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Date: April 18, 2008
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Executive Summary

The Cardiovascular Center (CVC) at the University of Michigan Hospital has implemented lean concepts to reduce the turnaround time of the medication filling process. To further reduce the turnaround time (TAT) UM-Carelink (UMCL), a computerized prescription order entry system, will be implemented during April 2008. This paperless entry system has been implemented in Mott’s Children Hospital and will be introduced to the CVC and entire University of Michigan Hospital (UMH) this spring. The Program and Operations Analysis’s task was to measure the current turnaround time for filling ordered medication on the 4th and 5th floor of the CVC.

The current process for filling medication in the CVC starts with the physician writing a medication order. The order is then faxed to the pharmacy and verified by the pharmacist. If the medication is in the Omnicell (machine that houses approximately 90% of patient medication), the nurse pulls the medication and administers it to the patient. If the medication is not in the Omnicell, pharmacy technicians have to prepare the order and deliver the order to the respective floor. These deliveries are made once every hour.

The TAT for the purpose of this project, is defined from the time the medication order is written by the attending physician to the time the medication is administered to the patient. The TAT of this process will be significantly reduced once UMCL is implemented. The findings from this report will be used as a basis to analyze the improvements from UMCL. This report also compares data from the pre-lean process to the current, post-lean, process to identify any potential reductions in TAT that are a result of the implementation of lean concepts.

Goals

The goals of this study are mentioned in the list below:

- To measure the TAT of the current medication filling process, the team accomplished the following goals:
- Measured TAT of Omnicell Orders and specific time intervals regarding Omnicell Orders
- Measured TAT and specific time intervals regarding medication orders through Pharmacy
- Compared the TAT of orders through day shifts and night shifts
- Examined the effects outside distractions have on the medication filling process
- Compared Pre-Lean analysis to Post-Lean analysis

Methodology

Several literature searches were performed to better familiarize the team with the expectations of this study. Previous studies on the TAT of the medication filling process were reviewed to gain a better understanding of the project. Also, previous studies that include pre lean data and post UMCL data provided the team with statistical expectations. Preliminary observations were used as a guide for establishing a uniform data collection method for the time studies that were later
collected. The team also collected computerized data to measure the time interval between verification of a medication and the time it was pulled from the Omnicell.

Conclusions and Recommendations

The results of this study showed that the lean concepts implemented on the 4th and 5th floors of the CVC did reduce TAT. However, some of the remaining issues associated with increased TAT will be eliminated once UMCL is implemented in the CVC. The team also noted that implementing notification measures and instituting standardized procedures for the medication order filling process will decrease TAT after UMCL is implemented. The team recommends future teams utilize the data collected and analyzed in this report as benchmark data, and compare our results with TAT data collected in the CVC post UMCL implementation. The team also suggests that rearranging some equipment in the pharmacy can help reduce the time it takes to prepare orders that need to be filled from within the pharmacy. Thus, reducing the TAT, as it related to orders filled within the pharmacy.

Introduction

The Cardiovascular Center (CVC) at the University of Michigan Hospital deals with patients who have recently undergone or plans to undergo surgeries with the heart, vascular, and stroke care. The 4th and 5th floors of the CVC have recently implemented lean concepts to reduce the process time to fill medication orders. Some of the major lean implementations made in the CVC included organization of the med room, and drawers in the Omnicell, which significantly reduced the front end of measured turnaround time (TAT). In April 2008, UM-Carelink (UMCL), a Computerized Prescription Order Entry System, will be implemented. UMCL is expected to reduce the order filling turnaround time by changing the current procedure for filling medication. UMCL is a paperless process that is expected to reduce mistakes in the order filling process, and make this process more efficient.

Currently, physicians fill out paper order forms that are faxed to the CVC pharmacy department by unit clerks. Depending on the urgency of the order, the order may be walked to the pharmacy by the attending nurse or called in to the pharmacy. Once an order is received in the Pharmacy it is entered into the Worx system by either a pharmacist or a pharmacy technician (pharm tech). Either way, the order has to be verified by a pharmacist before the medication is accessible in the Omnicell. After the order is verified by the pharmacist, the medication is dispensed [retrieved] via an Omnicell machine. If the medication is not available in the Omnicell, a pharm tech has to prepare the medication within pharmacy and deliver the medication to the unit. The CVC has one main pharmacy, on CVC 4. The pharmacy is closed between the hours of 11 pm – 6am, during which, orders are filled by the UH 6th floor satellite. During this time, the UH 6th floor satellite also services the entire UM Hospital.

