

University of Michigan Health System
Program and Operations Analysis

Analysis of PICU Patient Transfer Process

Final Report

Prepared For: Julie Juno, PICU Nurse Manager, Project Client
Corrie Pennington-Block, Lean Coach, Project Coordinator
Carali Van Otteren, POA Jr. Management Engineer, Project Coordinator
Mark Van Oyen, Professor
Mary Lind, Technical Communications Lecturer
Mary Duck, Liaison
Shair Malik, Graduate Student Instructor
C.S. Mott Children's Hospital, Pediatric Intensive Care Unit
1540 E. Hospital Drive
Ann Arbor, MI 48109

Prepared By: IOE 481 Project Team #2
Elise Lang, Student
Allison O'Leary, Student
Brendan Schultz, Student
1205 Beal Avenue
Ann Arbor, MI 48109

Date: December 9, 2014

Table of Contents

- Executive Summary1
- Introduction.....4
- Background.....4
 - Goals & Objectives5
 - Key Issues5
 - Project Scope5
- Methods.....5
 - Interviews.....5
 - Time Studies & Observations6
 - Literature Search.....6
 - Paging Surveys.....7
 - Data Analysis7
- Findings & Conclusions.....7
 - Interviews: Communication-Related Bottlenecks Exist7
 - Time Studies & Observations: Transfer Process Includes Conflicting Variables9
 - Literature Search Findings & Conclusions10
 - Increased Nursing Staff Level Not Feasible10
 - Increased Hospital Costs per Day per Patient.....10
 - Paging Surveys: UMHS Employees Favor Different Form of Notification.....10
 - Data Analysis Findings & Conclusions11
 - Process Times12
 - Occupancy Rates.....14
 - Manually Accessed Paging Samples14
 - Surge Charge Pager.....15
- Recommendations.....15
 - Prioritize Patient Bed Assignment15
 - Accept Patient Transfers during Rounds15
 - Enter Request for Beds after Rounds.....16
 - Implement Standardized Patient Transfer Process16
 - Implement Different Paging System.....16
 - Implement “Bring Your Own Device”16
 - Implement “Read Receipts”17
 - Verify Paging Recipients17
- Expected Impact.....17
- References.....18
- Appendices.....19
 - Appendix A: Current PICU Transfer Process.....19
 - Appendix B: Data Collection Sheet20
 - Appendix C: Current State Swimlane Diagram21
 - Appendix D: Value Stream Map.....22
 - Appendix E: UMHS Paging Survey23
 - Appendix F: Box Plots.....24
 - Appendix G: Occupancy Rates.....25
 - Appendix H: Future State Swimlane Diagram26

List of Figure & Tables

Table 1: Transfer Issue Breakdown	9
Table 2: Employees Surveyed Breakdown	10
Figure 1: Paging Survey Results.....	11
Figure 2: Receiving Unit Average Transfer Time	12
Figure 3: Receiving Unit Box Plot.....	13
Table 3: Bed Request Entry Times by Receiving Unit.....	14

EXECUTIVE SUMMARY

The current patient transfer process in the Pediatric Intensive Care Unit (PICU) of C.S. Mott Children's Hospital is experiencing delays and frustration for both staff and patients. As reported by the PICU Nurse Manager, Lean Coach, and POA Jr. Management Engineer, the PICU charge nurses are experiencing extremely long wait times in the process. Therefore, the PICU Nurse Manager asked a student team from IOE 481 at the University of Michigan to study tasks that occur in the transfer process to identify wasted time in moving patients from the PICU to general care floors. This evaluation consisted of analyzing the current patient transfer process used in the Pediatric Intensive Care Unit, evaluating potential systems, and developing recommendations for improving the patient transfer process. After examining the current situation, the team developed multiple alternatives for simplifying the patient transfer process and, in turn, reducing the average process time caregivers experience.

Background

The PICU is a 22-bed unit that provides intensive care for critically ill and injured infants, children, and adolescents. During the day and night shift there is one charge nurse working who is responsible for delegating nursing assignments, scheduling, and overseeing admissions, transfers, and discharges. To begin the transfer process, caregivers enter patient information into MiChart, a relatively new electronic medical record (EMR) database the University of Michigan Health System switched to within the last 4 months. Although a PICU Transfer Process Guideline is available for transfers from the PICU to the general care units, known as Service-to-Service Transfers, the process does not occur in a timely fashion. While not a specific part of the guidelines, bed-briefing activities occur every morning, which directly affect daily transfers. At each 7 AM bed-briefing meeting, the charge nurse and fellow from the night shift anticipate patients they feel may be able to be transferred from the PICU. They relay this information to the day shift charge nurse though patient status is subject to change. If the PICU is at its maximum capacity, patients cannot be accepted to the PICU and future surgeries are subject to cancellation. One key issue expressed was inadequate communication between the PICU, the Admissions and Bed Coordination Center (ABCC), and the general care units.

Methods

The team performed six tasks to evaluate and improve the transfer of PICU patients.

- *Interviewed seven C.S. Mott Children's Hospital employees.* The team selected a wide range of employees to obtain information regarding the patient transfer process, including the ABCC Patient Flow Coordinator, PICU Fellow, one of five PICU Nurse Practitioners (NP), PICU Case Manager, Chief Resident of the general care floors, second year PICU Fellow, and the PICU Division Director.
- *Conducted time studies and observations.* The team conducted time studies to determine averages for the entire transfer process from beginning to end and individual task times for each step of the process.
- *Performed two literature searches.* The first literature search included information on an IOE 481 project dealing with patient transportation and its relation to nurse workload. The second literature search gathered data on average costs for patients staying in the Intensive Care Unit (ICU) as opposed to general care units.

- *Distributed paging surveys among clinical staff.* Surveys asked employees to rate the effectiveness of the current hospital paging system as well as how frequently they do not receive pages, both on a scale of one to five. A free response section was also available for employees to voice suggestions.
- *Evaluated current transfer process through data analysis.* Using data gathered from MiChart, TeleTracking, and the Red Report, the team evaluated the periods of the transfer process that averaged the most time with correlating hospital occupancy rates.
- *Developed recommendations for improving the PICU patient transfer process.*

Findings & Conclusions

After conducting interviews, performing time studies & observations, researching relevant projects, administering paging surveys, and analyzing data, the team had the following findings and conclusions.

