Analysis of Nurse and Clerk Workflows in the University of Michigan C.S. Mott Children’s Hospital Pre-op Area to Reduce Patient Wait Time – Final Report

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Executive Summary

Introduction

Patients undergoing operations at the C.S. Mott Children’s Hospital are currently waiting in the pre-op area an average of 42 minutes longer than the one hour allotted time for pre-op in the operating schedule. This is according to data from the University of Michigan Health System’s Program and Operations Analysis Department. The managers of the area, including the Section Chief of Pediatric Surgery, the Section Chief of Pediatric Anesthesiology, and the Clinical Nurse Manager have expressed concern that the pre-op check-in process is inefficient and confusing. Due to these concerns, our team was asked to study the pre-op check-in process to identify bottlenecks and inefficiencies. Specifically, our team worked to determine the greatest slowdowns and quantify their impact on the pre-op check-in process as a whole.

Methodology

Our team used various methods to arrive at our findings. First, we utilized a literature search to research similar facilities and their pre-op check-in process, and for background information on strategies such as Lean Manufacturing for the office. We also visited both the University of Michigan’s University Hospital and St. Joseph Mercy Medical Center to see first hand how their pre-op check-in processes worked. We interviewed staff to evaluate the current state of the check-in process. We collected and analyzed stop sheets from the pre-op area, a tool that is used to indicate what steps patients still need to complete before surgery. We interviewed the area’s managers and other hospital employees for their beliefs of the pre-op area. We reviewed all of the forms currently used by all of the pre-op staff members. We documented the utilization of the Maize Room, which is part of Phase II recovery and can also be used for the pre-op check-in process. Finally, we completed with a joint pre-op OR study which related delays in pre-op to delays in the OR.

Current Situation

The pre-op area at C.S. Mott Children’s Hospital is currently staffed by two clerks and five nurses, and consists of four examination rooms (please refer to Appendix A for pictures of the area). In addition, 7 beds in Phase II Recovery, which is known as the Maize Room, may be used for the pre-op check-in process and is staffed by 1 or 2 nurses. The pre-op area checks in between 40 and 70 patients per day, according to the Clinical Nurse Manager.

In addition to the layout of the area, another factor believed to increase the time patients spend waiting in the pre-op area is the high amount of variation in the check-in process. This process starts the day before a patient’s surgery, when a clerk audits the patient’s file for a current History and Physical (H&P) and Consent Form. If these two documents are missing or not current within 30 days, the patient cannot be sent into surgery and the clerk notes it on the patient’s file. When the patient arrives on the day of surgery, his/her guardian is asked to fill out an anesthesia questionnaire. At the same time, if the H&P and consent are missing, the clerk will page the resident assigned to that patient, who is responsible to complete those documents before the patient’s surgery can begin. After the anesthesia questionnaire has been filled out, a pre-op nurse will see the patient and complete the pre-surgery examination. Following the initial examination, three additional groups of people must see the patient before surgery: a member of the anesthesia team (resident anesthesiologist or certified registered nurse anesthetist), at least
one member of the surgical service (attending physician, resident, physicians’ assistant, or medical assistant), and the operating room nurse. The procedures followed by these three groups vary by surgical service, do not necessarily occur in any particular order, and do not follow a preset schedule. After all steps have been completed, the pre-op nurse will release the patient to the operating room.

Summary of Findings and Conclusions

Our team has developed several key findings. First, there is little standardization in the pre-op check-in process. Depending on the patient, surgery type, and surgical service, patients will go through different steps and different paperwork will be filled out. There is a need for visual communication tools, as most communication is currently conducted verbally. Documentation delinquencies, such as not having current history and physicals complete before the day of surgery, are causing delays. The amount of paperwork is high and varies by surgery. The large amount of paperwork causes staff to spend unnecessary time filling out paperwork. Similar facilities work well with visual communication tools and have effectively used both lean and six sigma strategies to improve productivity in their operating rooms. The first cases of the day are starting late and may be causing delays in the operating schedule later in the day. Also, surgeries’ durations vary greatly from their scheduled duration. Finally, our team’s joint OR/pre-op study has given us many valuable statistics on the check-in process.

The following conclusions have been developed by our team based on our findings. The first conclusion is that the lack of standardization contributes to excessive pre-op wait times. Second, there is poor communication between various members of the staff associated with the pre-op area. This is compounded by the fact that most of the communication is completed verbally, as opposed to visually. Finally, the quantity and variation of paperwork is excessive and may lead to confusion.

Summary of Recommendations and Future Studies

Our team has developed several recommendations and recommendations for future studies. First, as nurses take patients for their initial exams, they should sign the schedule to inform all members of staff which nurse has the patient. This will help people increase non-verbal communication. Second, increasing the utilization of the Maize Room will help all members of staff locate their patients during the pre-op check-in process. The Maize Room allots a specific bed spot for each patient and this will also increase the non-verbal communication in the area. Finally, the implementation of Centricity Pre-op Manager will significantly reduce non-verbal communication in the area.

There are also future studies which will help better understand the area and may also reduce the time to complete the pre-op check-in process. These future studies are listed below:

- Lean Team
- Investigate and eliminate delays in first case of the day surgeries
- Increase Maize Room utilization
- Investigate Scheduling
- Investigate the Effectiveness of Centricity after implementation
- Investigate mobility of Centricity technology
- Investigate Patient Anxiety
Introduction

According to data from the University of Michigan Health System’s Program and Operations Analysis Department, patients undergoing operations at the C.S. Mott Children’s Hospital are currently waiting in the pre-op area an average of 42 minutes longer than the one hour allotted for pre-op in the operating schedule. The managers of the area, including the Section Chief of Pediatric Surgery, the Section Chief of Pediatric Anesthesiology, and the Clinical Nurse Manager have expressed concern that the pre-op check-in process is inefficient and confusing. Due to these concerns, our team was asked to study the pre-op check-in process to identify bottlenecks and inefficiencies. Specifically, our team worked to determine the greatest slowdowns and quantify their impact on the pre-op check-in process as a whole. The purpose of this final report is to present our approach and methodology, the current situation, the alternatives and hypotheses considered, our findings and conclusions, recommendations, and an action plan.

