The effects of EMR deployment on doctors' work practices: A qualitative study in the emergency department of a teaching hospital

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ABSTRACT

Objective: The goal of this study was to examine the effects of medical notes (MD) in an electronic medical records (EMR) system on doctors' work practices at an Emergency Department (ED).

Methods: We conducted a six-month qualitative study, including in situ field observations and semi-structured interviews, in an ED affiliated with a large teaching hospital during the time periods of before, after, and during the paper-to-electronic transition of the rollout of an EMR system. Data were analyzed using open coding method and various visual representations of workflow diagrams.

Results: The use of the EMR in the ED resulted in both direct and indirect effects on ED doctors' work practices. It directly influenced the ED doctors' documentation process: (i) increasing documentation time four to five fold, which in turn significantly increased the number of incomplete charts, (ii) obscuring the distinction between residents' charting inputs and those of attendings, shifting more documentation responsibilities to the residents, and (iii) leading to the use of paper notes as documentation aids to transfer information from the patient bedside to the charting room. EMR use also had indirect consequences: it increased the cognitive burden of doctors, since they had to remember multiple patients' data; it aggravated doctors' multi-tasking due to flexibility in the system use allowing more interruptions; and it caused ED doctors' work to become largely stationary in the charting room, which further contributed to reducing doctors' time with patients and their interaction with nurses.

Discussion: We suggest three guidelines for designing future EMR systems to be used in teaching hospitals. First, the design of documentation tools in EMR needs to take into account what we called "note-intensive tasks" to support the collaborative nature of medical work. Second, it should clearly define roles and responsibilities. Lastly, the system should provide a balance between flexibility and interruption to better manage the complex nature of medical work and to facilitate necessary interactions among ED staff and patients in the work environment.

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1. Introduction

Many healthcare organizations are undergoing a transition from paper records to "Electronic Medical Records" (EMR) systems [1]. Previous studies suggest the use of EMR has greatly affected the ways in which doctors document and manage patient information [2–8]. The influence of electronic systems on doctor work practices has drawn increasing interest from both the medical informatics and the human–computer interaction (HCI) communities. Literature in both these fields has studied the importance of human factors and organizational changes in the EMR implementation process; the EMR system influences not only people's behaviors at the individual level, but also the organization of work practices conducted in a healthcare institution. These studies have examined the influence of Information Technology (IT) on people's behaviors in a variety of work practices such as hospital inpatient units and outpatient clinics [9], and explored both beneficial and detrimental effects of computerized documentation on clinical and educational practices [10]. However, the majority of these HCI and Medical Informatics studies are either retrospective, conducted after the system had been implemented, or survey-based, focusing solely on one moment of an ongoing implementation process [10–12].

In this study, we intend to gain deeper understandings of how the design of EMR systems affects medical work practices by observing the rollout of the EMR *in situ* during the paper-to-electronic transition period. The EMR rollout at our field site is scheduled to occur in four phases over a three-year period. In this paper, we focused on the rollout of electronic MD notes, which was the first phase of the larger EMR study and only affected doctors' work practices. The importance of MD notes in healthcare is paramount. MD notes ensure patients' medical information is recorded accurately, efficiently, and quickly; and they provide written documentation for both medical research and legal purposes [2,13]. With the increasing adoption of EMR systems in the US, studying the effects of electronic MD notes has become a salient issue, since this may radically change every single aspect of doctors' work practices. Thus, efficient and effective documentation methods are always of interest to the medical informatics research community.

Although many studies have explored the consequences of EMR on clinical work practices and related design issues, such as usability or functionalities of EMR systems, in this study we intend to associate the work practices changes led by the EMR system with the actual design of the system and provide design guidelines for future EMR systems. This study aims to answer the following questions:

- How does the electronic documentation lead to the observed changes in ED doctors' work practices?
- What design guidelines could be used to alleviate these effects on ED doctors' work practices?

The timing of our study afforded us a unique opportunity to understand nuanced changes in ED staff behaviors and to obtain insight into the organizational impact of an EMR system during the paper-to-electronic transition of MD notes. Our study started three months before the system deployment, continued throughout one week of the deployment period, and ended three months after the deployment of the electronic MD notes. In our field study we found the deployment of the electronic MD notes had the following effects: (1) directly altering ED doctors' workflows and (2) indirectly affecting clinical collaboration and patient care (a consequence of the altered workflow). The direct effects of the system included longer charting times, workload changes, and workaround use developed by doctors. The indirect effects of system use included increased interruptions, increased multi-tasking, and decreased patient care time. These findings suggest system design should focus not only on medical practices, but on how the system will be used to conduct work practices. We suggest three design guidelines for electronic documentation systems: (1) design to support note-intensive tasks mainly affecting residents' work, (2) design to define different roles in collaborative work between residents and attendings, and (3) design to balance flexibility and interruption.

2. Related work

Previous studies indicate the use of Healthcare IT systems (HIT), such as Computerized Physicians Order Entry (CPOE) and Electronic Medical Records (EMR), can benefit medical practices in various ways, including providing easy access to and accurate documentation of patients' records [4–6], reducing potential medical errors [7], standardizing practice [2], improving the quality of patient care [2], and billing management [2,21]. However, these benefits are often coupled with unintended consequences in the actual work practices, such as increased documentation time [10,11], incompatibility with clinical workflow [10], more interruptions in medical work [22], and system-introduced errors in patients care [14,23]. Based on such findings, these prior studies indicate the importance of focusing on the possible consequences of documentation when studying HIT.

In particular, for the system being examined in the current paper, studies have shown electronic documentation can have diverse effects on clinical work processes. For example, Embi et al. [10] identify the fact that computerized documentation greatly enhances the accessibility and legibility of medical notes; however, electronic documentation changes the workflow, alters the structure of the MD notes, and even introduces errors into the documenting process. Other studies also examine changes in the work process. One suggests the way medical documents are "written, read and used" in electronic documentation systems has been largely overlooked [24]; another indicates the loss of important psychosocial information during the documentation process with deployment of the new CPOE system [25]; and the other presents a new framework for a document's life cycle based on when information is documented, who documents it, and how it is documented [26]. In addition, various design guidelines have been proposed to improve the usability of EMR systems, ranging from interface-level modifications such as supporting handwritten notes in electronic format [27], scanning and eliminating paper-based records for faster transition to full utilization of an