- *Interviews: Communication-Related Bottlenecks Exist.* The team pieced together a more accurate process of how transfers actually occur after finding more steps than documented in the original process map.
- *Time Studies & Observations: Transfer Process Includes Conflicting Variables.* There are many opportunities for transfers to be delayed and for problems to occur within the transfer process, the most common issue being staff not receiving pages from ABCC. The team developed a value stream map showing individual process times and various wait times of each task as well as between tasks.
- *Literature Search: Staff Increase & Cost Analysis Not Feasible.* The team found hiring more NPs to the receiving units would benefit the transfer process as these employees would be able to perform duties like that of physicians. Due to an NPs high average salary and the need for multiple per unit, the team concluded that suggesting more nursing staff is not feasible. The second literature search resulted in finding the average daily cost of a room in an intensive care unit as compared to a general care room. With a ratio of 5:1, the cost of keeping a patient in an ICU room is greater than a general care unit, concluding that a faster transfer process time will reduce overall hospital costs.
- *Paging Surveys: UMHS Employees Favor Different Form of Notification.* The UMHS Paging Surveys were completed by 33 clinical employees within the PICU and general care units. 33% of surveyed employees find they sometimes do not receive a page or never receive a page. 54% of surveyed employees find the current paging system somewhat effective to not effective at all. 61% of surveyed employees said they would change the paging system. 97% of employees own a smartphone. Key comments indicated using personal devices to communicate between units.
- *Data Analysis: Process Times.* Time stamped data of 804 PICU transfers from January 1, 2014 to September 30, 2014 was extracted from the MiChart system. Multiple findings were gathered from analyzing the data by quantifying process times, occupancy rates, accessing 50 samples of complete transfer information, and evaluating the paging recipients. Total process times were calculated for the receiving units. The longest time was 165 minutes between the PICU entering a Bed Request and the ABCC sending a page to the receiving unit. The second longest wait time was 74 minutes between ABCC paging the receiving unit and the receiving unit responding to the ABCC with a bed number.
- *Data Analysis: Occupancy Rates.* The UM Hospital Daily Red Report was averaged from June 1, 2014 - September 30, 2014. The PICU averaged 84.2% occupancy and the general

care departments averaged 81.1%. A graph was created to show the fluctuation of the occupancies and the relationship between them.

- *Data Analysis: Manually Accessed Paging Samples.* Due to differing data sets, it was necessary to manually access 50 samples to piece together the entire process including paging times to and from the receiving units. The team could not only look at when the bed request was placed because the receiving unit does not receive that request right away. Of the 50 samples retrieved, 11 of them had a page from ABCC to the receiving unit during rounds. Only 1 of the 11 transfers had accepted during rounds. The team concluded that receiving physicians are accepting patients after completing rounds.
- *Data Analysis: Surge Charge Pager.* After gathering paging data from the ABCC to receiving units and PICU, the team noticed a pager, which is currently not in use, is receiving pages regarding patient transfers. Based on this evidence, ABCC may not be sending pages to the correct paging numbers.

Recommendations

Based on the findings and conclusions from the evaluation of the transfer process, the team developed the following primary recommendations to improve the PICU patient transfer process.

- *Prioritize Patient Bed Assignment.* ABCC prioritize PICU transfers above other tasks as a short term improvement. In the long term, develop a program to immediately assign PICU transfer patients to open beds, assisting ABCC.
- *Accept Patients during Rounds.* Receiving physicians should accept patient transfers during rounds to expedite the transfer process. A physician can appoint one employee involved in rounds who is able to accept patients. With one appointed employee, physicians will be able to continue rounds with an emphasis on teaching and patient care.
- *Enter Requests for Bed after Rounds.* If unable to accept patients during rounds, the PICU should not enter bed requests until after completion of rounds.
- *Implement Standardized Patient Transfer Process.* Standardization using the future state map will decrease repetition of information and reduce the amount of time to give report by communicating all pages through the charge nurse. Standardization should be achieved through input from all nurse managers and staff.
- *Implement “Bring Your Own Device.”* Hospital employees would receive patient transfer notifications via the employee’s smartphone. BYOD would be a manageable transition and eliminate the wait time due to “lost pages” as expressed by the current paging users.
- *Implement “Read Receipts.”* When ABCC sends a page to a caregiver, a “read receipt” can be activated once the page is opened and read. If the ABCC does not receive this read receipt within a short amount of time, the page can be re-sent. Read receipts will eliminate wasted time and miscommunications between departments.
- *Verify Paging Recipients.* The ABCC is currently sending pages to the surge charge pager, which is not in use. ABCC should verify the paging numbers of their recipients and should not send pages to the surge charge pager when the surge charge is not on duty.

In the long-term, the team expects to reduce patient transfer time from PICU to general care floors and in turn, improve patient satisfaction as well as increase patient throughput. With more patients moving to general care at a faster rate, hospital costs for ICU beds will decrease. Furthermore, miscommunications between departments will be reduced and future surgery cancellations will be prevented.

INTRODUCTION

The Pediatric Intensive Care Unit (PICU) is a unit within C.S. Mott Children's Hospital that provides care for critically ill and injured infants, children, and adolescents. The current patient transfer process in the PICU has been experiencing delays and frustration for both staff and patients. PICU charge nurses are responsible for transferring patients from the PICU to general care floors. As reported by the PICU Nurse Manager, Lean Coach, and POA Jr. Management Engineer, the PICU charge nurses are experiencing delays in the process. Therefore, the PICU Nurse Manager would like to know the steps of the patient transfer process to determine those that are negatively affecting the time spent in the process. To address this question, the Nurse Manager asked an IOE 481 student team from the University of Michigan to identify the steps of transferring patients to identify wasted time in moving patients from the PICU to general care units. Based on conclusions made from collected data, the team recommends changes to reduce the time it takes to transfer patients. This final report presents the methods and activities performed in the PICU to develop recommendations to decrease the the length of time it takes transferring patients.

BACKGROUND

A Pediatric Intensive Care Unit is an area of the hospital that specializes in the care of critically ill children and teenagers. Physicians and nurses in the PICU are specially trained in pediatric intensive care to handle a variety of patient needs. Complex technology and equipment is often used when treating patients.

