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The Importance of Including Users in Clinical Software Evaluation: What Usability Can Offer in Home Monitoring

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Abstract

Background: Information Communication Technologies (ICTs) have been used in health care for many years. The impact of any ICT on its users, ie the nurses, doctors, patients, administrators and managers of healthcare facilities, is critical. It is necessary to ensure primarily that any new technology does not harm the patient and also that users do not get frustrated implementing it. A usability evaluation is designed to measure 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 (ISO 9241-111). In the clinical environment, little attention has been given to usability evaluation of ICTs, therefore there is minimal evidence of the usability of these systems or products. **Objectives:** The objective of this paper is to describe benefits of performing a usability evaluation, in context, of a home monitoring device where (1) patients perform guided measurements daily, and (2) nurses monitor patients via a web interface, from the hospital. The context of chronic disease, age and home environment are all factors in this study of patients with Congestive Heart failure and Chronic Obstructive Pulmonary Disease. **Method:** This study uses a mix of qualitative and quantitative data to assess the usability of home monitoring (Remote Patient Monitoring) at Austin Health. Patients use both software and the measurement instruments in their home and clinicians then use the web interface to check and monitor the patient's progress. As the focal variable of the evaluation is how the user normally utilises the system, both groups of participants were observed, videotaped and interviewed, in their own environment, this was at home for the patients and in the workplace for the clinicians. This data set becomes the baseline data from which the analysis is built upon to identify any usability issues. **Results:** The evaluation provided information on individual usability defects that have been classified following pre-defined criteria, and ranked regarding how critical they are (high, medium or low). No highly critical issues were uncovered, but many issues relating to guidance and prompting that led to confusion; and lack of functionalities that led to the users having to find work-around to achieve their tasks. The findings of this usability study identified a number of areas that impacted on the instructions to the patients on how to use the system effectively. The clinicians indicate that context is required when developing software to eliminate confusion or workarounds by the user. Particularly when patients are using systems in their homes **Conclusion:** The need/importance of performing independent usability of a home monitoring device has been demonstrated in this study with a range of defects being identified which would assist the patients with their daily measurements and improve the clinician web interface into a product that better suits the clinician.

Keywords:

Usability, home monitoring, remote patient monitoring

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Introduction:

In the past few decades, ICTs in healthcare have impacted clinicians' work more and more. However, during the development of these ICTs, user-centred approaches are often ignored (Beuscart-Zéraphir, M.C. et al., 2007). The main interest of current developments in the clinical environment is for ICTs to support clinicians at their point of work (Hullin, C., 2005). Since the 1990s, many organisations that dealt with healthcare ICTs tried to understand the role of human factors (Beuscart-Zéraphir, M.C. et al., 2007).

With the intensified introduction of ICTs in home healthcare in recent years, patients have become another big user group (Gosbee, J.W., 1999). Their requirements differ from healthcare professionals for example in the lack of medical knowledge. This study is looking at the usability needs of nurses within their clinical environment as well as trying to understand the usability needs of the patients in their homes, based on a usability evaluation of a Remote Patient Monitoring System. The application of usability evaluation in healthcare exists but is still in its infancy in contrast to other sectors where ICTs are used (e.g. business software or sales and customer web portals). Unlike the assessment of usability, the evaluation of ICTs in healthcare concentrates on functionality, patient's safety and cost reducing.

Literature Review:

This study uses the international standard, ISO 9241-11, which defines usability based on three main focuses:

> *"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."*

Effectiveness means how complete and accurate users achieve the aim of the product. Efficiency focuses on how much effort users require to achieve the aim in using the product. Satisfaction concentrates on what users think about the product and whether they like using the product.

N.C. Goodwin (1987) comments that usability affects how a system is used and its effectiveness, and even whether or not it is used at all. In healthcare poor usability might also lead to low morale as clinicians and patients blame themselves for not being able to use the newly introduced technology. Further, poor usability of ICTs in healthcare can cause errors which could harm the patient's health and even lead to their death (Hullin, C., 2005; Kushnirku, A.W. 2003). But when looking at the usability another impact should be considered, which differs from effectiveness and patients' safety: the context.

