

I just don't know why it's gone: Maintaining Informal Information Use in Inpatient Care

Xiaomu Zhou¹, Mark S. Ackerman^{1,2}, and Kai Zheng^{1,3}

¹School of Information, ²Department of EECS, ³School of Public Health
University of Michigan, Ann Arbor
{xmzhou, ackerm, kzheng}@umich.edu

ABSTRACT

We conducted a field-based study examining informal nursing information. We examined the use of this information before and after the adoption of a CPOE (Computerized Provider Order Entry) system in an inpatient unit of a large teaching hospital. Before CPOE adoption, nurses used paper working documents to detail psychosocial information about patients; after the CPOE adoption, they did not use paper or digital notes as was planned. The paper describes this process and analyses how several interlocked reasons contributed to the loss of this information in written form. We found that a change in physical location, sufficient convenience, visibility of the information, and permanency of information account for some, but not all, of the outcome. As well, we found that computerization of the nursing data led to a shift in the politics of the information itself – the nurses no longer had a cohesive agreement about the kinds of data to enter into the system. The findings address the requirements of healthcare computerization to support both formal and informal work practices, respecting the nature of nursing work and the politics of information inherent in complex medical work.

Author Keywords

Medical records, electronic patient records, organizational memory, informal information, psychosocial information, shift change, CPOE, CSCW, medical informatics.

ACM Classification Keywords

H.0 [information systems]; K.4.3 [organizational impacts]: Computer-supported cooperative work.

INTRODUCTION

Despite the general consensus that information technology (IT) has great potential to improve the safety, quality, and efficiency of healthcare, many health IT implementation projects have failed to achieve desired outcomes, partially

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

CHI 2009, April 4–9, 2009, Boston, MA, USA.

Copyright 2009 ACM 978-1-60558-246-7/09/04...\$5.00.

due to the complex organizational setting of healthcare institutions. Health informatics as a field has a prominent focus on outcome-based evaluations, while it has by and large neglected the socio-technical aspects of integrating IT systems with clinicians' daily practice. Researchers have therefore called for expanding the scope of informatics studies to take into account social, organizational, professional, and other contextual considerations [11, 14, 21].

Improving the quality and maintaining the continuity of patient care are major concerns in medical practice. This study is part of a larger project that investigates the social-technical issues in medical information generation, use, and documentation in a teaching hospital. The research was conducted during the adoption of a new information system, a Computerized Provider Order Entry (CPOE) system. The observation of the entire transition from a paper-based medical order entry system to an electronic operation provided a unique opportunity to investigate the various social-technical issues of information sharing. Our research aims in particular to discover whether and how the transition may cause information gaps.

In general, a CPOE system delivers electronic medical orders from doctors to pharmacies, labs, procedure departments, and nursing. It aims to reduce medication errors caused by misinterpreting doctors' handwriting and multiple handoffs, a major patient safety concern in hospitals. CPOE systems can generate beneficial outcomes, but it is recognized that they can also create new problems and even facilitate medication errors [12].

In addition to the electronic management of medical orders, the CPOE system in this organization was designed to replace all paper-based working documents for nurses. In this paper, we will look at the transition of two nursing documents, the Assignment Sheet (AS) and the Shift Sheet (SS). These documents served as informal, short-term working documents that were important to nurses' teamwork. Of specific interest, we will examine the use of psychosocial information, i.e. the psychological and social context for a patient, which is important to that patient's care.

Accordingly, we first discuss the related studies as background. We then describe the field site and data collection. Next, we describe the unit and its work, and

follow with an account of the working documents before, through, and after implementation. We end with a final discussion, implications, and future work.

LITERATURE REVIEW

There have been a number of informative HCI/CSCW studies within medical informatics. An important set of medical informatics studies has discussed the politics of information in hospitals and other medical environments. Bowker and Star [4] discuss how medical care is status-stratified, and how medical work is often arranged by status superiors and hidden by status subordinates. Computerization often ignores the hidden work, termed invisible work in Star and Strauss [16], or makes it visible and a target for managerial control [20].

Other research has noted the professional competency, context, ambiguity, and politics assumed in medical records. Heath and Luff [9] detail how other doctors read even minute fragments of patient records to re-create the salient details of patients' histories. Hardstone et al. [8] showed that some informal documentation is required for adequate care. Tellioglu and Wagner [19] and Schmidt et al. [15] note that medical information, especially documentation, is often arranged in assemblages of artifacts.

Of particular interest here is nursing work. Despite the early successful effort of the Florence project [2], which dealt with the use of computers in nurses' daily work, studies on nursing documentation have shown a number of challenges in computerizing nursing practice. What nurses actually do is not rendered transparently in the documentation [10]. For example, nurses' 'scraps' (their personal sheets) carry hidden nursing information and have significant influence on the delivery of care [7]. Further, nursing work is often situated, complex emotional-body work [20]. Bowker and Star [4] show the complexity of nursing work in analyzing various categories of nursing work, of which "humor" is listed as one intervention. They note:

Social-psychological care giving is one of the areas where the control-visibility dilemma is very difficult to grasp... How can one capture humor as a deliberate nursing intervention? Does sarcasm, irony, or laughter count as a nursing intervention? ...No one would dispute its importance, but it is by its nature a situated and subjective action. [p247]

These studies drew our research interests toward a more thorough understanding of nursing information practice with a special focus on the role of informal, short-term information recorded on paper-based working documents, given that our study site's order management was in transition from paper to an electronic operation. We wanted to explore further how an information system could be designed to improve and support important informal and collaborative processes alongside the promised formal documentation process.

