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Technology, work, and information flows: Lessons from the implementation of a wireless alert pager system

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Abstract

The combination of collaborative work practices and information technology affect the flow of information in clinical settings. The introduction of a new technology into these settings can change not only established work practices but also the information flows. In this paper, we examine the introduction of a wireless alerts pager in a surgical intensive care unit (SICU). Through a qualitative study, we analyze the effects that this new information tool had on both the work practices in the SICU and the information flow in the unit. We describe four challenges that SICU staff members faced with respect to the alerts pagers. We found that the pager provided new routes of information to SICU staff but in doing so disrupted existing work practices and information flows.

Keywords: Wireless alerts; Intensive care unit; Information flows; Human–computer interaction; Collaborative environments; Workflows; Qualitative research

1. Introduction

Information and information practices are at the heart of organizational work. For instance, computer users increasingly report that their primary daily activity is handling electronic mail—a means of moving information from one place to another [1]. Organizations are realizing the importance of providing the appropriate content, order, and structure of information to its workers [2]. Although the role of information in decision-making is well-known, it also plays a vital role in coordinating work activities and providing awareness of others' activities. Therefore, understanding "information work" [3] in organizations is the key to developing successful information management technologies and strategies.

We have been investigating the problems of information and work in the context of hospital care. For successful patient care, workers must have appropriate information when it is needed. Therefore, understanding how technologies and work practices affect *information flow* in healthcare settings is of growing importance. Although there is some disagreement about the precise meaning of the term information flow [4,5], we use it here to describe patterns of information movement in an organization. Flows of information connect the units of the hospital (OR, labs, and external physicians) and the members of each unit (nurses, physicians, pharmacists, and therapists). To understand how information flows are affected by the introduction of a new technology, we studied the adoption of a wireless alerts pager system.

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Medical informatics researchers are designing and implementing wireless technologies in various clinical settings [6]. Wireless technology is becoming a popular method for delivering patient-related information quickly to medical decision makers. Mobile devices linked to clinical information systems can provide real-time event notification to health-care workers [7–9]. These technologies hold the promise of improving information flow by providing users real-time notification of critical patient-care events. However, when introducing wireless tools, organizations often underestimate the impact these tools will have on users' work practices and consequently information flow. If a new technology provides little benefit and requires major disruptions in current practice, then health-care workers will resist the change. For example, the hierarchical structures of teaching hospitals support useful work practices such as residents and fellows attempting to deal with most patient-care problems before contacting an attending physician. This practice allows the attending physician to focus on the most critical patient-care issues, and allows the residents and fellows to take care of the rest. The introduction of wireless technology could affect these work practices. For instance, wireless technology can allow the attending physician to learn about a problem at the same time or before a resident or fellow. Although potentially beneficial for patients, such early notification changes the visibility of the residents and fellows' work. The same kind of hierarchical change could be ascribed to the simultaneous availability of data to all caregivers provided by an electronic clinical information system. However, a wireless alerting system can invoke more dramatic hierarchy changes because data is "pushed" to caregivers rather than being passively available on a video screen.

In this paper, we focus on the use of a wireless tool, an alphanumeric alerts pager, by staff working in a Surgical Intensive Care Unit (SICU) of a major teaching hospital. The alerts pager supports real-time notification of events including critical lab results, potential medication problems and critical patient trend information. Through a qualitative field study, we analyze the effects that this new information tool had on not only the work practices in the SICU but also on the information flows in the unit. The paper is organized as follows: in the next section, we discuss information flows and the role of pagers in hospitals. We then present an ethnographic field study of the adoption of a wireless alerts pager in a surgical intensive care unit. We describe four challenges that SICU staff members faced with respect to the alerts pagers. Next, we discuss how some challenges could be addressed by improving the wireless technology, but how other challenges are inherent to the nature of medical work. We conclude with some final thoughts concerning the importance of appropriately designing and implementing wireless technology in order to support information flows in people's daily work.

2. Information flow and pager use in hospitals

Hospitals and especially intensive care units are information-rich and information-driven environments. On a hour-by-hour, and even minute-by-minute basis, health-care workers must have the most up-to-date information in order to provide appropriate patient care [10]. The introduction of new technologies has, in many ways, improved the flow of information to the decision-makers; this improved flow in turn has facilitated critical health-care processes such as coordination of patient care activities in hospitals [11]. However, new technologies can also have negative consequences on information flows. For instance, in an implementation study of a hospital-wide information system, Bardram [12] found that the system did not support the information flow as well as an older planning board that was used in a radiology department of a Danish hospital. Therefore, the nurses would enter the information on the planning board and also in the system. This created double work for the nurses and was one of the reasons that the system was underutilized.

One tool that has been integrated into everyday use in hospitals and has affected the information flows in these settings is the pager. Pagers generally have two major roles in a hospital. First, they facilitate communication among staff members. Second, pagers serve as real-time clinical event notification mechanisms for hospital staff. In this role, an individual page notifies a user of a significant event and conveys relevant clinical information.

Pagers are key tools for keeping hospital staff members in touch with each other. In a study of clinical communication, Coiera [13] noted that the pager is a favorite tool of physicians when contacting each other because they can get an immediate response to a page. In related work, Coiera and Tombs [14] described the role of pagers and phones in the communication behavior of physicians and nurses in a general medicine department of a British hospital. They found that the mobility of the staff created communication patterns that resulted in an "interruptive" workplace, which lead to inefficiencies in work practice. They advocated better design of mobile technologies such as pagers to reduce these interruptions.

In addition to providing a communication mechanism for hospital staff, pagers tied to clinical information systems can automatically provide vital patient-related information to the staff. Although they used an early style PDA, Shabot and LoBue [9] were the first to send an alphanumeric text "alert" message directly to physicians from a clinical system, bypassing nurses, pharmacists, and laboratory technicians entirely. Their work showed