The context in which the ICT is used influences usability as well. In the clinical environment clinicians need to be highly mobile and their working place is intense and stressful (Kjeldskov, J. et al., 2004). Interruptions are much higher than in most other working environments. The patients have individual restrictions because of their diseases and aging process, and are performing measurements in a domestic environment with limitations and interruptions.

Mobility influences the usability of a system and is difficult to simulate for example in laboratory settings (Kjeldskov, J. and Graham, C., 2003). Furthermore it is hard to simulate the interruptions during the work of clinicians as well as the patients' individual diseases. In the healthcare environment the users' context has an impact on his needs.

Evaluation of usability is needed to assess if users can work with the functions of the ICT and if these functions meet the users' needs in the context of use. Usability distinguishes from the functionality of an ICT. As identified by Dumas, J.S. (2003) functionality shows what the system can do; in contrast usability refers to how users work with the system.

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Usability Evaluation Approaches and Methods:

As mentioned before, a usability evaluation will assess if the technology under test, meets the requirements of its users, in its context of use, and if users are satisfied with it. Furthermore aesthetic, emotional, engaging and motivating qualities can also play a role (Rogers, Y. et al., 2003).

Usability evaluation is a key component of the development of ICTs and improving existing ICTs and can be used in different stages of the product lifecycle (Rogers, Y. et al., 2003). In healthcare usability evaluation should not only be used to improve existing ICTs, but as a starting point should be applied when designing and introducing new technology (Beuscart-Zéraphir, M.C. et al., 2007). It is important to understand the implications and requirements of usability to the healthcare environment, as good usability is a key factor of the successful adoption of new ICTs by its end-users (Rogers, Y. et al., 2003). The approaches can be divided into user based, expert based and model based methods. The underlying methods differ for example in their type of participants (e.g. usability experts or representative users) or in the location (laboratory or field).

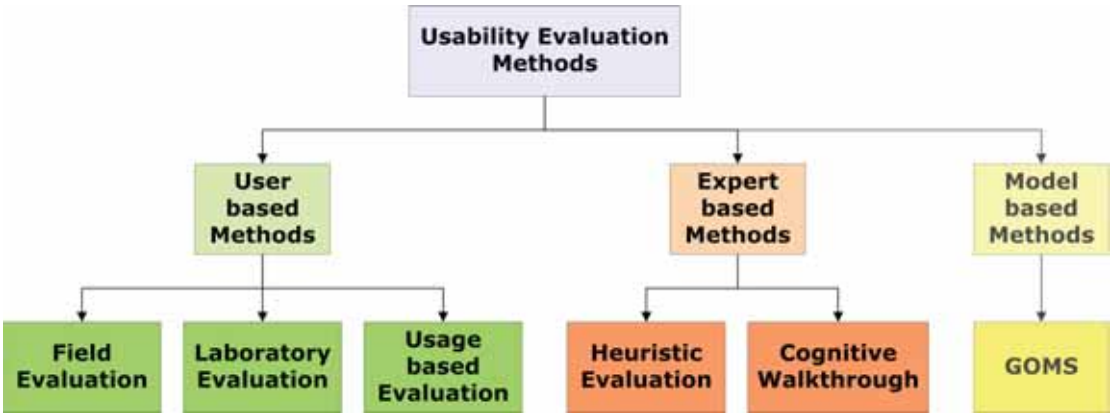

Figure 1. *Classification of Usability Evaluation Methods*

Method:

The chosen method was to conduct a user-based evaluation in the field (see Figure 1, method on the bottom, left hand side). The usability evaluation is based on observation and semi-structured interviews - to extract both qualitative and quantitative measurements.

The major usability evaluation goals were identified as:

- The users are able to use the technology and can adopt it to their daily life or work
- The technology is safe to use and builds confidence
- The technology supports the users and the dialogs and texts are understandable

The method employed in this investigation does not depend on statistical reliability outcomes. A usability evaluation aims to follow the most effective way to reach saturation in the number of usability defects the evaluation will highlight. As stated by Nielsen (1994) and illustrated below, running more test subjects increased the number of problems found, but with progressively diminishing returns; after five test subjects 77-85% of the critical problems had been found."

