Designing Flexible EMR Systems for Recording and Summarizing Doctor-Patient Interactions

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Abstract
Electronic Medical Records (EMR) are increasingly transitioning from desktop systems to mobile devices. This innovation presents challenges to medical practitioners in terms of doctor-patient interaction, patient record integrity and continuing reliance on paper-based annotation schemas. We describe findings from a pilot study of EMR use by physicians in a family medical clinic and propose guidelines for the design of mobile EMR systems. These guidelines seek to fuse the dynamic capabilities of digital systems with the immediacy and personal nature of paper-based records.

Keywords
Electronic Medical Record, Health Information Technology, Interface, Usability

ACM Classification Keywords
H.5.2 [User Interfaces]: Interaction styles; H.5.2 [User Interfaces]: User-Centered Design

General Terms
Design, Human Factors

Introduction

Hospitals, clinics, and private healthcare facilities in the United States are currently undergoing a transition from paper-based medical records to electronic systems, known as Electronic Medical Records (EMR). These systems allow patient health records to be stored, updated, and exchanged between various medical facilities and health-care organizations nationwide [4]. The functionality provided by these systems can include simple patient records, elaborate patient management, electronic medication ordering, and billing systems.

In the last decade, the adoption of electronic medical records has steadily increased, assisted in part by $19.2 billion in federal funding [8]. In addition to the software-based transition from paper-based records to EMR, the Health Information Technology (HIT) sector is simultaneously introducing considerable digital hardware innovations. In particular, small mobile touch-screen devices are more and more used for doctor-patient interactions, monitoring, and other tasks that benefit from enhanced mobility. This current intersection of digital transitions – the shift to EMR combined with the rise of mobile technology – introduces diverse challenges and opportunities for patients, doctors, support staff and administrators using these systems on a daily basis.

Recent studies indicate problems with physician compliance, highlighting in particular the continuing practice of supplementing or circumnavigating EMR systems with paper-based notes and notifications [3, 9, 12]. Other noted issues include inadequate training, minimal system feature use and negative perceptions about the impact of the systems on doctor-patient relations [6]. Given these limitations, we see strong opportunity for creating optimal digital solutions that better accommodate and enhance observed healthcare facility workflows.

This paper presents findings from a preliminary research study conducted at a small family clinic. Based on in-depth interviews with physicians at the facility we identify a series of recommendations for improving EMR system design and use. In the following sections, we describe related prior work, the study design and collected results, EMR design guidelines and directions for future work.

Prior Work

Our research looks to build upon three pertinent areas of research regarding EMR: 1) the balance of accountability and usability in EMR, 2) the use of analog technologies during the doctor-patient examination, and 3) the development of interface designs that allow flexible non-linear workflows.

Previous studies have highlighted the tradeoff between accountability and usability in EMR as a critical area for improvement. Due to the complex social and hierarchical structures within healthcare organizations, HIT departments currently balance the need for physician accountability with EMR usability in technology implementations [1]. In practice, this means that EMR systems are being primarily chosen for their ability to properly document the outcome of a patient interaction rather than for their ability to assist medical practitioners in their diagnosis [2].

This prioritization of accountability over usability has led physicians and nurses to supplement EMRs with

what Chen refers to as "transitional artifacts" [3]. These artifacts are most commonly hand-written paper notes that practitioners use to keep track of summarized patient data and to minimize the duration of interaction with the EMR during patient examinations [3, 9, 12]. Our research looks to develop methods for integrating more usable digital analogs of these paper-based practices in order to improve usability within system interfaces.

Wilcox et al. describe ActiveNotes, a prototype application for creating computer-assisted patient progress notes in Intensive Care Units (ICU)[10,11]. ActiveNotes builds on findings from prior research studies demonstrating physician preference for free-texting notes over the more standard template based approach adopted by many EMR systems [7]. ActiveNotes utilizes free-text fields to provide physicians with a data input method similar to word processing programs used to augment the EMR. We see an opportunity to leverage existing indexing algorithms to assist in the automatic generation of structured notes from this free-text based input.

The research of Tang and Carpendale has highlighted the dynamic nature of patient interactions. The study has shown nurse preference for continued use of paper notes, "which allows easy interweaving with the ongoing assessment and explanation of procedures and medication" [4]. Our study looks to develop improved methods for data input that accommodate the dynamic interactions that occur during doctor-patient visits.

Pilot Study

We adopted a participatory design approach in assessing the everyday use of an EMR system in a family medicine clinic in Phoenix, Arizona. We chose a family clinic to study as it offers an average use case scenario that falls between the urgency of an Emergency Department and the unique needs of a small-scale specialist office. The slower pace and smaller scope of treatment in a family clinic allows for a constrained, yet focused approach to developing a baseline understanding of the systems in place. Through a series of in-depth interviews and contextual inquiry sessions with medical practitioners at the clinic, we uncovered experience-based insights relating to our three research focus areas.

Study setting and participants

The family medicine clinic uses a popular and well-established EMR system, currently deployed in over 2,500 healthcare facilities. The clinic uses the system to record patient information, scheduling, and billing. The system runs on touchscreen laptops that have both keyboard and stylus input. A laptop is located in each exam room and is used by both physicians and nurses to enter patient data during examinations. Three medical physicians from the clinic (2 male, 1 female, average age 28) participated in this initial pilot study. The participants are in their second year of residency and have had experience with an average of 5 different EMR software applications.

Study participants were observed interacting with the EMR system in a contextual inquiry session where they were also asked a series of questions focused on developing a more comprehensive understanding of the scope, affordances and limitations of their daily interactions with the EMR system.