ABOUT THE STUDY

This paper reports on a nursing practice in an inpatient unit that provides internal medicine care. We chose this inpatient unit as our field site for two main reasons. First, the unit provides care to patients who are experiencing acute and chronic episodes of their illness across their adult life-span. The diversified patient profiles and disease conditions of this unit provided rich data for an information study. Second, the workload of this unit is notoriously heavy and the esprit of this unit is exceptionally team-oriented. This combination afforded a great opportunity to study the collaborative activities of information generation and use and explore the potential social issues involved in this practice.

Participants

The unit under observation has one nursing manager, one administrative assistant, one nursing specialist, 56 registered staff nurses (i.e. those taking care of patients on regular shifts), 19 nurses aids, and seven clerks. Among the 56 staff nurses, one senior nurse takes the role of clinical supervisor, and two senior nurses are education coordinators. These roles will be discussed later.

The unit has 32 beds, with 16 beds along each of two hallways. Figure 1 shows the layout of the unit. There were computers in all of the patient rooms in addition to the nursing conference room, satellite stations, and staff center. (See Figure 1.)

There is a huge ecology of information objects that the nurses must use everyday. They include eCare, an in-house developed electronic patient record system, a 24-hour patient care flow sheet, records of medication and administration, special specimen forms, reference books, whiteboards, and so on. Of critical importance to this study will be two working documents: the Assignment Sheet (AS) and the Shift Sheet (SS). In short, the AS summarized all patients of an entire hallway and the SS showed critical information about a specific patient. We will also discuss several other working documents, including the kardex, which summarizes a patient's illness, and personal sheets, where nurses keep track of their patients. These will be

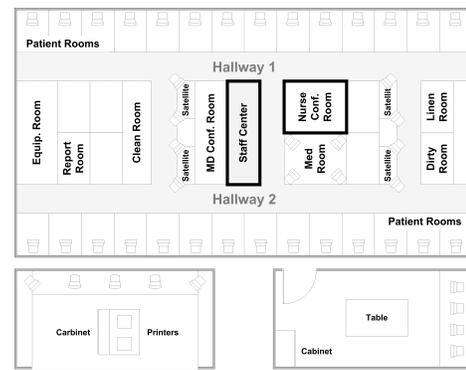


Figure 1. (top) Floor map of the unit; (bottom) Staff Center and Nurse Conference Room

described below.

Data and Data Collection

This study consisted of largely field observations as well as the examination of formal and informal nursing documents. Our investigation started four months prior to the CPOE system activation, and then continued through the entire phase of adoption into full use after for a total of eight months. The first author performed the field observations. She usually spent a few hours observing activities or reviewing onsite records and working documents, and then spent the rest of the day writing up notes (or the next day if the observation involved a night shift). In addition, she also took part in the meetings organized by the unit nursing leadership to prepare for the adoption of the CPOE system.

The observational activities involved shadowing nurses, asking questions if they were available to answer, tracking critical incidents, and jotting down notes. During the slow hours of the shift, the researcher also wrote down detailed notes at the site. The observations covered all three shifts, i.e. the morning shift of 7am ~ 3pm, the evening shift of 3pm ~ 11pm, and the night shift of 11pm ~ 7am of the next day.

We started with examining overall nursing activities on the entire floor, which included shift-change meetings, generating working documents, recording the medication administration and assessments of patients, writing nursing care plans into the computer system, and so on. We turned our attention gradually to the use of two working documents, the AS and the SS. We observed numerous uses of these documents and collected samples before these documents were discarded by nurses. All collected documents, 85 samples of the AS and 98 of the SS, were de-identified based on IRB regulations. In addition, the first author also reviewed about 360 copies of the SS on-site for data analysis. During the on-site observations, the researcher often asked nurses, if they were available, to clarify specific cases and potential confusions.

For the study reported in this paper, we extracted the portions from our observational notes that were related to the use of the AS and SS for data analysis. In addition, samples of the actual AS and SS allowed the researchers to examine language use in its original context. We coded the information on the AS and the SS for topics related to nursing practice and patients' illness experiences [4, 5, 13]. The field notes and documents were used to corroborate one another during analysis.

NURSES' WORK

Each nurse of this unit usually received three to five patients depending on which shifts she worked, and almost always was assigned at least one patient who needed total care. This was a heavy workload unit. Sometimes, one patient could have over twenty different kinds of medication in two hours, but nurses were not supposed to carry any medication in their pocket while hanging around

or prepare medications for two patients at the same time. This meant that nurses had to travel back and forth between patients' rooms and the medication room. During the rush hour (i.e., a period when many medications needed to be passed out), nurses often had to hurry from one place to the other. However, during slower hours, they often took time to have snacks or meals in the nurses' conference room, when topics might switch to wedding dresses, honeymoons, babies, and so on.

The incoming nurses usually arrived 15 minutes to half an hour before the shift change meetings took place, which were at 7am, 3pm, and 11pm respectively for the day, evening and night shifts. They prepared for the work, e.g., by putting supplies of writing instruments in their pockets and stethoscopes around their necks, and by chatting in the nursing conference room on various topics that often included what happened with the patients during their last shifts.

