

# Analysis of Communication Patterns in Critical Care Environments

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**Abstract** - Efficient and effective communication processes are critical for patient health and safety. Communication processes for patient admission within the UVa Surgical and Trauma Intensive Care Unit (SICU) vary depending on situational factors. Trauma personnel in the SICU are also involved in patient admission to the Operating Room (OR). In order to better understand communication patterns and identify inefficiencies and variation, an analysis of the patient admission processes from the Emergency Department (ED) to the OR and ED to SICU is performed.

To identify potential inefficiencies within patient admission, key sub-processes with high variability were identified. Process models were constructed to depict the current practices of each step and the associated communication patterns between stakeholders. Interviews, surveys, and focus groups were also conducted with trauma personnel to gauge opinions on the patient admission processes and to collect estimated waiting times at each step in the processes. Based on findings from interviews, process completion times were compiled and analyzed using Hurwicz Alpha Criterion. Results of the study indicate that communication processes with consults and the bed center, both located outside of the SICU, are variable and inconsistent. This variability in communication is a result of a lack of situational awareness and procedures external to the SICU.

*Index Terms* – communication, patient safety, SICU, situational awareness

## INTRODUCTION

Within a critical care environment, streamlined, efficient, and reliable communication schemes are necessary to prevent medical error and patient mortality. Preventable medical errors cause approximately 98,000 deaths every year and cost approximately \$29 billion per year [1, 2]. When medical errors occur in critical care environments such as intensive care units, there are negative physical, psychological, and economic effects on patients [2]. Miscommunication between healthcare professionals contributes to the prevalence of medical errors. Therefore, effective and timely communication methods are essential

for providing quality care and preventing medical error.

Consequently, communication patterns for patient admission processes were examined within the Surgical and Trauma Intensive Care Unit (SICU) at the University of Virginia Hospital. The current state of operations within the UVa SICU suggests that there is limited situational awareness among trauma personnel about a patient's care plan. Thus, patterns of communication related to patient admission need to be further analyzed. Trauma personnel within the UVa SICU aim to standardize the patient admission processes and improve teamwork and communication with the goal of providing more effective care for the hospital's sickest patients.

### I. Descriptive Scenario

The goal of the UVa SICU is to prevent morbidity and mortality from trauma-related injuries. This study focuses on the communication patterns involving trauma personnel in the SICU. Trauma personnel are also involved with the ED→OR admission process; patient admission to the OR and SICU often overlap. This research examines both patient admission processes between the ED and OR and the ED and SICU. These processes depict the communication flow from the onset of a trauma alert to the point at which a patient is admitted successfully to either the OR or the SICU.

Trauma personnel are notified of incoming patients to the OR and SICU via trauma alerts sent by Medcom, the medical communication dispatch center at the UVa Hospital. Trauma alerts are classified by highest to lowest severity as alpha, beta, or gamma alerts, respectively, and this severity is communicated to physicians awaiting the patient. Upon arrival to the ED, trauma personnel and necessary consulting services examine patients, and medical orders are placed. The results of the patient head-to-toe exam are sent to the trauma attending physician who ultimately decides on the patients' admission status to the OR or SICU. The communication process between all major stakeholders within the SICU occurs via pagers, wired telephones, and cellular phones. These modes of communication can be ineffective and inefficient leading to increased likelihood of medical errors.

### II. Stakeholder Analysis

The key stakeholders in the processes are patients, physicians, hospital administration, and Medcom. Figure 1

shows the relationship between stakeholder level of support and influence.

