Discuss Now, Document Later: CIS/CPOE Perceived to be a 'Shift Behind' in the ICU

Sarah Collins[a], Suzanne Bakken[a,b], David Vawdrey[a], Enrico Coiera[c], Leanne M. Currie[a,b,d]

[a]*Department of Biomedical Informatics, Columbia University, New York, NY, USA*
[b]*Columbia University School of Nursing, New York, NY, USA*
[c]*Centre for Health Informatics at the University of New South Wales, Sydney, Australia*
[d]*New York Presbyterian Hospital, New York, NY, USA*

Abstract

Effective communication is essential to safe and efficient patient care. We aimed to understand the current patterns and perceptions of communication of common goals in the ICU using the distributed cognition and clinical communication space theoretical frameworks. We conducted a focus group and 5 interviews with ICU clinicians and observed 59.5 hours of interdisciplinary ICU morning rounds. Clinicians used a CIS/CPOE system and paper artifacts for documentation; yet, preferred verbal communication as a method of information exchange because they perceived that the documentation was often not updated or efficient for information retrieval. These perceptions that the CIS/CPOE is a "shift behind" may lead to a further reliance on verbal information exchange, which is a valuable clinical communication activity, yet, is subject to information loss. Electronic documentation tools that, in real time, capture information that is currently verbally communicated may increase the effectiveness of communication.

Keywords:

ICU, Communication, Interdisciplinary

Introduction

Evidence linking ineffective communication in the inpatient setting to negative outcomes such as increased length of stay, increased patient harm and increased resource utilization heightens the need to understand patterns and perceptions of clinical information exchange[1-5]. Effective communication in the intensive care unit (ICU) is critical due to complex technologies, therapeutic interventions and high patient acuity [5]. In the United States, the Joint Commission has identified communication failures as the leading cause of sentinel events and listed ineffective shift report as a contributing factor[6].

Stein-Parbury and Liaschenko found that during stressful situations collaboration breaks down and professional boundaries are accentuated regarding who owns what kinds of knowledge and who is responsible for specific kinds of work[7]. The ICU is a stressful environment in which patient care is dependent on many disciplines who must simultaneously work both autonomously and collaboratively[8]. Shift work in the ICU, specifically the frequent hand-off of patient care responsibilities to a different clinician, is known to increase the demand

for effective communication[9, 10]. Additionally, division of labor (i.e., distribution of activities and responsibilities), which is utilized by clinicians to increase system efficiency and overall functioning, is dependent on information exchange[8].

The aims of this study were: 1) To describe the ICU activity system in the context of interdisciplinary communication of common goals; and 2) To describe nurses' and physicians' perceptions of interdisciplinary communication of common goals in the ICU.

Background

The theoretical frameworks of distributed cognition and Coiera's clinical communication space were used to better understand clinician patterns and perceptions of the communication of common goals in the ICU (see Figure 1)[11, 12]. In the theoretical framework of distributed cognition the unit of analysis is the *activity system,* which is composed of *individuals* and *artifacts* (e.g., technology). The theory posits that the pattern of *information exchange* can drastically modify the behavior of the activity system and that the behavior of the *activity system* should be described by the patterns of information flow [11]. As opposed to traditional cognitive frameworks that only analyze individual processes, distributed cognition integrates goal directed actions and interactions of *individuals* and *artifacts,* and information exchange within an *activity system*[11].

