
Andre W. KUSHNIRUK a,1, Kristin MYERS b, Elizabeth M. BORYCKI a and Joseph KANNRY b

a School of Health Information Science, University of Victoria, Victoria, BC, Canada
b Mount Sinai Medical Center, New York, NY, USA

Abstract. The relationship between usability and training remains to be explored in health informatics. We examine the training given during the implementation of an institutional electronic medical record system, as well as the usability of the system from the perspective of new users who have been recently trained. We examine in which ways video-based usability testing with new users, who received classroom training one month earlier, can be used to a) indicate needed changes in the training program, and b) provide feedback to improve system customization and deployment. Usability testing methods were found to be an important adjunct to system deployment: they can improve the system implementation as well as suggest strategies for user education.

Keywords. usability testing, usability engineering, electronic medical records, electronic health records, user training, system deployment

Introduction

Implementations of complex healthcare information systems (such as electronic health records) require careful consideration of both system design and customization as well as an understanding of the effective approaches for training new users. Indeed, learnability (i.e., how easy it is for users to learn and master system functions and be able to transfer this learning to real situations) and usability (i.e., a measure of how easy it is to use a system) have a close relationship, with some authors considering usability as one of a number of key components of overall system usability [1-3]. Effective user training will ensure that users are able to have an optimal starting point for working with new information systems. Even if they have not had a chance to master all features, they will have obtained a strong foundation for exploring a new system over time and will likely encounter fewer problems in interacting with systems. However, not all training approaches may be effective in complex areas such as health informatics. Indeed, there may be considerable room for improving training based on feedback that could be obtained from conducting usability tests with health professionals who have recently taken training courses in use of a newly implemented

1 Corresponding author: Dr. Andre Kushniruk; e-mail: andrek@uvic.ca
system. In this paper we describe a usability evaluation of the implementation of a commercial electronic medical record (EMR) system at Mt. Sinai Medical Center. The EMR was being implemented at Internal Medicine Associates which has 50,000 to 60,000 visits annually, with patients seen by 139 housestaff, and 45 attending physicians from November 28, 2006 to March 19, 2007. Based on our experience, we suggest that there is a close relationship between training and usability. This relationship remains to be explored and warrants further study.

1. Methods

   Subjects: Five subjects took part in the usability study. All of the subjects were physicians who had been using the system under study for approximately four weeks after taking part in a classroom training session about its use (none had used the system before taking the training session).

   Materials: A commercial EMR was implemented, for which training was supplied (and which was used during the usability testing). In order to carry out the usability study two representative scenarios were designed. The scenarios involved documenting patient history and physical information, entering medications, writing orders, checking alerts, and adding notes and letters (as well as checking the in-box for emails about the patient). The scenarios were presented to subjects as written scripts detailing the patient information and the required tasks (involving the computer system) from arrival of the patient to completion of notes and letters on the patient’s departure.

   Procedure: Initially background information was collected describing both the content and topics covered in the group in-class training session for the system. This consisted of a four hour class where examination of the materials indicated coverage of the following topics: 1) logging into the system and system overview, 2) documenting/reviewing standard office visit data, 3) placing orders, and 4) documenting a complex office visit. The usability testing sessions were conducted individually with each of the five subjects four weeks after attending the group in-class training session. During the usability testing sessions (which lasted approximately 40 minutes per subject) the subjects were asked to “think aloud” while they carried out the tasks in two scenarios (described above in the materials section). The audio portion of their think-aloud was recorded using a microphone connected to the computer they were accessing the system on. In addition, all the computer screens were recorded as digital movies using Hypercam® [4]. At the end of each usability testing session, a semi-structured interview was also conducted (and audio-recorded) where subjects were asked: 1) how often they had been using the system since the group training session, 2) how long they had been using the system, and 3) if they had encountered any problems in the session or in using the system in general. The interviews were also audio recorded in their entirety.

