Patient transport cards support formal and informal coordination in a hospital department

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The importance of coordination in hospitals is well recognized. A better understanding of existing work practices is needed to design and implement effective collaborative technologies. In this field study, we reveal how a cognitive artefact, a patient transport card, originally developed to support a formal patient transport process was subsequently integrated into other informal coordination practices to facilitate: (a) awareness of patient arrival, (b) identification of patient's wheelchair or bed, and (c) transport scheduling decisions. We conclude with implications for current and future research on collaborative artefacts as well as the design and implementation of collaborative technologies.

INTRODUCTION

Effective coordination is crucial for patient and staff wellbeing in hospitals (Shortell, et al., 1994). The Institute of Medicine (2001) advocates greater use of technology to support coordination in health care settings. However, researchers have shown that technology can actually hinder rather than help coordination, particularly when technology is developed without an understanding of existing work practices (Ash, Berg & Coiera, 2004). Consequently, many researchers have focused on exploring existing coordination behaviors and tools to inform the design of more effective collaborative technologies, in an effort to overcome these barriers (Abraham & Reddy, 2009; Bardram & Bossen, 2005).

We contribute to this research by examining different ways in which one such tool, a patient transport card, supported both formal and informal coordination practices in a hospital radiology department. First, we discuss relevant research from the coordination and cognitive artefact literatures. Second, we describe the research setting, the transport card and our research methods. Third, we present our findings on the different uses of the transport card and discuss implications for further research as well as the design and implementation of collaborative technologies.

Formal and informal coordination

Coordination can be defined as managing interdependencies among activities to achieve a goal (Malone & Crowston, 1994). In general, there are two types of coordination mechanisms: (1) formal procedures (e.g. standards, policies, guidelines) that indicate how work should be coordinated, and (2) informal practices (e.g. mutual adjustment, articulation work) that emerge from immediate local needs (Mintzberg, 1979; Strauss, Fagerhaugh, Suczek, & Wiener, 1985).

Previously, it was thought that effective coordination could be achieved by matching an appropriate coordination mechanism with the characteristics of a task (Mintzberg, 1979). Thus, formal mechanisms were recommended for work with low uncertainty and low information demands whereas informal mechanisms were recommended for work with high uncertainty and high information demands. However, empirical evidence revealed that effective coordination is achieved by providing a variety of coordination mechanisms in the workplace (Symon, Long, & Ellis, 1996; Young, et al., 1997).

Many current initiatives for developing coordination support structures and tools (e.g. Business Process Re-engineering, Enterprise Resource Planning) are derived from formal coordination processes (e.g. van Merode, Groothuis, & Hasman, 2004). A key problem with this approach is the lack of consideration and support for informal coordination practices (Berg & Toussaint, 2003) such as collaborative cross-checking and real-time sensemaking activities. A failure to support informal coordination practices can make work practices more vulnerable to coordination breakdowns. Studies suggest that informal coordination practices emerge from the need to bridge gaps in formal coordination mechanisms, and that they contribute to resilient work practices (Albolino, Cook, & O'Connor, 2007; Nemeth, et al., 2007; Patterson, Woods, Cook, & Render, 2007).

Therefore, collaborative technologies need to support both informal and formal coordination mechanisms. Unfortunately, informal coordination practices are often less visible and more difficult to identify than their formal counterparts (Strauss, et al., 1985). In the next section, we discuss how analysis of cognitive artefacts can give insight into both formal and informal coordination practices.

Cognitive artefacts and coordination

Cognitive artefacts are physical objects created by humans to support cognitive performance (Norman, 1991). Examples range from basic physical reminders and notes, to more complex tools such as schedules and computers. Cognitive artefacts play an important role in the coordination of work by supporting shared awareness of information about goals, resources, and task progress (Xiao, 2005).

Researchers have studied the features and use of various cognitive artefacts (e.g. whiteboards, schedules, notes and clipboards) in various healthcare settings including surgical scheduling (Nemeth, O'Connor, Klock, & Cook, 2006), emergency triage (Bjorn & Rodje, 2008) and trauma unit management (Gurses, Xiao, & Hu, 2009). A key finding from

the research is that non-electronic cognitive artefacts embody features that enable easy adaptation in response to the dynamic and information-intensive nature of hospital environments.

A consequence of this adaptability is that cognitive artefacts gradually become multipurpose tools that support many functions. For example, Wears and colleagues (2007) showed that the whiteboards of two different emergency departments supported both routine work demands (e.g. location of patients by healthcare workers from other departments) as well as non-routine work demands (e.g. tracking patient movements during periods of overcrowding). In this paper, we extend this research by exploring how one cognitive artefact - a patient transport card - originally developed to support a formal patient transport process was subsequently adapted and integrated into other informal coordination practices.