Communication between nurses and physicians is important in the ICU because these clinicians work closely together to coordinate ICU specific patient care, communicate frequently, and are the primary users of clinical information systems (CIS) and computer provider order entry (CPOE) systems [13]. Coeira's clinical communication space framework describes the communication and information exchange activities between clinicians within the activity system according to the amount of common ground that exists between the communicators[12]. *Goal directed actions*, such as patient care tasks, and *interactions*, such as communication tasks, can be explicitly modeled, and the appropriate communication or information tools can be anticipated using the clinical communication space framework. Baggs describes ICU interdisciplinary collaboration as contingent upon the antecedent conditions of *Being Available* and *Being Receptive* which facilitate the core process of *Working Together* to achieve the outcomes
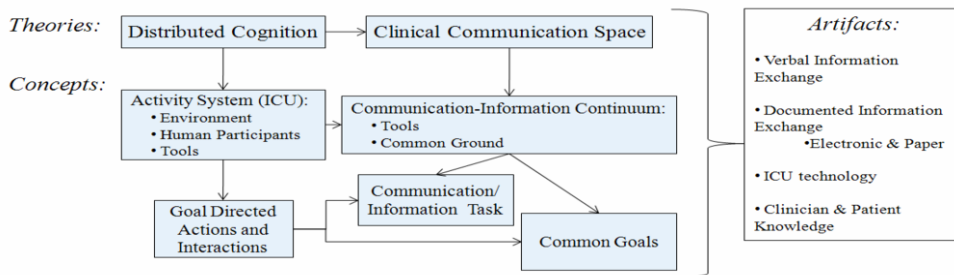
Figure 1 - Integrated Distributed Cognition and Clinical Communication Space Theoretical Frameworks

of *Improved Patient Care*, *Feeling Better on the Job*, and *Controlling Cost[14]*. The key focus of this study is *Working Together* which includes the *Coordination* and *Sharing* of patient care information in a *Patient Focused*, *Team* environment.

Materials and Methods

This descriptive study used ethnographic observation techniques, focus groups and interviews to identify characteristics of information exchange related to common goals in the ICU environment. This study took place at New York Presbyterian Hospital Columbia University Medical Center (NYP-CUMC) on the Neurovascular ICU (NICU), an 18 bed unit that specializes in intensive care for patients with neurovascular injuries. The hospital's vendor-based CIS/CPOE system supports electronic documentation of structured, semi-structured, and free text data for nurses, physicians, and respiratory therapists in the NICU.

Institutional Review Board (IRB) approval was obtained from Columbia University for all activities and informed consent was obtained from participants. The focus group and interviews, which were conducted with ICU clinicians, were held at a convenient time and place on the CUMC campus. All of the participants were compensated with a $10 cash voucher for their time. The focus group and interviews were audio-recorded and transcribed verbatim by a paid transcriptionist. The transcripts were verified against the audio-recordings by the researcher for accuracy. The field notes and interview transcripts were analyzed by the researchers for themes related to information exchange of common goals for patient care. ATLAS.ti™ (GmbH Berlin, Version 5.5.9) software was used.

We observed all clinicians who participated in interdisciplinary NICU morning rounds. During the observations the investigator (SC) observed and recorded handwritten field notes of the interactions of the entire NICU team (i.e., activity system) as defined by the distributed cognition and the clinical communication space theoretical frameworks. These interactions included conversations as well as clinicians' use of documentation artifacts, such as electronic documentation in the CIS/CPOE system and paper-based documentation. Data collection continued until data saturation (i.e., no new themes were identified) was achieved and the observational, interviews, and focus group data were triangulated for consistent themes.

We analyzed the triangulated data using distributed cognition to describe the *activity system* and the *goal directed actions and interactions* within the activity system. We also used the clinical communication space and Baggs' ICU interdisciplinary collaboration coding [14] to describe the communication and information exchange activities within the activity system (see Figure 1). Baggs' coding framework was extended where needed. The results are presented as: 1) the distributed cognition activity system description, and 2) the clinical communication space information exchange description.

Results

Clinicians were observed during NICU interdisciplinary morning rounds for a total of 16 days during the fall 2008 and spring 2009 which equaled fifty-nine and one-half hours. Each observation of NICU rounds lasted between three hours and four and a half hours. We also conducted one focus group that consisted of eight NICU nurses, one interview with an ICU staff nurse, and four interviews with ICU residents.

Distributed Cognition Activity System

Within the NICU's activity system, the individuals who were observed included the following types of clinicians: 1) Physicians (e.g., attendings, fellows, residents, and medical students); 2) Nurses (e.g., charge nurse, staff nurses, and nursing students); 3) Pharmacists; and 4) Respiratory therapists.

