

Order Entry Interface for a Computer-Based Patient Record System

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Abstract

PDA (Personal Digital Assistant) technology is beginning to emerge as a viable technology for accessing and updating patient records. A handful of studies can be found in the literature on the use of PDAs for accessing patient's records. However, none have actually presented a formal usability study of user interaction with these systems. In this paper we describe a usability study in which we compared two versions (PDA and laptop) of an application to access an electronic patient record system in terms of the efficiency and satisfaction achieved by physicians while conducting typical tasks.

The results of the study revealed that physicians are significantly faster on a laptop than on a PDA reading and performing tasks that require text entry. However, they are significantly faster on a PDA than on a laptop performing tasks that only require pointing and clicking. In general they are significantly more satisfied with the actions performed to complete typical tasks on the laptop than on the PDA.

1. Introduction

Because physicians spend a great deal of time in order entry tasks, most electronic patient record systems today are based on physicians order entry (POE). Physicians need a reliable and simple way to do orders. Depending on the specialty, setting and time, physicians' needs and preferences may vary. Some physicians may prefer to use a PC or notebook, while others may prefer hand held devices, and some may even consider using a combination of both. To provide different options, we have implemented two versions of an order entry interface, one for PCs and the other for hand held devices.

Also a user study was conducted, using these two interfaces, to measure usability

issues like: efficiency, user satisfaction, and the ease of learning to use the system.

Recent studies that have focused on measuring user satisfaction with order entry systems. The medical Gopher, a text-based electronic order entry system for direct physician order entry (POE) [Overhage01] is an example. This study revealed that physicians using the Gopher do not spend any more significant time writing orders than physicians using paper-based methods. The study also showed that physicians were satisfied with the system because they believed that the system improved patient care. Another study used a command-line interface using natural language [Lovis01]. The authors in this study measured time and satisfaction in completing a standard set of orders. The study revealed that physicians found the command-line interface easier to learn and faster to use than the usual menu-driven system. A study was made to measure user satisfaction in two order entry systems [Murff01]: a commercially available product using a character-based interface, and the Department of Veterans Affairs Computerized Patient Record System (CPRS) with a graphical interface. The study showed that physicians were more satisfied with the graphical system than the character-based system. In another study [Bates96] a survey was sent to physicians and nurses POE users to evaluate user satisfaction, correlates of satisfaction, and self-reported usage patterns. The study showed that satisfaction with POE was good and was more correlated with perception about POE's effect on productivity than on quality of care.

2. System Description

Our prototype is a computer-based medical record system for physicians. The system provides a graphical user interface with separate windows for viewing the patient record and for order entry. The View Record interface remained basically the same as the original version [Murillo02], but we have changed the design of the Order Entry interface with a new approach.

The Order Entry interface provides all the capabilities to do orders and notes. The new Order Entry interface for PCs (figure 1) displays the medical information similar to a directory tree. This tree provides a summary of the current patient's intervention. The new interface provides a top bar always visible to the user, with information about: the age, sex, weight, height, the name of the primary care physician, the insurance company, and the allergies of the patient. The system has ten main buttons with options for entering information on the patient's record and for order entry. The Complaints, Physical Exam, Problems, Notes and Diagnosis buttons are used for documenting physicians' assessment on patients. The Medications, Laboratories, Studies, Consults and Miscellaneous buttons are used for entering orders. When any of these buttons is selected a new window appears with the corresponding interface to enter the desired information. When the window is closed a new entry appears on the directory tree. Every entry of this tree structure corresponds to the information entered with the buttons. The entries can be expanded so that the user can see the full text of the information corresponding to the entry. The information can be hidden any time the users desires to do so. The remaining four buttons are used to clear the tree, remove individual items of information, save all the information to the record, and save a draft of the current information. Information already shown in the tree can be edited by double-clicking the information and making the changes on the new window that will appear.