Two teams worked on two hallways. Nurses started their work with the shift change meeting. Shift change meetings took place separately in the Nursing Conference Room and Report Room. The meeting always started on time. The incoming charge nurses played the audio tape report prepared by the outgoing shift charge nurses. This oral report contained information about all 16 patients on one hallway. The incoming nurses sat around the table, taking notes on the AS. After the tape report, which was usually less than ten minutes, the charge nurse assigned patients to incoming nurses based on the workload of each patient. The entire shift change meeting usually took less than 20 minutes.

After the shift change meeting, outgoing nurses took time to talk with the incoming nurses face-to-face on issues that had occurred very recently and were not covered by the audio report. Then, incoming nurses prepared their personal sheets, which included reading and copying information from various information objects, such as the kardex (nursing records), the SS, the AS, and the CPOE after the adoption. (We will come back to discuss fully each of these information objects in a later section.) Incoming nurses usually finished up the shift change meeting and personal sheet preparation within half an hour.

The outgoing charge nurse and team leader were responsible for updating information on the AS and making copies for each of the incoming nurses. Outgoing nurses also needed to write the important issues on the SS, update the kardex record for each of the patients they covered, and give an oral report to the outgoing charge nurse or team leader for the audio-taped report at least half an hour prior to the start of a shift change meeting. The outgoing nurses usually left the floor half an hour after the new shift came to work.

In the rest of this section, we report our findings sequentially according to the progress of CPOE adoption, with a focus on the use of the two working documents of particular interest.

Episode 1: Documentation and collaboration

The Assignment Sheet (AS)

At the beginning of the study, the AS was a within-shift shared document containing a summary of medical information about 16 patients at any time on one hallway, produced by the charge nurse at the end of each shift. It served the incoming shift as a working document for coordination during their shift, and then was discarded when outgoing nurses left the floor. The AS included each patient's room number, family name, diagnosis, activity assistance, treatments/IV fluids, vital signs frequency, I&O, CS/WT (chemstick/weight), specimens, and medical issues. (See Figure 2.)

Here is an example of what appeared on the AS for one patient:

"S/T 129, Johnson¹ Poss cholangitis, ↑ c [with] assist, IVF, QS, NPO, Fall prec " - [from the assignment sheet on Feb. 29, 2008]

This short quote tells incoming nurses: the patient Johnson is in room #129; her medical condition needs semi to total care (i.e. workload related); she may possibly have cholangitis (an inflammation of the bile duct), she can get up with assistance; she is getting ongoing intravenous (IV) fluids; she needs vital signs checked every shift; nothing per mouth is allowed; and, she is on fall precaution.

Each incoming nurse received the AS at the beginning of the shift. In addition, they listened to the tape report as a group during the shift change meeting. The tape report included more details, such as a patient's physical assessment, medical issues (e.g., dressing change, special wound care, IV fluids involved), patient's personality (e.g., pleasant, needy), mood (e.g., restless, calm, comfortable), and general issues (e.g., needs to see a social worker). By reading information about 16 patients on the AS and listening to the tape report, incoming nurses gained an idea of how busy they were going to be for their shift *as a team*.

As mentioned, the workload was very heavy in this unit.

| Room | Family Name | Diagnosis | Activity | IV | Med | Specimen | Other |
|-------|-------------|------------------|----------|-----|-----|----------|-----------|
| 123 | Johnson | Poss cholangitis | ↑ c | IVF | QS | NPO | Fall prec |
| 124 | | | | | | | |
| 125-1 | | | | | | | |
| 125-2 | | | | | | | |
| 126-1 | | | | | | | |
| 127-2 | | | | | | | |
| 128 | | | | | | | |
| 129 | | | | | | | |
| 130 | | | | | | | |
| 131 | | | | | | | |
| 132 | | | | | | | |
| 133-1 | | | | | | | |
| 133-2 | | | | | | | |
| 134-1 | | | | | | | |
| 134-2 | | | | | | | |
| 135-1 | | | | | | | |
| 135-2 | | | | | | | |
| 137 | | | | | | | |
| 138 | | | | | | | |

Figure 2. An example of AS use before the adoption of the CPOE system

Each nurse usually had one "total" care patient, combined with another "semi" care patient and two, three, or even four more normal workload patients depending on how busy that shift was. A total care patient often needs one-on-one attention. If one nurse was caught up by one total care patient, the other nurses on the team often took care of that nurse's remaining patients. In this situation, the AS provides a very convenient reference in real-time – a nurse could easily take this one piece of paper out from her pocket as a quick source before going to see a patient who was not covered by her duty. The nurses on one team often helped each other answer call lights. Without help from team members, some nurses might not be able to take care of their patients on time or would have to work overtime on documentation. In fact, all nurses carried the AS and their personal sheets (including detailed information about their own patients) in their pocket during the entire shift.

The AS also served as a great working document for the charge nurses because it included the information about all 16 patients under the team's care. Since they were responsible for passing along their patients' information to the next shift via the AS and audio tape, near the end of the shift, they used the AS to get an oral report from each nurse to prepare the tape report. They also needed to update the root AS, a pencil copy to allow for erasing old information, keeping any unchanged part as-is, and adding new information. They then made copies for incoming nurses.

It is worth pointing out that in order to maintain teamwork, the unit nursing leadership also created a local recognition program. Each nurse who received help from others always wrote thank-you notes with specific reasons and then posted them on the public information board in the conference room. A lottery at the end of each month would award one nurse, whose name was chosen from the thank-you notes, with a \$10 gift card. This reinforced their team collaboration and set it into the organizational culture.

