University of Michigan Health System

Program and Operations Analysis

Analysis of Medication Turnaround in the 6th Floor University Hospital Pharmacy Satellite

Final Report

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Executive Summary

Turnaround time for medications generated by the 6th floor pharmacy satellite of UMHS is under question. To assess changes made in the pharmacy in spring 2011, the Pharmacy Assistant Director asked a student team from the Industrial and Operations (IOE) 481 class for an analysis of the current medication use process and suggestions for improvement. To analyze this process, the team observed the current medication use process, created a current state flow chart, conducted time measurements of all steps in the process, and assessed each step of the process to assess turnaround time.

Background

The newly renovated 6th floor pharmacy satellite at the University of Michigan Hospital (UH) is a critical component of the pharmacy operation. The medication turnaround process in the pharmacy is important for three reasons: time sensitivity of medications, high volume of medications requested, and a low tolerance for error.

The 6th floor pharmacy satellite not only handles routine orders for medications, but also supplies “STAT” and “NOW” medications to the units. “STAT” medications must be delivered in less than 20 minutes and “NOW” medications must be delivered in less than 90 minutes. Routine medications are medications not labeled as “STAT” or “NOW”, and must be delivered within 2 hours. The current medication turnaround process is displayed in Appendix A.

Key Issues

The following issues drove the need for this project:

• Medication delays have been reported
• Medications are duplicated as a result of delays
• High number of phone calls related to “missing” medications

Goals and Objectives

To address concerns about medication turnaround time in the 6th floor pharmacy satellite, verify the level of efficiency, and identify causes of delayed medications the team carried out the following tasks:

• Observed the pharmacy to gain insight on the current medication turnaround process
• Conducted time studies of each task in the medication use process

With this information, the team has delivered the following:

• Current state process flow chart
• Statistical assessments of data collected at each step of the medication turnaround process
• Analysis of full process medication turnaround time

Project Scope

The medication turnaround process begins when a medication order is entered into a computer by a provider and ends when a nurse documents the medication administration to the patient.

The project scope did not include the precise preparation time of medications. Floor stock medications, cart fill medications, and intravenous (IV) room batch preparations were not considered.
Methods
To assess the overall medication turnaround time, the team collected and analyzed quantitative and qualitative data. The data was collected through observations, informal interviews, time studies, and computer system data requests. Microsoft Excel, Microsoft Access, Minitab, and flow charts helped the team organize and analyze these collected data.

Data Collection
Time study observations to collect these manual data took place October 16th through November 23rd. The team began the data collection process by observing the current medication turnaround process in the 6th floor pharmacy satellite. In the second week of data collection, the team began informally interviewing pharmacy staff and collecting manual data. The team matched manual data with computer system data that was requested from Information Technology Services. The team was able to match 214 data points after combining the manual data to the computer system data.

Data Analysis
The team organized time measurement data using Microsoft Excel and Access. Once the data were organized, it was analyzed using both Microsoft Excel and Minitab. Data were organized based on each step in the medication use process. The medication turnaround process steps were analyzed individually and as a whole. This allowed the team to determine which steps were problematic and what changes to implement.

Findings
Based on observations and analyses, the team prepared qualitative and quantitative findings. Qualitative findings were developed through interaction with pharmacy staff and observation of the medication turnaround process while quantitative findings were developed through the collection and analysis of medication turnaround time data.

Qualitative Observations
The team determined three qualitative causes for increased medication turnaround times. The team observed miscommunications between nursing staff and pharmacy staff. Additionally, the team observed delivery run inconsistencies and delivery staff not using available delivery carts. The team also observed that delayed staff reallocation increased medication turnaround time.

Quantitative Findings
The team conducted a time study to gather quantitative data. Data was stratified by:
- STAT/Non-STAT Medications
- Shift
- Delivery Type

The team found 39% of those medications never get administered or are administered and undocumented. The data also showed 66% of non-STAT medications arrive at the destination unit within the required 120 minute pharmacy requirement, while only 29% of STAT medications arrive to the destination units within the 20 minute pharmacy requirement.
Unit sit times differ between shifts. These data show that a significant amount of medications arrive the night before their scheduled morning administration.