The Order Entry interface (figure 2) for hand held devices is very similar to the one for PCs. This interface also displays the medical information similar to a directory tree. The top bar provides information of the name of the patient, the age, sex, weight and height. The system has eight main buttons: complaints, notes, diagnosis, medications, laboratories,

studies, consults and miscellaneous. The functionality and format of the information displayed is basically the same as the interface for PCs.

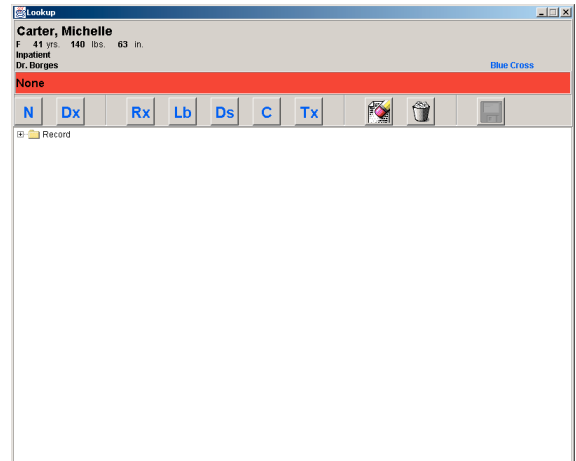


Figure 1. Order Entry User Interface for PC Version

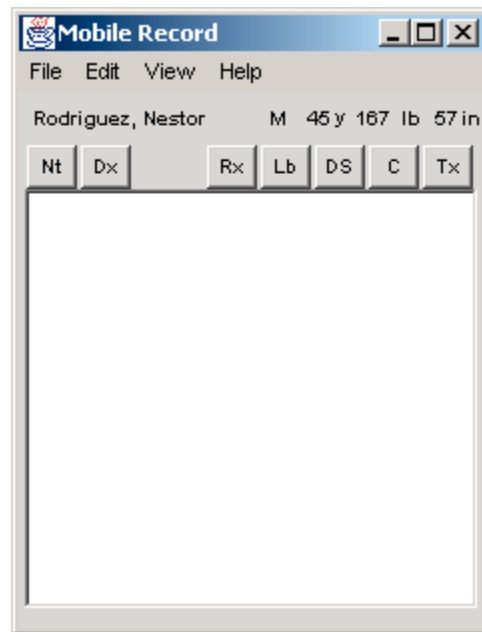


Figure 2. Order Entry User Interface for PDA Version

3. Usability Study

3.1 Research Design

Two versions of an application to access an electronic patient record system were used for

the study. The participants were asked to perform 7 tasks on each version. The tasks were the same in both systems. Ten of the participants performed the tasks first on the PDA version and then on the laptop version. The other ten participants performed the tasks first on the laptop version and then on the PDA version. All the participants were given a short tutorial of about 6 minutes on both versions. After performing the tasks on both systems the participants were asked to fill out a subjective user satisfaction questionnaire. The questionnaire asked the participants to rate 5 activities on a 1-7 scale (1 being poor and 7 being excellent) for each version. The activities were the following:

1. looking up vital signs list
2. reading results
3. ordering medications
4. ordering laboratory tests
5. writing notes

3.2 The Tasks

Each participant was asked to perform on each version the following tasks:

1. Indicate the age and weight of the patient.
2. Find the most recent vital signs.
3. Read the result of a CHEST (PA & LAT) study.
4. Order Ibuprofen 400m PO Q8H PRN
5. Order Heparin 5000 units SC Q24H
6. Order the SMG6 and CBC laboratory tests
7. Enter specified text as a note.

In addition the participants were asked to mention the things of each version they found easy to use and difficult to use. They were also asked to comment on anything else they wish to about each version.

3.3 Statistical Analysis

The dependent variables of the study were time to complete the tasks, number of task completed, and the subjective user satisfaction. A dependent-samples *t* test was used to compare the time to complete the tasks. A Wilcoxon sign-ranked test with an α level of .05 was used to compare differences in user satisfaction. Linear regression was used to evaluate the learning effect between the two versions.