The PICU at C.S. Mott Children's Hospital is a 22-bed unit that provides intensive observation and specialized nursing care to critically ill patients. One charge nurse works in the PICU during the day and night-shift and is responsible for delegating nursing assignments, preparing schedules, and overseeing admissions, transfers, and discharges. A PICU Transfer Process guideline currently exists for Service-to-Service transfers from the PICU to the general care units, as well as Same-Service transfers within the PICU (Appendix A). At times when all beds are occupied, the patient transfer process does not occur as quickly as needed from the PICU to general care units. If the PICU is at its maximum capacity, patients cannot be accepted to the PICU and future surgeries are subject to cancellation.

The PICU Transfer Process was drafted on October 8, 2012 and revised on November 7, 2012, but is not strictly followed. Communication between the PICU and the general floor has been identified as an area for improvement. Another component of this process includes entering data into MiChart, a relatively new electronic medical record (EMR) database UMHS switched to within the last 4 months. Since the medical staff are not yet familiar with MiChart, this may add to the problems of the current patient transfer sequence and take up valuable use of employees' time. Though not a specific part of the process guidelines, bed-briefing activities occur every morning, which directly affect the sequence of events. At each 7 AM bed-briefing meeting, the charge nurse and fellow from the night-shift anticipate patients they feel may be able to be discharged from the PICU. They relay this information to the day-shift charge nurse though patient status is subject to change.

The project determines the cause of lengthy patient transfer times and provides recommendations to improve the patient transfer process and reduce patient wait time.

Goals & Objectives

To identify total time and wasted time and determine the reasons the patient transfer process takes longer than desired, the team members accomplished the tasks listed below:

- Observe nursing shifts and patient discharge processes from the PICU to other general units
- Identify unnecessary wait times and disconnects within the discharge process

The team developed recommendations to achieve the following objectives:

- Minimize unnecessary wait times in the bed transfer process
- Create a standardized process that is robust to the PICU
- Minimize risk for critical surgery cancellations
- Offer suggestions on the staff resources scheduled per shift
- Improve overall patient care and general flow of PICU discharges and transfers

Key Issues

The key issues listed below are the driving factors behind this project:

- Undocumented standardized current process
- Dissatisfied patients due to wait times in receiving a bed and being discharged
- Dissatisfied staff due to lack of communication in transfer process

Project Scope

The scope of this project included only the Service-to-Service patient transfer process from the PICU to the seven general units of C.S. Mott Children's Hospital. This process begins when the PICU sending physician requests for a bed in a general unit of Mott Children's Hospital and ends when the patient is transferred to this designated unit.

The Same-Service transfer process was not in the scope of this project; however, the IOE 481 Project Team has been informed that the PICU Same-Service transfer process is less problematic. Therefore the design team will use the current Same-Service transfer process map as a tool for comparison and as an external reference. Other tasks not executed by the PICU or tasks that do not affect the transfer process are not in the scope of this project. Operating room procedures and patient care post floor transfer was not studied.

METHODS

Data collection was executed in four stages: interviews, time studies and observations, literature searches, and extensive analysis of MiChart data.

Interviews

The team interviewed seven employees from September 24, 2014 to October 20, 2014 including physicians, charge nurses, and other staff involved in the bed transfer process. Standard

questions were asked each employee including their responsibility in the transfer process, if they were aware of designated guidelines, and where they believe the problem lies.

Time Studies & Observations

From October 24, 2014 to November 14, 2014, the team conducted 42 hours worth of studies from witnessing 4 complete transfers and 19 transfers in total. The team used a data collection sheet (Appendix B) to record the times of the transfers and the tasks that may interrupt the flow of the process such as unrelated phone calls and pages to the charge nurse.

The team observed transfers out of the PICU and into general care floors. One specific instance of a study was conducted from 7:00 AM to 7:00 PM on October 24, 2014 between all three team members, rotating on four hour shifts. The team witnessed three transfers that day, as well as a transfer that was cancelled. The team observed the charge nurse, but was also in close contact with the bed-side nurses. The team took notes of activities completed by the nurses and their responsibilities that may have interfered with the transfer process. The team also recorded the number of pages, orders, reports, and phone calls experienced by the nurses in the PICU, following the procedures on the team's data collection sheet (Appendix B).

The following week, the team observed rounds to observe the sequence in which the residents perform rounds and input transfer orders. During these rounds, a Same-Service transfer occurred. Team members also timed nurse report handoffs. After rounds were finished, team members observed ABCC Coordinators entering transfer orders to determine how quickly they are notified.

Literature Search

The team conducted a literature search on projects that dealt with the transportation of patients and how it related to the workloads for each unit. The team found a past IOE 481 project from 2006 titled "Nursing SWAT Patient Transport Analysis Regarding Workload and Tasks." [1] The previous project team recommended different staffing levels based their findings. The team analyzed this project specifically on how data was collected, analyzed, and used to create the recommended staffing levels. From this, the team implemented some of the same methods to suggest staffing levels in the PICU.

The team researched other historical facts and trends about intensive care units in the U.S. The U.S. National Library of Medicine provided a publication from 2005 titled "Daily cost of an Intensive Care Unit Day: the Contribution of Mechanical Ventilation" which included mean costs and lengths of stay for patients with and without ventilators [2]. The Society of Critical Care Medicine reported Critical Care Statistics including the most common reasons for admittance into intensive care units and the average salaries of ICU professional teams [3]. The American Association for the Surgery of Trauma listed facts including the cost ratios for intensive care units to the total hospital costs [4]. Becker's Hospital Review also provided the team with average daily non-intensive care hospital costs for non-profit institutions specific to each state [5].

Paging Surveys

The IOE 481 team prepared a UMHS Paging Survey (Appendix E) to distribute to nurses and providers in the PICU and general care units from November 11, 2014 to November 18, 2014. The questionnaire asked employees to rate how effective they feel the current paging system is. It also contained a “Yes” or “No” question asking if employees would change how they are notified for handoff and if so, a response section for recommendations on their preferred method of notification.

Data Analysis

Time stamped transfer data from January 1, 2014 to September 30, 2014 was gathered from the MiChart electronic medical record database. The data included recorded times of when the “Request for Bed” was entered into MiChart, when ABCC assigned a bed to the patient, and when the patient occupied the bed. The team averaged the time between steps in the MiChart information using Excel. The MiChart data did not address every step of the transfer process; therefore, the team manually accessed paging times for pages being sent from the ABCC to the PICU and receiving units charge nurse. This was extracted from the TeleTracking system for 50 complete transfers from June 18, 2014 to November 7, 2014.