Delivery type was categorized as either special or regular delivery. Special deliveries are more common with STAT medications and during midnight shifts, while normal deliveries are more common with non-STAT medications and during morning and evening shifts.

Conclusions
Based on findings from observations, interviews, and time studies, the team has concluded:

- Poor communication between nurses and pharmacy staff leads to greater medication turnaround time
- Delivery runs do not follow standardized routes provided by pharmacy management, potentially causing delays to units that have urgent needs for medications
- Not using delivery carts can result in a build-up of returned and/or expired medications in units, a heavier load on pharmacy technicians, and faster delivery of medications to units
- Reallocated staff members contribute to delays at the pharmacy
- STAT medications do not arrive within pharmacy requirements while non-STAT do
- Turnaround time does not vary significantly by shift
- Special delivery type increases for late shifts as well as STAT medications

Recommendations
Based on the findings from observations and data analyses the team recommends the following:

- Ensure delivery runs leave on the half hour of every hour
- Create a standard method to notify nursing units when medications arrive at floor
- Reevaluate delivery route and standardize hourly delivery run
- Put process in place to enforce the use of delivery carts as a standard
- Assess reallocations of pharmacy personnel before the start of shift and standardize the communication at shift changes to team members
- Develop process to recreate data in a useable form for dashboard purposes
- Reduce time medications sit in the units
- Use barcode technology to track medications through the system
- Increase awareness of STAT medications in the process
- Develop standard process to ensure meeting of STAT time expectations of delivery for less than 20 minutes
- Distinguish between STAT and NOW medications in computer system
- Evaluate causes related to percentage of medications dispensed from the 6th floor pharmacy satellite that are not administered

Expected Impact
The team anticipates that following the above recommendations will result in improved

- Medication turnaround time
- Communication between pharmacy and nursing personnel
- Standardization of process to reduce failure rates
- Satisfaction of patients and employees
Introduction

Multiple pharmacy satellites service the University of Michigan Health System (UMHS). Currently the turnaround time for medications generated by the 6th floor pharmacy satellite in the University Hospital (UH) is under question. In the spring of 2011 UH combined the 5th and 6th floor medication dispensing areas. Because of this change, the Pharmacy Assistant Director asked for an analysis of the current medication use process for the 6th floor pharmacy satellite and suggestions for improvement. To analyze the process, the Industrial and Operations Engineering (IOE) 481 student team assigned to this project developed a current state flow chart of the medication turnaround process, conducted time studies of the various steps in the process, and developed an assessment of the time each step takes in the current medication turnaround process. This final report outlines the methods the team used to gather data, the findings from the data, the conclusions the team developed, and the recommendations for the Pharmacy Assistant Director to improve overall medication turnaround time.

Background

The newly renovated 6th floor pharmacy satellite at the University of Michigan Hospital is a critical component of the pharmacy operation. The work process in the pharmacy is important for three reasons: time sensitivity of medications, high volume of medications requested, and a low tolerance for error.

The 6th floor pharmacy satellite not only handles orders for routine medications, but also supplies “STAT” or “NOW” medications to the units. “STAT” medications must be delivered in less than 20 minutes and “NOW” medications must be delivered in less than 90 minutes. Routine medications include medications not labeled as “STAT” or “NOW” and must be delivered in less than 2 hours. It is also reported by pharmacy staff that duplicate medications are made as a result of delayed medications and that there is an increase in the number of phone calls related to “missing” medications. Furthermore, there is a very low tolerance for error in medications that go through the pharmacy because of patient safety. These requirements make the medication turnaround process extremely important.