Study Results

The key insights gained from our initial study related to perceptions about the lack of flexibility in the system, the use of transitional artifacts, and concerns about the interference of the system in productive doctor-patient relationships.

EMR FLEXIBILITY AND USABILITY

The EMR system used by the study clinic is designed with a primarily 'template' based input system. These templates are predefined lists of options, checkboxes, and radio buttons that a user can select with a stylus to record data about a patient's past medical history, or current medical condition. A primary concern of the physicians interviewed was the rigidity of these templates. Our interviews revealed that while not meant for this purpose, all three doctors often entered patient notes into the provided 'comments' field in each template rather than selecting the appropriate options. One doctor explained the reasoning for this as "Unfortunately, for very specific complaints [there] are often no available templates that adequately encompass the patient's history and thus require free texting". Elaborating further, another physician stated that, "When I talk to a patient, they don't use medical terms to describe their problem - they tell me a story about what's wrong..." The physician continued to describe the difficulties in using the template system to record this information and explained that using the comments field often provided the best alternative for recording the patient's description.

This flexibility to record patient information in more intuitive ways prompted discussion of user customization within the EMR. While the current system allows users to customize lists, reports, templates, and add favorite medications, only one of the physicians interviewed reported having used these features. A common reason for being unaware of certain EMR features was a lack of software training. Each physician interviewed reported attending a short seminar about using the software but said most actual learning was done through using the system.

TRANSITIONAL ARTIFACTS

Each physician interviewed reported using paper notes in some capacity during exams. The use of these paper notes ranged from supplementing the EMR to completely replacing it. The information contained in these notes was generally entered into the EMR following a patient visit, which occurred immediately, or up to 24 hours later if the physician's schedule was particularly busy during their shift.

Two physicians reported writing their notes on patient *face sheets* - one page printed patient summaries. One doctor noted that "Typically these are just reminders of the plan that we have developed and I use this when writing my plan and completing my tasks for them after I leave the room." Although face sheets originated from paper-based medical records, they are continuing to be used to supplement the EMR.

Further discussion revealed that nurses and medical assistants taking patient measurements and vitals before the physical exam also preferred to use paper face sheets. Patient vitals were generally quickly noted on these sheets and then transcribed into the EMR before the physician entered the exam room. The face sheet was then transferred to the doctor who continued to make additional notations that were later transferred into the finalized electronic record.

Figure 1 – EMR with ability to input and display non-medical, personal information

Figure 2 – EMR with ability to make personal notes directly over the record during a patient exam

DOCTOR-PATIENT RELATIONSHIPS

When asked why they preferred to use paper notes over the EMR, one physician stated, "I have a personal preference to not let the EMR come between me and a patient on a first encounter." The idea that the EMR is something that interferes with the personal nature of the doctor-patient exam was a recurring response in our interviews. The physicians all felt that quickly writing notes on paper was less distracting to a patient than stopping to focus on a laptop and type their notes on the keyboard.

Study Takeaways

Our interviews have highlighted the importance of accommodating the dynamic narrative that occurs between a doctor and patient. Medical professionals must constantly cognitively process a patient's story for relevant medical information throughout the exam. The strict, linear process of template based EMRs is based on the necessity of recording the outcomes of patient interactions but does not offer assistance in the recording or analysis of this dynamic information during a patient examination.

Paper notes are used to compensate for a lack of flexibility that is inherently required during patient exams. These notes are most commonly used to capture information to assist in diagnoses but are also used as reminders of personal anecdotes that help to build overall patient relationships.

While prior research has focused primarily on EMR use in hospitals and emergency rooms, we feel the setting of a family medicine center offers a unique perspective into the doctor-patient interaction. In this relatively slower paced environment, physicians and nurses build closer personal relationships with their patients over time. Although previous studies have highlighted the necessity for flexible interfaces that can accommodate multi-user interactions, we have found that the same solutions have additional benefits [5]. They may not only improve the ability of the EMR to record patient data, but also allow the EMR to act as a tool for building physician-patient relationships, and improve the quality of diagnoses.

Design Recommendations

Enhance personal connections

Our research has shown that a mutually perceived personal connection is a critical component of doctor-patient interaction. The addition of free-text annotation fields for physicians to *add personal, non-medical (e.g. "recently lost long-term job") patient notes and memory cues* can assist in building and sustaining this personal connection [Figure 1]. The *adoption of smaller, touchscreen tablet systems* may also help to reduce the perceived distraction of the EMR during patient exams.

Seamless input of contextual data

The ability to quickly note supplemental information and reminders is critical to physician workflow. Our research has shown physician preference for recording these hand-written notes in the context of past patient information rather than on a blank page. We recommend that the EMR interface should *support the creation of stylus written reminders directly over the existing record display* [Figure 2]. This layer of contextual notes is saved for physician reference during the finalization of a patient treatment plan.

Figure 3– EMR with dynamically generated visit summary based on captured narrative record.

Record and summarize dynamic narratives

We believe that the addition of flexible, free-text input can also improve the physician's ability to *capture the dynamic narrative generated during patient exams*. We propose an automated system to assist physicians in distilling these narratives into concise summaries. By leveraging existing indexing algorithms, *medically relevant terminology could be extracted from the narrative record to generate an initial summary of the patient visit* [Figure 3]. The system would then allow physicians to review and make additional clarifications to these summaries. The patient visit summary would also maintain hyperlink references to the original narrative for more thorough review.

Future Work

The next stage of our participatory design research will involve interviewing additional clinic stakeholders, results from our interviews will further inform the development of our system prototype, which will then undergo evaluation at the clinic site.

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