No data had been collected regarding medication TAT between the post lean implementations and pre UMCL time periods in the CVC. The Program and Operations Analysis team was asked to measure the current TAT for filling medication through both the Omnicell machine and
pharmacy delivery. This TAT data will be used as baseline measurements pre UMCL implementation and will aid future research once UMCL is implemented in the CVC. The data will also be used to compare, track, and document the improvements made using lean concepts in the CVC. The purpose of this report is to present the findings, conclusions from this analysis, and recommendations for future studies.

Background

The CVC at the University of Michigan Hospital is comprised of patients who require both critical care and general care for any cardiovascular condition. The CVC has its own pharmacy, located on the 4th floor, which is used to verify and deliver medication orders when needed between the hours of 6am-11pm. Nurses on the 4th and 5th floor of the CVC follow a distinct process for ordering a patient’s medication. The order process begins with the physician writing the medication order. Physicians write prescription orders with different priorities: routine and urgent. A routine order filled in the pharmacy without a time constraint, except specific dosage times. If an order is urgent it is marked STAT, hospital policy states the medication must be administered within 20 minutes. If the order is marked NOW hospital policy states the medication must be administered within 90 minutes. The order is then faxed to the pharmacy, entered into the pharmacy system, and verified by the pharmacist. Once the medication is verified, the medication is available for nurses to pull from the Omnicell. If the Omnicell does not have the ordered medication or if a medication order has to be prepared in the pharmacy, the order must be delivered from the pharmacy. Finally, the medication is administered to the patient. A flowchart of the order filling process is shown in Appendix B. Depending on the urgency of a prescription; nurses may bypass faxing the order to the pharmacy and walk the order up to the pharmacy to be immediately filled or verified.

An Omnicell is a machine that houses close to 90% of the medication for patients on floors 4 and 5 of the CVC. The Omnicell consists of many drawers and sub drawers containing the medications. A nurse may log into the Omnicell to retrieve a patient’s profile and pull the medications that are needed for that patient. Each floor has two Omnicell machines. During the medication ordering process, the pharmacist must verify and approve an order before it can be taken out of an Omnicell by the nurse. Once the medication for the patient is selected by the nurse on the Omnicell, it will allow access to the correct drawer with a blinking light above the drawer. However, there are a select few medications that allow nurses to officially override the required pharmacy approval, but only if such a situation requires immediate medication administration to a patient.

Key Issues

The following key issues were driving the need for this project:

- No data has been collected on the post-lean TAT to document the improvements made
- Data of the current process must be collected as a baseline to track improvement that will be made by UMCL
- Analysis of the improvements from lean implementation may be useful to other centers in the UM Hospital

**Goals and Objectives**

To measure the current state of the post-lean medication order filling process, compare the TAT during various implementation projects in the CVC, and develop recommendations, the team completed the following tasks:

- Measured TAT of Omnicell Orders and specific time intervals regarding Omnicell Orders
- Measured TAT and specific time intervals regarding medication orders through Pharmacy
- Compared the TAT of orders through day shifts and night shifts
- Examined the effects outside distractions have on the medication filling process
- Compared Pre-Lean analysis to Post-Lean analysis

**Project Scope**

This project included only the TAT for the medication filling process on the 4th and 5th floors of the CVC. The TAT begins when the medication is written by the physician and ends when the nurse administers the medication to the patient.

The project examined the processes on the CVC unit and inside the pharmacy. The team collected data on various medications, with a primary focus on ASAP, STAT and NOW orders and several high-impact medications including antibiotics, cardiac drips and pain meds. Anything related to the cost of the project was not included in this project scope. Any task not connected with the medication filling or administering process on the 4th or 5th floors was not included in this project. The project only focused on medication orders during the day and night shifts of weekdays; weekends (Saturday and Sunday) were not included.

**Methodology**

The team conducted a literature search, collected computerized data, performed preliminary observation, time studies and conducted informal interviews to measure the medication TAT in the CVC.

