

Guest Editorial

Human-Centered Computing in Health Information Systems – Issue 2: Evaluation

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This is the second of the two special issues on human-centered computing in health information systems (see [1] for Issue 1 Editorial). Human-centered computing is based on four types of analyses for users, functions, representations, and tasks [1-2]. It is also a process that includes work domain analysis, design, and evaluation as three major steps. The first special issue focused on the domain analysis and design components of human-centered computing in health information systems. The current issue focuses on the evaluation component.

Evaluation is always an important process for the design and implementation of any health information system [3]. This second special issue brings together original research and methodology papers that are primarily concerned with how effective and efficient a system is, along user characteristics, such as ease of use, ease of learning, reduction of medical error, and user satisfaction.

The first paper by Pizziferri et al. [4] examined whether an EHR (Electronic Health Record) system decreased or increased physician times on clinical tasks. Time is one of the critical factors that often dictate the success or failure of an EHR system. The authors used a time-motion study method to collect the times primary care physicians spent on clinic tasks before and after the implementation of an EHR system. They also conducted a survey to assess physicians' perceptions regarding the EHR. The results showed that there was no significant difference in times spent on clinic tasks before and after the implementation. However, only about a third of the survey respondents reported that EHR took the same amount or less time than paper records, although the majority of them believed that EHR resulted in better care quality. Time-motion studies such as the current one are valuable for the assessment of the efficiency and effectiveness of health information systems. With more detailed observations that include times on non-clinical as well as clinical tasks, times on different types of tasks, task steps, and errors, we can gain more insight in human-centered characteristics of EHR systems.

The second paper by Patterson et al. [5] is a study of the barriers to the effective use of clinical reminders. Advances in health information systems have made possible many decision support systems such as clinical reminders for recommended actions due for a patient and clinical warnings that immediate actions should be taken to avoid harm to patients. Despite evidence that clinical reminder systems improve adherence to guidelines, there are some challenges in having providers consistently use clinical

reminders as intended. This study described a study using multiple methods, including ethnographic observations and surveys, to triangulate an understanding of barriers to the effective use of clinical reminders in the Veteran's Health Administration (VHA). Six barriers were identified from the first study and four more identified from the second study. It is important to note that nearly all of these barriers are caused by user, social, organizational, educational, and other non-technology factors.

The third and fourth papers focus on patient safety considerations in medical device purchasing process. The paper by Laxmisan and colleagues [6] is the sister paper of Malhotra et al. [7] published in the first Special Issue that focused on analysis and design. Laxmisan et al. used three medical device error cases to create three scenarios for the study of how people with different types of expertise evaluate patient safety and device-related medical errors in the decision process of medical device purchasing. They found that clinicians (nurses and doctors) focused on clinical and human aspects of errors, biomedical engineers focused on device-related errors, and administrators focused on documentation and training. This study raises the question of whether the differences caused by various types of expertise may reflect the broader issues in institutional decision making such as interventions of medical errors, medical device purchasing, and deployment of information technology. The paper by Ginsburg [8] is a clear demonstration of how a human factors evaluation could affect the decision making in hospital procurement process. In this study three infusion pumps were evaluated for their usability problems in five clinical areas in two phases: heuristics evaluation and user testing. The results from methods were consistent and they clearly favored one of the three infusion pumps. Due to the success story of this study, the author recommended that a human factors evaluation should be performed to influence all hospital procurement decisions about medical devices to enhance patient safety.

The next two papers are concerned with the use of telehealth systems and wireless communication devices. The paper by Farzanfar et al. [9] describes a user evaluation study of an automated telephone-based system for health promotion and behavior interventions. It is generally assumed that adherence to the recommended schedule is related to the impact of the system on users. However, it is not clear what factors influence users' decisions on using or not using the system. The results of this study show that both user and system factors were responsible for the underutilization or non-use of the system. Studies such as the current one have great potentials for the identification of the barriers and the improvement of usability in telehealth systems that have been growing in numbers, uses, and popularity. The paper by Reddy et al. [10] evaluated the impact of the introduction of a wireless alert pager system on collaborative work practices and information flows in a surgical intensive care unit. New technologies are often introduced with good intentions and with optimistic expectations. They can in many ways improve clinical work flows. However, new technologies can also have negative, often unexpected, consequences on information flows. This is the dilemma illustrated by the results of this study, which show that the paging system provided new routes of information to clinical staff but in doing so also disrupted existing work practices and information flows. This study once again shows that implementing a health information system is not a straight IT project: it involves many non-technology factors that often determine the success or failure of the system.

The following paper by Wachter et al. [11] describes a user evaluation study of a pulmonary graphic display that depicts pulmonary physiological variables for intubated, mechanically ventilated patients in a graphical format. Traditional ICU medical monitors provide discrete data and discrete alarms that alert clinicians to parameters outside a set range, but they do not provide a comprehensive representation of patient physiology by integrating multiple data points. The authors developed an integrated display that is designed to match users' mental models, increase situation awareness, and help users in assimilating information more rapidly and facilitating efficient and timely medical interventions. This study evaluated how this new technology was integrated and accepted by users. The results, though preliminary, show that the system was monitored, used, and well perceived, and that the integrated display was considered as an accurate representation of respiratory variables.

The final paper by Despont-Gros et al. [12] is the methodology review paper for this special issue. The authors reviewed articles that are studies of user evaluation of clinical information systems. From this comprehensive review they identified eight dimensions used in the evaluations, which were then integrated with the dimensions already identified in the human-computer interaction literature. From these integrated dimensions the authors developed an evaluation model for clinical information systems. This model is a nice bridge that connects the traditional methods used in clinical information system evaluations and the human-computer interaction methods that focus on human dimensions.

The current special issue on evaluation and the earlier one on analysis and design are two collections of original research and method papers on human-centered computing in health information systems. We hope they will promote and advance human-centered design in health information systems for improving healthcare quality, increasing patient safety, and reducing healthcare cost.

Acknowledgement:

I would like thank all the reviewers for their comprehensive reviews. Without their hard work and professional recommendations it would be an impossible task for me to compile this special issue. Their constructive criticisms also greatly helped the authors in their revisions. I would also like to give special thanks to Vimla Patel for her encouragement and support in producing both of these special issues.

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