The team developed a current state flow chart of the current medication turnaround process as depicted in Figure 1 below. A larger image of the flowchart can be seen in Appendix A. The current process is as follows:

1. Provider enters an order for a medication
2. Medication is either released by nurse or physician to be verified by a pharmacist or medication goes straight to verification after being entered by physician
3. Pharmacist verifies the order and a label prints for the medication
4. Pharmacy technician prepares the medication
5. Pharmacist or pharmacy technician places the medication in either
   • the pneumatic tube and medication is sent directly to the unit
   • a delivery bin
   • or a nurse picks up the order from the pharmacy and goes directly back to the unit
6. If a delivery bin is used, pharmacy technicians deliver the contents of the medication delivery bins to the various units every hour on the half hour
7. Nurse administers the medication and documents this administration

Figure 1. Flowchart of the current medication turnaround process

Figure 1 depicts the seven steps of the medication turnaround process. The upper flow represents actions that take place in the pharmacy, while steps in the lower flow occur outside of the pharmacy.

**Key Issues**

The following issues drove the need for this project:

- Medication delays have been reported
- Medications are duplicated as a result of delays
- High number of phone calls related to “missing” medications

**Goals and Objectives**

In order to address concerns about medication turnaround time on the 6th floor pharmacy satellite, identify its level of efficiency, and determine causes for delayed medications the team carried out the following tasks:

- Observed the pharmacy to gain insight on the current medication turnaround process
- Conducted time studies of each task in the medication turnaround process

With this information, the team has delivered the following:

- Current process flow charts
• Statistical assessments of the data collected from each step of the medication turnaround process
• Analysis of the entire current medication turnaround time for medications ordered through the pharmacy

**Project Scope**

The medication turnaround process begins when a medication order is entered into a computer by a provider and ends when a nurse documents the administration of the medication to the patient.

The project scope did not include the precise medication preparation time. The “preparation time” analyzed in this project refers to the time from when a label is printed to when the medication is placed into the delivery bin. Floor stock medications, cart fill medications, and intravenous (IV) room batch preparations were not considered.

**Methods**

To assess the overall medication turnaround time, the team collected and analyzed quantitative and qualitative data. The data was collected through observations, informal interviews, time studies, and computer system data. Microsoft Excel, Microsoft Access, Minitab, and flow charts helped the team organize and analyze these collected data.

**Data Collection**

Time study observations to collect these manual data took place October 16th through November 23rd. The team began the data collection process by observing the current medication turnaround process in the 6th floor pharmacy satellite. In the second week of the data collection period, the team began informally interviewing pharmacy staff and collecting quantitative data.

*Observations of Current Process and Informal Interviews*

The student team first observed the 6th floor pharmacy satellite to gain direct insight into the current medication turnaround process. In the second week of the data collection period, the team began informally interviewing pharmacy staff. The team only questioned staff in the pharmacy that appeared to have some free time or pharmacy technicians while out on delivery runs. Some of the questions the team asked the staff included what they like about the current process, what they think could be changed, and why they think some medications have long turnaround times.

*Manual Data*

The IOE 481 student team and pharmacy technicians of the 6th floor pharmacy satellite collected some data manually. The team collected manual data from October 17th through November 23rd. This data was recorded by hand on General Medication Information Forms, as seen in Appendix B. The team later reentered the manually collected data into Microsoft Excel. Manual medication order data was recorded for the following times in the process:

• Preparation by pharmacy technician
• Delivery departure from pharmacy
• Arrival to destination unit
Either pharmacy technicians delivering medications to the units or the student team members recorded times for medication departure from the pharmacy and delivery to the destination unit. If a delivery went out in the middle of a student team member’s observation, pharmacy technicians recorded the times by hand on Delivery Run Information Forms as seen in Appendix B. Pharmacy technicians aiding in data collection on delivery runs allowed the student team to collect data in the pharmacy without interruption. If a delivery went out at the end of an observation period, the student team member shadowed the pharmacy technician and recorded the delivery times on these same Delivery Run Information Forms.

**Computer Data**
The team collected computer data by request to the Information Technology Services (ITS) department at UMHS for October 27 through November 23rd. ITS has two computer systems for the collection of medication turnaround time information: Carelink and WORx. Requests were put in for data corresponding to specific dates and times during which the team collected manual data. The two computer systems contain the following times regarding medication orders:

- Entered time by provider
- Released time by physician or nurse
- Verified time by pharmacist
- Administered time by nurse

The team then matched computer data to the corresponding manual data based on the following key identifiers: full patient name, medication name, and delivery unit. The team matched the manual and computer data to have every step of the current medication turnaround process analyzed.