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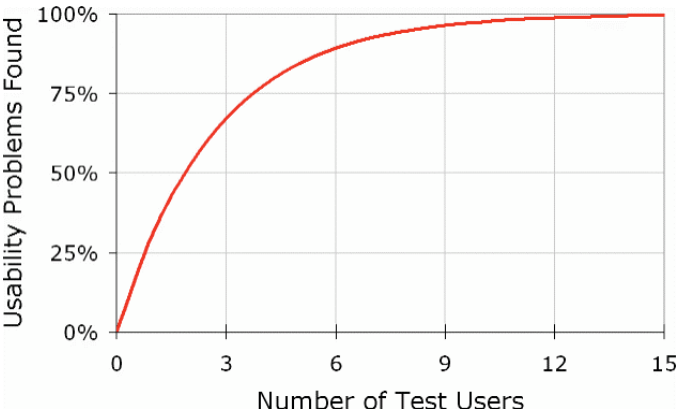

Figure 2. *Graph showing the Usability Problems Found depending on the Number of Test Users (Nielsen, J., 1994)*

Participants:

Patients on Home monitoring: 5 patients were evaluated in their own homes.
Clinical staff: 2 Clinical nurse consultants who use the system on a daily basis were evaluated in their workplace.

Techniques:

During the evaluation each user was observed and video taped while interacting with the health monitor by going through their normal routine. The user was asked to think aloud to gain more information about the user's thoughts, feelings, opinions and working process - when possible and if comfortable, as for some patients talking can be difficult. A post-observational interview enabled the researcher to ask details about difficulties and the user's background.

Results:

As summarised in table 1, few critical usability issues were found.

	Critical	Medium	Low
Patient interface *example*	3	10	9
	Does not allow for interruptions	*Insufficient prompts whilst loading*	*Difficulty to remove cuff*
Clinician interface *example*	1	18	2
	Alerts are ordered by measurements, not by date	*The patient list is not ordered*	*No help is provided, while a "Help" menu exists*

Table 1. *Number of usability issues found and examples.*

Results from patient interface:

The most common problem found during observation of the users' interaction with the system was a problem of guidance. The system itself should prompt the users and guide them with clear instructions on how to take their own measurements correctly. The system should take into account the physical limitation of elderly and ill users, and build secondary feedback mechanisms into the system where audiology may be replaced by vibration, or a visual cue on the screen, to improve the user experience.

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Another significant issue that users found with the system was lack of user control. One user in particular complained that the Measurement Schedule did not allow for interruptions during use, like a phone call. The user had learnt to work around this, however this method of circumventing the limitation of the system is not ideal as it depends on the patient's memory of where he had stopped. Also, most patients had learnt to prepare all the items they would need when using the Measurement Schedule, as a delay would not be tolerated by the Scheduled process.

The naming conventions in the system were also noted for improvement. When asked to show the days where measurements were not recorded, a user got mixed up and went to "My Measurements" instead of "My Results". This is a simple problem that can be solved by making the menu options into verbs, eg. "Take Measurements" and "See My Results

Results from the Clinician Web Portal:

On the whole, the usability issues discovered in this area found inadequate functionality for clinician use.

A user suggested that "Ideally I would have all the information on one screen! So I wouldn't have to click for everything. The alerts and the information about the latest data on the left hand side, the graph screen on the right hand side. Maybe all the graphs could be shown minimized to get an initial overview. A lot of work is merely clicking and clicking and clicking." The system needs to better adopt to the users' workflow and their needs. In particular clinicians have time constrains and are often interrupted. A quick and precise overview would help to structure the workflow.

Conclusion:

The results provide information on individual usability defects that have been classified following pre-defined criteria, and ranked regarding how critical they are (high, medium or low). An initial set of recommendations on how to address the issues found during the evaluation were provided. The context of system use was highlighted in the usability study. Age, language, disability, education level, environment, interruptions, and technical experience were all a factor. The benefits of performing usability have been in providing structured feedback, and highlighted the importance of performing independent usability in health care. The context of the application is not to be overlooked and work flow is fundamental to the clinical user in order to maximise the benefits of ICT's in healthcare.

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