The Shift Sheet (SS)

In addition to the AS, another important working document was the SS², also heavily used by the nurses. The SS was jointly written by three shifts nurses and it carried *one* patient's overall information during her hospitalization. Social issues, emotional needs, and warnings, i.e. psychosocial context, constituted a distinctive category of information appearing on the SS. (See Figure 3.)

The SS was produced daily, but stored *cumulatively* with a patient's nursing kardex in the kardex folders placed on the tables in the nursing conference room and report room, in

¹ All names in this paper, including the names of the electronic applications and hospital, are pseudonyms.

² The SS was colloquially called by the unit nurses by the first name of the nurse who developed it. This is in honor of his invention of this working document six years ago to encourage information sharing and maintain the continuity of patient care.

Figure 3. An example of the SRS use before the adoption of the CPOE system

which the shift change meeting took place. When the patient was discharged, her kardex and the SS were discarded.

A nursing kardex was a card that provided a quick overview of basic patient care information, including name, age, marital status, religion, allergies, diagnoses, orders (for medication, treatment, diet, IV therapy, tests, procedures), do-not-resuscitate status, consultations, permitted activities, functional limitations, and emergency contact numbers. To complement the information on a nursing kardex, the unit nurses adopted the SS six years ago as their routine practice. It was essentially a 3x3 table. Three rows were headed with “Interdisciplinary plan of care,” “Lab specimens,” and “Nursing plan of care;” the three columns were for night, day, and evening shifts. (See Figure 3.)

In the box “Interdisciplinary plan of care,” the nurse of the current shift would write a summary of the doctor’s admission notes if a patient was a new admit, or progress notes if the patient had been staying in the unit. This summary included the present illness, past medical history, past surgical history, home medication, allergies, social history, and family history, providing the nurses on the next shift(s) a quick understanding of who this patient was and why she was here by just a glance at this box. This box was left blank if a patient had no significant progress or deterioration since being admitted. In order to make this summary, nurses needed to log into eCare, an in-house developed electronic documentation system to read the doctor’s notes. In fact, many nurses just printed out a doctor’s admission note from eCare with a small font and pasted it into this box. Patients’ lab and procedure results were also stored in eCare.

Information in the “Nursing plan of care” on the SS was handwritten by each shift nurse. Here is an example:

- AO3,VSS
- Fall Precautions; Non compliant
- Hot packs applied to back & btwn ankles
- PCA dose ↑ from 0.2 mg to 0.3mg
- Recheck pain & assoc info Q1H
- Very needy pt

[- from the SS, evening shift on April 13, 2008]

This annotation explained that the patient was alert; she had been asked about orientation on three dimensions (knows who she is, where she is, and what the current date and time is); her vital signs were stable; she was on fall precautions, but she was not compliant; there were hot packs applied to her back and between her ankles; her PCA [Patient-Controlled Analgesia] dose increased from 0.2 to 0.3mg; there was a need to check patient’s pain-related issues every one hour; and, the patient was very needy. Information in this box conveys both information about medical conditions and social-emotional issues about this patient.

To a nurse, both “total” and “needy” meant more work when dealing with a patient. However, “total” was a neutral word that described the medical issue workload, while “needy” was certainly a negative word that implied the patient’s unpleasant personality, extra requests, and manipulative behavior. This assessment was the result of behavior of a patient, including frequently pressing the call light, frequently asking nurses to page doctors to change medications, and so on.

“Needy” is a word that rarely took place on the AS, because the AS was only to include what were considered “medical facts.” “Needy,” as were many other words considered subjective, was passed along via the SS or the tape report, or through face-to-face interaction. In fact, this word seemed so powerful and popular to describe the situation that nurses used it quite often, yet they were very cautious not to put it on any permanent documents. During the preparation meeting for the adoption of the CPOE system, the lead group especially discussed this issue. They warned the nurses of the unit not to use this word, or other subjective or judgmental language to describe a patient in the new computer system to avoid trouble, as the formal record was subject to audit by the records review committee of the hospital or potentially used for legal purposes.

As mentioned, side notes about psycho-social issues, emotional needs, and warnings about patients were one important category of information on the SS. Examples included “pt only speaks Russian,” “pt moaning,” “pt requesting to be woken up for pain meds,” “see social worker and my note to get whole story,” and “tearful, brother at St. Pauls [another hospital in town].” This type of information not only conveyed extra workload-related information (in addition to the medical issues listed on the AS) but also told and suggested to an incoming nurse how to approach her patients. In some cases, nurses put casual information, such as “daughter very friendly/needy,” “calm today,” “likes talk a lot,” “likes orange sorbet,” and “pt is a MD - urologist,” as a way to provide a richer picture of the patient’s situation.

For the SS, each outgoing nurse spent a little time, usually near the end of the shift, to note both medical and social issues and emotional needs about a patient. The overall benefit was that the next incoming nurse would gain an efficient and thorough familiarity about her patients by

reading the accumulation of nurses' notes from several previous shifts, and thereby a longer view of a patient's entire hospitalization. Even though the SS might contain what was considered socially sensitive information or judgmental words, nurses felt comfortable writing them down when they believed it was good to let the incoming nurses know. The SS was only kept during the patient's hospitalization, and only shared among the unit nurses. Since it was eventually thrown away, nurses had fewer concerns about what to say or not say on this sheet.