Background

The pre-op area at C.S. Mott Children’s Hospital is currently staffed by two clerks and five nurses, and consists of four examination rooms (please refer to Appendix A for pictures of the area). In addition, 7 beds in Phase II Recovery, which is known as the Maize Room, may be used for the pre-op check-in process and is staffed by 1 – 2 nurses. The pre-op area checks in between 40 and 70 patients per day, according to the Clinical Nurse Manager.

In addition to the layout of the area, another factor believed to increase the time patients spend waiting in the pre-op area is the high amount of variation in the check-in process. This process starts the day before a patient’s surgery, when a clerk will audit the patient’s file for a current History and Physical (H&P) and Consent Form. If these two documents are missing or not current within 30 days, the patient cannot be sent into surgery and the clerk will make a note on the patient’s file to that extent. When the patient arrives on the day of surgery, the patient’s guardian is asked to fill out an anesthesia questionnaire. At the same time, if the H&P and consent forms are missing, the clerk will page the resident assigned to that patient, who is responsible to complete those documents before the patient’s surgery can begin. After the anesthesia questionnaire has been filled out, a pre-op nurse will see the patient to complete their pre-surgery examination.

Following the initial examination, three additional groups of people must see the patient before surgery: a member of the anesthesia team (resident anesthesiologist or certified registered nurse anesthetist), at least one member of the surgical service (attending physician, resident, physicians’ assistant, or medical assistant), and the operating room nurse. The procedures followed by these three groups vary by surgical service, do not necessarily occur in any particular order, and do not follow a preset schedule. After all steps have been completed, the pre-op nurse will release the patient to the operating room. A more detailed explanation of the pre-op check-in process is given later in this report in the Current Situation section.

Currently, the operating schedule allows 1 hour for the completion of the check-in process in the pre-op area or the Maize Room. However, according to data from the University of Michigan Health System’s Program and Operations Analysis Department, the average wait time in the pre-op area is 1 hour and 42 minutes, with most patients experiencing a wait time closer to the median, approximately 1 hour and 28 minutes. Figure 1 presents data on pre-op wait times from
2070 surgeries collected in two periods, from June 1, 2004 – August 31, 2004 and June 1, 2005 – June 30, 2005, by the University of Michigan Health System’s Program and Operations Analysis Department.

![Figure 1. Time (in hours) Spent by Patients in Pre-op](image)

Managers of the area have been considering several options to shorten patient wait time, including deployment of new software to reduce paperwork and potentially hiring additional staff.

The following key issues necessitated this project.

- Pre-op and surgical staff experience difficulties in tracking patients throughout the check-in process
- Paperwork varies by surgical service and arrives to the pre-op area in different media (electronic, facsimile, or hard copy)
- Coordination issues are perceived to prevent pre-op, surgical, and anesthesiology staffs from completing required tasks for a patient in less than one hour
- Pre-op staff believes the surgical service members are not available to complete their parts of the check-in process in a timely manner

The primary focus of this project was to identify inefficiencies in the check-in process which negatively affect patient wait times.

**Project Scope**

The scope of this project addressed the pre-op area’s check-in process at the C.S. Mott Children’s Hospital. Although the check-in process starts the day before surgery when the clerk checks for a current H&P and Consent form, we considered the process to start when the patient arrives at the pre-op area and to end when the patient leaves the area to go to the operating room.
As part of the project our team has studied:

- Nurse and clerk workflows in the pre-op care area
- Nurse and clerk interactions with patients, physicians, anesthetists, and each other
- Coordination among the nurses, clerks, patients, physicians, and anesthetists

Any task not connected to the pre-op process in the current C.S. Mott Children’s Hospital was not considered in this project. Specifically, our team has not studied tasks or activities within the operating room or the postoperative care area in the C.S. Mott Children’s Hospital unless they directly affected the pre-op process. Any pre-op care that takes place outside of the pre-op area was not included in this study.

Goals and Objectives

The project goals were to determine and quantify the causes of extended patient wait times in the pre-op area of C.S. Mott Children’s Hospital.

To meet these goals our team has:

- Interviewed nurses, clerks, anesthetists, and physicians to identify perceived causes of extended patient wait times
- Conducted an extended time study which will account for delays in the check-in process and their impact on operating room utilization
- Researched a previous value-stream flowchart with an emphasis on identifying inefficient work and procedures

After completing these objectives, our team has developed recommendations to:

- Reduce non value-added work and procedures
- Improve coordination efforts between members of the area staff
- Develop standard operating procedures for pre-op and operating room staff workflow for the efficient management of patients during the check-in process
- Reduce the overall patient wait time in the pre-op area

Approach and Methodology

Literature Search

The team searched hospital literature from multiple sources for further studies of pre-op procedures and methodologies used to better the pre-op process. The sources used are cited in the Appendix B.

Similar Facilities Investigation

Our team visited St. Joseph Mercy Hospital in Washtenaw County, Michigan. This visitation was done to observe different procedures and draw qualitative comparisons between the Mott Children’s Hospital and other hospitals.