   Analysis: The analysis of the data consisted of first having all the “think-aloud” and interview data transcribed. Then the digital movies of the user interaction with the system were coded to identify usability issues or problems encountered by subjects as they carried out the requested tasks in the two scenarios. Extending coding described by Kushniruk & Patel [5] and using transana® video annotation software [4], we specifically examined the data to identify areas where users encountered problems in carrying out their tasks and in mapping their terminology and expressions into those allowed in the system (using the system’s coded vocabulary for medical terms,
qualifiers and medications). It should be noted that a study by Aaroson et al suggests a potential relationship between training and implementation, which is where training occurred in this study [6].

2. Results

All subjects completed both test scenarios in an average time of 38 minutes, with little variation in the completion time across subjects. Subjects generally showed a good facility for using the system in carrying out the representative tasks and were overall favorable in their comments about the system, as illustrated by the responses from the subjects below (obtained from the post-task interviews) when asked about their overall satisfaction with the system:

“I do think it's really good for on-call, for telephone calls, or whatever, because usually you'd have to find the charts, read the person's handwriting and here you just look it up and it's really helpful for me” (subject 1)

“It's good, it's a good system. Like I didn't realize until today you could add a past medical history onto a problem, that's easier” (subject 2)

“Generally it's pretty good, I like it” (subject 3)

“I love it, I absolutely love it, I hate writing notes and my handwriting is terrible and I find typing much faster, more satisfying “ (subject 4)

“I'm generally very happy with it” (subject 5)

Several specific areas where the usability testing revealed that refinement could be made (which were largely unexpected) were identified and illustrate the use of the approach taken in this paper to providing iterative feedback (based on usability study) to both (1) system customization and to (2) system training. These areas are described below.

2.1. Matching of User Desired Terms to Terms Provided by the System

The most frequently coded issue with use of the system (for the assigned tasks) was finding a matching term in the system (with several coded occurrences of such issues per subject) – all subjects indicated at least one problem with the mapping of terms they had in mind to the completions offered by the EMR system for selecting from (e.g., for entering medications, diagnoses). For example, one subject (subject 4) noted that in entering the family history there appeared to be no match for the entry “lung cancer”, rather they had to enter “cancer” and then qualify it. Other instances of non-matching (i.e., of user entered terms not matching to terms returned by the system in a list to select from) were identified in the transcripts (and coded by the annotation “Problem – No Match”). This occurred on average once per case entered by each of the subjects and in one instance led to the subject not entering information about leg stiffness. One subject (subject 1) discussed this issue during the post task interview, stating the following when asked about problems they had encountered: “If there is something in the fill-in boxes, this doesn’t happen as often, like a diagnosis, or a prescription it can’t find, like something … that doesn’t show or fit in whatever boxes they have here, and
it can’t find it”. This is consistent with earlier findings from [7] where usability testing indicated that matching user desired terminology to coded terms (contained in pick lists within a patient record system) is a major issue during interaction with electronic health records. The implications of this for training in use of EMR are discussed below.

2.2. Use of the System for Patient Charting (i.e., Training in Context of Use)

Although the study did not directly look at the interaction of the subjects with the EMR system in the real setting of system use (i.e., in a clinic during regular workflow or with a patient present during charting) several subjects mentioned, during their post-task interview, potential issues with use of the system when charting during interactions with the patient present. When asked about use of the system, the subjects were overall very positive about the system (as described above) and positive about the system use under certain work conditions, but some subjects indicated they had problems with it one month after training when attempting to use it with the patient present (implications for potential training are described below):

“Its very tedious to do while I’m charting patient care but its very good for following and continuity of care so if I’m not actually seeing a patient its great, but if I’m actually trying to see a patient and chart things in it, or even just getting through my clinic day its … cumbersome … It doesn’t help during, its not very useful during the actual, after the visit, cause I don’t even do it when the patient is in the room, I do it afterwards once the patient has left the room to chart it” (subject 1).

This was also noted by a second subject (subject 3) who stated that they had difficulty remembering what patients may be telling them (when using the system with the patient present), particularly if they took the strategy of waiting to start creating a note till later in the interaction (which brings in the issue of training in strategies of system use during patient encounters or more complex workflow).