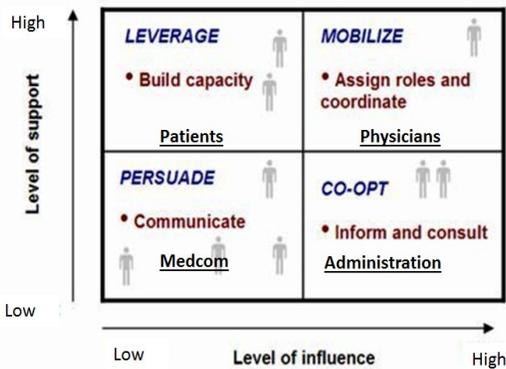


FIGURE 1  
STAKEHOLDER ANALYSIS MATRIX

### Patients

Effective and efficient communication is integral to the quality of care and safety of the patient. The patient’s safety is at risk due to factors such as ill-defined care roles and responsibilities, information misinterpretation, and unclear or faulty transmission of orders [7]. Patients have a vested interest in communication patterns within critical care environments not only because their life is in the hands of clinical staff, but also because they pay for their care through personal cost or insurance. Patients arguably have the most to lose in regards to what is at stake in a critical care environment.

### Physicians

Physicians are bound by the Hippocratic Oath under which they have sworn to practice medicine to the “best of [their] ability” with “special obligations to all fellow human beings” [8]. Physicians need to maintain this oath, and if they fail to uphold patient safety and quality care, they can face malpractice lawsuits. “Medical malpractice cases arise when a patient is harmed by a doctor or nurse (or other medical professional) who fails to provide proper health care treatment” [9]. Effective and efficient communication aids physicians in conducting themselves in alignment with the requirements outlined in the Hippocratic Oath.

Throughout the processes analyzed in this research, physicians play a pivotal role. In the Emergency Departments to Operating Room process, physicians perform the initial exam of the patient, perform specialty consultation exams, place medical orders, perform scans, review the results of the scans, and ultimately decide upon the admission status of all patients entering the ED and SICU.

### Administration (Monitor)

Hospital administration is in charge of the leadership and management at all levels of healthcare information systems. Administration ensures that specific outcomes are attained, departments within the healthcare system operate

effectively, people are competently employed in appropriate positions, expectations of care are clear, and that resources are utilized efficiently with the common goal of patient care and safety.

Hospital administrators oversee all activities within the departments of the hospital. More specifically, they are aware of the communication that occurs throughout these processes and they are concerned with their effectiveness.

### Medcom

Medical Communication Center (Medcom) at UVa is a 24/7 communication service. The responsibilities of Medcom include, but are not limited to, providing ground and air transportation of patients to the hospital, and alerting the trauma team of patient arrival, status, and condition.

Medcom is the source of the trauma alert that prepares the trauma team to assemble in the ED to examine the patient.

## RELEVANT WORK

Past studies show that communication inefficiencies and errors can have a detrimental effect on the quality of healthcare. In [3], communication between health professionals is investigated. The study revealed that a lack of standardized communication for patient care led to each handoff having a unique communication scheme. Eighty-four percent of study participants preferred verbal communication throughout the transfer process. This suggests that in order to streamline communication and make the patient admission processes at the UVa SICU more efficient, horizontal and simultaneous communication is needed.

Research in [4] suggests that a lack of efficient communication and situational awareness leads to compromised quality of patient care. This study, conducted in a surgical intensive care unit at a university hospital, found that that on average, 1.7 errors per patient occur each day, as well as potentially fatal errors occurring two times a day. These errors were largely caused by communication errors and a lack of situational awareness, demonstrating that organizational factors can significantly impact patient care. Additionally, in studies [4-6], cultural factors significantly impact patient care. For example, power struggles among healthcare professionals affect staff attitudes towards the adoption of new communication systems [5]. Furthermore, professional boundaries make inter-professional communication, collaboration, and teamwork more challenging and “can jeopardize the provision of safe, high quality patient care” [6].

This illustrates the complexity of communication systems and the influence of culture, professional boundaries, and power struggles on communication inefficiencies. Organizational, cultural and technological aspects were considered for the analysis of clinical communications within the UVa SICU.



processes, teamwork dynamics, issues with the SICU chain of command, and descriptions of ideal communication systems.