Staff Interviews and Questionnaire

Our team asked five questions of two clerks, two area managers and three nurses in the pre-op unit. The questionnaire was used to determine the existing system and its problems in the pre-op
area, as well as to provide recommendations to resolve these problems; a copy of the questionnaire can be found in Appendix C.

Stop Sheet Study

In the pre-op area, six conditions were identified as necessary for a patient to be administered to the operating room (OR), and their absence can cause patient delay. These include consent forms, the administration of Tylenol, markings, lab information, the History & Physical (H&P), and an R.N. signature. As discovered in interviews, it is routine practice to record if any of these conditions are unfulfilled; this is recorded by a nurse on a “stop sheet.” Typically, these stop sheets are thrown away after they are no longer needed.

However, this information could be saved to construct a chart that could be used to rank order the most common causes for patient delay. The main concern with this collection technique would be biased toward tasks not performed by nurses, since the stop sheets are filled by nurses who are more apt to complete a task than to mark a stop sheet.

Key Personnel Interviews

- Janet Murray, RN, Clinical Nurse Manager, Pre-op and Post-Op
  The team discussed the role of nurses and nursing tasks in pre-op. Also, we toured and observed the pre-op area and Maize Room. The purpose of this visitation was to meet with our client and to understand what she expects from the project.

- Sheila Trouten, RN, Educational Nurse Coordinator, UMH Post Anesthesia Care Unit
  The team discussed the role of nurses and nursing tasks in pre-op. Also, we toured and observed the pre-op area and Maize Room. The purpose of this visitation was to meet with our client and to understand what she expects from the project.

- Chris Carroll, Clinical Nurse Manager, University of Michigan's University Hospital OR
  The team discussed the use of Centricity in the UHOR. We toured and observed the operations in the UHOR pre-op area and viewed the Centricity software being used. The purpose of this visitation was to see how a similar pre-op unit was operated and monitored by Centricity technology.

- Ronald Hirschl, MD, Section Chief, Pediatric Surgery
  The team discussed the project objectives, goals, and approaches. The purpose of this meeting was to meet our main client and to understand what he was looking for in the project.

- Paul Reynolds, MD, Section Chief, Pediatric Anesthesia
  The team discussed the progress on the project as well as solutions, such as the use of Centricity technology in the pre-op unit. The purpose of this meeting was to meet our client and to understand what he expects from the project.

- Peter Bow, Applications System Analysis Project Supervisor, Centricity
  The team discussed the availability of Centricity technology and its application to the pre-op unit. The purpose of this meeting was to determine if Centricity’s addition to
the pre-op unit would help to standardize the processes and correct for poor communication within the unit.

- Connie Burns, OR Nurse Manager, St. Joseph Mercy Hospital
  The team discussed St. Joseph hospital’s pre-op and operating room procedures. The purpose of this meeting was to visit an equal sized operating room at another facility so as to understand how other hospitals’ rules and processes.

- Julie Piazza, Senior Activity Therapist, UMH Child and Family Life
  The team discussed the life therapist’s role in the pre-op area. Also, we discussed potential ways of keeping patients occupied and calm during their pre-op check-in process in the Maize Room.

Documentation Review

The team collected all of the required forms that need to be filled out in the pre-op process from the Clinical Nurse Manager. These forms included the patient questionnaire, the consent, the surgical H&P, the anesthesia H&P, the nurse’s form, and addition consents and paperwork from specific departments. The purpose of this collection was to familiarize the team with the paperwork needed for each patient, as well as to identify duplicate information on multiple forms.

Analysis of Historical Data

The team acquired historical data on past surgeries in the Mott Children’s Hospital from the University of Michigan Health System’s Program and Operations Analysis Department. The data included information on arrival time, scheduled surgery start time, actual start time, scheduled duration, actual duration, surgical service, and patient location while in pre-op. Our team used this data to determine surgical on-time starts, deviation from scheduled duration, and Maize Room utilization.

Joint Pre-Op and OR Time Study

As discussed in the Findings section, the three most common causes for patient delay were tasks that required personnel from the OR. Therefore, a joint pre-op/OR study was needed to investigate how the pre-op and OR relate. In this study, the times were recorded for stages in the patient’s progress from the moment he or she enters the pre-op area until he or she leaves the OR. These observations would allow for gross comparisons in performance to be made.

Surgery start and end times were recorded to see how well scheduled surgery start and duration times predicted actual performance. The beginning and end times for nurse, anesthesiologist, and H&P tasks were also recorded. Patient arrival times were recorded to describe wait times for patients. However, the data for all pre-op times are incomplete due to difficulty with tracking patients; often only about half of tracked cases yield data about pre-op tasks. Forms for the pre-op/OR study are found in Appendix D.

Current Situation

The current pre-op check-in process has many steps that need to be completed before a patient can be sent into the operating room. Our team has broken these steps into 6 categories: tasks to
complete the day before, clerical tasks, pre-op nursing tasks, anesthesiology tasks, surgical service tasks, and operating room nurse tasks.

Tasks to Complete the Day Before

Several steps occur the day before a patient’s surgery. First, two nurses from the pre-op area are assigned to make patient calls. These nurses will call the next day’s outpatients to reconfirm their surgery time, type of surgery, and review any special instruction the surgical service or anesthesia may have. These special instructions include, but are not limited to, what medications the patient can and cannot receive prior to surgery and the last time the patient can eat. The nurses receive all of the information for these phone calls from the patients’ charts, and simply check off that they have called each patient.