The artifacts used by the clinicians as information resources in the NICU were used to provide and capture information during and after ICU interdisciplinary morning rounds. During ICU interdisciplinary morning rounds, the artifacts that provided information to the clinicians were: 1) Computer terminals used by the attending, two residents and a pharmacist to provide access to the hospital's CIS system; and 2) Personal notes. These personal paper-based notes were carried by clinicians and included information written down during hand-off and throughout their shift. Personal notes consisted of the clinicians' to-do lists and the nurses' paper-based vital signs flow-sheet, as well as printed information from the CIS such as the medical administration record (MAR) and the attending's ICU note or the resident's sign-out note. During rounds, two residents sat at computer terminals and, based on the discussion, retrieved laboratory values, clinician notes, vital signs, and radiology results such as x-rays from the CIS.

Additionally, the resident who was presenting information about the patient referred to information that he or she printed

from the CIS/CPOE system as well as personal notes such as to-do lists. The patients themselves also served as an information resource during the moments that the team was in the patient's room during ICU interdisciplinary morning rounds. For example, during a given patient's bedside assessment the team also referred to data from the various therapeutic technologies in the room such as ventilator settings, intravenous medications, intravenous pumps rates, cardiac monitoring, and intracranial pressure monitoring data.

The artifacts for documentation that were used by clinicians to record the information that was discussed during rounds included paper documentation and the electronic CPOE system. The attending physician documented what was discussed by all of the clinicians who were present at rounds on the "Attending ICU note" in the CIS/CPOE system. Additionally, each one of the other clinicians were observed to hand write brief notes on their own personal papers at varying time points. The residents, using the computer terminal, continuously entered discussed orders into the CPOE system during rounds.

In addition to the artifacts that were used during rounds, the CIS/CPOE system included an interdisciplinary plan of care flow sheet. Nurses, respiratory therapists and nutritionists used this structured electronic flow sheet to document care. However, this flow sheet was not talked about or looked at during ICU interdisciplinary morning rounds. The only documents that were looked at during rounds were the "Vital Signs" and the "Intake and Output" flow sheets in the CIS/CPOE system as well as the paper-based vital signs flow sheet used by nurses. A paper-based nursing care plan was available but was not used; the nurses stated that it could be useful, but that they did not want to have to fill out any further documentation or duplicate information that they already documented in the CIS/CPOE system.

Despite documenting vital signs, medications, and fluids in the CIS/CPOE system, the nurses also documented the patient's vital signs and intravenous medications and fluids on the paper-based vital signs flow sheet that they carried around with them. The charge nurse also used a paper-based sheet that was written on and updated by each nurse during nursing rounds. This sheet contained information about each patient's diagnosis, any abnormal vital signs, intravenous lines, and plans for

imaging tests (e.g., computed axial tomography, also known as a CAT scan) or surgery. The charge nurse information sheet also contained information about interventions such as the use of a cooling blanket, if Tylenol was given for a fever (a fever is a concern for neurological patients due to a link to poorer outcomes), and if intravenous medications were used to control the patient's blood pressure.

Clinical Communication Space

Clinician perceptions and patterns of interdisciplinary communication and information exchange activities were coded according to Baggs' ICU Interdisciplinary Collaboration coding framework. We found that clinicians preferred verbal discussions as a method of *Sharing* information. Therefore, to explicitly capture the clinical communication space concepts of *communication and information tasks* we added the codes *Verbal* and *Documentation Information Exchange* to the ICU collaboration framework (see Table 1). Both of these categories had positive and negative aspects, therefore, they are each represented by positive and negative clinician quotations.

Verbal Information Exchange

Overall, verbal communication was the preferred method of information exchange in this ICU. The residents used the CIS/CPOE system to retrieve vital signs, the patient's fluid balance and to make sure that orders were entered; the residents verbally asked the nurse for other information related to the nursing assessments, interventions, evaluations and coordination of care for the patient. The residents stated that they place emphasis on entering new orders in the CPOE system, yet the nurses stated the importance of verbally communicating and discussing these orders. The nurses stated that part of sharing goals is making sure everyone knows the reason for why you are making a change. "Whether or not some documentation is updated is variable, but [we try] to always verbally communicated the updates to each other in shift report."