SETTING AND METHODS

In this section, we describe the research setting and the transport card as well as our research methods.

Setting

Ethical approval for the study was granted by the university and local hospital ethics committees. The study was conducted in the radiology department of a major Australian tertiary hospital. The radiology department provides medical imaging support services to the emergency department and inpatients within the hospital, as well as outpatient examinations. Between the period of July 2007 and June 2008, the department performed approximately 180,000 medical imaging examinations.

The types of medical imaging services include diagnostic imaging as well as interventional procedures across a range of modalities, including computed tomography (CT), magnetic resonance imaging (MRI), vascular and interventional radiology (V&IR), nuclear medicine (NM) and general x-ray (GX). Examination times range from minutes (e.g. GX) to hours (e.g. V&IR procedures).

A key point of our study was the transport of inpatients between other areas of the hospital and the radiology department. Patients are transported to and from their wards either in wheelchairs (provided by the radiology department) or beds. Therefore, efficient and well-coordinated patient transport is crucial to the functioning of the radiology department in reducing time for examinations and maintaining the safety of staff and patients.

The radiology department has dedicated porterage staff who transport the patients. On weekdays, the number of porters range from 2 (during the early morning and late evening shifts) to 12 (from midday to afternoon). There is also a porterage supervisor who coordinates patient transport on weekdays.

The transport card

The transport card (see Figure 1) comprises the torn bottom quarter of a size A4 paper sheet printed from the radiology department's computer appointment scheduling system, CERNER®. The transport card includes the following information:

- Patient's name and date of birth
- Patient's ward location
- Scheduled examination time
- Patient's mobility needs (i.e. wheelchair or bed)
- Patient care needs (i.e. oxygen, IV pole, nurse escort)

Transport cards can also be completed manually via a handwritten square-shaped card, for extra patient transport jobs that have not yet been entered into the CERNER® system.

In addition to the information listed above, the nurse or porterage supervisor may make annotations on the card. For example, a pink or brown dot sticker on the card indicates to staff that additional infection control precautions (e.g. gown, mask) are required when dealing with the patient. V&IR transport cards have a sticker that reminds the porter to check that the patient is wearing an operating theatre gown. Staff may mark the card "Urgent" if the patient is clinically unstable and therefore required with a degree of urgency, or may write on the card "ASAP" to inform the porterage supervisor that a patient is required presently.

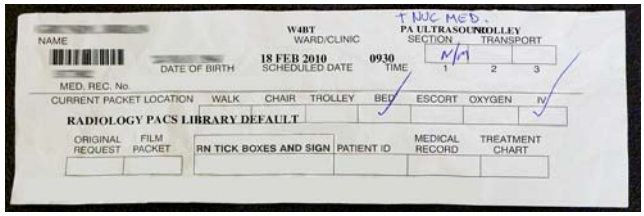

Figure 1. A typical patient transport card

Data collection and analysis

We conducted field observations, interviews with staff and analyses of artefacts to gather information about patient transport work practices and the use of the transport card. We observed over 100 hours of work in the radiology department during May-August 2009, taking detailed field notes throughout. During the observations, we explored the work of key staff who came in contact with the transport card: the porterage supervisor, porters, radiographers, nurses and administrative staff. In addition to conducting informal interviews during the observations, we conducted formal interviews with the porterage supervisor and two senior radiographers which were later taped, transcribed and analysed. We also collected copies and took photographs of the transport card and its use in the workplace.

FINDINGS

We now discuss the different ways in which the transport card supports both formal and informal coordination practices.

Support of formal coordination procedure

The sequence of tasks associated with the formal intended use of the transport card is described below.

1. The radiology department receives a request for examination.
2. Administration staff enters the request into the CERNER® system.
3. A size A4 paper sheet is printed from CERNER® and the transport card is torn from it. (The top part of the printout is stapled to the radiology request form. Barcodes on the printout are used by the radiographers to store medical images in the Picture Archiving and Communication System (PACS).)
4. The transport card is given to the porterage supervisor either immediately (e.g. GX) or when the nurse/radiographer is ready for the patient (e.g. CT).
5. The porterage supervisor gives the transport card to the next available porter when the scheduled appointment time approaches.
6. The porter uses the information on the card to determine and remember the patient's name, location and transport needs, and keeps the card while travelling to the relevant ward.
7. On arrival to the ward, the porter can check the patient's name on the card with the ward's patient list to determine where the patient's bed is located.
8. The transport card is discarded when the porter returns to the radiology department with a patient.