It is interesting to note that this issue is not specific to this particular EMR but to use of currently available EMRs in general, as noted by Kushniruk et al [8] who found considerable difference in user satisfaction with an EMR system when comparing subjects’ interactions involving a) tasks that involved entering information into the system in isolation of the patient (as in typical system training and usability testing) versus b) tasks that involved entering information in the system while interacting with a patient during a doctor-patient interview. There are a number of implications of this both for system design and customization (which go beyond the scope of this project) but also for need for training in the use of system under different clinical conditions (e.g., entering orders, charting with or without the presence of a patient, and using the system while carrying out workflow involving medical procedures and other physical or mental activities). This could involve training using simulations of workflow and conditions under which the system will be used in real clinical settings.

2.3. System Stability

One of the subjects claimed that the system would occasionally crash while they are in the middle of entering a history (although it should be noted that this potential issue was not recorded during the test sessions). This was something that may be relevant to note for the system implementers to look into (rather than for training) – potentially
using Hypercam © or other screen recording programs to document such incidents in real-life contexts of use.

2.4. Inability to Locate Missing Documentation in Order to Close a Record

Generally, when subjects went to close a note and a required entry was indicated that must be completed before the subject could close the note, this was understood by the users (who then completed the required documentation). However, one of the subjects, when confronted with such a message, was unable (from the information presented by the system) to locate where in the documentation the missing information would need to be completed. Messages must be meaningful for users to locate where problems may be occurring and this is an area for potential targeting for further training/customization.

Other more minor issues/problems were noted in the annotated transcripts, which included error messages popping up several times for some subjects in the entry of height and vital data (e.g., if a number was entered without indicating a metric), occasional problems in the subject not being able to scroll through a list (i.e., the scroll bar not being accessible on the screen) and minor suggestions regarding screen layout.

3. Recommendations and Implications for EMR Training

Based on the current training all subjects were able to successfully complete the scenarios with which they were presented. This included successfully completing all required tasks and doing so in a timely manner. However, the sessions did reveal a number of areas and suggestions for augmenting current training given the nature of the EMR system (and this was fed back to the training team). These include the following:

- Providing training specifically about the terminology that the system accepts and the synonyms that are acceptable to the system. This was a surprising finding. One of the consistent recommendations in the informatics literature has been to have a synonym list for problems [9-11]. This EMR has a third party option for a synonym dictionary which was installed at this site as well as others [12]. The users still had anecdotal difficulty during implementation similar to that found in the study as they were getting too many synonyms back (granularity wasn’t the problem).

- Providing advanced training on strategies regarding use of the system in varied clinical contexts, most specifically, providing practice that could involve the use of a trainer playing a simulated patient (while the physicians learn how to use the system in simulated doctor-patient interactions). This could also include testing of physician (and student) competencies in charting while using an EMR (an area that could be incorporated in health professional student training as well).

- For training of physicians and other health professionals (e.g., nurses) this could be extended to include training in use of the system for different types of workflow.

- Such advanced training could deal with strategies for coping with situations of urgency, complexity or unusual cases of workflow (e.g., when ordering
preventative tests, dealing with error messages and working with incomplete patient information).

Other aspects of the results of this study were fed back to the implementation team. For example it was recommended based on the study that training could include practice in use of the system for different types of workflows and this recommendation was later adopted for nursing.

4. Conclusions

Overall the EMR system was received positively by the subjects tested, who were able to complete the tasks in the scenarios presented to them during usability testing one month after in-class training. The subjects were all using the system in their practice, although the type of their use, frequency of use and strategies for using the system varied. Furthermore the subjects tested demonstrated good knowledge of the main features and functions of the system and were able to carry out the required tasks one month after receiving formal in-class training. Some suggestions for augmenting the training were provided based on the study.

In summary, the approach taken was able to arrive at some interesting and potentially relevant findings and recommendations given a small number of subjects tested one month after training. The result of such usability testing was found to provide useful feedback both for system customization as well as for training. Results of small scale and rapid usability tests can provide useful feedback for improving both system usability (through feedback to system implementers) and potentially system learnability (through feedback to training). The challenge is adapting to the constraints of a commercial system.

References