Common goals for the patient were verbally shared by physicians and nurses during morning rounds; yet, the clinicians acknowledged that sometimes a goal was explicitly stated and sometimes it was just implied in a CPOE order or other documentation and may be missed, forgotten or not prioritized as intended. Nurses stated that if they were not present at rounds, due to conflicting patient care responsibilities at that time,

Table 1- Clinician Perceptions of Verbal and Documented Information Exchange

Verbal Information Exchange	(+) *Resident:* It's a lot faster and easier to ask 'Please, just verbally, quickly tell me what's going on.' (-) *Nurse:* It doesn't all get written down [at rounds] and the night nurses don't know, sometimes in the report it gets lost in transition...miscommunication or doesn't get passed on, and you work twelve hours with one eye closed, basically not having all the information with you. (-) *Resident:* A third of the time, usually the event is communicated verbally and the issues or treatment and results are communicated verbally again, but nothing's ever written down.
Documentation Information Exchange	(+) *Resident:* The [beside chart] of the nurse's notes...past medical history and pertinent... a log of what happened. If I know a specific event happened, and I'm trying to get more details, that's where I may go. (+) *Nurse:* Writing things down in succinct manner physically next to the patient is very helpful. Because [then] everyone's very aware of it and people start saying, "Hey, did you see them?" "No, let's call them again." It's very helpful in getting things done and communicating, because it's written down, kind of almost set in stone once something's written down. (-) *Nurse:* The computer system doesn't even remotely match what's going on with the patient. It's ridiculous; there'll be Cardizem hanging [intravenous medication] and no orders for it [in CPOE system].
(+) positive aspect of category, (-) negative aspect of category	

they would piece together the plan and determine the patient's goals from their own assessment, attending note, resident sign-out, nurse shift report, orders and unit standards "that we all know." During the observations, the charge nurse and the fellow (i.e., a physician receiving specialty training) acted as liaisons between the medical and nursing teams. There was no formal team-based meeting after morning rounds to communicate changes in plans between nurses and physicians or to come to consensus about changes in patient goals. As one nurse stated, "sometimes nursing goals and medical goals conflict; however, due to the high amount of verbal communication on the unit they often overlap." The residents and nurses agreed that "if goals are known they are used to guide the day." Therefore, the clinicians expressed that it may be beneficial to provide unified general patient goals, specific tasks and major events of the day in a simple format that is readily accessible and contributed to by everyone.

Documentation Information Exchange

Clinicians emphasized aspects of documentation in the ICU that inhibited their workflow such as patient information contained in multiple disparate sections of the EHR, and information that was not updated to reflect current patient goals. Moreover, nurses commented that orders appear in the CPOE system that were not explicitly related to the nurses perceived understanding of the common goals for the patient. One resident described difficulty in keeping the medication list accurate: "Yes, because I find that it changes frequently, that list, whether it's the drips versus the standing medications."

However, the clinicians also described aspects of the computer-based documentation that enhanced clinical workflow. One resident stated that documenting a plan "can solidify it" to help to ensure that the plan will be carried out and its progress will be evaluated. Nurses commented that 'if someone forgot to tell you the plan in report, it was wonderful if it was written in the computer.'

Our observations identified that the structured documentation in the CIS was typically supplemented by CIS free text notes written by nurses and CIS sign-out notes written by residents at or near the end of their shifts. These notes included information that may have been documented in a structured format in other parts of the CIS, but summarized the structured data and provided additional contextual information in order to "tell the story" of the patient and the patient care that was provided during that shift.

