

Improving Operating Room Coordination

Communication Pattern Assessment

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Objective: To capture communication patterns in operating room (OR) management to characterize the information needs of OR coordination.

Background: Technological applications can be used to change system processes to improve communication and information access, thereby decreasing errors and adverse events. The successful design of such applications relies on an understanding of communication patterns among healthcare professionals

Methods: Charge nurse communication was observed and documented at four OR suites at three tertiary hospitals. The data collection tool allowed rapid coding of communication patterns in terms of duration, mode, target person, and the purpose of each communication episode.

Results: Most (69.24%) of the 2074 communication episodes observed occurred face to face. Coordinating equipment was the most frequently occurring purpose of communication (38.7%) in all suites. The frequency of other purposes in decreasing order were coordinating patient preparedness (25.7%), staffing (18.8%), room assignment (10.7%), and scheduling and rescheduling surgery (6.2%).

Conclusion: The results of this study suggest that automating aspects of preparing patients for surgery and surgical equipment management has the potential to reduce information exchange, decreasing interruptions to clinicians and diminishing the possibility of adverse events in the clinical setting.

The Institute of Medicine (IOM) estimates that between 44,000 and 98,000 Americans die each year as the result of medical error.¹ Communication or the lack of it has been shown to be a major contributor to these errors in healthcare.²⁻⁴ Donchin et al³ found that 37% of errors in a critical care unit were associated with verbal exchanges between nurses and physicians. In a retrospective review of adverse events in 28 hospitals in Australia, Wilson et al² discovered that communication errors were the leading cause and were associated with twice as many deaths as clinical inadequacy. An examination of 419 adverse incidents in New Zealand recovery rooms revealed that communication deficits were the second most common reason for error.⁵

Part of the reason for communication-related errors may be how communication is accomplished. While communicating information concerning patient care, health care providers are frequently interrupted and forced to carry out multiple communication tasks simultaneously.⁶ Such disruptions can cause an individual to forget to carry out an intended act, even when only 10 seconds separates the intention from the interruption.⁷ In a study of communication loads in emergency departments, Coiera et al⁸ found that nearly a third of the communications were interrupted, with an interruption rate of 11 per hour.

Technological applications have the capability to change system processes to improve communication, thus enhancing patient safety. However, technology introduced to enhance communication may have a negative impact on care processes. Messaging devices such as paging systems,⁹ telephones,¹⁰ and instant messaging¹¹ can disrupt current activities. The successful design and use of technological applications relies on an understanding of information types and communication patterns among healthcare professionals.¹²

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Articulation Work

Delivery of healthcare services requires intense communication. Dedicated personnel are employed to coordinate the use of staff, equipment, and available space over time to minimize error and maximize efficiency of cooperative work. Managing the tasks and lines of work necessary for patient care requires the coordination of numerous activities into a coherent sequence of events. The concept of articulation work has been introduced to describe the requisite work to ensure that individual efforts result in more than discrete and conflicting fragments of accomplished labor.¹³ Articulation work includes those efforts involved in coordinating, scheduling, meshing, and integrating collaborative activities.¹⁴

The management of operating rooms (ORs) is an example of articulation work. OR charge nurses are responsible for ensuring safe and effective patient care in an environment that requires coordination across multiple disciplines of healthcare workers.¹⁵ The charge nurse coordinates staff, patients, and equipment to ensure that patients move seamlessly through the surgical process. Charge nurses must coordinate activities in conjunction with other hospital units, such as the patient admitting and holding areas, ambulatory surgery units, inpatient surgical units, and the postanesthesia care unit. OR articulation work includes ensuring that the patient is ready for surgery, surgeons are available to perform the surgery, the operating room is cleaned, the appropriate equipment is prepared for the planned surgery, and a compatible operating room staff is assigned.

The Association of Operating Room Nurses (AORN) lists coordination of care for surgical patients as the first item in their outline of the responsibilities of perioperative nursing practice and specifically identifies communication skills as a key component of coordination.¹⁶ Sonneberg advises OR charge nurses to “communicate, communicate, communicate”¹⁷ for successful coordination. Therefore, we chose the communication of OR charge nurses as the focal point in our observational study.