4. Results

A dependent-samples *t* test revealed a significant difference on the average time it took the participants to complete all the tasks on the PDA version and the laptop version $t(19) = 13.45, p < .05$. The participants completed all the tasks in significant less time in the laptop version ($mean=199.7, SD=31.5$) than in the PDA version ($mean=370.4, SD=58.54$). Overall, the participants were 46.1% faster with the laptop version than with the PDA version. A linear regression indicated that there was a significant learning effect carried by the participants from the laptop version to the PDA version but none from the PDA version to the laptop version.

With the exception of task 1 dependent-samples *t* tests revealed a significant difference on the average time it took the participants to complete individual tasks with the PDA version and the laptop version. For tasks 3 to 7 the participants were faster with the laptop version than with the PDA version (see table 1). For tasks 2 the participants were faster with the PDA version than with the laptop version.

Table 1. Means, Standard Deviations and Speedup for Completion of Individual Tasks.

Task	PDA Version		Laptop Version		Speedup
	Mean	SD	Mean	SD	
1	3.3	1.5	2.9	1.3	12.3%
2	3.5	1.6	4.8	2.0	27.4%
3	30.6	4.4	27.2	4.2	11.7%
4	54.6	16.5	31.1	6.8	43.0%
5	40.7	14.0	24.4	7.0	40.0%
6	79.3	39.6	57.6	19.8	27.3%
7	158.5	26.34	51.8	15.1	67.3%

Most of the participants were able to complete all the tasks. Table 2 shows the number of participants that completed each of the tasks for each version of the application.

Table 2. Number of Participants that Completed Each Task.

	Task						
	1	2	3	4	5	6	7
PDA	18	20	19	19	20	18	20
Laptop	19	20	20	20	20	20	20

A Wilcoxon test revealed a significant difference in overall users satisfaction. The

participants were more satisfied with the laptop version ($M=5.73$) than with the PDA version ($M=4.65$). Wilcoxon tests also revealed significant differences in user satisfaction in all individual activities except for looking up vital signs. The relative difference in satisfaction rating for each activity on each version can be appreciated in figure 4.

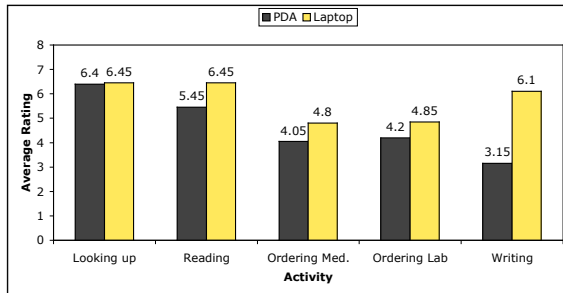


Figure 4. User Satisfaction Rating for Each Activity on the PDA and the Laptop Versions.

5. Conclusion

Physicians are significantly faster performing tasks that require text entry on a laptop than on a PDA. They are also significantly faster reading on a laptop than on a PDA. However, they are significantly faster on a PDA than on a laptop performing tasks that only require pointing and clicking. In general they are significantly more satisfied with the actions performed on the laptop than on the PDA. Tasks that require text entry are the most difficult ones to perform on the PDA.

Considering the high percentage of task completion in both systems and the short tutorial given to each participant on each of the versions of the application used in this study we must conclude that both applications were easy to learn.

The results of this study suggest that limitations of the user interface of the PDA had a significant effect on the performance of the physicians and their user satisfaction. Its small screen and in particular its text input modalities are key elements of the user interface that affect physician performance and user satisfaction. Unless text input modalities are improved, user interfaces on the PDA should be designed in such a way that text entry is minimized. Tasks requiring a significant amount of text entry

should be left for applications running on laptop or desktop computers.

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