FINDINGS & CONCLUSIONS

Seven C.S. Mott Children’s Hospital employees were interviewed in order to gather an all-encompassing view of the various steps involved in transferring patients. Over a total of 42 hours, the team conducted time studies while also observing the charge nurse. Literature searches were performed to investigate the optimal nursing staff levels and hospital cost information. Paging surveys were conducted to gather employee views on the reliability and effectiveness of hospital pagers. Data analysis was performed to quantify wait times in the process and to filter the data based on criteria such as receiving service, receiving units, and time of day in order to see trends.

Interviews: Communication-Related Bottlenecks Exist

The team interviewed various employees of C.S. Mott Children’s Hospital. The first was with the Admissions and Bed Coordination Center (ABCC) Patient Flow Coordinator, who acts as the admitting department by locating patient beds on the general care floors. She stressed that the handoff part of the process could be improved. She also believed a large reason for inefficiencies in the process is a combination of miscommunication and a non-standardized process between the sending and receiving teams.

Second, the team interviewed a PICU Fellow. She makes the final medical decision regarding patient stability and places the transfer order when they are ready to leave the PICU. She indicated that C.S. Mott Children’s Hospital is a teaching institution and an appropriate balance is required between efficiency, patient care, and education. Specifically, rounds are done in the morning between 8:00 and 10:00 AM and during these hours no orders are placed because all of the residents’ attention is focused on rounding. She also stated that the PICU does not always receive pages from the ABCC when a bed is ready so that hand-off can be initiated. When pages

are not received, patients wait longer to transfer from the PICU, therefore, the Fellow hopes to have more consistency with paging in the future.

One of five Nurse Practitioners (NP) in the PICU was then interviewed. She also has the ability to write transfer orders for patients in the PICU. The PICU is one of the only units in Mott Children's Hospital that employs Nurse Practitioners. When residents, fellows, and physicians are performing their rounds, an NP can write "Request for Bed" orders. The PICU NP cited order timing with the receiving team as a problem. She said the receiving team has many obligations such as taking care of patients and maintaining an educational environment, which interfere with the flow of transfer orders. Sometimes the PICU and receiving team make multiple calls to each other because of other obligations.

The PICU Case Manager was interviewed next. She plays no role with the physical transfer; however, she uses the TeleTracking system to input information about the patients to the ABCC. ABCC looks at this information to determine whether patients will be ready to be transferred out of the PICU that day or the next. TeleTracking is the electronic version of the morning bed-briefing, which is a daily meeting relating how many beds are full within the unit between the night and day shift as well as suggest patients projected to be transferred or discharged that day. The Case Manager suggested the PICU physicians should prioritize rounding on patients who are ready to be transferred so that orders can be entered into the system immediately after.

The team also interviewed the Chief Resident of the general care floors, who is responsible for rounding on patients and accepting patients who are being transferred to her floor. She stated that the rounds in the PICU are more efficient than the rounds on general care floors, and the general care rounds are not finished until about 11:00 or 11:30 AM. This disparity in timing causes delays because receiving teams do not usually accept patients until their rounds are completed. The Chief Resident expressed a concern about the time it takes for patients to be moved after a "Ready for Transfer" order is entered into the system.

The next interview conducted was with a second year Fellow. He posed several questions about the PICU transfer process and the communication between the ABCC and PICU. The Fellow suggested phone calls are a more urgent and direct communication method than paging, but phone calls are forwarded most of the time. He also explained if a resident is occupied with a patient at a time of a transfer page, and the resident's pages are not being forwarded to someone else, then the pages get lost, which hinders the transfer process.

The final interview was with the PICU Division Director. His role within the the PICU is to decide whether a patient should move to a general floor. This decision triggers the patient transfer process. The Director noted that the long wait times before a patient is physically transferred most likely lies with the process having too many moving parts. He recommended selecting one individual, possibly the charge nurse, to be responsible for receiving the "bed-available" page rather than it being sent to whoever put in the request. Furthermore, he noted that approximately one-third of PICU transfers are within the Same-Service. Same-Service transfers occur when a service rounds on a patient in the PICU, deems them able to leave the PICU, and

immediately accepts them into their own unit. Although the Same-Service patient transfer process was not within the project scope, it was considered when analyzing MiChart data.

In each of these interviews, responses consistently indicated communicated-related bottlenecks were occurring outside of the interviewee’s unit. After listening to the transfer process from the PICU and the ABCC, the team pieced together a more accurate process of how transfers actually occur. This is depicted in the swimlane diagram of Appendix C. The diagram displays each entity involved in the process, the PICU, ABCC, and the receiving unit, and what role they play. The team found there are more steps to the process than what was noted in the original process map, and that a majority of the power lies with the ABCC when deciding the time and location of the transfers.

Time Studies & Observations: Transfer Process Includes Conflicting Variables

The time studies and observations unveiled several reasons as to why there are delays in the transfer process. Out of a total of 19 observed transfers, the team observed 4 complete transfers from beginning to end, some of which encountered multiple issues, while others experienced none. Table 1 displays the different causes for delay and the frequency of each.

Table 1: The PICU faces a wide variety transfer issues, the most being “lost” pages.

Transfer Issue	Frequency
"Lost" Pages	4
MiChart Confusion	3
Transfer vs. Discharge Decisions	3
Changes in Patient Health	2
Specialist Visits	2
Interference with Rounds	1
Changes in Provider's Decision	1
No Available Ventilators	1
Family Meetings	1

Source: UMHS Hospital, 19 samples, 10/24/14-11/13/14

As seen in the table, there are many opportunities for transfers to be delayed and for problems to occur within the process. The most common issues were claims of not receiving pages from the ABCC, confusions and miscommunications with the use of MiChart, and decision changes from the patient being transferred to being discharged.

Observations of the ABCC showed evidence that Bed Coordinators are notified of bed requests through the office printer. Furthermore, investigating the TeleTracking system, the team noted that pages are physically sent from the program. There is also a column indicating whether the page the Bed Coordinator sent was successful.