The pre-op clerks also have several tasks to complete the day before a surgery. First, they check for each patient’s chart, and audit it for a History and Physical (H&P) and Consent form, both of which must be current within 30 days. The H&P and consent form may already be in a patient’s chart, faxed from the surgical service, placed on CareWeb electronically, or not present at all. If the H&P and Consent are missing, the clerk will make a note to that extent. Finally, the clerk will stamp all patient files and I.D. bracelets with their University of Michigan Health System’s ID card.

Clerical Tasks

The clerks of the Mott pre-op are the patients’ first point of contact on the day of their surgery. The first task the clerk must complete for each patient is to check the patient into pre-op. This involves highlighting a printout of the day’s surgical schedule to inform all parties in the pre-op area that a particular patient has arrived. The clerk then gives the patient or patient’s guardian an Anesthesia Questionnaire, which asks for details such as when the last time the patient ate and if they have taken any medication in the past 24 hours. The clerks also offer to validate parking tickets for the patient or patient’s guardian.

After the patient has left the clerks’ desk to complete the Anesthesia Questionnaire, the clerk checks the patient’s chart for the H&P and Consent forms. If they are missing, the clerk pages the surgical resident of surgical faculty member to inform them of this delinquency. When the patient or guardian returns with the completed Anesthesia Questionnaire, the clerk’s part of the case is completed, and the case is passed on to nursing.

Pre-op Nursing Tasks

A pre-op nurse is the next person to see a patient after the clerk. The nurses’ main job is to complete a pre-op assessment or exam. This assessment includes taking of vital signs, reviewing lab studies, assessing pain and uneasiness and confirming there is a current H&P and consent. This assessment has been estimated by our team (See Findings section) to be approximately 13 minutes and is all completed on a paper document. After the pre-op nurse completes this assessment, it is the nurse’s job, as per the UMHS Mott Pediatric PACU Guide, to release the patient to the operating room when all of the pre-op check-in steps have been completed.
One of the pre-op nurses is designated as the Pre-op Team Leader. This nurse is responsible for completing the nurse examination on patients, and has several added duties. These duties include; review the schedule with all area (OR, Post Anesthesia Care Unit, and Maize Room) leaders, update the OR schedule as issues arise, monitor when patients leave for the OR, indicate which patients have move to the Maize room, check for OR delays, communicate delays throughout the day with all team leaders, and identify which patients should be checked in at the Maize Room and which should be checked in at the pre-op area.

**Anesthesia Tasks**

Anesthesia will see a patient after the pre-op nurse assesses the patient but before a patient can go to the operating room. Their evaluation consists of many of the same components as the pre-op nurse, as per the Documentation Review. The evaluation can be completed by a Faculty Anesthesiologist, Resident Anesthesiologist, or Certified Registered Nurse Anesthetist. They review what medications have been taken by the patient, the last time the patient ate, and the proposed anesthetic plan. Anesthesia is likely to be with the patient until the patient is taken to the Operating Room. Anesthesia tasks are estimated to be completed in 10 minutes. All of these tasks are completed in electronic form.

**Surgical Service Tasks**

The surgical service may or may not need to visit a patient during the patient’s time in pre-op. Many Faculty Surgeons reintroduce themselves to the patients, and review the procedure. However, this step is not mandatory. If an H&P and Consent form need to be completed the day of surgery, this must be done by a member of the surgical service such as a faculty member, resident, or physicians’ assistant. The person who completes this task varies from surgical service to surgical service. Also, if the surgery a patient is undergoing involves a specific site, the patient must be marked. Patient marking can only be completed by a faculty surgeon or resident who will be in the room for the operation. Finally, several services require an additional H&P and Consent form for their surgeries, and do not use the standard H&P and Consent forms.

**Operating Room Nurse Tasks**

The operating room nurse, also known as the rotating nurse, only has one duty in pre-op. It is their duty to come and review their patient’s file for completeness, and they are the final sign off to send a person to surgery.

**Alternatives and Hypotheses Considered**

The following alternatives have arisen during the team’s final analysis of the data findings. These hypotheses should be considered and tested at a later date to conclude their validity or their impacts on the pre-op process.

**Rotation of Nurses**

According to the Clinical Nurse Manager of the pre-op unit, nurses are rotated through the pre-op unit daily, with some nurses working full-time shifts and others working part-time shifts. This constant variability in staff might make it difficult to standardize the pre-op process, as well as to communicate effectively across the unit.

**Patient Early Arrivals**
Guardians of children that are scheduled for surgery on a given day are advised to arrive in the pre-op unit at least one hour prior to their child’s scheduled surgery time. However, some guardians arrive with their children to the pre-op unit earlier than the advised time. This early arrival time on the part of the patient would increase the overall average patient wait time, thereby skewing further studies based on this data.

Scheduling

Within the University of Michigan Hospital System, a scheduling department provides the pre-op with its daily schedule of surgeries, each surgery’s estimated duration time, and each patient’s operating room assignments. Each surgery’s estimated duration is set by the surgeon, who may overestimate or underestimate the surgery time.

The introduction of the ORMIS, an automated, computerized scheduling system, should help to predict surgery duration times more accurately. ORMIS could do this by estimating surgery duration based on recent historical data. To go one step further, if the surgeons followed lean methodology, and were trained to perform the same surgeries using the same techniques, this consistency would decrease the variations in results between surgeries and build in quality.

Findings

Through our team’s various approaches and methodologies, we have agreed on the following key findings: lack of process standardization, excessive/repetitive paperwork, other facilities’ practices, first cases of the day start late, deviation between actual and scheduled procedure duration, excessive wait time in pre-op, and Maize room utilization. Each of these findings will be discussed in the following subsections.