**Data Analysis**

This section addresses the methods the team used to analyze their data, including both qualitative and quantitative data.

**Qualitative Data**
The team analyzed the observations of the current medication turnaround process by creating a flow chart of the current process, as seen in Appendix A. The team analyzed the informal interviews of pharmacy staff by looking for process inconsistencies and areas of dissatisfaction.

**Quantitative Data**
The team organized the time measurement data using Microsoft Excel and Microsoft Access and analyzed the data using Microsoft Excel Minitab. Data were organized based on the times in the medication turnaround process as follows:

- Entered by provider
- Released by physician or nurse
- Verified and label printed by pharmacist
- Prepared by pharmacy technician
- Delivery departure from pharmacy
- Delivery to destination unit
- Administered by nurse
These steps were analyzed individually to determine specific areas of improvement. Appendix A shows the flowchart of the current medication turnaround process as described above. By examining each step in the process individually, the team was able to determine which steps were problematic and what changes should be implement. In addition, the times were analyzed together to observe the process as a whole. This perspective helped indicate how much time the entire medication turnaround process is taking and what changes should be implemented.

Findings

Based on observations and analyses, the team identified both qualitative and quantitative findings. Qualitative findings were developed through observations of the current medication turnaround process and informal interviews of pharmacy staff. Quantitative findings were developed through the collection and analysis of medication turnaround time data.

Qualitative Findings

This section discusses the qualitative findings the team developed including miscommunications, delivery run inconsistencies, and staffing issues. These were determined through pharmacy observations and interviews of the pharmacy staff.

Miscommunications
One of the most notable issues was miscommunication between nursing and pharmacy staff. Medications are often reported missing and duplicate medications are made. Pharmacy and nursing staff need to resolve

- Missing requests
- Missing orders
- Unused or duplicate medications

Delivery Runs
The team observed inconsistencies in the way medication delivery runs are handled. Standardized delivery routes have been determined for pharmacy technicians scheduled to deliver medications, as seen in Appendix C. The purpose of the specific delivery route is so units with critical patients receive medications as quickly as possible. Instead of following this route, pharmacy technicians often follow an individually developed route they believe is best. The standard delivery route was never used during the team’s observations.

Pharmacy technicians making delivery runs are also expected to make their deliveries every hour on the half hour. However, the team observed that pharmacy technicians occasionally begin their deliveries up to ten minutes late. During the team’s observations, it was found that deliveries leave the pharmacy 10 minutes late 25% of the time.

The team also observed that pharmacy technicians rarely use the available medication delivery carts. Medication delivery carts are supposed to be used for various reasons including the collection of expired, unused, or otherwise unneeded medications at the different units. The carts are also meant to protect the pharmacy technicians since there are often a large amount of medications to be delivered and these loads are sometimes heavy. Through interaction with the pharmacy technician delivery staff, the team found that taking the carts requires the use of an
elevator every time the carts need to go to a different floor. Using elevators can be time consuming because pharmacy technicians need to wait for an available elevator or defer an available elevator to patients, especially during busy hours of the day. The team found delivery carts used 5 out of 35 observed delivery runs.

**Staffing Reallocations**

The team documented issues with staffing as well. In the early morning shift (07:00-15:00), the team observed staff reallocation was completed after the shift had already started. In one case the team observed that a staff member started their day working in the B2 Pharmacy but was reallocated to the 6th floor pharmacy satellite about 20 minutes into their shift. They were reallocated to fill in for an absent staff member, but because of this delay, arrived about 30 minutes late. This delay resulted in a buildup of medications to be prepared and the delivery run leaving late. Not only was the delivery late, but the delivery run also did not include medications that had not yet been prepared because of the buildup.

**Quantitative Findings**

This section discusses the quantitative findings the team discovered which were determined through the collection and analysis of medication turnaround time data. The team stratified the data by delivery type, non-STAT medications, STAT medications, and shift. From a sample size of 155,668 medications, the team found 39% of those medications never get administered or are administered and undocumented.