With input from PICU staff as well as time study values, the team developed a value stream map (Appendix D) showing individual process times and the various wait times of each task and between tasks. Of note, the longest time occurred between the PICU entering a Bed Request and the ABCC sending a page to the receiving unit, with a wait time of 165 minutes. The second longest wait time was 74 minutes between ABCC paging the receiving unit and the receiving

unit responding to the ABCC with an available bed number. The team found these two steps to be crucial areas for improvement and needed further analysis to discover the root cause of long transfer times.

Literature Search Findings and Conclusions

Two literature searches were conducted on nursing staff levels and hospital costs per patient. The following paragraphs indicate the team’s findings from both searches.

Increase of Nursing Staff Level Not Feasible

The literature search resulted in information pertaining to other projects focused on transportation of patients and how transportation related to the workloads for each unit. A past IOE 481 project was found from 2006 titled “Nursing SWAT Patient Transport Analysis Regarding Workload and Tasks.” Their project team recommended different staffing levels based on their findings.

Based on this data, the team investigated nursing levels within the PICU transfer process. It was found that hiring more Nurse Practitioners to the receiving units would greatly benefit the transfer process as these employees would be able to perform duties like that of physicians, specifically, accepting a patient to their unit. Hiring Nurse Practitioners to receiving units would mean hiring two for each of the four general care units to work both day and night shifts. As evidenced by the Society of Critical Care Medicine, a Nurse Practitioner’s average salary is \$100,406 [3]. Due to the high salary of an NP, as well as the need to hire at least eight Nurse Practitioners, the team concluded that suggesting more nursing staff was not feasible.

Increased Hospital Costs per Day per Patient

The average daily cost of a room in an intensive care unit is approximately \$6,700 without a ventilator and \$10,800 with a ventilator [2]. Of note, the primary ICU admission diagnosis is respiratory insufficiency and failure, requiring the patient to have a ventilator [3]. Furthermore, although ICU beds account for 10% of hospital inpatient beds, the ICU beds account for 20-35% of hospital operating costs [4]. A general care room in a Michigan hospital costs \$2,020 [5]. At ratios of 5:1 for a ventilator and 3:1 without a ventilator, the cost of keeping a patient in an ICU room is much greater than a general care unit. These findings verify the need to transfer stable patients at a faster rate to reduce overall hospital costs.

Paging Surveys: UMHS Employees Favor Different Form of Notification

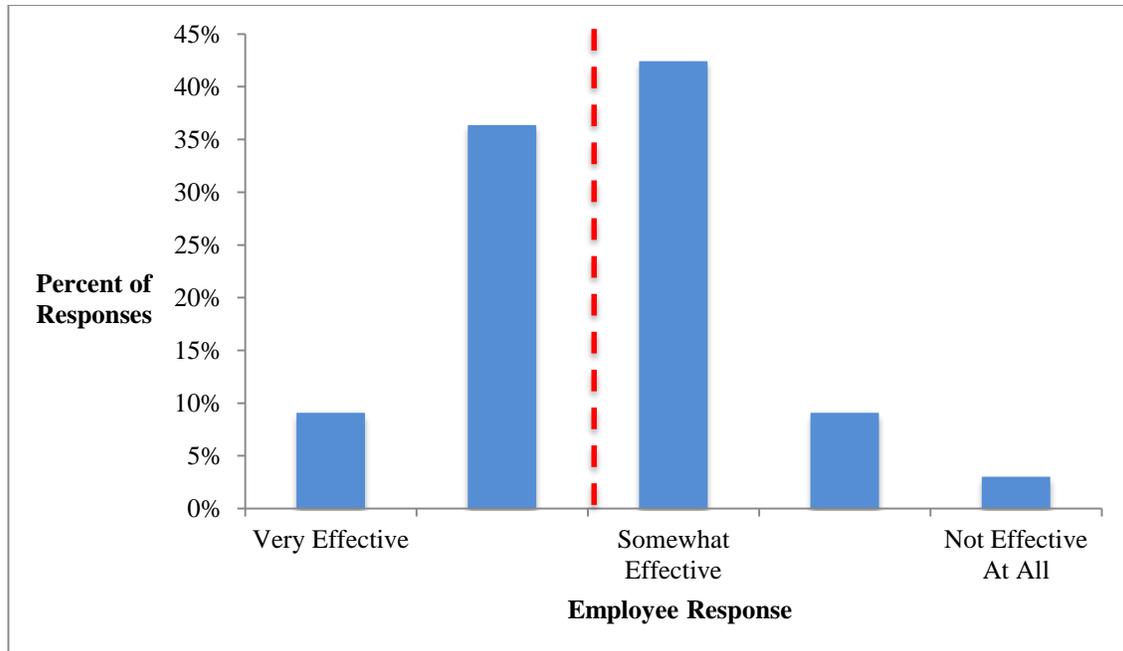
Due to staff testimonials from those interviewed, the IOE 481 team decided to gauge the opinions of nurses and providers that frequently use the current paging system during transfers. The UMHS Paging Surveys were filled out by 33 clinical employees within the PICU and general care units. Table 2 below indicates the range of surveyed employees.

Table 2: Nurses completed the greatest amount of paging surveys.

Employee Position	Percentages
Nurse	61%
Resident	18%
NP	12%
Fellow	3%

Source: IOE 481 Paging Surveys, 33 samples, 11/12/14-11/18/14

The majority of completed surveys were from UMHS nursing staff. 33% of surveyed employees find they sometimes do not receive a page or never receive a page. Employee responses to the survey question regarding the effectiveness of paging are shown in Figure 1 below.



Source: IOE 481 Paging Surveys, 33 samples, 11/12/14-11/18/14

Figure 1: Over 50% of employees feel paging is somewhat effective to not effective at all.

A total of 54% of surveyed employees find the current paging system somewhat effective to not effective at all. The team introduced a goal line, indicated by the dashed line, to represent that the ideal responses should be to the left of the line. Since patients’ lives are the focus in everyday operations, it is unacceptable to only have a “somewhat effective” paging system. The results also showed that 97% of employees own a smartphone. 61% of surveyed employees said they would change the paging system if possible and key comments indicated a preference to using personal devices to communicate between units instead of hospital provided pagers.

The data from TeleTracking also showed an extensive amount of time in the transfer process between the request for bed and ABCC’s page to the receiving unit, which verifies the staff surveys and team observations.