Lack of Process Standardization

Our team first realized there was a lack of process standardization in the pre-op check-in process from our interviews. A nurse told us “...however, this method has not been adopted by all of the pre-op, surgical and anesthesiology teams.” The quote is referencing dry erase boards which are placed on each of the four exam room doors in the pre-op area. When a nurse, member of a surgical service, or a member of the anesthesiology team takes a patient into in exam room, they are supposed to write the patient’s first name and last initial on the door. However, this had not been practiced by everybody involved in pre-op, thereby decreasing its effectiveness.

After our interviews, we directly observed the lack of standardization in the check-in process. Below is a table that describes how the pre-op process can vary from case to case and what impact it has on the process.
<table>
<thead>
<tr>
<th>Cause of Variation</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation not complete</td>
<td>A member of the surgical service is required to complete both the History &amp; Physical and Consent from. This involves a team member leaving a surgery to complete the paperwork for the next case. If documentation is not complete by the day of surgery, this can lead to longer wait times in pre-op. Also, a member of the Anesthesiology team is required to do paperwork for each case as well.</td>
</tr>
<tr>
<td>Anesthesiology Staff Rotation</td>
<td>Depending on types of surgeries, the number of Anesthesiology staff can vary greatly from one operating room to the next. However, when only one resident is used per room, it will increase wait time because the resident must stabilize the previous case before moving to the next case.</td>
</tr>
<tr>
<td>Surgical Service Staff</td>
<td>Each surgical service operates differently. Some will always use a physicians' assistant in pre-op to finish incomplete paperwork all of the time. Others will occasionally use a physicians' assistant. Whereas, some never use one.</td>
</tr>
<tr>
<td>Patient Placement</td>
<td>There are two rooms that a patient can be checked in at: the pre-op area and the Maize Room. The first cases of the day are always sent to the Maize room. However, the nurses in pre-op can decide which patients go to Maize on a case to case basis. No protocol exists for determining which patients go to the Maize room and why.</td>
</tr>
<tr>
<td>Paperwork Differences</td>
<td>Majority of paperwork is the same. However, several surgical services prefer to use different forms for their consents.</td>
</tr>
</tbody>
</table>

Table 1. Main Variations in the Pre-op Check-in Process

In addition to the variations mentioned in the table, the order in which the groups of people see their patient does vary from surgery to surgery. Sometimes, two or three staff members will be with one patient at a time, which may reduce on the patient answering the same questions several times.

The Check-in process does vary greatly from one surgery to the next. Because of this, the process is very difficult to measure, rate, and compare. Also, because there is a lack of standardization, it may lead to errors, and potentially sending patients to surgery that are not ready to go to the operating room.

Need for Visual Tools

Our interviews were the first indication that more visual tools could be used in the pre-op area and the Maize Room. Several nurses told us that there could be more visual tools to aid the check-in process.
The other finding comes from the publication "Lean Tools for the Office." It discusses the importance of visual tools, such as patient tracking boards, for improving workplace efficiency. It defines "visual controls and management" as "simple signals that provide an immediate understanding of a situation or condition. They are efficient, self-regulating, and worker managed."

Also, the University of Michigan's University Hospital pre-op area has a very visual tool for their process: Centricity Pre-op Manager. This software displays every patient in pre-op, the assigned doctor, nurse, and anesthetist, their status, what needs to be complete, and if they are ready for surgery or not. In addition, the display board is completely color coded, for quick, easy reference. According to the nurse manager at the University Hospital, this tool has streamlined communication by decreasing verbal communication while increasing non-verbal communication.

**Documentation Delinquencies**

Our team collected 76 stop sheets in the period February 13, 2006 – February 20, 2006. Figure 2 below displays our findings.

![Figure 2. Lack of Consent is Highest Cause of Delay](image)

The three main causes for delay, as determined by the collection of stop sheets, are Consent, H&P, and Site/Side Marked. Note that all three of these causes are related to communication between various people both in and out of the pre-op area. Also, the two most common sources for delay, consent and H&P, deal with the processing of paperwork.

An article entitled "Ideas for improving the pre-op process" from the publication, "OR Manager," discusses the practice of scheduling those patients who have all paperwork completed, including a current H&P, as the first cases of the day. Furthermore it advocates only
adding patients to the schedule once their paperwork is completed. This gives doctors an
incentive to see patients the day before the scheduled surgery to ensure they receive priority
scheduling. This was based on policies at the Rush University Medical Center in Chicago,
Illinois, as per the OR Manager article.

Also, at St. Joseph Mercy Medical Center in Ann Arbor, Michigan, the hospital has a surgical
prep center. This center allows members of staff to complete all paperwork the day before
surgery so the patient’s check-in process the day of surgery is very short.

Documentation Summary
The team looked at all of the documents used the pre-op area for each patient, and observed a
total of approximately 20 pages of paperwork. The exact forms that need to be filled out before
each surgery are dictated by the circumstances surrounding the patient and surgery type. The
forms are listed below:

- Nursing Form
- Anesthesia Questionnaire
- In/Out-Patient Notes
- Physician’s Orders
- Anesthesiology Pre-Op Evaluation
- H&P Short Form
- Consent for Blood Transfusions
- Consent for Optional Tissue Research
- Outpatient Cover Sheet
- Consent
  - Otolaryngology Consent

Key Findings from Similar Facilities
From the investigation of the University Hospital pre-op our team was able to see how well a
paperless system could be implemented. Doctors and nurses were able to quickly determine
where their patients were located, and exactly what tasks still needed to be completed before the
patient could be ready for surgery.