**Conducted Literature Search**

The team reviewed previous studies regarding the medication TAT in the CVC pre-lean implementation, TAT in Mott’s Children Hospital pre-UMCL implementation, and TAT in Mott’s Children Hospital post-UMCL implementation. In addition, the team reviewed other studies from previous lean projects within the CVC. These studies included; UMHS Program and Operations Analysis Department Orders Management Medication Project (OMP) and Patient Medication Delivery in the Thoracic Intensive Care Unit (TICU). The team used the research...
from these studies to gain a better understanding of the project. The team also used past studies to compare data analysis between different stages of lean and UMCL implementations within the UM Hospital System.

Data from the CVC pre-lean implementation study (TICU) was the most valuable resource to this project. Since the goal of this project was to compare pre-lean analysis to post-lean analysis, it was crucial to understand the previous study. The results from this project were analyzed and compared to the pre-lean results to highlight improvements from the lean process.

Collected Computerized Data

The team utilized computer generated times to analyze the interval from the time a medication is verified in the pharmacy to the time the medication is pulled from the Omnicell. From direct observation, the team discovered that nurses do not receive notification of when a medication is verified, making it difficult for the team record the time interval in the medication TAT. Therefore, the project client, Brian Callahan, has provided Omnicell data specific to this interval.

Performed Preliminary Observation and Conducted Interviews

In addition to the Omnicell data received, the team conducted a preliminary observation of the medication filling process on the 4th and 5th floors of the CVC. The team directly observed processes related to the medication order filling process and interviewed key staff including: pharmacists, pharmacy technicians, nurses and clerks. This preliminary study helped the team gauge the volumes of orders written in a specific time frame, as well as provided a visual of the medication filling process. From this preliminary observation, a uniform data collection method was established within the team, and a set number of weekly observation hours were assigned to each team member.

During the preliminary observations, the team also conducted informal interviews with key staff including: pharmacists, pharmacy technicians, nurses, and clerks. These interviews were used to gain a better understanding of the medication order filling process. The team members asked a representative of each key staff to describe their role in the order filling process. The responses received helped to divide the intervals of the process in a way that could be recorded while collecting data. After developing on a method to collect and record data, the team consulted the key staff members to ensure that the methods were feasible.

Performed Time Studies

The team completed 140 hours of time studies which included weekly day and night shifts. Data was collected by breaking the medication filling process into intervals. These intervals included:

- Written to faxed
- Faxed to verified
- Verified to pulled from Omnicell machine
  - Label print to pickup
Pharmacy Data Collection

To collect the first two intervals, the team spent 24 hours in the CVC pharmacy. In the pharmacy, the fax machine is next to the pharmacist’s computer, so the pharmacist can quickly grab faxes as they arrive (see CVC Pharmacy layout Appendix B). A team member sat a short distance behind the pharmacist which was close enough to see the computer screen, but not enough to interrupt the regular flow. As faxes arrived, the team member recorded the actual time the fax arrived, and the time it was verified by the pharmacist. After the pharmacist verified the order, the pharmacist handed it to the team member to record the time the order was written, the time stamp from the fax machine, the medication name, priority, and the CVC floor. During preliminary observations, the team noticed that certain distractions caused a delay during the time that orders are verified. The distractions included: interruptions by the OR, medication requests from the walk-up window, calls to the pharmacy, and illegible writing on the medication orders. The team kept track of the amount of times these distractions occurred while collecting data in the pharmacy.

After an order is verified in the pharmacy, nurses have the ability to retrieve it from the Omnicell machine. If an order is not the Omnicell machine, it is filled in the pharmacy and delivered to the patient’s floor. After the pharmacist verifies an order that is to be filled in the pharmacy, a label is printed. The label is then pick up by a pharmacy technician, filled, and delivered. These deliveries are only made once an hour. The team focused on these time intervals as well. When a label was printed, the team member recorded the time the label was printed, the time the label was picked up by the pharmacist, the time the order was delivered, and how long each delivery took.

Testing Accuracy

The team relied on the nursing staff and pharmacist to identify the priority in which specific medications belong, as well as to accurately document times written on the medication order forms and on patient’s files. To ensure that these times were accurate, the team collected data comparing the actual time to the time documented. For example, when medication is administered to a patient, the nurse documents the time it was administered in the patient’s file. Team members spent several days following nurses, documenting the actual time a medication was administered, and comparing it to the time documented on the patient’s file. These comparisons helped to verify that the data being collected was accurate.

Analysis and Results

The project team compiled the data and surveys to perform the analysis. The team used Microsoft Excel, and Minitab, a statistical software program, to analyze the collected data.
The team found averages for each time interval within the process and examined the variation of each time interval.