Contrary to the final point, our observations revealed that the transport card is often not discarded and is involved in several other informal coordination practices which we now describe.

Support of informal coordination practices

Facilitate awareness of patient arrival. In general, when the porter arrives at the radiology department with a patient, he or she informs the relevant nurse that the patient has arrived. The nurse indicates on CERNER® that the patient has arrived. The radiographer will hence be alerted via CERNER® that the patient has arrived and collect that patient for the imaging exam.

This process is not used for general x-ray (GX) exams for two main reasons. First, unlike other types of exams, GX exams do not have predetermined appointment times. The porterage supervisor has discretion as to when he schedules pickups of GX patients. Therefore, the radiographer does not know when to expect patients. The porterage supervisor usually schedules GX patient transports on a "first come first served" basis, and scheduling depends on patient readiness and the needs of other sections in the department. Second, GX exams make up the largest proportion of total exams performed. Due to each exam being booked into CERNER® at an arbitrary time, the radiographers find it difficult to distinguish the relevant booking from the numerous appointments displayed onscreen, and thus have difficulty determining which patients have arrived in the department and are waiting for their x-ray.

To address this patient arrival notification problem, a different process was used that involves the transport card. When the porter arrives with a GX patient, the transport card is given to the GX nurse. The nurse takes the card to the GX office area and puts it in a transparent container attached to the wall next to the door (see Figure 2). The radiographers just need to glance at the container to see if there is a transport card in it and thus if a patient has arrived.

Figure 2. The transport card in this container notifies the GX radiographer that a patient has arrived.

We also observed that nurses are often busy with other tasks such as preparing patients for their exam or escorting a patient back to their wards. Therefore, they may not be available to receive the transport card when patients arrive. On these occasions, the porters would put the transport cards on the nurses' desk area (Figure 3). This act communicates to nursing staff that a patient has arrived, without requiring porters to convey this directly. Hence, the porter is available to collect the next patient.

Figure 3. The transport card is left on the nurse's keyboard to make her aware that a patient has arrived.

Facilitate identification of patient's bed or wheelchair. Our observations revealed that when the porters bring patients for particular procedures, they attach the transport cards to the patient's wheelchair or bed (see Figure 4). Discussions with staff revealed that this usage helped to avoid placing patients on the wrong wheelchair or bed after their examination or

procedure. Patient beds or chairs may be stored in the examination room or removed elsewhere during a procedure/examination, depending on the nature of the modality used and physical constraints of the room. If beds and chairs are removed, they are stored in waiting areas where patients are initially brought.

With the transport card attached to the patient's chair or bed, clinical staff can identify to which patient the chair or bed belongs to when the patient is not present. In addition, when there are multiple patients in the waiting areas, transport cards help staff quickly differentiate between patients without having to disturb them or check their armbands. Finally, the coloured stickers on the transport card help staff quickly determine if the patient is infectious so they can take the necessary precautions for their own safety and that of other patients.

Figure 4. A transport card is attached to a patient's bed to help staff remember which patient the bed belongs to.

Facilitate transport scheduling decisions. The porterage supervisor is responsible for holding transport cards for jobs that are still to be completed, and for scheduling the jobs. Our observations revealed that the transport cards are arranged on the porterage supervisor's desk area in a way that assists scheduling decisions (see Figure 5). Transport cards for radiology modalities with predetermined appointment times (e.g. MRI and CT) are arranged in a column on the right side of the desk area in temporal order, with more immediate appointments at the bottom. All GX transport cards are similarly arranged on the left of the desk area. The porterage supervisor may also put cards for the urgent transport jobs in the middle of the desk area as a reminder to allocate a porter for that job as soon as possible.

By studying this transport card arrangement, the porterage supervisor can quickly assess the number of GX transport jobs pending. He can also assess transport demand for modalities with predetermined appointment times over time. An immediately accessible representation of transport demand enables efficient scheduling of transport jobs and effective management of porterage staff. For example, the scheduling of GX jobs can be increased during times when modalities with predetermined appointment times have less demand.