### III. Hurwicz Alpha Criterion

Hurwicz Alpha Criterion, a criterion used for decision-making under uncertainty, was used to model the variability associated with completion of communication loops in the patient admission processes. Variables such as time of day, resource availability, and style of communication used all affect the time required to complete certain steps in the admission processes. Hurwicz Alpha Criterion measures the time required for completion of the steps against an  $\alpha$ -value between 0 and 1, representing the uncertainty associated with completion time. The ideal situation is the one that requires the least amount of time to complete;  $\alpha = 0$  represents the maximum process completion time, and  $\alpha = 1$  represents the minimum process completion time. Alpha values close to 1 represent optimism (that the process will be completed in a time close to the minimum reported value), and those near 0 are associated with pessimism (that the process will be completed in a time close to the maximum reported value).

Pooling interview results from trauma personnel, minimum, maximum, and average wait times associated with steps in the ED  $\rightarrow$  OR and ED  $\rightarrow$  SICU admission processes were considered. Reported times varied across different healthcare professions, though all responses were considered when graphically executing the Hurwicz Alpha Criterion analysis. In order to control for extreme values, the maximum reported average time was associated with  $\alpha = 0$  and the minimum reported average time with  $\alpha = 1$ . The processes with the steepest slope trajectories represent those with the greatest range between average maximum and average minimum time, associated with high variability. These steps, associated with greatest variability in completion time, should be considered as potential inefficiencies in patient admission processes.

### RESULTS

When asked about overall satisfaction with SICU communication, 85% of survey participants agreed or were neutral about overall operations being satisfactory. However, when asked about their level of frustration with current communication, 60% of participants either agreed or strongly agreed that the inefficiencies in the current system were a hindrance to their delivery of care. Thus, there is a discrepancy in overall opinion. General observations demonstrate that SICU personnel are accustomed to the system being inefficient, yet they still feel frustrated with its operations. Over the course of the interviews and focus groups, communication with consults followed by communication with the bed center were identified as the most significant contributors to these inefficiencies. The Hurwicz Alpha Criterion also allowed us to narrow in on these factors as the most significant contributors to inefficient communication.

Considering interview results provided by healthcare professionals, graphical visualizations were used to understand the time required for completion of each step in both patient admission processes. Using histograms and box-and-whisker plots, one commonly occurring finding was the variability in times reported for all steps. The Hurwicz Alpha Criterion charts (Figure 3 and Figure 4) were also observed, as they can be used to model the uncertainty in completion time. The trajectory of the line connecting  $\alpha = 0$  to  $\alpha = 1$  displays how distinct the difference between worst-case and best-case scenario. With respect to this research, the maximum reported average completion time represents  $\alpha = 0$  and the minimum reported average completion time represents  $\alpha = 1$ . The results are shown below with the legend describing each sub-process in Table I:

TABLE I  
SUB-PROCESSES LEGEND

Sub-Process	Description
1	Communication between Chief Resident and Attending Physician
2	Contacting necessary Consults
3	Communication between MD and Attending Physician
4	Contacting Emergency Department
5	Contacting Bed Center
6	Contacting SICU
7	Contacting Nurse Supervisor

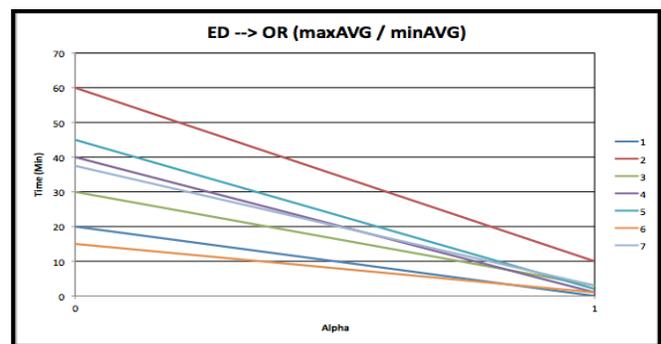


FIGURE 3  
HURWICZ ALPHA CRITERION MODELING PATIENT ADMISSION PROCESS FROM EMERGENCY DEPARTMENT TO OPERATING ROOM.