Discussion of the Assignment Sheet and Shift Sheet

Both the AS and the SS served as a good example of collaborative practice. The AS was created by the charge nurse and used among the nurses on one shift to support teamwork; the SS was created jointly by each nurse and benefited all on the next few shifts. It was indeed an effort for an outgoing nurse to update the SS and note important social and emotional issues for incoming nurses, especially given that the overlap time between two shifts was only half an hour. How to efficiently pass along various kinds of information in such a short time has been a key issue for nursing shift changes [18]. The joint effort of information sharing smoothed an otherwise fragmented clinical practice.

The nurses' behavior suggests a collective pride in providing not only medical care but also emotional support; the content of the SS seems to validate a philosophy of nursing which centers on emotional work and care provision [6]. The combined use of the AS and the SS was the effort of this unit to ensure the continuity and quality of patient care. In fact, team-oriented caring is often recognized and appreciated by the patients of the unit.

Episode 2: The loss of psycho-social information

Although the major function of the CPOE application was to deliver electronic management of medical orders, the system in this institution was also designed to embed side functions to replace all paper-based nursing working documents, including the nursing kardex and locally-created working documents, i.e. the AS and the SS in this unit. A page in the CPOE called "Clinical Summary" was expected to replace the kardex, and the "Comments" field on this page would carry all information originally populated on the SS. (See Figure 4.)

During the preparation of the system adoption, the unit CPOE adoption lead team, including the clinical nursing supervisor, the nursing specialist, one education coordinator, and two senior nurses, discussed the future of the AS and the SS. The lead team quickly reached an agreement – keep both of the documents!

The clinical nursing supervisor stated that she did not want to "change too much at one time." This seemed to fit the unit leadership's basic concerns of continuity and consistency of the work practice. However, they were also aware that paper-based documents, no matter what they were, would eventually go away. Indeed, they were told by

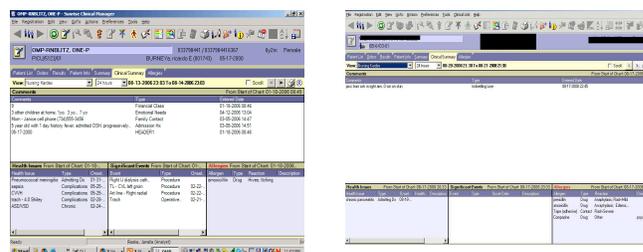


Figure 4. (left) Promotion page of the CPOE system; (right) Actual page of the CPOE system

the hospital's top management that all paper-based documents were discouraged.

The lead team had no doubts about keeping the AS because neither the CPOE nor eCare had the functionality of providing a quick, portable overview of information on 16 patients at a time. As we discussed above, the main purpose of the AS was to give nurses a quick source in their pockets when they needed to assist other nurses, i.e. teamwork support. Without the AS, the shift change meeting would have to change to another model – from a group shift change meeting to a one-on-one handoff, which would take much longer time to finish in a unit where each nurse took over four patients. One senior nurse made the point very clearly: "We are doing the teamwork, and we still want to."

There were several rounds of discussion on whether to keep the SS by this lead team. Although the "Comments" field in the CPOE system was designed for sharing nursing information, the lead team of adoption was concerned about the transfer into the new system of the subjective and judgmental language used by the nurses in the paper SS. In addition, the clinical nursing supervisor did not want to change the workflow, which included documenting patients' social issues and emotional needs on the SS near the end of the shift. Eventually, the lead team reached an agreement to keep the SS, just to see how it would go.

Since the very day (April 28, 2008) that the CPOE system went live, the conference room table has been clear. Previously, the kardex folder, which also stored the SS, was placed on the table. The function of the kardex was completely replaced by the CPOE clinical summary page. Although the SS was supposed to stay, it was moved into the hallways and kept with the patient's 24 Hours Patient Care Flow Sheet. This in fact changed the workflow for assembling information.

Prior to the CPOE system, during the shift change meeting, nurses sat around the table. After listening to the audio tape report and receiving the patient assignment, nurses immediately picked out their patients' kardex and the SS. The kardex, as a universal nursing document, includes clearly defined categories of information to describe a patient's medical issues. Checking the kardex to get a first overview of a patient was what nurses always did to prepare

for personal sheets. The information on the SS, often rich in psycho-social context, contributed to a nurse's understanding of how a patient had been doing during last several shifts. Since the kardex and the SS were placed on the table, this was a seamless action right after patient assignment. After they prepared the personal sheet, they went to the hallway to check the paper-based 24 Hour Patient Care Flow Sheet and Records of Medication Administration before seeing patients.

After the CPOE adoption, the physical tie between the kardex and the SS was broken because the paper kardex was converted into an electronic version in the CPOE. After the patient assignment, nurses always rushed to the computers in the conference room to check whether they had any immediate orders. The CPOE also gave them a patient's overall medical information to prepare their personal sheet. In this new workflow, an extra trip to the hallways to access the SS seemed not to fit.

Gradually, the SS was abandoned. The first author collected samples of the SS after the introduction of CPOE, and found that many pages were left blank. On May 16, the Workload Review Committee (WRC) of the unit met for over three hours to discuss the workload after the CPOE. The WRC members decided to provide more extensive audio tape reports to compensate for the loss of the SS. The committee concluded with the decision to discontinue the use of the SS.

