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Usability Field Study of Home Health Monitoring Devices Used by Older Adults

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Abstract

The use of telecommunications and home-based medical monitoring devices can provide a 'medical life-line' for the chronically ill, disabled and elderly home-bound persons. Since these medical monitoring devices are used by older adults, frequently living alone, in their homes it is critical to study their usability. Field studies in the home of the older adult are used to evaluate differences in the usability for experienced and new users of a home health monitoring device. Semi-structured interviews and video tape analysis of the participants provide the basis for the quantitative and qualitative measures reviewed in this study. The analysis of the qualitative results show high device and input button satisfaction ratings for both the experienced participants and the volunteers. However, the participant comments during the interview and video analysis provide insights into some of the usability challenges of the device buttons.

Keywords

Human Factors, Usability, home health monitoring, telehealth.

Introduction

The use of technology in healthcare is becoming more essential as the 'baby boomer' population ages and the caregiver population shrinks. There is a growing need for easy to use, mobile home-based health monitoring of the aged and chronically ill.
Telehealth and telemonitoring are terms used to describe the use of technology to remotely connect and exchange information between the healthcare provider and the patient living at home. In the area of telemonitoring, we have seen advances in the past decade in the remote collection and measurement of the patient's health status. The key drivers of this capability are the decreases in the size of the systems required to measure vital signs of basic body functions, such as blood pressure, heart rate, and pulse. Additionally, the complexity and skill required to perform these vital sign and clinical measurements has decreased, as seen by the automated blood pressure measurement devices located in many pharmacies and the glucose measurement meters used by most diabetics to monitor their own glucose levels. As these devices become a part of our everyday lives, we need to assure that the designers and testers have focused on the usability factors. The home health monitoring devices, used primarily by older adults, must be easy to learn, easy to use and easy to remember. Consideration must also be given to older adult limitations in the ability of the see and hear while interacting with the device to assure accurate patient use in their home.

Related Work

The primary focus of telemedicine and telehealth studies over the past decade has been outcomes, costs, satisfaction, quality, telemedicine adoption by physicians and organizations, and telehealth success. While the study of mobile home health device usability testing, in the healthcare domain, is becoming more prevalent, the majority of the mobile device usability studies in healthcare have focused on the use of Personal Digital Assistants (PDA) by nurses and physicians [7,9] and the use of glucose meters [4,6]. Older adult usability studies have considered the use of mobile telephones [1] and PDAs [8]. Few research studies were found evaluating the usability of health monitoring devices used in the home. [2, 3] The Kaufman et.al. [3] study evaluates usability of patients in their home using a desktop computer-based health care system for diabetes health care. While the Farzanfar et.al. [2] study evaluates two automated home-based patient management systems usability. The first system is a computer telephony based Diet Adherence system for dyslipidemia was conducted in the research offices and the second is a personal digital assistant and internet based home asthma system was conducted in the patient's home. No studies in patient homes were found in the literature evaluating the usability of home health monitoring devices for vital signs and health related questions. Yet the key factors for the successful adaptation of these home monitoring devices is usability and accessibility. Janine Purcell in her article "Home Use of Medical Devices" quotes Rita Kobb as stating that " Many advances in technology are needed, but none are more important than a concentrated focus on hardware usability by patients." [5]

Experimental Design and Process

The goal of this research study is to identify the usability issues for older adults using home-based health monitoring devices in their homes. This study will provide criteria and recommendations for the improvement of home health monitoring devices.

The study and testing of the usability of mobile monitoring devices by older adults is important because these devices offer new challenges in the smaller size of the mobile monitoring devices, the lighter weight of the devices, the various input methods (smaller buttons, text and font size, readability, color, etc.), and various communication modes (text, voice). The form and features of the devices' human factors interaction between the user and the computerized device and the satisfaction of the users are essential in the evaluation of devices for use by older adults.

The Primary Research Questions

Are home health monitoring devices designed for the usability needs of older adults?

What usability factors are the key features for home health monitoring devices to be used productively and effectively by older adults?

Research Methodology

Phase 1 Survey the Accessibility and Usability perceptions of twenty-one older adults, 50-88 years of age, using a home health monitoring device for more than 7 days, with a

focus on the factors causing difficulties, previous computer use and satisfaction. Semi structured telephone interviews, which in research studies are shown to be effective in obtaining information from older adults, were used to obtain the satisfaction and device use information. A modified Likert scale is used for the responses with a 4 factor scale. A neutral value is not offered in the scale to assure the participants provide a positive or negative response.

