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Low-Cost Rapid Usability Testing: Its Application in Both Product Development and System Implementation

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Abstract. In recent years there has been considerable discussion around the need for certification and regulation of healthcare information technology (IT). In particular, the usability of the products being developed needs to be evaluated. This has included the application of standards designed to ensure the process of system development is user-centered and takes usability into consideration while a product is being developed. In addition to this, in healthcare, organizations in the United States and Europe have also addressed the need and requirement for product certification. However, despite these efforts there are continued reports of unusable and unsafe implementations. In this paper we discuss the need to not only include (and require) usability testing in the one-time development process of health IT products (such as EHRs), but we also argue for the need to additionally develop specific usability standards and requirements for usability testing during the implementation of vendor products (i.e. post product development) in healthcare settings. It is further argued that health IT products that may have been certified regarding their development process will still require application of usability testing in the process of implementing them in real hospital settings in order to ensure usability and safety. This is needed in order to ensure that the final result of both product development and implementation processes take into account and apply the latest usability principles and methods.

Keywords. Usability, human-computer interaction, healthcare information systems, usability testing.

1. Introduction

The usability of health information systems has become a major concern worldwide. There are increasing reports of issues with systems such as electronic health records (EHRs) and other related information technology (IT). The cited problems include lack of usability, lack of customizability, frustration with integrating systems into work practices and potential inadvertent negative impact leading to medical error [1-3]. In response there has been a move towards creating improved processes for the development of health IT products, including ISO standards for applying user-centered design processes. In addition, healthcare organizations, such as the Office of the National Coordinator (ONC) in the United States, have put forth programs for certifying the usability of vendor based IT products, such as EHRs [4]. These

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guidelines have included the requirement to apply user-centered approaches, including usability testing in the design process of the IT products for use in healthcare settings.

Despite these efforts to provide regulation and certification of healthcare IT regarding usability, there continue to be increasing reports worldwide of dissatisfaction with implementations of certified vendor based products [1-3]. In this paper we consider this issue and argue that certification of vendor based EHR systems for usability does not guarantee that the actual implementations of these systems will lead to good usability, end user adoption and satisfaction, or even safety. Indeed, it will be argued that usability testing methods that are beginning to be mandated in the one-time design and development process of healthcare IT products also be mandated for application in implementation of vendor products at local healthcare sites (where these certified systems will need to be modified and customized for local use in specific hospitals and healthcare settings and contexts). It will be argued that similar usability testing methods used to support design of vendor products should also be applied when healthcare IT products are being deployed in real healthcare contexts in order to ensure their effectiveness and safety before going live. This local institutional application of usability testing is additional to usability testing mandated to vendors in the certification process for product development. Along these lines, in order to simplify the application of usability testing methods and "take them out of the usability lab and into the field" the authors have developed what they have termed local low-cost rapid usability testing, that can be rapidly applied by staff with varied backgrounds (e.g. IT, healthcare management etc.) locally in real hospital settings where vendor products are being deployed [5]. Such testing is needed prior to large scale deployments of vendor based systems in real healthcare settings in order to ensure such systems are safe before releasing them for widespread use in a healthcare institution. Furthermore, these considerations argue for the need for the requirement for usability testing conducted by both private stakeholders (i.e. EHR vendors) and public stakeholders (e.g. regional health authorities who implement vendor products).

2. Local Low-cost Rapid Usability Testing Methods

In this section the application of low-cost rapid usability testing to local testing of vendor-based products (such as EHRs) will be described. The stages we have developed were based on the authors' experiences in working on EHR implementations across a range of healthcare institutions and countries. The steps will be considered in the context of implementation of vendor-based EHR systems in healthcare institutions.

Step 1. Development of an Integrated Test Plan:

The integration of usability testing into the critical path of implementation of vendor-based systems requires careful upfront coordination with the implementation team and healthcare management and must fit within the schedule and timeline of the implementers. This necessitates a practical approach to usability testing. This led to the creation of an approach to usability testing that we have termed low-cost rapid usability testing that has been used for both product development and implementation testing [5].

Step 2. Working with Training Department:

It is important to interface early on with the training team who will be ultimately responsible to training end users on the new EHR system. This may involve observing (and video recording for later review) training sessions, collecting training materials and working with trainers to identify user issues, problems with the system early in deployment, potential safety issues. In addition, the training team will be able to help in identifying participants for subsequent usability testing (i.e. health professionals who have recently received or will receive training for the EHR being deployed).

Step 3. Selection of Usability Test Participants:

The application of usability testing in implementing EHRs typically involves an initial limited number of participants (e.g. 20-25) who will be followed individually in detail as they learn how to use and master the use of the EHR during early phases of implementation. Ideally, an initial group of users who will be first adopters of the system can be identified and these users can be recruited as participants for usability testing studies. In some of our studies this included health professionals who were scheduled to be involved in an early system deployment phase.

Step 4. Baseline Usability Testing:

Low-cost usability testing can be characterized by use of methods that are portable, low-cost and that can be applied in an agile manner in any number of healthcare settings. This typically involves installing screen recording equipment on computers that participants will be tested on, along with audio recording of their verbalizations as they carry out tasks using the system. This involves collection of video and audio data corresponding to user's interactions with a system being tested. As described by Kushniruk and colleagues [6-7], the resultant video and audio recordings are rapidly coded to identify usability problems, safety issues and inadvertent effects of the system on work.

