of working life, mobility can be defined in three modalities: wandering, travelling and visiting. These modalities are useful when evaluating mobility in trials, and they are included in the International Classification of Functioning, Disability and Health (ICF) guidelines on activity and participation. The ICF has been accepted by 191 countries as an international standard. Using the ICF framework, the effects of impairment associated with health conditions are explored. While traditional health indicators are based on mortality rates, the ICF shifts the focus to “life”, i.e., how people live with their health conditions, and how these can be improved to achieve a productive, fulfilling life. It has implications for medical practice; for law and social policy to improve access and treatment; and for the protection of the rights of individuals and groups.

In the MobiHealth project, the mobility of patients and caregivers mobility was evaluated and measured in different ways, including self-reported activity, the ability to be in different places while still conducting the trial, diary, step-length and walking distance. For example, “What is it like to move around wearing the MobiHealth BAN?” “Can you use your hands and still be connected to the BAN?” “Can you be out in the forest picking berries and still wear the BAN and be connected?”

Quality of Life and Life Satisfaction
Health-related quality of life includes different dimensions such as physical and mental health, everyday function, social role and general well-being. This is based on a holistic view, which presupposes balance between body and mind, and a harmony between the physical and psycho-social environments.

Because of the large variety in generic and disease-specific quality-of-life instruments,
each trial owner had to decide prior to the beginning of the trial which quality-of-life instrument would most suitable for them while keeping the core purpose of the evaluation.

Ethical Considerations
In recent years, there has been a significant shift from a dependency culture to empowerment philosophy and a more formal shaping of ethical values in rehabilitation\textsuperscript{12,13}.

Discussion
This paper described the development of the MobiHealth usability evaluation questionnaire. The official aim of the MobiHealth evaluation was “to include effects of the interventions on the participants and their families, the experiences of using new techniques, the experience of dependence, independence and power to influence both the person or family or staff”. The main task of MobiHealth was to deliver a flexible and dynamic service to patients and health care providers with a focus on optimal utility and usability. The dimensions in the usability evaluation questionnaire were developed with this aim in mind. This may explain the variety of dimensions, from usability to ethical dimensions.

Earlier research suggested that several dimensions were related to and relevant in a usability evaluation. The development of evaluation measures that are of high scientific quality in ongoing. Today, evaluation instruments can vary from being on Level 1 (meta-analysis of randomized trials) to Level 4 (consensus between professionals in the field) (1). In this study the usability evaluation questionnaire is at Level 4; since it was developed on the basis of consensus between professionals in different countries together with researchers in a step-wise process. Rehabilitation is a multi-disciplinary and complex process and the small numbers of patients in the trials made randomized controlled trials designs inappropriate here.

The step-wise process to reach consensus was beneficial. It assured a close interaction between researchers, technology developers and end-users. However, there were differences between the different sites in terms of cooperation. Nonetheless, the evaluation questionnaire underwent several iterations before it was finalized. This was carried out in close cooperation between trial owners and technical partners, in weekly “face-to-face” meetings, and also every six months between all project members.

There were also problems in the developmental process. It proved to be difficult to identify the "best way" to evaluate new information systems or services. The technologies were still in a prototyping phase. The question “to what extent do this new technology fit in with or change the earlier process or way of doing a certain kind of health service delivery” was asked many times during the process. Qualitative interviews were used only a few times. It was also difficult to conduct the qualitative interviews with many partners and countries involved, which entailed linguistic differences.

The dimensions chosen showed were not equally useful. The questions about functionality, user interface, effectiveness and efficiency gave useful results from the patients and personnel. Satisfaction and safety questions were also answered, but the personnel and patients had to refer to a prototype and not a definitive product. The dimensions “mastery and empowerment” and “quality of life and life satisfaction” were answered in a neutral way. The same was true for mobility. Both patients and personnel were looking at the future potentials of the product, and only a few negative opinions were expressed.

In this process usability includes accessibility aspects as well as subjective perceptions of how well the design of a system or service enables functioning and well-being from the user’s perspective\textsuperscript{3}. In summary, the results of the evaluation showed that all users could see a clear need for a mobile system and they had high expectations from the start. However, the system which was delivered and tested in field trials was not up to the expectations of the users. Hence, expectations had to be lowered among the users (especially the patients). This perception varied from site to site, and seemed to vary depending on the closeness of involvement between the technical developers and the users.

Conclusion
The MobiHealth usability evaluation questionnaire has been developed in a step-wise process between theory and practice in a multi-
professional cooperation between professionals in different fields in different countries together with researchers. It can be used as a basis for method development when evaluating mobile care and rehabilitation devices, but should be tested for reliability before use.

References