**Data: Post-Lean**

The team collected 904 data points from time studies in order to examine specific intervals within TAT. The team then found the average times of each interval based on the data points in each interval. The team summed the averages for each interval within the turnaround time, and that is how the team obtained an estimate for the average turnaround time for the order filling process. The project team divided TAT into four main intervals:

<table>
<thead>
<tr>
<th>Interval 1</th>
<th>Interval 2</th>
<th>Interval 3</th>
<th>Interval 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written to Arrival</td>
<td>Arrival to Verification</td>
<td>Verification to Pull</td>
<td>Pull to Administration</td>
</tr>
</tbody>
</table>

Figure 1: Flowchart of TAT

The flowchart above is a high level map that explains the flow of a prescription from order to administration. The greatest time interval occurs between the time a prescription is verified in the pharmacy to when it is retrieved by the nurse. This interval accounts for 76.06% of TAT. The differences between these four time intervals that compose TAT can be observed in Figure 2 below.

Figure 2: Box Plots of TAT Intervals
Figure 2 shows the large range and high variation of the 3rd interval, verified to pulled. The times in this interval range from 1 minute to 551 minutes. The standard deviation is 133.1 minutes. The cause of this is unknown and outside of the scope of this project but could be followed up in a future study for continuous improvement. The box plot shows there are Outliers in Interval 1, Interval 3, and Interval 4. This means that there is a possibility in each of these intervals to have a time that is much greater than the normal range. Nonetheless, most of the times for each interval are less than the means for those intervals. The higher means have been caused by the many outliers that were observed.

The team was able to obtain statistics to describe each interval involved in TAT. Descriptive Statistics for the four intervals that were involved are shown below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>SE Mean</th>
<th>StDev</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written to Arrival</td>
<td>137</td>
<td>31.86</td>
<td>2.88</td>
<td>33.76</td>
<td>9.00</td>
<td>19.00</td>
<td>50.50</td>
</tr>
<tr>
<td>Arrival to Verification</td>
<td>183</td>
<td>9.760</td>
<td>0.646</td>
<td>8.742</td>
<td>2.00</td>
<td>6.00</td>
<td>17.00</td>
</tr>
<tr>
<td>Verified to Pulled</td>
<td>26</td>
<td>144.1</td>
<td>26.1</td>
<td>133.1</td>
<td>30.0</td>
<td>134.9</td>
<td>179.7</td>
</tr>
<tr>
<td>Pull to Administer</td>
<td>31</td>
<td>3.742</td>
<td>0.871</td>
<td>4.851</td>
<td>1.00</td>
<td>2.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Interval 1 accounts for 16.82% of the total turnaround time. Interval 2 accounts for 5.15% of the total turnaround time. Interval 3 accounts for 76.06% of the total turnaround time, while interval 4 accounts for 1.98% of the time. It can be observed from the descriptive statistics that the Verified –Pulled interval has the largest average time at 144.1 minutes. The team developed some possible reasons for the large mean time for this interval. There is no signal going to the nurses letting them know that their medication is ready to be pulled from the Omnicell. This causes nurses to have to estimate the time it will take for the medication to be ready. Sometimes nurses go into the medication room to retrieve their medication, and the medication is not ready. Also, since the nurses do not have a great deal of knowledge about how the pharmacy process work, sometimes they assume that the medication is not ready when it actually is. This causes a nurse to do other things rather than retrieving the medication, and allows the medication to just sit in the Omnicell after being verified. Another reason for the high time for interval 3 is the fact that the team did not only look at Stat or now orders. This means that some of the medications that we looked at were administered at standard times. For these medications, it is possible that the nurses waited for the regular administration times to pull the medications and thus the time between verification and pull will be longer because the nurses are waiting to pull the meds. Theses factors make interval 3 the largest one. When summing all of the mean interval times, the team obtained the average turnaround time of the order filling process. The turnaround time calculated through this process is 189.5 minutes.