**Delivery Type**

One of the process decisions observed in the time study was the delivery type. The team classified deliveries by two types: normal deliveries and special deliveries. Normal deliveries refer to when pharmacy technicians go on their normal hourly medication delivery runs. Special deliveries refer to when a medication is sent by the pneumatic tube system for delivery, picked up by a nurse from the unit, or walked over by a pharmacy technician outside of the normal delivery schedule. The team found that the most common form of special delivery was the pneumatic tube which was observed to be used 38 out of 43 times. Special deliveries were most common with STAT medications and during midnight shifts and account for 23% of all deliveries. Normal deliveries account for the remaining 77% of medications and are used as a standard delivery type. Appendix D shows a more detailed analysis of delivery use.

**Non-STAT Medications**

The team found that non-STAT medications arrive to their destination units in about 91 minutes on average with a median time of about 67 minutes after they are requested. The team found 66% of non-STAT medications (n = 148) were delivered on time. This time accounts for the amount of time the medications wait to be verified (verification time), the amount of time the medications wait in the pharmacy after being verified (pharmacy time), and the amount of time it takes for the medications to arrive at the units once the delivery has left the pharmacy (delivery time). The amount of time that the medications wait at the units before being administered (unit sit time) is the longest part of the medication turnaround process and had an average time of about 267 minutes, with a median time of 145 minutes. These times are shown in Figure 2 below.
Figure 2 displays values for different steps within the Non-STAT medication turnaround process. Further analysis of non-STAT medication times is contained in Appendix D.

**STAT Medications**

The team found that STAT medications arrive to their destination units in about 59 minutes on average with a median time of 35 minutes after they are requested. 29% of STAT medications (n = 31) were delivered on time. Each step of the turnaround process was shorter for STAT medications, and unit sit time was proportionally much lower compared to non-STAT medications. However, Figure 3 below shows that unit sit time was still the largest area of the process, with a mean of about 54 minutes and a median of 40 minutes.
Figure 3 gives a summary of values for the STAT medication turnaround process. Further analysis is contained in Appendix D.

**Entire Process**

The team also looked at the current medication turnaround process as a whole. This involved the time between medication order release and medication administration. The team found that the mean time for Non-STAT medications was 173 minutes and the mean time for STAT medications was 53 minutes. There a large amount of standard deviation so quartile values are displayed in the boxplot below. The median for non-STAT medications was 59 minutes while the median for STAT medications was 31 minutes.
Figure 4. Boxplot of entire medication turnaround process

Figure 4 shows the Non-STAT and STAT values for the entire medication turnaround process. Upper outliers for Non-STAT medications are excluded for higher resolution. Outliers decrease in a near linear pattern to the maximum value of 4769 minutes. Further analysis is contained in Appendix D.

Shift
Another way the team stratified medication turnaround time was by shift. The three shifts observed were the midnight shift, from midnight to 7 am (00:00-07:00); the morning shift, from 7 am to 3 pm (07:00-15:00); and the evening shift, from 3 pm to midnight (15:00-24:00). The medication turnaround process was again broken down into four steps: system sit time, pharmacy time, delivery time, and unit sit time. The team found that turnaround times were fairly consistent between each shift. A noticeable time difference between shifts is the evening shift unit sit time. The unit sit time of the evening shift was a little more than double the other shifts. Another difference was the variation in request and arrival times. The midnight shift request to arrival times averages 24 minutes longer than the evening shift. Figure 5 below is a boxplot of the team’s findings.
Figure 5 shows the values calculated for the medication turnaround process based on different shifts. Further analysis is contained in Appendix D.

Conclusions

From observing and collecting data from the 6th floor pharmacy satellite throughout the duration of this project, the team has developed various conclusions which includes qualitative and quantitative conclusions.

Qualitative Conclusions

This section discusses qualitative conclusions developed by the team based on findings regarding frequent miscommunications, delivery run inconsistencies, and staffing issues.