As a result, the SS was terminated after six years of serving as a teamwork and information sharing document. It was interesting to note that no person who served in the CPOE adoption lead team and recommended keeping the SS served subsequently on the WRC. While being asked individually, the CPOE lead team expressed that they were all surprised by the SS being gone so soon. Asked what might be the reason for this situation, they gave different answers:

- I just don't know why it's gone.
- People think it is a bit repetitive and they have to do extra work for no good reason.
- We [the CPOE lead team] talked about the possibility to discontinue the SS, but we did not know how the work would be changed after the [CPOE], so we decided to keep it. It came a lot sooner than we expected. Plus, prior to [the SS] (was created), people still could do the work. They passed over the information from oral report.
- Perhaps the (physical) location. I am surprised why [the manager of the unit] let it go. [- from field notes, May 20th, 23rd]

It is worth noting that both the creation and the termination of the SS were attempts to reduce workload. Before the CPOE, the nurses did not have to spend much time in front of computers, except when they had to enter nursing notes or prepare discharge documentation for the patients in the eCare system. In this situation, the SS, which pulled out a lot of medical information (i.e. doctors' notes and lab

results) from the eCare by outgoing nurses, allowed incoming nurses to immediately know about the patient without having to log into eCare. After the CPOE, the kardex was in the computer system, so nurses needed to access the computer right after the patient assignment to get an overview of the patients' information. In addition, they could also easily switch from the CPOE to eCare to read doctors' notes and get lab results about their patients. From this perspective, there was no need to require outgoing nurses to still handwrite this kind of information on the SS. The termination of the SS saved outgoing nurses' time, so it was a happy outcome for many nurses.

The majority of nurses cheered the termination of the SS, arguing that the eCare system adequately carried most of the information the SS used to contain. They did not see the need to keep the SS. However, it was clear to the researchers that they had disregarded that the SS carried so much nuanced psycho-social information in the "Nursing Plan of Care box," which could not be found in the CPOE or eCare.

The nursing leadership anticipated the full use of the "Comments" field in the CPOE system as a way to pass along nursing care information. However, the comments field was still largely empty. Surveys of CPOE records conducted at the end of the sixth, eighth, and sixteenth weeks after the CPOE adoption showed no information entered into the comments area for between 13 and 16 of 32 patients each time. The rest of the patients had 1 to 7 entries, but roughly 10 patients contained only one entry: family contact information or antibiotics precaution.

There was a deep concern about writing things into an electronic system. Nurses learned from each other that information entered into the computer system would be permanent; even though you could delete the text on the screen, that text would still stay in the log data. Nurses were warned by the management of the unit not to put any "judgmental" words (e.g., "needy") into the system because the information in the comments area was shared throughout the entire hospital. As a result, psycho-social contextual information originally passed along through the SS was lost in written format. Nurses have since been trying to have more oral communication, but the oral channel is only good from one shift to the next, not *across* multiple shifts: An outgoing nurse tended to report what had happened during her shift instead of the cumulative information that the original SS carried.

While not entering any potentially sensitive information in the CPOE system, some nurses did not even enter medical nursing care information either. The clinical nursing supervisor once encountered a patient with a cast on her right leg, which certainly needed special care. However, this medical care need was not noted down anywhere, which left the incoming nurse, the supervisor herself, with a huge surprise. "That's not acceptable", she reported. To deal with this problem, the WRC sent an email to all nurses:

Midnight shift update clinical summary, and all nurses - be sure to look at nursing (e)Kardex under order tab and also clinical summary for pertinent patient information.]

Episode 3: Oral communication

With the termination of the SS and the hesitation to enter information into the new system, psycho-social information gradually appeared on the AS, which used to only include medical issues before the CPOE system. For instance, "Needy & [with] pain meds" had been frequently seen on the SS before but now was seen on the AS. This is a somewhat insider phrase among clinicians, which clearly conveys that this patient might be a potentially problematic drug seeker or be very manipulative about certain pain medications. An incoming shift nurse would then be prepared to deal with it. Other social, emotional support needs and warnings on the AS included "Gender Identity Disorder", "Do paper work when son-in-law here", "very depressed, lethargic", "Needs Abuse/Neglect, paper work done" [send for counseling], and "[feed] meds with applesauce."

However, in coming upon psycho-social information on the AS, one nurse expressed discomfort about using words such as "needy" on the AS. She said all agreed that the AS should include only medical issues given the space limitation (i.e. one patient only gets one line).

To date, the nursing care information previously carried by the SS has been divided into three communication processes. One is via an audio tape report and occasional face-to-face meetings between an outgoing nurse and an incoming nurse if they happen to meet, the second is sporadic notes on the AS, and the third is very limited CPOE comments. It was confirmed by the nurses that the audio tape typically carried more psycho-social information and was lengthier than before the CPOE. Although it has only limited use, the comments field in the CPOE system does sometimes contain warnings and serious psychological information so that a nurse stands a better chance of seeing it. In one problematic situation, we found two entries:

- Family requests that no visits allowed or information be given to 17 Y.O. [year-old] female named Kristen
- Pt. non-compliant & [with] NPO order [nothing per mouth]. Pt found drinking NS [an intravenous IV fluid], tube feeding mix, using cups from the garbage to drink from the sink. All drinkable items removed from pt's room. MD notified

The language use was very careful in these two entries. The nurse described the situation, and left others to sense what was going on with this patient, his family relationship, and his psychological situation. This patient's situation was also recorded on tape, on which the word use was quite casual and also subjective (e.g., "needy", "crazy"). In fact, at this point, several nurses report that they always pass along important information (both medical and psycho-social) through oral means, because they are not sure whether the

incoming nurses would even look at the comments field in the CPOE system.