Our team also visited St. Joseph Mercy Medical Center. Here, the pre-op check-in process is
somewhat different from University Hospital and Mott’s. St. Joseph’s has a “surgical prep
center” which all outpatients report to a day before their scheduled surgery to ensure their H&P
and other paperwork is in order. Additionally St. Joseph’s is working on implementing “six
sigma” and “lean” programs, and has started a system where staff are penalized for being late to
perform pre-op tasks. For example, if an anesthesiologist is late in coming to consult with the
patient before the operation, they could be fined. Additionally, doctors can loose priority
scheduling and nurses can even be fired. Finally it is worth noting that St. Joseph's uses a totally paperless system for the check-in process.

**Lateness in First Case of the Day**

Each operating room is scheduled to start working at 7:30 am except for Thursdays, when the cases start at 8:30 am. The Mott OR Nurse manager has informed our team though, that surgeries actually start between 7:30 am and 7:45 am (8:30 am and 8:45 am on Thursdays). This is because a Faculty Anesthetist will be running two rooms. Therefore, approximately half of the surgeries should start at 7:30 am and the other half should start by 7:45 am. However, our team has found that this is not the case.

Below is a histogram of lateness (in minutes) of 471 first case surgeries spanning July 1, 2004 – August 31, 2004 and June 1, 2005 – June 30, 2005.

![Histogram of First Case Lateness](image)

**Figure 3. First Case Lateness**

The chart indicates the average surgery would start 14.3 minutes after it was scheduled to begin. This is in the 15 minutes time frame for starting surgeries; however, since this is the overall average, surgeries are starting too late. If half of all surgeries started at 7:30 am and the other half started at 7:45 am, the average lateness would be 7.5 minutes. This means surgeries start on average 6.8 minutes late. Assuming an opportunity cost of $40/ min /operating room, this corresponds to over $700,000.00 in opportunity costs per year. Approximately 40% of first cases start after the 15 minute window has expired. Additionally, if the first case of the day starts late, there is a greater likelihood that all subsequent surgeries will start late.
Refer to Appendix E for more detailed information on start times.

Discrepancies between Scheduled Surgery Time and Actual Surgery Time

Our team observed that there is a discrepancy between the time scheduled for an operation and the actual duration of the operation. This can cause an operating room to work ahead of or behind its schedule, leading to potential delays in pre-op. Below is a chart that shows how many minutes surgeries differed from their scheduled duration. The chart has data from 1721 surgeries spanning July 1, 2004 – August 31, 2004 and June 1, 2005 – June 30, 2005.

![Chart showing deviation of surgery duration from scheduled time]

**Figure 4. Deviation of Duration from Scheduled**

On average, surgeries are 3.9 minutes shorter than they are scheduled. However, the standard deviation of the discrepancy is 30.8 minutes. Also, there is a large tail, indicating that many surgeries are scheduled much shorter than they actually last.

Below is another figure which shows the amount of time surgeries differed from the scheduled time as a percentage of scheduled durations. Again, the chart is based from the same 1721 surgeries spanning July 1, 2004 – August 31, 2004 and June 1, 2005 – June 30, 2005.
Again, the average surgery is fast by 7.6% of its scheduled duration. Also, the standard deviation is 27.9%.

Please refer to Appendix F for more detailed information on deviation from schedule.

**Low Maize Room Utilization**

The Maize Room is utilized at various times of the day at various rates. Every first case of the day is checked in at the Maize Room, but then there is no set order for which patients go to the Maize Room. This can lead to confusion for staff members when locating patients and may indirectly increase wait times. After the first case of the day, the Maize room is utilized 46.3% and corresponds to 3 occupied beds (4 open beds).

**Key Findings of Joint OR/Pre-Op Study**

Below, Figure 6 shows that the overall process is in control. Two outliers are inconsequential, because those excessive wait times are the result of early patient arrivals. There are also no remarkable mean shifts, or other special causes of variation. Because all the variation is common cause, no single factor is responsible for excessive wait times, and the pre-op process as a whole needs to be redesigned. Note that the mean observed wait time is about 80 minutes.

The actual total wait time is likely to be longer, because some of the arrival times were missed and not recorded.
Table 2 lists mean times, variation and the coefficients for various aspects of the Mott pre-op process; Figure 7 displays those coefficients graphically. While all variables show coefficients from about 30% to 250%, the mean durations of nurse, H & P, and anesthesiology tasks are small. Furthermore, differences between those task durations are not statistically significant. However, differences between nurse and anesthesiology tasks are statistically significant at a 95% level of confidence (95% confidence intervals were about 7 to 20 minutes, 18 to 39 minutes, and 32 to 72 minutes for nurse, H & P, and anesthesiology tasks respectively). The most important pattern in Table 2 is that standard deviations build from nurse tasks (10 minutes) to anesthesia tasks (36 minutes) to total pre-op wait time (66 minutes) to surgery delay (114 minutes). This increase in variability reinforces the finding from the Figure 7; specifically, all factors in patient wait times can be improved.
<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean Time (minutes)</th>
<th>Standard Deviation (minutes)</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse Task Duration</td>
<td>13</td>
<td>4</td>
<td>31%</td>
</tr>
<tr>
<td>H &amp; P Task Duration</td>
<td>11</td>
<td>5</td>
<td>45%</td>
</tr>
<tr>
<td>Anesthesiologist Task Duration</td>
<td>10</td>
<td>5</td>
<td>50%</td>
</tr>
<tr>
<td>Nurse Lead Time</td>
<td>13</td>
<td>10</td>
<td>77%</td>
</tr>
<tr>
<td>H &amp; P Lead Time</td>
<td>29</td>
<td>16</td>
<td>55%</td>
</tr>
<tr>
<td>Anesthesiologist Lead Time</td>
<td>52</td>
<td>36</td>
<td>69%</td>
</tr>
<tr>
<td>Pre-op Wait Time</td>
<td>80</td>
<td>66</td>
<td>83%</td>
</tr>
<tr>
<td>Surgery delay</td>
<td>44</td>
<td>114</td>
<td>259%</td>
</tr>
<tr>
<td>Deviation from Scheduled Surgery Duration</td>
<td>-9</td>
<td>49</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2. Mean, Standard Deviation and Coefficients, All Tasks, Lead Times and Surgery Metrics Show High Variation