Determining Information Needs

Inadequate information-system design can actually increase, rather than decrease, the risk of medical error. In January 2003, Cedars-Sinai Medical Center suspended the use of a \$43 million computerized system for physician order entry because physicians complained the system endangered patient safety

and required too much work.¹⁸ In another recent case, poor information system design resulted in a transplant patient receiving organs from a donor of the wrong blood type.¹⁹ While information regarding the donor’s blood type was listed in a computerized database, no system was in place for cross-checking this information with that of the recipient’s blood type.

The high rate of information system failures²⁰ underlines the need for methods to identify the appropriate information needs for system development. A number of methods have been used to determine user information needs: interviews,²¹ questionnaires,²¹ focus groups,¹² and thinking aloud.²² Some researchers have found conflicting results with different methods, whereas others supplemented one method with another to strengthen understanding of information needs.

Surveying, interviewing, and focus groups can be very efficient to deploy. They are based on the assumption that users can: (1) specify their requirements, (2) make explicit how they (actually) accomplish their work, and (3) use formal specification techniques (eg, process modeling) with confidence.²³ Because these techniques rely on the perception of users, discrepancies arise between reported and actual work practices.²⁴ These reported methods of determining information needs provide useful insight into general, broad categories, such as categorizing information needs as patient specific, institution specific, domain specific, and procedural specific.²⁵ However, while these studies were able to identify broad categories of information needs and communication patterns, a more specific level of data could prove more useful for application design.

Methods

In a previous study, we described the communication patterns of charge nurses in a trauma OR to determine information needs for their articulation work.²⁶ In the current study, we were interested in determining if the same method could be refined and used to investigate communication patterns in general OR suites. Therefore, the purpose of this study was three-fold: to evaluate a methodology for determining information needs through a data collection tool, to document OR charge nurse communication patterns with the tool, and to characterize the information needs in articulation work for OR coordination. The goal of the observation method was to collect data on and categorize occurrences of communications to provide a basis for determining

information needs. The data collection tool was developed to answer the following questions on communication patterns:

1. What are the purposes of communication?
2. Who is involved in communication?
3. What media or modes of communication are used?
4. What is the duration of communication for each episode?

Settings

Four OR suites at 3 tertiary hospitals were selected for observation based on research access, variation in size, and hospital type. All 3 hospitals were located within a large metropolitan area in the mid-Atlantic region. Two of the OR suites were in two university hospitals; the other two were in a community hospital. OR staff consisted of nurses, anesthesiologists, surgeons, operating room technicians, equipment managers, and clerks. Table 1 lists the number of operating rooms and types of surgery conducted at each suite.

Development of Data Collection Tool

The data collection tool was developed and pilot-tested in a trauma center OR suite²⁶ to capture communication patterns through observation. Through an iterative process, categories were developed and validated in the clinical setting, until the categorical set was stable. Then, the tool was verified with the OR charge nurses for face validity. The sensitivity of the tool was demonstrated by comparing the original data with data obtained using the tool from a general OR suite in a separate hospital. These data showed that the tool was able to show differences between communication patterns in different types of operating room suites.²⁷

Table 1. *Characteristics of OR Suites*

Suite	No. of Rooms	Types of Surgery Performed
1	18	Transplants, open heart, orthopedics, general surgery
2	9	Trauma, burns, orthopedics, general surgery
3	8	Trauma, open heart, orthopedics, general surgery
4	4	Orthopedics

Each observed communication episode was recorded on the data collection tool. For the current study, a communication episode was defined as an exchange of information between the charge nurse and another person for a single purpose. The data collector captured each communication episode about its purpose, mode (face to face, telephone, wireless telephone, pager, or intercom), the target individual, and the duration of the communication. The categories used to define the purpose of the communication were:

- schedule surgery (eg, accepting a new case, negotiating time for new case);
- reschedule surgery (eg, negotiating a change in case time, canceling a case);
- coordinate staffing (eg, assign particular staff to case, arrange staff coverage during lunch breaks);
- coordinate room assignment (eg, assign case to particular room);
- coordinate equipment (eg, locate the correct equipment for a particular case, direct the preparation of equipment); and
- coordinate patient preparedness for surgery (eg, determine if the anesthesiologist has seen the patient, determine if the patient is in the holding area).