DISCUSSION

Much of what happened on the unit has been seen in many other settings [8, 9] – but with key differences. Several interlinked reasons explain why the psycho-social information largely vanished from written form by the end of the study. First, before the CPOE adoption, the SS had been in the conference room, where everyone could view and use it. In a decision that must have appeared to be a minor change to the unit leadership, it moved to the hallways. The conference room is the place where nurses start to assemble information to prepare their personal sheets from a variety of sources (e.g. tape report, working documents, and face-to-face interaction), so there is an expectation to the focus in this location. In the hallway, information exchange does take place; however, it is only sporadic and informal. In addition, the kardex, an important information resource including most of what nurses need to know in order to provide medical care, has now been digitalized into the CPOE. This requires nurses to log onto the computers immediately after the patient assignment. While there are computers in the hallway corners, nurses prefer to use the computers in the conference room; they often discuss issues with each other and outgoing nurses can expect to find them if needed. Thus, the new location for the SS made it difficult to use and did not fit the new workflow. This may have partially explained why the SS was terminated so quickly after the CPOE adoption even though the decision was made by the leadership to keep the SS.

Second, the CPOE system worked well enough for order management of nursing practice. In addition, the new system also provided a convenient link directly to the eCare patient record, which stores doctors' admission notes and lab results; this information used to be assembled (by nurses via handwriting) on the SS. From this perspective, the CPOE system simplified nurses' documentary practice. Therefore, since nurses' work is largely organized by administrating medication orders provided by doctors [20], the CPOE was appreciated overall by the nurses despite its inadequacy for the SS' Nursing Plan of Care section and the loss of psycho-social context information. Indeed, this study once again shows how even small differences in convenience and functionality can separate partial success from success (or failure) in system adoption [3].

Third, the CPOE field for "Comments" was implemented as being institution-wide visible. Computerization potentially makes nurses' invisible work visible [4, 16], and publishing entries in the CPOE could make nurses a target for social control and surveillance [20]. Indeed, nurses thought that psycho-social information, as "subjective" information, should be shared only within the unit - it was only for them to know about their patients.

In addition to being visible, entries in the “Comments” field of the CPOE system were permanent. The SS, on the other hand, was a temporary document, and was thrown away every few days. Hospital systems are often systems of accountability [1], and this CPOE was no exception. Systems of accountability are concerned with auditing capabilities and clear lines of responsibility. The permanence of the CPOE record, and the visibility to check on it, brought with it vocal concerns. Entering socially sensitive, emotional, or judgmental information about patients was held to be problematic by management at all levels. This reinforced the “politics of knowledge” often found in nursing care [4, 20]. Even though nurses are concerned about care and have career anchors in care, their work is often considered problematic or secondary by doctors. As a result, a considerable portion of nursing work becomes essentially invisible and excluded from consideration.

As a result of the location, convenience, visibility, and the permanency, the “subjective” information retreated or moved (depending on the informant) to an oral presentation. This returned the psycho-social information to a non-permanent, non-written, non-visible state.

However, what we also observed was that the unit’s nurses made many different attempts to find written locations for the psycho-social information. The AS was found to be the wrong size, with little room for each patient. Some nurses even tried entering psycho-social information into the CPOE, but for the reasons discussed above, only certain kinds of psycho-social data, ones considered suitably decontextualized and close enough to “medical facts,” were placed in the CPOE. Since no location prevailed, each also had the standard melt-down problem from CSCW: When no one looks at the location, the motivation for using the location also decreases, fewer people use the location, and the use cycles down. No suitable location has been found to date.

All of the discussion above of the concern about disclosing subjective information does not really explain why the nurses also omitted even general care information in CPOE, which used be carried largely by the SS. To write the nursing care information on the SS near the end of the shift was an institutionalized arrangement, which had been in place for years. In this view, the nature of information work in hospitals requires extremely complex and overlapping assemblages of information objects. In fact, the SS itself was an assemblage, with its three boxes drawing on multiple links to other information objects.

When the CPOE system was introduced, the SS shattered. The assemblage disintegrated, as two of the boxes were superseded by CPOE functionality. But more importantly, the institutionalized arrangements that made SS use possible also shattered.

At the beginning of the study, the politics of information were essentially hidden in that institutionalized

arrangements had been negotiated (implicitly or explicitly) among the nursing staff. The politics of this arrangement became critical, however, when the CPOE record became visible to a larger public (and therefore a boundary object [4]). The previous agreement to detail the psycho-social information but to keep it private and informal disintegrated. The public nature of the CPOE record made the generation and within-group sharing of local knowledge problematic.

As discussed above, what we saw in the unit were arguments about the very nature of psycho-social context information. This could be seen, for example, in the argument about whether “subjective” data could be placed in patient records or only “medical facts.” After the CPOE introduction, the politics of knowledge metastasized – discussions were no longer just about the CPOE system, but about the value and nature of the data itself. The unit nurses no longer had agreement about what it meant to be “data.”

We believe that this led to the floundering and thrashing about where to place the psycho-social information. The unit leadership and nurses have not been able to find better solution other than lengthening the tape report. What will be required is a new negotiated order, Strauss’ term for a new consensus about meanings [17]. In this case, it is a consensus about proper data. Without the consensus of a new negotiated order, there can be no new form.

IMPLICATIONS AND CONCLUSIONS

This paper presented a field-based study of a hospital ward, focusing on the transition from paper order management to an electronic operation. Specifically, we studied nursing practice on the unit and nurses’ use of working documents, the Assignment Sheet (AS) and the Shift Sheet (SS), to detail psycho-social information. The short-term information on especially the SS provided much richer information about patients and maintained the continuity of patient care. However, after the introduction of a CPOE system, the psycho-social information was no longer captured in written format.