The team was also able to compare the Statistics of the pharmacy during the night time to the pharmacy statistics during the daytime.
Table 2: Daytime vs. Nighttime Pharmacy Mean Arrival and Verification Times

<table>
<thead>
<tr>
<th>Shift</th>
<th>Written to Arrival (min)</th>
<th>Arrival to Verified (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>21.06</td>
<td>9.94</td>
</tr>
<tr>
<td>Night</td>
<td>41.86</td>
<td>4.58</td>
</tr>
</tbody>
</table>

Table 2 shows that the mean time between order writing and arrival in the pharmacy increases from 21.06 minutes in the Daytime, to 41.86 minutes in the night time. This could be due to the level of staffing in the CVC being less during the night shift than it is during the Day shift. Nonetheless, the time between arrival and Verification decreases from 9.94 minutes in the Daytime to 4.58 minutes in the Night time. Since there are less planned medication administration periods during the Night time, most of the orders that come to the night shift pharmacy are Stat or Now orders. This would necessitate that the pharmacists to work faster to verify them, and this could be the reason for the decrease in Verification time.

Data: Pre-Lean

The team also examined a study done on the medication turnaround time of the Thoracic Intensive Care Unit (TICU), to compare with the CVC. In the TICU study, there were only 3 intervals. The first interval described the time between when the order is written until it is processed by the clerk. The second interval is the time between when the order is processed until it is received by the pharmacy. The final interval describes the time between the order being received by the pharmacy and when it is delivered to the TICU. Although these intervals are much different from the ones used in CVC it is still helpful to examine the statistics for this study. The median for the TICU processing step is 15 minutes and the median for the retrieval step is 16 minutes. While the median for the TICU delivery step is 59 minutes.
The sum of the processing and retrieval steps describes the time between when the order is written until it is received by the pharmacy. Therefore this sum can be compared to the first interval of the CVC data. In the TICU study, the sum of the median times between the order being written and the pharmacy receiving it is equal to 31 minutes, while the median for this time in the CVC is 19 minutes. This front end reduction can possibly be attributed to the implementation of lean concepts, in the front end of the process. This implementation took place prior to the current project, and was meant to reduce the turnaround time of the front end of the order filling process.

Additional Findings from Observations

While collecting data, the team discovered significant observations that affected the TAT of medication orders. These observations pertain to the medication order filling process on the CVC 4th floor, CVC 5th floor, and CVC pharmacy.

4th and 5th Floor Observations

The 4th and 5th floors of the CVC contain patients who have recently undergone or plans to undergo surgeries. The 4th floor of the CVC is an Intensive Care Unit (ICU) and the 5th floor of the CVC is a general care floor. Medication orders are written by physicians for these patients and sent to the pharmacy. After verification, the medications are pulled and administered to the patients on these floors. The observations gained for these processes are significant for improving and understanding the current medication filling process.
One of the most important observations on the 4th and 5th floors of the CVC is that nurses receive no notification when a medication is verified. After a medication order is faxed to the pharmacy, nurses estimate the time it would take to verify the order. The amount of time that nurses wait depends on the priority of the order and the stabilization of the patient. If the medication is of high priority, nurses would wait for a standard amount of time and then try pulling the medication from the Omniscell machine. If the medication is not yet verified at that time, the Omniscell machine would not allow the medication to be pulled and the nurse would give the pharmacy more time before trying to pull it again. If the medication is needed right away but not yet verified, the nurses will call the pharmacy to request quick verification. This process can have a significant effect on the TAT of medication orders. If an order is verified quickly, a nurse may wait a lengthy amount of time before attempting to pull it. This is an example of unnecessary waste in time. If nurses received some type of indication of when an order is verified, this wasted time would be eliminated.

UMCL may be a possible solution to this problem. Currently physicians are using paper Medication Administration Records (MAR) system. Once UMCL is implements, the MAR system will become electronic. There will be a computer in each patient’s room which will give nurses quick access to the patient’s medication records. When medications are verified using the UMCL system, it will be recorded in the patient’s medical records which are readily accessible to the nurses.

Another important observation from the 4th and 5th floor of the CVC is that peak times of fax orders are after physicians make their rounds and after nurse/clerk break periods. Physicians do approximately two rounds during the day, at which time sufficient medication order are written and faxed. Nurses/Clerks also take breaks throughout the day and if medications orders are written during this time, they would not be faxed until the nurse/clerk returns. At these times the amount of medication orders build up and batches of medication orders are faxed to the pharmacy. This creates an overflow of work for the pharmacist and increases the TAT of those orders. UMCL may eliminate this problem as well. UMCL will enable physicians to make medication orders on the computers that are placed in each patient’s room. These orders will be sent directly to the pharmacy’s computer and prioritized electronically. As doctors are doing rounds, the process of sending orders to the pharmacy will be steadier as the physicians move to each room. This eliminates batches of medication orders being sent to the pharmacy at the end of rounds. It also eliminates the middle process of giving medication orders to nurses and clerks to be faxed. So breaks periods will not affect the medication TAT.

