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User-designed information tools to support communication and care coordination in a trauma hospital

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ABSTRACT

Background: In response to inherent inadequacies in health information technologies, clinicians create their own tools for managing their information needs. Little is known about these clinician-designed information tools. With greater appreciation for why clinicians resort to these tools, health information technology designers can develop systems that better meet clinicians' needs and that can also support clinicians in design and use of their own information tools.
Objective: To describe the design characteristics and use of a clinician-designed information tool in supporting information transfer and care coordination
Design: Observations, semi-structured interviews, and photographing were used to collect data. Participants were six nurse coordinators in a high-volume trauma hospital. Content analysis was carried out and interactions with information tools were analyzed.
Results: Nurse coordinators used a paper-based information tool (a nurse coordinator's clipboard) that consisted of the compilation of essential data from disparate information sources. The tool was assembled twice daily through (1) selecting and formatting key data from multiple information systems (such as the unit census and the EHR), (2) data reduction (e.g., by cutting and whitening out non-essential items from the print-outs of computerized information systems), (3) bundling (e.g., organizing pieces of information and taping them to each other), and (4) annotating (e.g., through the use of colored highlighters and shorthand symbols). It took nurse coordinators an average of 41 min to assemble the clipboard. The design goals articulated by nurse coordinators to fit the tool into their tasks included (1) making information compatible with the mobile nature of their work, (2) enabling rapid information access and note-taking under time pressure, and (3) supporting rapid information processing and attention management through the effective use of layout design, shorthand symbols, and color-coding.
Conclusions: Clinicians design their own information tools based on the existing health information technologies to meet their information needs. The characteristics of these clinician-designed tools provide insights into the "realities" of how clinicians work with health information technologies. The findings suggest an often overlooked role for health information technologies: facilitating user creation of information tools that will best meet their needs.

1. Introduction

Effective information transfer and care coordination is critical to patient safety [1] and efficiency [2] in acute care settings, especially in the context of increasing demands for beds, reduced inpatient capacities, and the increasing costs of care [3]. Health information technologies (HIT) have the potential to improve coordination [4], quality and safety of care [5] and efficiency in resource management in acute care settings. In this paper, we use the term "information transfer" to describe clinicians' activities to achieve and share a common understanding with others such as fellow clinicians and patient families. This common understanding can include goals, perspectives, responsibilities, authorities, capabilities, task status, and expectations of future events. Information transfer is achieved by verbal communication between the relevant parties as well as by the synchronous or asynchronous means of receiving or sharing information via paper and computerized information tools.

A growing body of evidence indicates that the introduction of HIT into care settings is not always successful and often results in unintended consequences [6–9]. Examples of HIT failures common across care settings include incompatibility with existing workflow [9,10] the inadequate support of team-based care [6,11], the creation of more work for clinicians [10,12–14], a reduction in efficiency [15], and the overuse of reminders, alerts or

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warning messages [6]. HIT failures are largely attributed to the mismatch between the theories and assumptions of technology designers and the realities of clinical work [7,16,17]. Designers frequently assume that the work environment is rational, linear, individualistic, and objective [16], while in reality clinical work is complex, high-paced, interruptive, opportunistic, personal, and collaborative [18,19].

To support their tasks and overcome challenges with HIT, clinicians often have to develop their own "workaround" solutions [20]. Clinicians have been found to modify, tailor, and design tools to fit their information needs for communication and coordination [21–23]. HIT purchased from vendors are almost always used in ways different from those intended by the designers of those systems [24]. For example, an observational study conducted in two intensive care units revealed that clinicians assembled paper-based tools into "bundles" of highly selective information to reduce cognitive workload, allowing them to more easily maintain situation awareness and to more efficiently identify problems [25]. Sticky notes, personal "cheat sheets" and paper-based templates are all examples of common user-designed information tools in health care [21,22,26]. Analogous user-design activities can be found in non-healthcare domains. For example, airline pilots typically mark their charts and flight manuals with highlighters or colorful sticky notes to increase the speed and ease of searching and accessing critical information [27].