Conduct of Study

The data collection tool was used to study the communication patterns of charge nurses at the four OR suites. A registered, nurse experienced in operating room procedure, collected data, as the observer, during the busiest time in OR management, generally between 6 AM and 12 noon. When communication occurred, corresponding numerical codes were entered on the data collection tool, which included the duration, the mode, the target person, and the purpose of the communication. When the observer was unclear about the purpose of the communication or the target person, the charge nurse was asked to clarify. Codes collected about observed communication episodes were entered into a statistical program for descriptive analysis on individual suites and on pooled data from all suites.

Outcomes

Observation was made on 17 nonconsecutive days, each for a period of 4 to 6 hours. A total of 2,074 communication episodes were observed in approxi-

mately 100 hours. The number of communication episodes ranged from 32 to 74 communications per hour. The charge nurses at suite one, which had the greatest number of OR rooms, communicated the greatest number of episodes per hour. The charge nurses at suite four, which had the fewest OR rooms, communicated the lowest number of episodes per hour.

Purpose and Target of Communication

The most frequent communication target of charge nurses was OR nurses (39%), followed by OR technicians (14%), OR clerks (12%), surgeons (11%), and equipment managers (9%). Coordinating equipment was the most frequent purpose of communication (39%) in all suites. Coordinating patient preparedness for surgery ranked second (26%) in frequency, staffing third (19%), room assignment fourth (11%), and scheduling and rescheduling fifth (6%). When separately analyzed, data for each OR suite showed the rankings of communication episodes by purpose were the same across all suites with one exception (OR suite 3); these findings are presented in Table 2.

There was a significant association between the purpose of the communication and the target person of that communication (Chi square, $P < .001$). For example, 51% of communications with OR technicians were to coordinate equipment, whereas 89% of communications with the ambulatory surgical unit were to coordinate patient preparedness. Table 3 lists the most frequent target person of communication by the most frequent purpose of the communication.

Mode of Communication

The most frequent mode of communication occurred face to face (69%), followed by telephone (18%) and intercom (7%). Face-to-face communication was used 77% of the time in communication related to staffing, 72% in both equipment management and room assignment, 57% in patient prepa-

ration, and 40% in information regarding scheduling or rescheduling surgery. There was a significant association (Chi square, $P < .001$) between the mode of communication and the target person of that communication. For example, 85% of the communication with floor nurses and 86% of communication with the preoperative holding areas were by telephone.

Wireless telephones were available for use in 3 of the 4 operating rooms. At 2 suites the wireless telephones were considered unreliable and seldom used. Suite four contained the largest number of operating rooms and frequently used the wireless telephone. Although face-to-face communication was still the preferred mode at this suite (71%), the wireless telephone was used more than twice as much as the stationary telephone and was the second most preferred mode of communication (17%).

Duration of Communication

The duration of communication episodes ranged from 10 seconds or less to 10 minutes, with a mean duration of 40 seconds and a median duration of 20 seconds or less. Communication episodes of 1 minute or less constituted 93% of all the communication episodes.

These data show a significant difference (ANOVA, $P < .001$) in duration of communication episodes between the categories related to purpose. Post-hoc comparisons showed that the category "coordinating patient preparedness" differed significantly on communication duration from all other categories except "coordinating equipment." Table 4 lists the mean duration of communication by purpose of the communication.