Discussion

Computerized systems may increase the effectiveness of communication within the nursing or medical discipline [15, 9]. However, the integrated distributed cognition and clinical communication space analysis demonstrated the perceived lack of effective and updated electronic documentation artifacts within the ICU activity system that was examined. Limited use of electronic documentation restricts the ability of clinicians to establish common ground through the CIS regarding their *goal directed actions and interactions*, *communication and information tasks*, and *common goals* of patient care. Our analysis suggests that when the CIS does not facili-

tate clinicians establish common ground they prefer verbal information exchange.

Based on the clinicians' statements during the focus group and interviews, information contained in the CIS is often perceived to be a *shift behind* (e.g., night shift or day shift) and includes only the clinical care that has already been provided to the patient. Therefore, the current structure and content of the documentation tools in the NICU may not be sufficient to capture the information exchange of common goals that occurs during and in between ICU interdisciplinary morning rounds. The perceived lack of updated documentation may increase clinicians' reliance on verbal communication. For instance, if the clinicians perceive that other clinicians are not updating the electronic documentation frequently they may wonder if frequently updating the electronic documentation is an efficient use of their time during their shift in the fast paced and complex ICU environment. These perceptions likely influence clinicians' behavior to electronically document patient information at the end of their shift or to omit information that had been verbally exchanged from the electronic documentation. Kim et al., also found that the restrictions imposed by the CIS developers caused nurses to omit many information layers and data categories that would have represented greater contextual information that was useful for clinical care as well as for data reuse for administrative and research purposes [16].

Clinicians' continued reliance on personal paper-based notes suggests that the CIS may facilitate establishing common ground amongst the clinicians. One of the intended useful roles of a CIS at the point of care is to provide clinicians with access to shared information regardless of constraints such as their location or the time of the day. The sharing of paper based documentation is limited by constraints such as the location of the documentation or the shift worked by the clinician that is in possession of the paper documentation.

Of note, the clinicians that were interviewed appreciated the potential benefits of electronic documentation such as increasing common ground regarding the patient's plan of care, preventing information loss, and increasing the opportunity for information retrieval. However, the continued use of personal paper-based documentation by clinicians and their preference for verbal communication, despite their acknowledgments of the potential benefits of electronic documentation, are evidence that clinicians are ignoring aspects of the CIS/CPOE tools that do not fit into their clinical workflow.

Despite the clinicians' perceived limitations of the CIS/CPOE system to support ICU communication and information exchange activities, the clinicians continued to use the CIS/CPOE system; however, they supplemented the system by implementing verbal information exchange conventions. These verbal conventions were used to verify information that was updated in the CIS/CPOE system in an effort to ensure the quality and safety of patient care. For instance, the nurses stated that CPOE orders may only imply what the related patient goal was; therefore, if a goal related to an order was not previously discussed or documented the nurses' verbal double check may be the only form of verification that the order was entered as intended. In a previous study we found that nurses perform these double checks by determining the physician's rationale for an order as a method to assess the safety and ap-

propriateness of the order [17]. These finding about the clinicians' use of verbal double checks relate to Hazlehurst and colleagues conclusion that multiple representations, or redundancy, of information in the ICU increases robustness of the system and ensured correct functioning [18]. Including contextual clinical information linked to CPOE orders or nursing actions, such as the rationale or an explicit patient goal, may provide the multiple representations that may be sufficient as a double check. Moreover, the clinicians' free text documentation in the CIS provided contextual information and summarization of the interpretation and meaning of the structured data points in various parts of the CIS. Clinicians' discussions may inform the "story of the patient" that is told in the free-text documentation; additionally, a clinician may "tell the story" of the patient in free-text documentation because once his or her shift is over there likely will be no further opportunities to discuss and convey summarized and contextual information about the patient with other clinicians who may care for the patient. According to Coiera's [12] clinical communication space theoretical framework, information that is routinely verbally discussed during rounds or documented in free-text notes that summarizes and contextualizes patient information to "tell the story" of the patient, may be ripe for an automated information tool.

The limitations of this study are that the observations were conducted on one NICU and that all of the clinicians that were interviewed or participated in the focus group were from one hospital. Therefore, some of the findings may not be transferable to different ICUs, different types of patient care settings, or other hospitals. Additionally, we did not conduct any observations during the night shift in the ICU. However, the data saturation and triangulation of the observational, focus group and interview data increase confidence in the discussed themes and conclusions drawn from this study.