Our study has several implications for information technology development and deployment in healthcare settings. Our study reiterates that while a new system may support the formal work processes, making those practices visible and permanent changes the nature of those practices. It can also change other, largely invisible practices necessary to accomplish the work. In addition, our study suggests a common story about the politics of medical information. Computerizing patient information was not just a matter of understanding the workflows and work; it was also a matter of understanding the routinized agreements around that information. Furthermore, and more importantly, some of those agreements will be only “good enough” [17]; they were working arrangements that did not carry full agreement. In this site, once the psycho-social information was brought into play with the CPOE, there

was no politic, easy way to put the Humpty-Dumpty of the arrangements back together again, despite the nurses' best efforts. The issue has been too contentious; the oral presentations were the best they could do. We believe this may be an important contribution not only to medical informatics but also to collaborative information sharing overall, since status and politics often influence adoption resistance.

Many stories of computerization, especially in medical settings, stress that one must understand the nature of the work and workflow before implementation and adoption. Ethnographically-informed requirements analysis, it is argued, can provide this. What we have seen here, however, is that not only the work activities and processes must be understood in their context, but even the social constructions and shared meaning. This also includes a better understanding of how practice becomes visible or invisible.

Indeed, our study may serve as a caution, even within HCI. Well-intentioned efforts, such as [18], can too casually attempt to computerize documents, records, or artifacts, assuming it is only a transition across media. We have seen in this study that even taking into account the social context may ignore the institutional arrangements that allowed those artifacts to exist in the first place.

As mentioned, this is part of a larger study. We are currently looking at doctors' medical practice from the perspective of long-term use of medical information. Our study, through exploring social-technical issues of information construction, will highlight design factors that can affect information sharing and reuse and thus the quality of patient care.

ACKNOWLEDGMENT

This work was supported, in part, by a University of Michigan Barbour fellowship and NSF grant 0325347. We thank the nursing staff of the study site for their incredible support. We are also grateful to Michael Cohen, Lee Green, Rhonda Schoville, Madhu Reddy, and all of the anonymous reviewers.

REFERENCES

1. Bardram, J. "I love the system - I just don't use it!" *Proceedings of ACM GROUP* (1997), 251-260.
2. Bjerknes, G. and Bratteteig, T. The memoirs of two survivors. *Proc. CSCW* (1988), 167-177.
3. Blythin, S., Hughes, J. A., Kristoffersen, S., Rodden, T., and Rouncefield, M. Recognising "success" and "failure". *Proceedings of ACM GROUP* (1997), 39-46.
4. Bowker, G. and Star, L. *Sorting Things Out: Classification and Its Consequences*. MIT Press, 1999.
5. Charmaz, K. *Good Days, Bad Days: The Self in Chronic Illness and Time*. Rutgers Press, 1993.
6. Edwards, D. *Philosophy of nursing: An introduction*. Basingstoke, Palgrave, 2001.
7. Hardey, M., Payne, S., and Coleman, P. 'Scraps': hidden nursing information and its influence on the delivery of care. *Journal of Advanced Nursing*, 32, 1 (2000), 208-214.
8. Hardstone, G., Hartswood, M., Procter, R., Slack, R., Voss, A., and Rees, G. Supporting informality. *Proc. CSCW* (2004), 142-151.
9. Heath, C. and Luff, P. Documents and professional practice: 'bad' organisational reasons for 'good' clinical records. *Proc. CSCW* (1996), 354-363.
10. Hyde, A., Hyde, A., Treacy, M., Scott, A., Butler, M., Drennan, J., and Irving, K. Modes of rationality in nursing documentation. *Nursing Inquiry*, 12, 2 (2005), 66-77.
11. Kaplan, B. Evaluating informatics applications - some alternative approaches. *International Journal of Medical Informatics*, 64 (2001), 39-56.
12. Koppel, R., Metlay, J. P., Cohen, A., Abaluck, B., Localio, A. R., and Kimmel, S. E. Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors. *JAMA*, 293, 10 (2005), 1197-1203.
13. Miles, M. and Huberman, M. *Qualitative Data Analysis*. Sage Publications, Inc, 2nd edition, 1994.
14. Reddy, M., Pratt, W., Dourish, P., and Shabot, M.M. Sociotechnical Requirements Analysis for Clinical Systems. *Methods of Information in Medicine*, 42 (2003), 437-444.
15. Schmidt, K., Wagner, I. and Marianne, T. Permutations of cooperative work practices. *Proceedings of ACM Group* (2007), 1-10.
16. Star, S. L. and Strauss, A. Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work. *Computer Supported Coop. Work*, 8, 1-2 (1999), 9-30.
17. Strauss, A., Wiener, C. and Shizuko, F. *Social Organization of Medical Work*. Transaction Publishers, 1985.
18. Tang, C. and S. Carpendale. An observational study on information flow during nurses' shift change. *Proc. CHI* (2007), 219-228.
19. Tellioglu, H., & Wagner, I. Work Practices Surrounding PACS: The Politics of Space in Hospitals. *Journal of CSCW*, 10, 2 (2001), 163-188.
20. Wagner, I. Women's voice: The case of nursing information systems. *AI & Society*, 7, 4 (1993), 295-310.
21. Xiao, Y. Artifacts and collaborative work in healthcare: methodological, theoretical, and technological implications of the tangible. *Journal of Biomedical Informatics*, 38, 1(2005), 26-33.