Lastly, the team noticed that the 5th floor CVC has a more standardized medication order process than 4th floor CVC. While the standardized process on CVC 5 directly were associated with the front end of the medication order filling process, standardizing a medication process could be useful if ever UMCL was unavailable. On CVC 5, medication orders are color coded, and organized by unit clerks in a specified section on the floor. Contrarily, on CVC 4, the unit clerks have to retrieve medical records from throughout the floor, and search through the entire MAR for any newly written orders. The team’s informal interviews with the staff attribute the difference in unit procedure to the difference in demand on the two units. Since CVC 4 is an
intensive care unit, the nurse to patient ratio is smaller and the workload is more variable, compared to the consistent care provided on CVC 5.

Pharmacy Observations

The pharmacy located on the 4th floor is only used by the CVC. Pharmacists verify faxed orders and when necessary, pharmacy technicians fill medication orders that are not in the Omnicell machine. The team observed and collected data on this process. A significant part of this process that the team observed is that labels are printed for medications that have to be filled in the pharmacy. For medications that are not in the Omnicell machine, a medication label prints for once the order is verified. Figure 3 displays a general overhead view of the main pharmacy room. As shown on the visual, a label printer is located on the right side of the pharmacist’s chair, between the pharmacist and the fax machine. There is another label printer located in the room connected to the main pharmacy room. Technicians are often moving around the pharmacy between the connected room and the main room. The location of the label printer and the active movement of the technicians create a delay when labels are being printed. Often technician do not instantly recognize labels when they are printed. After analysis, the team discovered that the average time it takes a label to be picked up by a technician is 8.1 minutes. This included a range of 0-89 minutes. Therefore depending on the workload of the pharmacist and technician, the time it takes the technician to recognize the label can affect the TAT of a medication order.

Since UMCL only affects the way orders are verified in the pharmacy, labels will still have to be printed for medications that have to be filled in the pharmacy. The team recommends relocating the placement of the label printer to reduce the time it takes for technicians to recognize the label. The label printer should be placed on the left end of the pharmacist’s table (as displayed in the visual). This location will allow the printer to be more visible to the technician which may create a significant increase in the medication order TAT.

In addition, pharmacists are often distracted of interrupted during the entry and verifying of medication orders. As stated prior, the pharmacy on CVC 4 services the entire CVC. During the time of the team’s observations, it was noted that quite often the CVC operating room (OR) needed medication immediately. Once a physician from OR walks up to the window, they are awarded priority and the immediate attention of the pharmacist on duty. Likewise, if a nurse walks up to the pharmacy window, he/she is typically in need of STAT/NOW order immediately. This nurse will also have priority over whatever the pharmacist was previously doing. Also, phone calls are a common distraction within the pharmacy. While phone calls are often nurses calling up orders that are needed immediately, sometimes the pharmacist has to use the phone to verify something written on the order. These distractions are consistent between the day and night shifts, except for the OR walk up distractions, as the UH 6th floor satellite pharmacy does not service an OR. Below is a table of the average number of distractions recorded in a 24 hour observation period.
Table 3: Day Shift vs. Night Shift: Average Distraction Times (mins)

<table>
<thead>
<tr>
<th>Shift</th>
<th>Walk Up</th>
<th>Phone</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>4</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Night</td>
<td>9</td>
<td>26</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Team 12, Winter 2008, April 2008

Figure 4: Overhead View of 4th floor pharmacy’s room
Another observation from the pharmacy that affects the TAT of medication orders is the handwriting on the order forms. Often pharmacists are not able to read the names of medications, dosage and patients’ names. If a pharmacist is confused about something that is written on an order form, the pharmacist will call the CVC floor to verify the information. This can increase the TAT. Also, pharmacists often have problems with fax machines which may also increase TAT. The fax machines that are used to transfer orders from the CVC floors to the pharmacy are unable to process the volume of orders that are faxed. This creates technical problems that can interrupt the flow of medication orders. Fax machines also do not indicate when it is out of paper, so pharmacists have to constantly check whether there is paper in the machine. A delay can occur in the medication filling process if the pharmacist doesn’t recognize that the fax machine is out of paper for a significant amount of time. However, all of these problems will be eliminated by UMCL. Medication orders will go straight to the pharmacist’s computer and eliminate all problems that occurred from the faxing paper orders. Technical issues and issues with batching orders and sending them to the pharmacy, are also expected to be eliminated once UMCL is implemented.