Figure 3 depicts that sub-processes 2 and 5 have the steepest trajectories in the ED  $\rightarrow$  OR admission process, correlating to greatest uncertainty in process completion time. Specifically, medical consults and the contacting of the bed center take variable amounts of time to complete. In the ED  $\rightarrow$  SICU admission process, Figure 4, sub-processes 2 and 3 have the steepest slope in the Hurwicz analysis, followed by process 5.

Greatest variability in completion time occurs during consult (sub-processes 2 and 3) and bed center communication (sub-process 5). These findings are reinforced in the boxplots shown in Figure 5. Figures 6 and 7 depict the variable sub-processes, circled in red, in the admission processes.

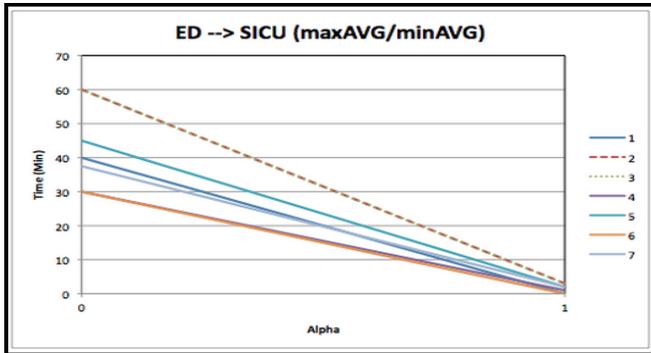


FIGURE 4

HURWICZ ALPHA CRITERION MODELING PATIENT ADMISSION PROCESS FROM EMERGENCY DEPARTMENT TO SICU.

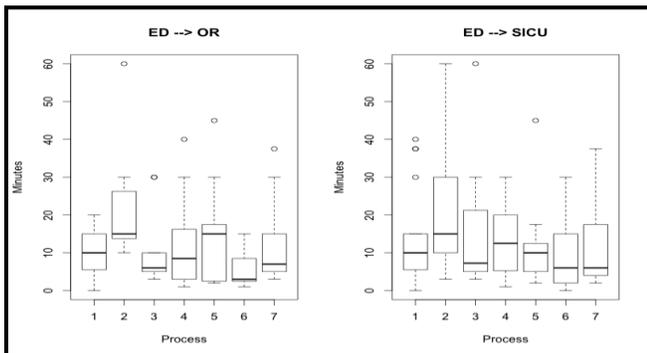


FIGURE 5

BOXPLOTS SHOWING DISTRIBUTION OF WAIT TIMES FOR ED→OR AND ED→SICU SUB-PROCESSES

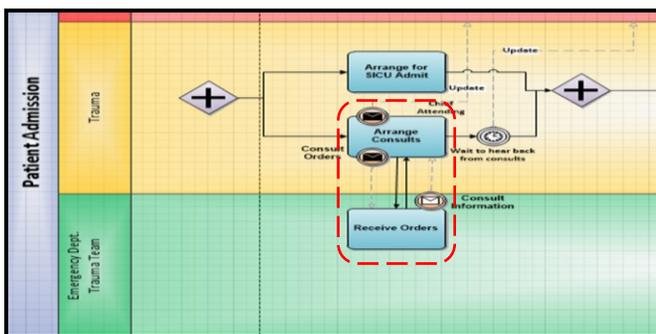


FIGURE 6

SUB-PROCESS OUTLINING CONSULT COMMUNICATION.