Phase 2 Experimental field study observation of older adults using the home health monitor (Device 1) to measure vital signs (weight, temperature, blood pressure, pulse, blood oxygen) and respond to health related questions. Phase 2 of the study includes the video and audio recording of seven older adults (ages 50 - 80), from the Phase 1 study, who are experienced users of the home health monitoring device in a field study in the participant's home. A control group of ten older adult volunteer participants (ages 50 - 80), who have no experience using home health monitoring devices, were also audio and video recorded using the same home health monitoring device in their homes. Following the video taping, the volunteers were ask to responded to a semi-structured questionnaire regarding participant demographics, level of satisfaction with the device and the device features.

Phase 3 Experimental field study using audio and video recording of eight volunteer participants from the phase 2 study using a second home health monitoring device (Device 2) in their homes. Device 2 also measures vital signs (weight, temperature, blood pressure, pulse, blood oxygen) and health related questions. Three volunteers used Device 1 first and then Device 2, while five volunteers used Device 2 first and then Device 1. Comparison of the Device 1 and Device 2 qualitative user satisfaction from the questionnaires and quantitative measures from the video recording were performed.

Measures

Task time, subtask time, error rate, number of questions about how to use the device, number of steps/button presses to perform a task, accuracy (% of errors as compared to total), previous computer experience, age, technology attitude, and satisfaction.

Results and Discussion

The results of the Phase 1 semi-structured telephone interview of experienced older adults using Device 1 indicate that although the satisfaction with the home health monitoring device is high, several participants described usability challenges with the flat buttons on the front of the monitoring device. A key finding of the qualitative portion of this research is that the comments provided to the author during the semi-structured interviews provided much more valuable information about the usability of the home health monitoring devices, than the responses to the questions. The satisfaction rating of more than 90% was given for the use of the data entry buttons, however the numerous participant comments offered issues with the size of the buttons, the location of the buttons on the front of the monitor, the flat surface of the buttons lacking texture, the lack of contrast for the buttons and the lack of tactile feedback for successful pressing of the buttons. The usability of the buttons were studied further in Phase 2 using video and

audio recording of patients and volunteers using the home health monitoring device in their home.

The Phase 2 results show that, for Device 1, the satisfaction and quantitative measures (subtask time, button presses, number of errors, number of questions) are similar in the experienced participants in the test group and the inexperienced volunteer control groups. The average task time to responding to six health related questions was 32.5 seconds for the experienced use group and 30.1 seconds for the inexperienced control group. There were two button press errors by one person in the test group and zero button press errors in the control group.

The Phase 3 results of the qualitative and quantitative studies of Device 1 and Device 2, show that observation and video recording of participants using a home health monitoring device provides more information and insights into the usability of a device than the participants are verbalizing in the responses to the interview.

The button use errors found during the video taping of a participant with Device 1 were based on the lack of positive auditory feedback for a person with less than optimal hearing. And many of the button use errors for Device 2 may be related to the more complex human computer interface of this device and the greater number of button presses required to use this device. The device interaction is familiar to a computer user with 'up' and 'down' arrows to move the cursor bar on the screen and select an item with the 'OK' key. Yet, all volunteers using Device 2 had button use errors.

The hypothesis that user satisfaction will be high for devices with low task time was considered. Chi-squared studies comparing Device 1 and Device 2 computer task time found a highly significant (p=less than .01), however the device satisfaction comparison of the two devices shows similar ratings. These statistics indicate no relationship between device satisfaction ratings and task time.

The order of the device use in the study was, however, found to be important in relation to the satisfaction ratings. Although the volunteers expressed satisfaction with the usability of both devices, two volunteers indicated that they would have rated Device 2 differently on the satisfaction questionnaire, if they had used Device 2 before Device 1, because Device 1 was easier to use. This appears to indicate that participants will rate devices as satisfactory unless they have a comparison device that is easier to use or a very negative experience with the device they are rating. It appears that more refined satisfaction ratings can be obtained by permitting the participants to use both devices first and then performing the device use and satisfaction interview.

Device Button Usability Recommendations:

- Button Location/Spacing –
    - On top of machine or on an angle screen rather than on the front of the machine

    - Space between buttons to avoid double button press or incorrect button press
- Button visual-
    - Button color – bright colors
    - Button contrast - high contrast with background color
    - Button text color – color bright
    - Button text contrast – high contrast with background color
- Button Auditory –
    - Button auditory feedback for button pressing
- Button Tactile –
    - Button texture – different for each button for visually limited persons to differentiate buttons by texture
    - Button tactile feedback upon pressing
    - Raised button to differentiate from device
- Button Operations –
    - Minimize the number of buttons
    - Minimize the number of button presses

Future Research Considerations

A future study could involve a larger population of participants to provide statistically significant evaluation. A comparison of additional home health monitoring devices would provide a broader insight into the devices on the market today. For more valid information about the use and satisfaction of the devices, the interview would be conducted after the operation of multiple devices for a better comparison of the devices.

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