Data Analysis Findings and Conclusions

Multiple findings were gathered from analyzing the data by quantifying process times, occupancy rates, and accessing 50 samples of complete transfer information.

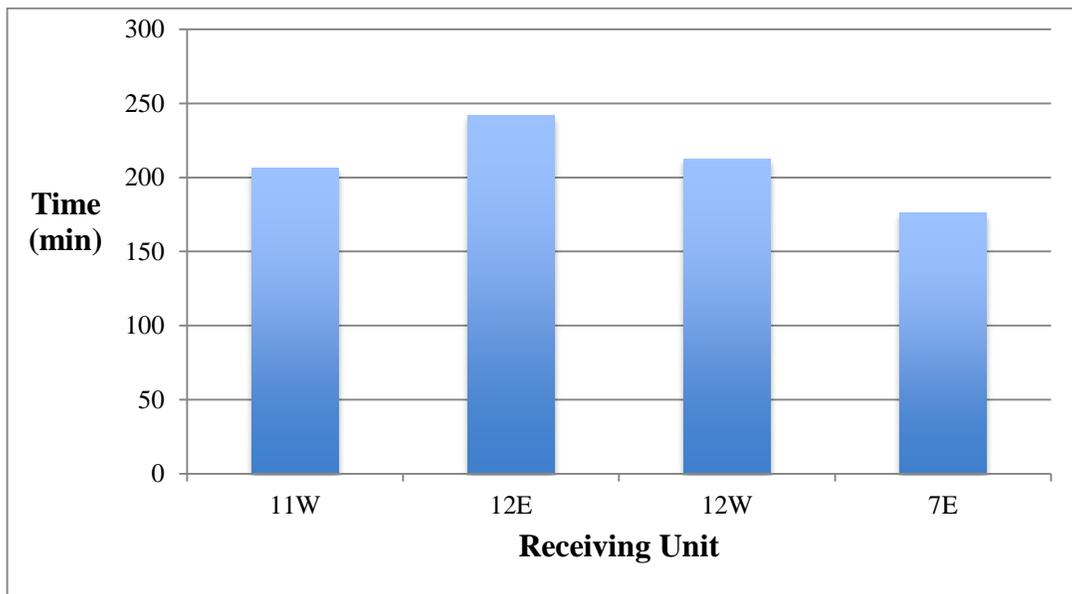
Time-stamped PICU transfer data from January 1, 2014 to September 30, 2014 was extracted from the MiChart system. The crucial parts of this data lie in the specific time of day that orders for patient transfers are placed by the sending physicians and the time the patients are received by the other unit. The team used Microsoft Excel to calculate the total average time, and standard

deviation, taken to transfer a patient and identify the parts of the process taking the longest. The team also used other Microsoft Excel functions and applications to filter out factors such as day of the week, time of day, and receiving unit. Minitab was utilized to create box plots to show trends and special cases in the data.

Using the information obtained from MiChart, the team addressed several issues from the data set. Initially, the team determined outliers within the data as there were 40 entries when a “Ready to Transfer” order was placed before a “Bed Request” was placed. This information means that the transfer process is not being followed in order. With direction from the Project Coordinators, the team accounted for data points where a “Ready to Transfer” occurred before a “Bed Request” by adjusting the time it took to zero minutes, to show how the process is not strictly followed.

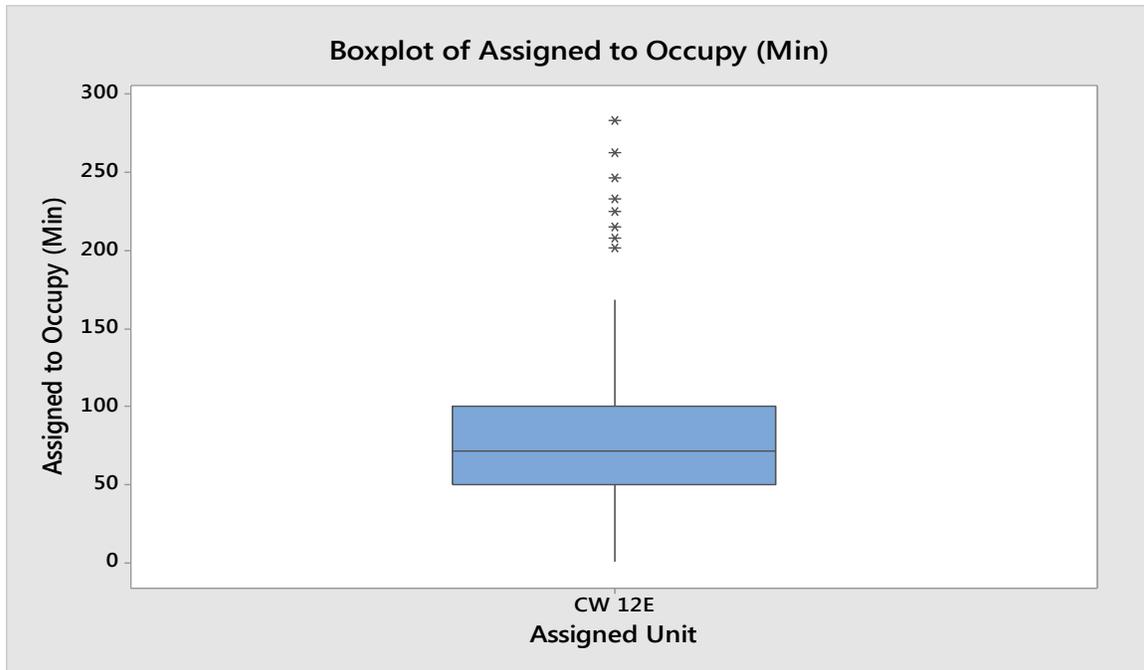
Process Times

To obtain a more realistic view of the transfer process, the timing information was filtered by the receiving department due to the possibilities of Same-Service transfers in the data. Narrowing the departments down to 12 East, 12 West, 11 West, and 7 East made the data more reliable for what the team was looking for. The team looked at all transfers going to these units and arranged times for the following steps: Request for Bed to Bed Assigned, Bed Assigned to Bed Occupied, and Request for Bed to Bed Occupy. The team created a graph showing how long transfers take across the four units. Figure 2 below compares the mean of each department.