Figure 7. Comparison of Coefficients, All Tasks Have Excessive Variation (Greater than 10%)

Below, Figures 8 and 9 respectively compare task durations and lead times for nurse, H & P, and anesthesiologist tasks. Sample sizes differ because cases differ in the types of data available. However, Figures 8 and 9 do illustrate practical differences for lead times are much greater than for task times. Again, no significant difference was found for task duration, but nurses had significantly shorter lead times than anesthesiologists with a 95% level of confidence.
Figure 8. Comparison of Average Task Durations, Tasks Are Approximately Equal in Duration

Figure 9. Comparison of Average Lead Times, Nurse Tasks Occur the Earliest
Conclusions
The aim of this project was to determine the cases for patient delay in the pre-op area of Mott. From the findings listed above our team identified three main conclusions as to the sources of these delays.

Lack of Process Standardization
We found a lack of process standardization in the pre-op process as a whole. This does not necessarily reflect on the specific tasks within pre-op, such as those preformed by the doctors or nurses, as our study did not study these specific tasks in-depth. It is worth noting that further study may show a lack of standardization on that level as well. The problem is that every patient takes a different path through the pre-op process. Not all patients are the same, and each will have different needs and different paths through pre-op. However there does not seem to be an existing standard protocol for determining a patient’s track through pre-op. Many of these decisions are left to the nurses and doctors to make on an individual basis, which leads to confusion and inefficiency later in the process.

Poor Communication
Much of the delay observed in pre-op was due to staff not having the information they needed when they needed it. This is related to the lack of process standardization, because more communication is needed to keep everyone informed of the situation when it is not standardized.
Varying and Duplicate Paperwork
The amount and composition of the paperwork associated with the pre-op process relates directly to the other two causes of patient delay listed above. Time spent sorting out the patient status and determining what needed to be done next with the paperwork was a considerable source of delay.

Recommendations
Though the main focus of our project was to determine the causes of delay, and not necessarily their solutions, our team did generate the following recommendations:

• When nurses take their patient for an exam they should sign the schedule next to the patient’s name to indicate that they have that patient. This way if someone comes to the clerk’s station looking for the patient the clerk will be able to direct them appropriately.
• Work to increase the utilization of the Maize room. It is much easier for doctors and anesthesiologists to find and examine patients in the Maize room where patients are each assigned an individual bed space and do not have to move to an examination room.
• Implement a visual tool for tacking patients and their progress though pre-op. Initially our team proposed creating a patient tracking board; however, we now feel that such a board would only be a “quick fix” solution and that ideally the pre-op area should adopt the Centricity computer system as soon as possible.

Action Plan
The following steps are provided to suggest the most effective implementation of the recommendations. These steps offer a general plan of action meant to lead the reader toward his/her objective of reducing the wait time in pre-op.

Centricity Observation
Chris Carroll, the Clinical Nurse Manager at the University of Michigan’s University Hospital OR (UHOR), has volunteered to set up a meeting with those interested in learning more about the Centricity software. During the meeting, she will briefly overview the Centricity system and its impact to the UHOR. In addition, visitors can view the live software functioning in a unit that closely corresponds to the Pre-Op/OR process.

Staff Instruction
According to Peter Bow, the Applications System Analysis Project Supervisor of Centricity software, the Centricity system will be ready for deployment to the pre-op unit in approximately by June, 2006. Before the arrival of the new software, the staff should be trained in the system, to immediately use Centricity once implemented in the pre-op unit.

In addition, the team learned about the nurse training for Centricity Pre-Op Manager in the UHOR. According to the Clinical Nurse Manager, approximately 4 nurses were sent to training on Centricity technology, and in turn trained the rest of the staff on the software.

Top-Down Reinforcement
After visiting the OR department at St. Joseph Mercy Hospital, the team learned that this hospital reinforces its rules by penalizing its staff. If a nurse is late to work three times, the nurse’s employment at the hospital is terminated. Anesthesiologists and surgeons can be tardy three times before they are fined or lose scheduling priority, respectively. All of the chiefs of staff
support this system and discipline their staff accordingly, making sure that there are no exceptions to the rule. A similar plan encouraging punctuality, accountability and cost savings may be implemented in the Pre-Op/OR units, but only after other changes have been made to the Mott Children’s Hospital system.

**Future Studies**

There are several studies which should be carried out in the near future. The following studies will help address the root causes of many of the area’s issues.