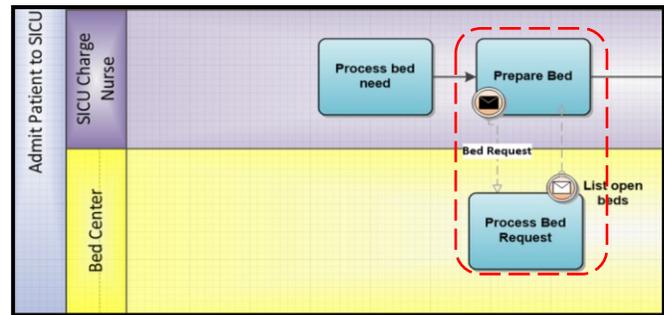


FIGURE 7

SUB PROCESS OUTLINING CONTACTING OF BED CENTER

When asked about their satisfaction with the current communication scheme and if there was anything they would change about the communication process, 41% of interview participants (N = 22) mentioned the need for improved communication with consults. One resident mentioned that communication with consults was “too time consuming and inefficient” and that there needed to be “a quicker turnover from consulting services.” This concern addresses the fact that within consulting services, there is room for improvement; communication issues with consults have had a rippling effect on the SICU’s ability to handle patient admissions effectively.

Numerous factors, highlighted in focus group discussions, point to such frustrations trauma personnel have with consults. The trauma team is a closed-system with relatively standard protocols and consistent team dynamics. However, other teams that interface with the SICU, such as consulting services, are not well-defined systems with standard protocols. One resident during a recent focus group mentioned that there is “no standard delivery of consulting information” to the trauma team, since consulting services are relayed on an individual-by-individual basis, as opposed to standardized or team-oriented protocols.

SICU nurses also expressed that they often act as the middle ground between consults and the trauma team members (e.g. residents, chief residents, and attendings). Consults do not have time to communicate directly with the healthcare providers responsible with making clinical decisions. One nurse claimed that consulting services “just want to give their recommendation and leave.” Thus, instead of consults and the trauma team communicating directly, nurses are often tasked with relaying messages from consults to the trauma team.

A lack of standard procedures in consulting services along with a lack of direct communication between consults and trauma personnel are primary reasons why the time it takes to communicate with consults can be highly variable. One resident who participated in focus groups asserted that “it always takes longer” than it should when communicating with consulting services, demonstrating that interaction with consults causes delays in patient admissions and affects overall SICU communication.

Though most of the interviewed trauma personnel mentioned communicating with consults as an issue, 5% of

participants (N = 22) expressed concern with communication with the bed center. One nurse practitioner claimed that the “bed center doesn’t understand the severity of the situation and how important it is to admit these patients.” A chief resident also mentioned that “a lack of beds makes patient care challenging.” Additionally, when asked about communication inefficiencies that negatively impact patient care, the bed center was mentioned as a source of potential bottlenecks 5% of the time. One nurse practitioner “wished there was a button to communicate directly with the bed center.” Overall, communication with the bed center can be an obstacle and can delay a patient’s admission to the SICU. Every operation the SICU performs is based on bed availability and thus, when a lack of communication exists with the bed center and beds are unavailable, patient care is compromised.

Ultimately, variability in communication became evident in all areas of our research; many trauma personnel in the interviews and focus groups expressed a primary concern with consulting services and a lack of reliability in communication with the bed center. Although other inefficiencies exist within the SICU, results from this study point to the fact that SICU operations are most often compromised when operations *outside* the unit are not running smoothly.

### CONCLUSION

The development of process models, interviews, surveys, focus groups, and Hurwicz Alpha Criterion analysis, point to the fact that the highest variability in communication occurs in interactions involving consults and the bed center. Several trauma personnel indicated that inefficiencies occur during scenarios of high variability. A trauma resident noted that the wait time for hearing back from consults can sometimes be so long that a whole day passes before a decision is made on a patient’s treatment. This lengthened stay can create increased costs and potentially adverse events for patients. In order to minimize this variability and increase situational awareness, the implementation of a real-time communication system is recommended.

### FUTURE WORK

Future work for this study includes a comprehensive data analysis on medical orders and ICD-9 diagnosis codes. Each code corresponds to a patient and patient visit pair which can be used to analyze patient trajectory and length of stay in the hospital. Additionally, the use of medical mortality scoring systems such as MEWS, MOSF, and APACHE II can be calculated to increase understanding of a patient’s average length of stay with respect to medical diagnosis and the severity of the patient’s medical condition.

and the scores need to be collected over the course of the patient’s stay. A data analysis would highlight additional sources of inefficiencies that may be contributing to the communication issues in critical care environments.

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