Source: MiChart, 804 samples, 01/01/14 – 09/30/14
Figure 2: 12 East has the highest average transfer time.

Figure 2 depicts 12 East being the unit with the longest total transfer time. The team then took this data and used Minitab to create box plots for the total transfer time in these units. Given that the standard deviations were high for the transfer times, the team created box plots to show that variation. The box plot shown in Figure 3 depicts the time and variability 12 East experiences in transferring patients.



Source: MiChart, 804 samples, 01/01/14 – 09/30/14

Figure 3: 12 East median time of 305.5 min. First-quartile at 189.9 and third-quartile at 424.2.

The team looked at the median of the box plot as well as the first and third quartile ranges, resulting in the team being 50% confident that the time transferring patients to 12 East will take between approximately 190-424 minutes. Boxplots for units 12 West, 11 West, and 7 East can be found in Appendix F.

The team concluded that the total transfer time was not enough to conclude average wait times over the entire process across all units, the reason being the process ranges across three separate units; thus, there are times in the process when a receiving unit is waiting on the other unit to complete tasks. The team sampled 50 transfers from the data set so that more steps, including paging times, could be analyzed. Instead of looking at Bed Request to Bed assigned and then Bed Assigned to Bed Occupied, the team took time stamps to show the following steps:

1. Bed Request to ABCC Pages Receiving Unit for Bed
2. ABCC Pages Receiving Unit for Bed to Bed Assigned
3. Bed Assigned to ABCC Pages PICU Bed Information
4. ABCC Pages PICU Bed Information to Handoff/Ready to Transfer
5. Handoff/Ready to Transfer to Bed Occupied

After performing further analysis, the team found that the longest process time, which accounts for 60% of the total patient transfer time, occurs from entering a bed request to ABCC paging the receiving unit to find a bed at an average of 165 minutes. Also, the team found that the second longest time occurs from ABCC paging the receiving unit to locate a bed to when the bed is assigned at an average of 74 minutes later. In order to understand the extensive times of the two steps, the team investigated the occupancy rates of the PICU and general care units to assess each department's workload and whether or not they were busy. The team originally assumed the

ABCC does not page out to the receiving unit to find a bed when the occupancy rates are high; therefore, the team expected to see high occupancy during long process times.

Occupancy Rates

The team conducted further analysis on the occupancy in the general care units and PICU from June 1, 2014 - September 30, 2014. Appendix G shows the flux in general care and PICU occupancy. UM hospital has 4 occupancy alert levels:

- 90-93%
- 93.1-96%
- 96.1-100%
- >100%

UM hospital considers 90% to be “high occupancy.” Of the 122 days analyzed, the general care units were above the 90% threshold 18 times, or 14.75%, and the PICU was above the 90% threshold 37 times, or 30.33%. The PICU on average was at 84.2% occupancy and the general care units were on average at 81.1% occupancy. A relationship was observed between the two departments as well. As the occupancy rates in the PICU increase, the occupancy rates in general care units increases as well. These numbers did not support the team’s original hypothesis that the long times in the beginning of the transfer process were because of high occupancy.

Manually Accessed Paging Samples

The samples taken from MiChart indicate that PICU physicians are entering bed requests during rounding hours as seen in Table 3.

Table 3: 62% of the time, PICU caregivers are entering bed requests from 6 AM to 12 PM.

Receiving Unit	Time of Day				Total
	(12AM-6AM)	(6AM-12PM)	(12PM-6PM)	(6PM-12AM)	
CW 11W	14	59	26	7	106
CW 12E	7	105	36	4	152
CW 12W	16	219	104	24	363
CW 7E	11	110	56	6	183
Total	48	493	222	41	804

Source: MiChart, 804 samples, 01/01/14 – 09/30/14

The team defined rounding on patients for both the PICU and receiving units to start at 8 AM and complete by 11:30 AM each morning. Due to differing data sets, it was necessary to manually access 50 samples to piece together the entire process including paging times to and from the receiving units. The team could not only analyze when the bed request was placed because the receiving unit does not receive that request right away, so the team looked at when the ABCC was paging the receiving unit to find a bed to see if it occurred during rounds. Of the 50 samples retrieved, only 17 samples occurred where the receiving unit was contacted by ABCC during rounds. Six of the 17 transfers were Same-Service transfers, which is outside the scope of this project. Narrowing the data to the 11 Service-to-Service transfer samples, 10 beds were assigned after rounds. From this, the team concluded that receiving physicians are accepting patients after completing rounds.

Surge Charge Pager

While analyzing the paging data, the team discovered that the ABCC is paging information to the PICU charge nurse pager as well as the surge charge pager, which is currently not in use. The surge charge pager is for surge charge nurses who work when occupancy is above 100%. This occurs when the 22 staffed beds are full, and the PICU opens the additional 8 beds. The team noticed that the majority of the pages being sent to the surge charge pager were also being sent to the PICU charge nurse pager. The team was not able to verify every page due to the high volume and short time constraints; however, in interviews and observations, lost pages were expressed to be a problem. Although the team did not find a particular instance where a page was sent only to the surge charge pager and not the charge nurse pager, the team believes this could be a cause of the lost page problem.

RECOMMENDATIONS

From the findings and conclusions, the team developed six main recommendations for the PICU and general care units of C.S. Mott Children's Hospital, as detailed in the following paragraphs.

Prioritize Patient Bed Assignment

Occupancy for both the pediatric general care and pediatric ICU is considered high at greater than 90% patient volume. With an average of 83.6% occupancy for the 50 samples, the general care units are not considered close to patient capacity, which does not support the claim that ABCC is waiting to send pages to the receiving units due to high bed occupancy and high hospital admissions. With an average of 165 minutes before the ABCC pages the receiving units, the team concluded this step to be contributing to a majority of the wait time. The team believes the ABCC could be placing more of an emphasis on bed assignments for other transfers.

As a short-term improvement, the team recommends the ABCC prioritize PICU transfers above other tasks. Time studies could be performed to evaluate the workload of the ABCC and staff allocation of their time and resources. As a long-term improvement, the ABCC could implement a program to immediately assign PICU transfer patients to open beds. The program will utilize constraints pertaining to the amount of open beds in the hospital. The program will integrate MiChart and TeleTracking occupancy information where if a general care unit is below 90% occupancy, a patient will be immediately assigned to that unit, given the unit can accommodate the patient's needs (i.e. mechanical ventilator). As long as all of the currently staffed beds are accounted for in the occupancy rates, staffing should not be an issue. If the constraint is not met, the transfer will be sent to ABCC who will then determine the patient's future location.