Conclusion

The large amount of information that is verbally exchanged amongst clinicians is evidence that clinicians have not harnessed the CIS/CPOE tools available for their maximum use of information exchange. According to the clinicians observed and interviewed, CIS/CPOE documentation is a *shift behind* and information retrieval is not efficient, leading to a further reliance on verbal information exchange. Moreover, verbal information exchange is subject to information loss.

Our data indicate that the current documentation tools in the NICU may not be sufficient to capture the interdisciplinary communication of common goals that occurs during, and in between, ICU interdisciplinary morning rounds. Therefore, future research should aim to further understand and meet the need for CIS/CPOE documentation to support verbal information exchange in the ICU in real time.

Acknowledgments

References

[1] Fagin C M 1992 Collaboration between nurses and physicians: no longer a choice. Acad Med 67 295-303

[2] Larson E 1999 The impact of physician-nurse interaction on patient care. Holist Nurs Pract 13 38-46

[3] Sexton J B, Thomas E J and Helmreich R L 2000 Error, stress, and teamwork in medicine and aviation: cross sectional surveys BMJ (Clinical research ed 320 745-9

[4] Zwarenstein M and Reeves S 2002 Working together but apart: barriers and routes to nurse--physician collaboration. Jt Comm J Qual Improv 28 242-7, 09

[5] Pronovost P, Wu A and Sexton J 2004 Acute decompensation after removing a central line: practical approaches to increasing safety in the intensive care unit. Ann Intern Med 140 1025-33

[6] The Joint Commission 2000 Sentinel event alert. In: The Joint Commission,

[7] Stein-Parbury J and Liaschenko J 2007 Understanding collaboration between nurses and physicians as knowledge at work Am J Crit Care 16 470-7; quiz 8

[8] Patel V L, Zhang J, Yoskowitz N A, Green R and Sayan O R 2008 Translational cognition for decision support in critical care environments: a review. Journal of biomedical informatics 41 413-31

[9] Strople B and Ottani P 2006 Can technology improve intershift report? What the research reveals. J Prof Nurs 22 197-204

[10] Arora V, Johnson J, Lovinger D, Humphrey H J and Meltzer D O 2005 Communication failures in patient sign-out and suggestions for improvement: a critical incident analysis. Qual Saf Health Care 14 401-7

[11] Hutchins E 1995 Cognition in the Wild (Cambridge, MA: MIT Press)

[12] Coiera E 2000 When conversation is better than computation JAMIA 7 277-86

[13] Munir S K and Kay S 2003 Organisational culture matters for system integration in health care. AMIA Ann Symp procs 484-8

[14] Baggs J G and Schmitt M H 1997 Nurses' and Resident Physicians' Perceptions of the Process of Collaboration in an MICU. Research in Nursing and Health. 20 71-80

[15] Van Eaton E G, Horvath K D, Lober W B, Rossini A J and Pellegrini CA. A randomized, controlled trial evaluating the impact of a computerized rounding and sign-out system on continuity of care and resident work hours. J Am Coll Surg, 2005 200 538-45

[16] Kim H, Harris M R, Savova G K and Chute C G 2008 The first step toward data reuse: disambiguating concept representation of the locally developed ICU nursing flowsheets. Comput Inform Nurs 26 282-9

[17] Collins S A, Currie L M, Bakken S and Cimino J J 2009 Information needs, Infobutton Manager use, and satisfaction by clinician type: a case study JAMIA 16 140-2

[18] Hazlehurst B, McMullen C, Gorman P and Sittig D 2003 How the ICU follows orders: care delivery as a complex activity system AMIA Annual Symposium proceedings 284-8

Address for correspondence

Sarah Collins, 622 West 168th Street, Vanderbilt Clinic, 5th Floor, New York, NY 10032, email: sarah.collins@dbmi.columbia.edu