- **Lean team**
  - The lean team will be able to investigate many issues
  - Can effectively stimulate change in the pre-op value stream
- **Investigate and eliminate delays in first case of the day surgeries**
  - The first case of the day delays may be contributing to delays later in the day
  - The delays are also contributing into significant opportunity costs
- **Increase Maize Room utilization**
  - The Maize Room is currently underutilized
  - Maize Room facilitates the check-in process, and may reduce the check-in process time if more utilized
- **Investigate Scheduling**
  - Scheduling may be contributing to lateness throughout the day
  - ORMIS may help surgeon’s more accurately schedule their surgeries
- **Investigate the Effectiveness of Centricity after implementation**
  - After Centricity has been implemented at Mott’s, it will be necessary to assess its impact on the process
  - If changes need to be made, they should be considered and investigated
- **Investigate mobility of Centricity technology**
  - Nurses have expressed concern that Centricity will limit where they can do their job
  - By putting Centricity on mobile devices may help nurses do their job more effectively
- **Investigate Patient Anxiety**
  - Child Life Therapist and Nurse Manager expressed interest in this study
  - Anxiety of patients and parents may be increasing the time the pre-op check-in process takes
  - Study should consider how to effectively decrease patient and parent anxiety while waiting for surgery
Appendix A – Pre-op Area Pictures

Figure A.1. Pre-op Area as Seen From Entrance

Figure A.2. Pre-op Area as Seen from Rear
Figure A.3. Pre-op Clerk Desk
Figure A.4. Scheduled Surgery Charts

Figure A.5. Completed Chart Board
Appendix B – Literature Search Works Sited


Appendix C – Staff Questionnaire

1. Regarding Stop and Go sheets, what is their purpose? Do you feel they are effective tools?
2. What is your role in the pre-op care area?
3. Do you feel that there are enough personnel to handle the current patient flow in the pre-op care area? What would you estimate the current patient flow to be per day?
4. What issues are causing delays in the pre-op area into the operating room area?
5. If we were to create a better tracking method for patients, what information would you like to see for each patient? Would you be willing to participate in this new system?
Appendix D - Data Collection Sheets

IOE 481 Group 10 Data Collection Sheet

<table>
<thead>
<tr>
<th>Record Number</th>
<th>Patient Name</th>
<th>Patient Being To</th>
<th>Consent Given</th>
<th>Consent Received</th>
<th>N=2 Region</th>
<th>N=2 Finished</th>
<th>Morning Begun</th>
<th>Morning Finished</th>
<th>Taken to OR</th>
<th>Schaduled to Op</th>
<th>In OR</th>
<th>Schaduled to ER</th>
<th>How</th>
<th>Surgical Date</th>
</tr>
</thead>
</table>

Figure D.1. Pre-op Observation Sheet

<table>
<thead>
<tr>
<th>Room</th>
<th>In Surgery</th>
<th>Surgery Complete</th>
<th>Cleaning Start</th>
<th>Cleaning Complete</th>
<th>In Surgery</th>
<th>Surgery Complete</th>
<th>Cleaning Start</th>
<th>Cleaning Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Room 1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td></td>
<td></td>
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<td></td>
</tr>
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<td>Operating Room 4</td>
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<td></td>
</tr>
<tr>
<td>Operating Room 6</td>
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</tr>
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<td>Operating Room 7</td>
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</tr>
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<td>Operating Room 8</td>
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<td></td>
</tr>
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<td>Treatment Room 2</td>
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</tr>
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</table>

Figure D.2. OR Observation Sheet
Appendix E - First Case of the Day Analysis

Table E.1. Lateness of First Case by Surgical Service

<table>
<thead>
<tr>
<th>Group</th>
<th>No of Observations</th>
<th>Average Start Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Cardiac</td>
<td>20</td>
<td>5.3</td>
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<tr>
<td>Otolaryngology</td>
<td>62</td>
<td>11.5</td>
</tr>
<tr>
<td>Urology</td>
<td>57</td>
<td>14</td>
</tr>
<tr>
<td>Plastics</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Pediatric Surgery</td>
<td>100</td>
<td>15.5</td>
</tr>
<tr>
<td>Ortho</td>
<td>103</td>
<td>16.2</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>34</td>
<td>16.4</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>33</td>
<td>18.3</td>
</tr>
</tbody>
</table>

Collection Dates 6/1/04 - 7/31/06 and 8/1/05 - 8/31/05
Source: UMHS Program and Operations Analysis Department
Appendix F - Deviation from Schedule Analysis

<table>
<thead>
<tr>
<th>Service</th>
<th>Deviation (min)</th>
</tr>
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<tbody>
<tr>
<td>Cardiac</td>
<td>55.2</td>
</tr>
<tr>
<td>Ortho</td>
<td>15.3</td>
</tr>
<tr>
<td>Plastics</td>
<td>3.1</td>
</tr>
<tr>
<td>Pediatric Surgery</td>
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<tr>
<td>Neurosurgery</td>
<td>-3.5</td>
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<tr>
<td>Otolaryngology</td>
<td>-6.4</td>
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<tr>
<td>Ophthalmology</td>
<td>-7.5</td>
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<tr>
<td>Urology</td>
<td>-12.7</td>
</tr>
<tr>
<td>Dental</td>
<td>-14.5</td>
</tr>
</tbody>
</table>

Collection Dates 6/1/04 – 7/31/06 and 8/1/05 – 8/31/05
Source: UMHS Program and Operations Analysis Department

Table F.1. Deviation from Schedule Duration in Minutes by Surgical Service

<table>
<thead>
<tr>
<th>Service</th>
<th>Deviation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>22.4%</td>
</tr>
<tr>
<td>Ortho</td>
<td>9.1%</td>
</tr>
<tr>
<td>Plastics</td>
<td>2.7%</td>
</tr>
<tr>
<td>Pediatric Surgery</td>
<td>-0.6%</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>-1.4%</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>-9.5%</td>
</tr>
<tr>
<td>Dental</td>
<td>-9.6%</td>
</tr>
<tr>
<td>Urology</td>
<td>-10.1%</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>-10.4%</td>
</tr>
</tbody>
</table>

Collection Dates 6/1/04 – 7/31/06 and 8/1/05 – 8/31/05
Source: UMHS Program and Operations Analysis Department

Table F.2. Deviation from Schedule Duration in Minutes by Surgical Service