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Using Personas and Prototypes to Define Nurses' Requirements for a Novel Patient Monitoring Display

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Abstract. Software is often designed based on the designer's mental model rather than the user's. To correct this, we created personas (archetypes) of nurses using observations and semi-structured interviews. We developed and evaluated patient monitoring display prototypes for each persona. Among 11 ICU nurses, we found that the majority of nurses preferred a parsimonious data representation with large numbers and waveforms allowing all relevant data to be visible. Using personas and paper prototypes is an inexpensive and effective way to assess nurses' requirements and design preferences.

Keywords: Personas, nurses, human computer interaction, monitor design

Introduction

In the past, patient monitors were developed primarily for anesthesiologists to observe patients during surgical operations. Nurses, however, are now the largest number of monitor users. Their work design, tasks, information needs and mental models are often different than anesthesiologists. Novel graphical designs for anesthesiologists resulted in increased speed of adverse event detection and more accurate diagnoses (1-3), but these kinds of designs have received only modest attention for nurses (4, 5). New monitor designs for nurses are needed to better match their information needs.

We describe a new method, personas, to elicit user requirements for a new patient monitor design. Personas are archetypes of users that reduce the bias of typical focus groups where more aggressive users can overwhelm others' opinions (6-8). Personas can increase the usability and actual usage of the devices (7). We developed and evaluated prototype monitor designs based upon four personas.

Objectives

This article describes: a) nurses' information needs for monitoring based upon observations and semi-structured interviews, b) related personas, c) prototype monitor designs for the four personas, and d) findings from prototype evaluations.

Methods

Sample and setting. We interviewed 10 MICU nurses from the University of Utah Health Sciences Center to determine personal differences, goals and related information. Next, 11 MICU nurses evaluated paper monitor prototype designs for usability and preferences. The study was approved by the local Institutional Review Board.

Personas and Prototype Designs. To create personas, we asked nurses semi-structured questions about their care goals and demographic information, e.g., "What's your goal

in patient care?" Among others, key variables were: age, whether nurses were technologically-savvy, their nursing expertise, and whether they were more proactive or reactive in their approach to work. Using these key variables, behavioral profiles were created for each nurse. Later, similar profiles were merged to create four diverse personas, archetypes that differed on at least one major variable.

The first persona was *Melissa,* 30 years old, experienced in the ICU, familiar with computers, and proactive with treatment plans. Possible supportive features are access to knowledge on a wide range of information, charting on the screen, the ability to write tasks for the next nurse, distinguishing alarms according to urgency, and customizing the display to individual needs. The prototype in Figure 1 was designed to satisfy these needs.

Figure 1: Interactive prototype, showing waveforms and numbers in the familiar way. Laboratory results, the patient history, charting, and doctor's orders can be pulled up, as well as tasks for the next nurse, e.g. planned antibiotics, can be noted; colleagues can be contacted for help from inside the room.

The second persona was *Rosanne*, 60 years old with decades of ICU experience. Although familiar with computers, she does not like them and avoids them when possible. Rosanne wears bifocals and sometimes has a hard time remembering little things. Supportive features include: visibility from afar, information to avoid moving between locations, simplistic design, and one button interactions.

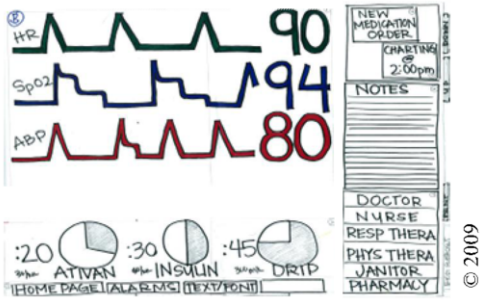

Figure 2: Parsimonious, static prototype, showing basic information. Filling levels of medication are visible from afar. The text/font size can be adapted with one button. Notes can be taken on the screen, and coworkers can be contacted with one button. The display also allows the nurse to see recently issued doctor's orders from inside the room.

Carter, the third persona, is a novice in the ICU, with six months of experience. By independently reading books, he gradually figured out the big picture of patient monitoring. New devices are his passion. A useful display provides him with all additional information when needed, e.g. how to perform rare tasks or what the change in a specific vital sign might mean. Trending information helps him grasp the big picture, and a task list helps him organize his day.

Figure 3: This display is detailed with interactive task lists with details about procedure upon interaction. Carter's big-picture stance is supported by standard trend views of vital signs, by scanning medication and showing the physician's order, the maximal rate and compatibility for medications. Touching a vital sign gives additional information, e.g. normal values.

Joseph is new to the ICU. Being reactive, he waits until someone tells him what to do or something happens before he goes into action. He likes focusing on completing all tasks with no interruptions. Being more social, Joseph asks others how to do procedures and when such procedures are necessary. The display is simple and easy to understand (intuitive). This allows him to see and organize upcoming tasks, and allows him to consult others.