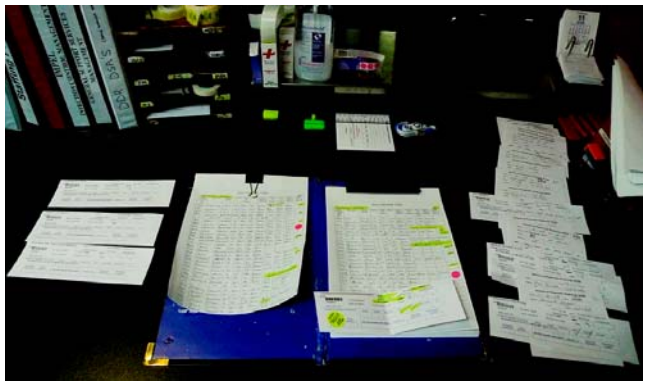

Figure 5. The porterage supervisor's desk area with GX cards on the left, other cards on the right and worklist in the middle.

DISCUSSION

We have shown that a cognitive artefact intended to support one formal coordination practice has been exploited by healthcare workers to support secondary informal coordination practices. The formal purpose of the transport card was to be a memory aid for porters to facilitate patient transport. However, gaps in existing coordination methods for related tasks lead to the transport card being adapted to support these processes as well. For example, due to the high volume and temporal uncertainty of GX examinations, existing coordination processes were not effective in communicating the arrival of patients to radiographers. This problem was solved by placing transport cards of newly arrived patients into a transparent container located near the radiographers to provide a more obvious visual cue of patient arrival. Similarly, in areas where patients were separated from their bed or wheelchair for their examination or procedure, staff had difficulty distinguishing which empty wheelchair or bed belonged to which patient. This problem was solved by simply attaching the patient transport card to the relevant item.

The many uses of the transport card contribute to the reduction of workload and turnaround time for staff. For example, at times when nursing staff were not immediately available to receive transport cards, porters left them in specified area instead of waiting to verbally communicate this information; thus porterage staff were promptly available again to complete other jobs. Similarly, attaching the transport card to a patient's wheelchair or bed meant that staff did not have to interrupt each other to check which bed or chair belonged to a patient and whether infection control precautions were required to handle it. Finally, the tangible nature of the transport cards meant that the porterage supervisor was able to physically arrange the cards in order of priority, and to quickly see at a glance which jobs are pending. This practice minimized the cognitive work required by the supervisor to maintain awareness of fluctuations in patient transport demand, and allowed him to quickly react to any changes (such as when patient urgency changes, or a patient is absent from the ward when a porter goes to collect them).

The generalizability of our findings is limited because they were generated from one radiology department. Nevertheless, the findings are consistent with other research that has

implicitly and explicitly shown that cognitive artefacts can serve multiple functions (Bardram & Bossen, 2005; Symon, et al., 1996; Wears, et al., 2007). A limitation of our study is that the observations were conducted some time after the transport card was introduced into work practice. Therefore we could not observe how the transport card evolved its various additional uses. It may be worthwhile for future research to explore how new cognitive artefacts are used by healthcare workers in new and evolving ways, and what contextual factors influence this evolution.

Our findings have implications for both the design and implementation of technology to support coordination. Researchers have emphasized the adaptive and information-rich properties of cognitive artefacts and suggested that such qualities be designed into their digital counterparts (Xiao & Seagull, 2007). We suggest further that designers of digital artefacts consider both the formal and informal functions of any cognitive artefact to be replaced. Failure to do so may have adverse effects for staff and work practices. For example, in the present case, if transport cards were replaced with a computerized patient transport allocation system, such a system should allow the porterage supervisor to continue viewing and analysing information in a way that supports reasoning and awareness of the temporal order and demand for patient transport jobs.

In the case of technology implementation, change managers should consider the effects of the technology on relevant informal coordination practices as well as normative workflow. It may be that the technology introduces greater efficiencies to a formal coordination process. However, it is important to consider that such technologies may not support other important informal coordination practices. For example, in the present case, a computerized patient transport allocation system would not facilitate identification of patient beds. Therefore, if such a system was implemented, new mechanisms would need to be put in place to provide continued support for such informal work practices, to ensure this process does not break down. Unfortunately, due to lack of consideration of the issues outlined above, healthcare workers are often left to the job of finding new ways to bridge gaps in coordination that result from the introduction of new technology.

CONCLUSION

Due to social and financial pressures, hospitals need to improve the efficiency and effectiveness of their work processes. Technology can only support these objectives if designed and implemented appropriately. In this paper, we have shown that studying the use of cognitive artefacts provides useful information about formal and informal coordination practices in hospitals. We hope this research contributes to the design and implementation of better collaborative technologies to support a greater variety of coordination practices within the complex and dynamic hospital environment, while reducing the burden of unintended adverse effects from technological change.

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