Step 5. Follow-up Usability Testing:

In order to assess the extent to which users adapt to the system being deployed, usability testing as described in Step 4 can be repeated with the same participants at one or more subsequent time intervals (e.g. one week after initial implementation, two weeks and then one month after implementation). This will allow for collection of data about the efficiency of users in learning how to use and master the new system (to develop an expected learning curve for users of the product), as well as allowing for collection of new information concerning potential usability problems and possible safety issues.

Step 6. Feedback to the Implementation and Training Teams:

From the testing conducted in Steps 4 and 5 an assessment can be made of whether refinements to the system customization, training or system itself, need to be made prior to widespread organizational deployment of the system. Decision making regarding changes to the implementation, training or potentially the system itself

should be made with all relevant stakeholders, including the staff responsible for conducting the usability testing, as well as meeting with the implementation and training teams.

Step 7. Roll out Across the Organization:

Once the feedback from Step 6 has been incorporated, the organization may opt to carry out one or more additional cycles of limited testing of the system, or proceed to full scale implementation across the hospital or healthcare institution.

Step 8. Periodic Usability Testing:

Once the system (e.g. the EHR) has been implemented on a larger scale and healthcare users are actively using the system, periodic usability testing (with individuals or groups of participants) can be conducted in response to new error reports or user dissatisfaction.

3. Application of Usability Testing During Product Development Versus During Implementation of Vendor-Based Systems

Textbooks and educational materials developed about usability testing have typically focused on its application in the design and development phase of new IT software and systems. Along these lines, guidelines, regulations and certifications are emerging for ensuring that user-centered design and usability testing approaches are included in the process of product development for healthcare IT. However, the application of usability testing for guiding the implementation of commercially available healthcare IT systems in real healthcare settings has received less attention from healthcare agencies, regulatory authorities and vendors. Although certification of software product development is essential it will not guarantee that a certified system will work well under the particular conditions of a hospital or healthcare setting, which may account for the varied success of even the same commercial system across different sites, locations and healthcare systems. In this paper we have focused on the application of low-cost rapid usability testing in implementing commercial vendor-based systems in healthcare organizations.

4. Experiences to Date

The approach to integrating usability testing into healthcare IT system implementation described in this paper developed from work the authors have been involved in across North America, Europe and Asia. At several institutions we have worked with, the approach described has continued to be applied and has become part of the institutional strategy for integrating and implementing new health information technologies.

In an initial series of projects conducted at Mt. Sinai Medical Center in New York, the authors began to apply the steps described above in the roll-out of an enterprise-wide EHR implementation at that institution [6]. For this project, working closely with the training team (responsible for teaching physician and nurse users how to use the system) proved to be essential in linking the usability testing to the first encounters of

the system with end users. As described above, initial tracking of users who attended the initial training sessions (through to subsequent individual usability testing) proved extremely valuable in identifying initial usability problems, identifying requirements for system customization and refinements by the implementation team, as well as identifying changes and additions to the training program (to include need for a number of workarounds and changes to customizable aspects of the user interface). Since that project was completed, a process has been developed at that institution to incorporate usability testing in subsequent EHR roll-outs as well as for projects involving the integration of decision support tools (e.g. known as best practice advisories) into the EHR. This latter work involved conducting a series of usability studies with potential end users of the decision support tools to identify usability and content issues. The fine-tuning of the combined EHR-decision support system (based on the usability testing) has led to improved adoption and uptake of decision support offered by the system (in particular, greater acceptance by end users of the advice provided by the system) [7].

Other applications of the approach described in this paper involved fine-tuning and optimizing commercial vendor-based EHR systems with bar-coding technology in a large healthcare institution [8]. This project involved conducting low-cost usability testing in-situ in hospital rooms after hours, where the type of technology the EHR would need to interface with (i.e. the bar coding technology) was available. The usability testing was found to identify key usability and safety issues (i.e. the need for a way to override the system during emergencies) that were needed prior to widespread release of the system in the hospital. It should be noted that the problems identified regarding interfacing with local interfacing technologies could not have been predicted without having conducted the usability testing at the local site (i.e. issues were detected that were not identified by product certification or centralized conformance testing). From our experience, factors that affect the effectiveness of the method include number of users tested (and number of scenarios used in testing) which will depend on practicalities at the local test site. Other challenges include gaining access to local contexts and settings.

5. Conclusion

Just as it is essential for product development, the application of effective and practical approaches to integrating usability testing into the process of implementing commercial vendor-based systems is needed. Lack of standardized approaches for this type of local institution-based usability testing may well account for the variable results from implementation of the same vendor systems (in terms of chance of successful implementation) across different sites, contexts and healthcare systems. We have described a step-wise process for integrating usability testing into the implementation of commercial vendor-based systems in a number of major healthcare organizations. It is hoped that just as certifications and guidelines have appeared recommending application of usability testing in healthcare system design and product development, work to develop such guidance will also emerge for integrating usability testing in the implementation of vendor-based systems in healthcare organizations. It is hoped that the work described in this paper will form a step towards this goal.

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