Implications

Evaluation of the Method

The stability of communication categories, consistent ranking of coded communication patterns across nontrauma specialty OR suites, and differen-

Table 2. Percentage of Communication Episodes by Purpose

Purpose	Mean, %	Suite 1, %	Suite 2, %	Suite 3, %	Suite 4, %
Equipment	39	33	36	43	46
Patient preparation	26	26	32	17	24
Staffing	19	22	13	25	17
Room assignment	11	14	12	10	6
Schedule or reschedule	6	5	7	6	8

Table 3. *Target of Communication by Most Frequent Purpose*

Target	Purpose (%)
OR nurse	Equipment (37)
OR technician	Equipment (50)
OR clerk	Patient preparedness (34)
Surgeon	Patient preparedness (32)
Equipment manager	Equipment (94)

tiation of these patterns from those of a trauma OR suite²⁷ demonstrate the utility of this methodology for determining information needs. Communication episodes related to OR coordination were completely captured by the categories included in the data collection tool. The only adjustment the tool needed was to add the target category "bed control" at 1 suite.

Documenting communication in this manner was minimally intrusive to OR workers, did not violate patient confidentiality, and required a relatively small allocation of time and resources. On the other hand, this method requires that the observer have knowledge of the specific clinical domain. Deciding how to categorize communication episodes according to purpose necessitates an interpretation of the content and context of the communication occurring in the clinical area. In this study, only one observer was used to code communication episodes. Using multiple observers to establish interrater reliability of these data would have further strengthened these findings.

Information Needs in General Operating Room Suites

The results on communication patterns indicated that communication between OR charge nurses and other health care workers was face to face (69.24%),

Table 4. *Mean Duration of Communication by Purpose*

Purpose	Mean Duration, sec	SD
Patient preparedness	31	42
Equipment	40	43
Staffing	44	94
Room assignment	51	75
Schedule or reschedule	55	57

short in duration, and most often related to equipment management or patient preparedness. The longer duration of communication episodes related to patient scheduling, rescheduling, room assignment, and staffing could be attributed to the nature of the communication related to these categories. These categories of communication often involved negotiation between participants. Conversely, communication episodes related to equipment management were shorter because they generally involved receiving or transmitting a piece of information needed for tracking equipment or patients. The study depicted a short status query and an updating nature of the communication associated with equipment management and patient preparedness; this finding suggests that these information needs may be fulfilled by automated status displays and short messages.

Automated Patient Tracking

Automating aspects of health care delivery can reduce errors, control costs, and improve patient outcomes.²⁸ The current study supports the value of automated tracking of patients' location throughout the hospital and through their preparation process. Tracking information provided automatically can greatly decrease communication and interruptions for the charge nurse. Communication in this category generally related to tracking the patient throughout the hospital or tracking the patient throughout the preparation process. Before surgery, financial forms, admission assessments, and diagnostic testing must be completed. In addition, surgeons and anesthesiologists must examine patients before surgery can be initiated. This process was observed to be essentially the same in each hospital. An electronic representation of patient status, eg, disseminated via an intranet, throughout the hospital would eliminate a great deal of the communication related to patient preparedness with surgeons, ambulatory surgery staff, floor nurses, anesthesia staff, and OR nurses.

Equipment Management

The study results also support the development of strategies to enhance equipment management. Communication episodes related to equipment management concerned the location, status of preparedness, and working condition of equipment. Tracking by location and status of preparedness (ie, dirty, clean, sterile, working) could decrease communication that could lead to error while greatly enhancing OR efficiency. Much of equipment track-

ing and patient preparedness could potentially be accomplished through the use of passive sensors. For example, as equipment is removed from a shelf or enters an OR or processing area, its location could be recorded by sensors on the shelf or door to the area. Tracking information could be accessed electronically by staff members, saving the time and communication overhead associated with equipment tracking.

Communication

Asynchronous methods of communication, such as electronic mail and voice mail, were never used for OR coordination, although they were available to the charge nurses in the current study. With as many as 74 communication episodes in 1 hour, these charge nurses did not have the time to access the asynchronous communication methods available to them. In addition, in this interrupt-driven environment, immediate acknowledgment of a message reduces mental burden by allowing for the quick completion of the task.⁶ This is especially true in health care, where the consequences of communication errors can be so significant; workers need explicit acknowledgment that a communication has been received.⁷ Currently, this is accomplished through the use of synchronous communication; however, hand-held devices with audio alerts and immediate acknowledgment of communication might make the use of asynchronous communication more attractive in the OR.