The characteristics of the user-designed information tools may reveal cognitive and collaborative work carried out in practice but unrecognized by designers [24,28–30]. In this study, we focused on a specific tool known as the nurse coordinator's clipboard or, in short, "the clipboard," that was designed by nurse coordinators and has been used for the last eight years to support their information transfer and care coordination activities in a trauma hospital. We used ethnographic methods to understand the characteristics of this tool. Our observations and interviews were guided by questions based on how the clipboard was prepared and used, as well as how the user-defined design characteristics of the clipboard supported cognition and collaborative work in the highly demanding work environment of a trauma hospital. We also examined the implications of the characteristics of the clipboard for nurse coordinators' work as compared to the other existing information sources in order to inform future HIT design.

2. Methods

2.1. Setting

The study was conducted in a trauma specialty hospital (104 beds) in a major urban academic medical center between March and December of 2006 after approval from the Institutional Review Board. The trauma hospital is a primary referral center for a statewide emergency medical service system. The hospital is a six-story building that is connected to an academic medical center. The trauma hospital contains a twelve-bay trauma resuscitation unit, a six-room operating suite, a nine-bed post-anesthesia care unit, three intensive care units (total 36 beds), three intermediate care units (total 36 beds), and a general ward (20 beds).

2.2. Participants

There were a total of six nurse coordinators in the hospital, each working 12-h shifts to achieve a 24/7 coverage. All six nurse coordinators participated in the study. We shadowed three of the nurse coordinators followed by informal, short interviews. We held sit-down formal interviews with five of the nurse coordinators.

In this hospital, nurse coordinators are responsible for day-to-day care coordination. They are the hub of the information transfer and storage necessary for care coordination. They facilitate patient access and patient flow by removing barriers to resources (for example, by requesting additional staff) and operations (such as by requesting urgent completion of clinical tests needed in order to discharge a patient) and by negotiating differences among various specialties. When asked what their role is, one nurse coordinator stated "We make sure that there is a staffed bed appropriate for each patient based on the level of care needed." To be able to coordinate care effectively and use limited resources efficiently in this high-paced, highly demanding clinical work environment, nurse coordinators need to have quick and easy access to various types of information. For example, they need to know whether a particular patient can share the same room with another patient based on their infection status, which beds are likely to be available in the next few hours, which nurse(s) would be willing to work in a unit other than their main working area, and plans for possible discharges based on patients' clinical conditions. Based on all of these different pieces information, nurse coordinators develop and apply a "coordination plan" at the beginning of each shift, which covers issues such as which bed to assign a particular patient or which nurse to reassign to another unit. Nurse coordinators update this coordination plan as new information becomes available.

2.3. Data collection

Data was collected through shadowing nurse coordinators, conducting formal interviews, taking photographs, and sampling the clipboards from six consecutive shifts.

2.3.1. Shadowing

Shadowing is an ethnographic technique by which an observer unobtrusively follows a subject over a long period of time, with the goal of collecting in-depth data to answer the research question [31]. To facilitate data collection, an observation instrument was developed using an iterative approach based on the shadowing of nurse coordinators. We (APG, PH) shadowed two of the nurse coordinators for a total of 33 h in order to sample different activities throughout a 12-h shift. In addition, we conducted informal, unstructured interviews with these nurse coordinators to clarify any outstanding issues that arose during shadowing. The content validity of the instrument was assessed by conducting short interviews (15–20 min in length) with three nurse coordinators.

The unit of analysis of observations was an 'information transfer episode.' An information transfer episode includes activities concerning information receiving and sharing for a single purpose such as informing a charge nurse about a possible admission or receiving information about a particular surgery's completion. The observation instrument was in a table format and designed for collecting data on eight variables of information transfer: duration of an information transfer episode, location, number of times a particular information tool such as the clipboard was used for a single information transfer episode, number of annotations on a particular information tool for a single information transfer episode, people involved in an information transfer episode (if any), modality used (e.g., verbal, observation), purpose of information transfer, and any other observations noted by the observer. Using this observation instrument, a human factors engineer (APG) shadowed three nurse coordinators on twelve different shifts for a total of 42 h. The shadowing covered three periods of a nurse coordinator's shift that reflect how the clipboard is assembled and used by nurse coordinators: the preparation for handoff, the handoff, and the first walkthrough in the hospital just after the handoff. To be systematic, the observation periods were deliberately varied across day–night shifts and weekend–weekday shifts.