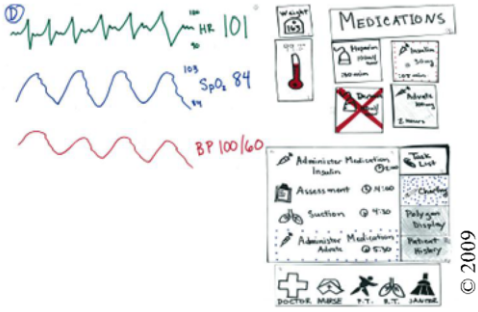

Figure 4: Display, where *changes are displayed saliently, e.g. in the patients vitals or display setting.* Symbols increase intuitiveness, and communication is easily accessible. Display shows the minimal amount of information necessary to monitor the patient or types of tasks easily recognizable by symbols.

Prototype evaluation procedure. All four prototypes were presented to nurses in random order. We explained each element of the prototypes and asked participants' opinions about novel patient monitor displays. We asked users to comment on the intuitiveness of the content, requiring that they tell us how they'd expect something to work before informing them of our actual implications. Then nurses chose the display they felt was most useful for their own way of working as well as the one they preferred most. Finally, we asked them to construct their own personal prototype by combining elements from all prototypes in order to distinguish preferences about single elements within displays.

Results

Among participants, six nurses matched the persona Melissa with 83% of their self-assessed behavioral variables (see Figure 1), two matched Carter at 75% (Figure 3), one matched Rosanne (Figure 2) and two matched Joseph at 83% (Figure 4). Nurses chose the prototype designed for their persona 45% of the time. Pure chance would have been one out of four or 25%.

Perceived Usefulness. The second prototype, Figure 2, with large display elements and no necessary interaction was perceived as most useful in daily work by 5 of the 11 nurses (45.5%). Figure 1, integrating more data and minimal interaction, was chosen next at 27.7% (3), followed by the interactive and high information content in Figure 3 (2). The guided display for a novice, Figure 4, was lowest (1).

Usefulness of single elements. Eight of 11 nurses deemed these elements most useful: The ability to administer medications by scanning them, seeing current orders, and medication compatibility. Next, nurses chose: Charting on the screen e.g. temperature, urine output, and neurological status (n=5), setting up tasks for other nurses (5) and the large waveforms in Figure 2 (5). 4/11 nurses chose the medication representation (4) as well as the communication (4) on Figure 4. Only three nurses chose the smaller waveforms on Figure 1, and 3/11 chose the task list on Figure 4.

Preferences. The simple prototype, Figure 2, was preferred by 36% (4/11). This was closely followed by Figure 1 (3/11) and Figure 3 (3/11). Only one nurse preferred Figure 4, the guided prototype.

Discussion

The use of personas allowed divergent displays to be developed and evaluated. In this study, nurses preferred a traditional physiological display with parsimonious elements, large fonts and all essential data remaining visible. Nurses chose displays with which they were most familiar. The next most preferred display included complex data and interactions. The implications of these close preferences may mean that designers should create a display for some nurses that is parsimonious with large fonts and have a second, selectable display with complex interactions, integrated data and access to knowledge resources for others.

The use of personas is economical in time and programming resources because major display elements can be determined before any software coding occurs. Most importantly, differences between the designers' ideas and nurses' information needs can be elicited, e.g., in this study nurses wanted a task list showing additional tasks beyond those usually performed during a shift. Overall display preference was less useful to designers because two of the displays scored nearly the same. The more helpful aspect was single element selection. This allows designers to combine elements into a display that was not yet conceived. In the future, researchers will want to include this component into their persona analyses.

This study was limited by the relatively small sample size of 10 and 11 nurses. However, Nielsen (9) indicates that even 5 to 8 users can detect 80% of design flaws. While many nurses' choose the prototype designed for them, to reach a higher match in future studies, the prototypes could be modified to even more closely match the nurses' specific expectations.

The prototype evaluations also occurred in the ICU setting, an environment where inherent interruptions could have impacted nurses' attention during assessments. Further, nurses' preferences might change with more exposure and practice (10). In the future, informaticists will want to provide more training and practice before asking the users about preference and usefulness.

Conclusions

Using personas allowed us to imagine a broad range of diverse functionality in the initial prototypes, a robust start to discuss possible features with nurses. In the future, researchers could spend more time enhancing and verifying the constructed personas with nurses before designing the display prototypes. This would allow displays to be designed even more accurately to meet the personas and ultimately nurses' information needs for patient monitoring displays. The next steps in this research will focus on expected information content of the highly preferred and compare novel ways of representing data.

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