Variation Between Settings

Findings from a previous study that analyzed charge nurse communication in a trauma OR suite,²⁶ differ from those from the OR suites in the current study, where general and trauma surgery was performed. In the trauma OR suite, where accommodating emergency cases is a frequent occurrence, scheduling and rescheduling surgery accounted for more than 32% of the communication episodes. In addition, surgeons there often scheduled nonemergency cases the same day of surgery, as their schedule allowed. The overriding organizational goal of providing immediate trauma care resulted in frequent changes to the surgical schedule and the necessity of the charge nurse to negotiate each of these changes. Emergency surgeries must also be accommodated in the general OR suites, but most surgeries were scheduled as much as 2 weeks in advance, resulting in fewer changes to the surgical schedule.

The frequency of communication by purpose was ranked the same across all OR suites, except OR suite 3. At suite 3, communication episodes related to patient preparedness ranked third in fre-

quency, when this category ranked second in frequency at all the other study suites. However, at OR suite 3, an OR clerk assumed much of the responsibility for patient preparedness that the charge nurse managed at the other suites. The most frequent reason for communication in the general OR suites was to coordinate equipment (39%); this same category accounted for only 19% of the total communication episodes in the trauma OR suite. We propose two possible explanations for this discrepancy: (1) there was more variation in the types of surgeries conducted in the general OR suite, and (2) operating rooms in the trauma OR suite were stocked with the standard equipment necessary for most trauma cases.²⁷ This contrast further demonstrates the sensitivity of the data collection tool to measure similarities and differences between OR suites.

Future Research

The results of the current study suggest that automating aspects of patient preparedness and equipment management in ORs has the potential to provide information on demand, decreasing interruptions to clinicians and diminishing the possibility of adverse events in the clinical setting. Replication of this method, across clinical settings, by multiple observers would further our understanding of clinical communication and clinical coordination, and assist in refining this method to determine information needs.

Although the categories used in the current study were developed through experience of OR procedure, observation, and validation of charge nurses, they mirror some concepts depicted in the Conceptual Schema for Communication Space portrayed by Stetson et al.²⁹ Concepts included in the Conceptual Schema for Communication Space and their relation to categories used to characterize communication in this study include result (purpose), agent (charge nurse), recipient (target), duration (duration), and medium (mode). Our categorization of clinical communication also has some similarities with that used by Coiera et al⁸ to study communication in two emergency departments. In that study, communication was characterized by the time involved in communication; number of communication events; interruptions and overlapping communications; choice of communication channel; and purpose of communication.⁸ Perhaps with additional study in this area, a taxonomy for clinical communication could be developed and used in the design of technological applications to support clinical processes.

Stetson et al²⁹ delineated 2 assumptions related to clinical communication: that there is no instance in which coordination of care takes place in the absence of communication, and that there is no instance in which clinical information exchange occurs in the absence of clinical communication. Articulation work for coordination first requires the timely and accurate compilation of information from multiple sources, the synthesis of this information into a coherent plan, and the dissemination of the plan to all involved with its execution. Generally, we have categorized tasks that are supported by telephones as communication tasks and those supported by computers as information tasks³⁰; however, with the advent of telephones that incorporate computer functions and the use of computers for teleconferencing, these distinctions tend to blur.

Regardless of whether the support is classified as communication or information technology, a better understanding of communication in the clinical setting should enable the identification of the

appropriate means for supporting the information needs of clinicians. With this knowledge, we should be better able to match the right support tool to the particular information needs of clinicians in different clinical settings.

Conclusion

This article describes a methodology to study information needs in articulation work, using OR management as an example. The study results demonstrated the potential utility of this method and the usefulness of the categories used to characterize communication, and provided a better understanding of the information needs in OR suites. The results of the current study suggest that automating aspects of patient preparedness and equipment management in ORs has the potential to provide information on demand, decreasing interruptions to clinicians and diminishing the possibility of adverse events in the clinical setting.

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