Conclusions and Recommendations

The results of this study show there are countless opportunities of improvement to the current medication order process once UMCL is implemented. The team’s calculations show that currently the average TAT for medications is 189.5 minutes. When comparing this to other studies [TICU], the front end of the medication order filling process has reduced by about 35.4%. The team noticed that since the Omnicell houses approximately 90% of all medications, less than 15 orders needed to be filled in the pharmacy, after 24 hours of data collection. This result was expected upon implementation of the Omnicell machine, thus reducing TAT in intervals that were wasted with deliveries.

Although the team expects the front end of the medication order process to be virtually eliminated once UMCL is implanted, the team recommends the following actions in order to continue to improve and monitor TAT:

- Move the printer to a more visible [for pharm techs] area within the CVC 4 pharmacy
- Implement a system that will notify pharmacy staff of orders that need to be prepared within the pharmacy
- Implement a system to notify nurses when a medication order is able to be retrieved from the Omnicell
- Further studies analyzing the TAT with UMCL should be conducted after the system is implemented to the University Hospital and CVC in April of 2008.

The project team recommends that the printer that prints the labels for medication orders that have to be filled/prepared within the pharmacy be moved from its current location, between the pharmacist and the fax machine, to near the entrance of the pharmacy (see CVC Pharmacy Layout Appendix B). Moving this machine will reduce the time it takes for pharm techs to notice
a label that has been printed for a medication that needs to be prepared in the pharmacy. From our study, it took on average about 8.1 minutes for a label to be acknowledged [picked up] by someone from the pharmacy staff after it had been printed. From the team’s study, most of the phrm tech’s time is spent in a room adjacent to the main room of the pharmacy. Thus moving the printer to a location that is more visible from this room will ideally reduce TAT for medications that have to be filled through the pharmacy.

As explained by the details of UMCL, there is an opportunity to achieve the second recommendation of notifying nursing staff of when medications are available to be pulled from the Omnicell. As stated before, nurses do not receive notification of when medications are ready to be pulled from the Omnicell. Because of this, there is often time wasted when a nurse has to guess when the order is able to be pulled. Once UMCL is implemented, a patients MAR will be electronic (EMAR). This EMAR will display when specific medications have been verified by the pharmacy, and are ready to be pulled from the Omnicell. Successful utilization of this feature will only require a nurse to check the patients EMAR more often; however, less time will be spent checking the EMAR than walking to the med room, logging in, finding a patient, and realizing the medication is unable to be pulled.

Once these two issues have been addressed, this study can be used as a baseline for future projects following the UMCL implementation. The statistics taken from this study should be used to verify that UMCL is a more efficient paperless process than the current paper medication ordering process. UMCL will eliminate the front end of the medication order process, and make the back end more efficient, thus reducing the TAT of the medication order filling process.
Appendix A: Process Flow Chart Comparison

Current Order Process

1. Physician writes Order
2. Order Faxed to Pharmacy
3. Order Arrives at Pharmacy
4. Pharmacist Verifies Order
5. Order Entered into WORx
6. Medication Picked Up by Nurse
7. Medication Administered

Future UMCT Order Process

1. Physician writes Order
2. Order Faxes at Pharmacy
3. Pharmacist Verifies Order
4. Medication Pulled from Omniscell
5. Medication Filled by Pharmacy
7. Medication Picked Up by Nurse
8. Medication Delivered by Pharmacy Tech.
9. Medication Administered

Team 12, Winter 2008, April 2008
Appendix B: CVC Pharmacy Layout

Entrance

Filled Medication Table

Walk-Up Window

Operating Room (OR) Walk-Up Window

Pharmacist’s Chair

Fax Machine

Label Printer

Omnicell Machine

Team 12, Winter 2008, April 2008
Appendix C: Average Number of Distractions in Pharmacy

<table>
<thead>
<tr>
<th>Shift</th>
<th>Walk Up</th>
<th>Phone</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>4</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Night</td>
<td>9</td>
<td>26</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Team 12, Winter 2008, April 2008