Accept Patient Transfers during Rounds

As evidenced by the samples taken from MiChart data, receiving physicians are only accepting patients during rounds 9% of the time. In order to expedite the patient transfer process, the team recommends that receiving physicians accept patient transfers during rounds. Since multiple trained employees participate in rounds, the team believes a physician can appoint one employee, such as a fellow, who is able to accept patients. With one appointed employee, physicians will be able to continue rounds with an emphasis on teaching and patient care.

Enter Requests for Bed after Rounds

If unable to accept patients during rounds due to educational purposes, the PICU should not enter bed requests until after completion of rounds. Analyzing process time, entering bed requests after rounds will achieve a reduced amount of time from entering a request for bed to the receiving unit paging the ABCC with a located bed number and in turn, will reduce the total time of the transfer process; however, even though the process time will be reduced patients will not be moved until the afternoon and will still be absorbing PICU resources while they are physically stable to stay in the general care units. This recommendation allows the units to block off the morning hours for educational responsibilities and will relieve the workloads of residents and fellows to focus on other duties.

Implement Standardized Patient Transfer Process

The team heard several different transfer process steps from the various interviewed employees. The current process maps developed from the description of the process do not match that of the Current PICU Transfer Process Guidelines. The MiChart data had several instances where steps later in the process occurred before initial steps were performed. As evidenced from the interviews, current process maps, and MiChart data, transfers are not occurring in the standard order as defined by the Current PICU Transfer Process Guidelines. As a result, there is extensive variation in the time between transfers.

The IOE 481 project team recommends that the charge nurse of the PICU receive all incoming pages. This will reduce the number of moving parts within the transfer process in terms of the number of employees being notified by ABCC. The updated process centralizes pages through the charge nurse and can be seen in the modified swimlane diagram (Appendix H). Although the team was unable to quantify an overall turnover time improvement, simplifying the patient transfer process reduces the number of moving parts and chance for “lost pages” as indicated in paging survey responses, interviews, and observations.

Implement Different Paging System

Based on findings from interviews, observations, and paging surveys, the team developed two recommendations to address the issue of lost pages.

Implement “Bring Your Own Device”

33% of surveyed employees claim they sometimes do not receive pages or do not receive pages at all. Approximately 54% of surveyed clinical employees find the current paging system is somewhat effective to not at all effective and another 61% would prefer to change the paging system if able; therefore, the team recommends the hospital implement a “Bring Your Own Device” (BYOD) paging system. BYOD is a growing trend among large businesses and healthcare institutions. Several IT journals such as ITBusinessEdge are highlighting the economic advantages of implementing BYOD programs since the employees would now be responsible for the expense instead of the hospital. Since 97% of nurses and providers surveyed own a smartphone at C.S. Mott Children’s Hospital, BYOD would ensure a manageable transition and eliminate the wait time due to “lost pages” as expressed by the current paging users.

Implement “Read Receipts”

Another paging option to consider is to activate “read receipts” with each page sent throughout the process. Once the nurse or provider “reads” the page, a read receipt will be sent to the sender, which in this case is mainly the ABCC. If the ABCC does not receive this read receipt within a short amount of time from sending the page then the page can be re-sent, eliminating wasted time and miscommunications between the departments involved in the transfer process.

Verify Paging Recipients

As a quick win solution for the patient transfer process, the team recommends the ABCC verifies the paging numbers of their recipients and does not send pages to the surge charge pager when the surge charge is not on duty. The team also suggests that the ABCC performs more research on whether pages sent to the surge charge affect the pages being sent to other units as well.

EXPECTED IMPACT

Each of the team’s recommendations is expected to reduce patient transfer time from PICU to general care floors. Prioritizing patient beds from the PICU to general care units will reduce ABCC’s workload, allowing emphasis among other roles within bed coordinating. Upon appointing an employee to accept patient transfers during rounds, physicians will be able to continue rounds with an emphasis on teaching and patient care. Implementing the standardized patient transfer process will reduce the patient transfer process time by focusing contact with the charge nurse throughout the whole transfer.

Upon implementing a better paging system, overall employee satisfaction will improve and the number of “lost pages” will decrease. Reducing the number of lost pages will increase employee awareness of patient transfer status, reduce department miscommunications, and reduce the time the entire process takes.

With faster transfer times, patient throughput will increase and in turn, hospital costs will decrease, future surgery cancellations will be avoided, and patient satisfaction will increase.

The team cannot quantify a number in how much time the process will be reduced by each recommendation due to the variations within the whole process; therefore, the PICU should decide which recommendation to test and conduct further time studies in order to quantify improvements.

REFERENCES

- [1] M. Blasco, M. Brennan, and L. Soderstrom. "Nursing SWAT Patient Transport Analysis Regarding Workload and Tasks." IOE 481: Ann Arbor, Michigan. Report. 27 Nov. 2006.
- [2] J. Dasta, *Daily cost of an Intensive Care Unit Day: the Contribution of Mechanical Ventilation*. 2005 June. [Online]. Available: <http://www.ncbi.nlm.nih.gov/pubmed/15942342>. [Accessed: 20 November 2014].
- [3] Society of Critical Care Medicine, *Critical Care Statistics*, Society of Critical Care Medicine 2012 January. [Online]. Available: <http://www.sccm.org/Communications/Pages/CriticalCareStats.aspx>. [Accessed: 21 November 2014].
- [4] TraumaSource: The American Association for the Surgery of Trauma, *Critical Care Illness*, TraumaSource: The American Association for the Surgery of Trauma, 2005. [Online]. Available: <http://www.aast.org/GeneralInformation/criticalcareillness.aspx>. [Accessed: 20 November 2014].
- [5] J. Oh, *Average Cost Per Inpatient Day Across 50 States in 2010*, Becker's Hospital Review, 30 April 2012. [Online]. Available: <http://www.beckershospitalreview.com/lists/average-cost-per-inpatient-day-across-50-states-in-2010.html>. [Accessed: 23 November 2014].