Frequent Miscommunications
One of the key qualitative findings was a lack of clear communication between nursing and pharmacy staff. This results in missing and duplicate medications, which forces the hospital to incur unnecessary costs and decreases employee engagement. In addition, there was a continual stream of secondary communication between pharmacy and nursing staff as a result of the initial miscommunication. This is time consuming and a distraction from other value-added tasks. The poor initial communication leads to constant checking from nurses to make sure that the medications they have requested were not forgotten. Insufficient initial communication also causes pharmacists and pharmacy technicians to waste time checking and reassuring nurses that medications are on the way. In critical situations (STAT medications), this check is acceptable.
However if inquiries for routine medications are frequent, the overall medication turnaround time is slowed.

*Delivery Run Inconsistencies*

Another issue discovered was a lack of use of the standardized medication order delivery route. Different pharmacy technicians go to different units on a route which they believe is best. A standardized delivery route that takes urgency and speed into account has been introduced, but was never followed during the team’s observations. As a result of this standardized delivery sequence not being followed, medication turnaround time may be increased and more critical requests may not be receiving priority.

Pharmacy technicians making delivery runs are also expected to make their deliveries every hour on the half hour. However, pharmacy technicians often start their deliveries up to ten minutes after the half hour. Because of this, medications arrive to units later than expected and medication turnaround time is increased.

Delivery carts which are provided for delivery runs are also not always utilized. When pharmacy technicians go out on a delivery runs, they often carry the medications by hand if possible and do not take the delivery cart. One of the downsides of not taking the cart is that there can be a buildup of returned and/or expired medications in the units. Without the cart, all of these returns are often not picked up. Not using the delivery carts could also result in physical injury to the pharmacy technicians due to heavy delivery loads. However, an upside to not using the delivery carts is fast delivery of medications to units. Without the carts, pharmacy technicians do not need to use elevators to travel from floor to floor. While this may seem like an incidental tradeoff, the team’s observations showed that waiting for elevators can be very time consuming.

*Delayed Staffing Reallocations*

The team also found issues with the staff reallocation process. Delayed staff reallocation put extra stress on employees who were sent to a new station after the shift had already started. In the 6th floor pharmacy satellite, delayed reallocation could create a serious conflict for the technician. This conflict forces pharmacy technicians to choose between leaving on an increasingly late delivery run or completing the buildup of medication requests. Forcing technicians to make these decisions could result in failure to notice critical medication requests or the late delivery of important medications. This delayed reallocation also results in increased turnaround time until the buildup of medication requests and late delivery runs are normalized as the shift goes on.

*Quantitative Conclusions*

This section discusses quantitative conclusions developed by the team based on findings from the data which was stratified by delivery type, non-STAT medications, STAT medications, and shift.

*Delivery Type Results*

The team observed a higher percentage of special deliveries for STAT medications and an incremental decrease in special deliveries from the midnight shift as can be seen in Appendix D. This incremental decrease can be explained by the decreased medication requests volume. As the
volume decreases, the need for hourly delivery runs decreases. This decrease in request volume allows medication deliveries to be handled by the pneumatic tube system, individual delivery by pharmacy technicians, or pickup by the nursing staff. The high percentage of special deliveries for STAT medications is due to their high priority. Special deliveries eliminate the medication sit time in the pharmacy and ensure a quicker arrival time. The low percentage of special delivery for non-STAT medications can be explained by their high volume. The quantity of non-STAT medications exceeds the capacity of a special delivery route and therefore is handled by regular delivery runs. Additionally, it was determined that the majority of special deliveries are handled by the pneumatic tube system. In the team’s observations, 38 out of 43 special deliveries are sent through the pneumatic tube system.

Non-STAT Medication Timeliness
For calculations of non-STAT medications, standard deviation for each step time was high. This is partially due to outliers in the data which are created when medication requests miss delivery runs or must be filled by request to the B2 pharmacy. Due to the high standard deviation, the median was used to provide a balancing metric for analysis. Both mean and median values for unit arrival times were below the 120 minute turnaround target. Unit sit times were proportionally very large compared to the other steps times. However, medications often arrive at the unit well before they are needed so high unit sit time is not necessarily bad (Appendix D).

STAT Medication Timeliness
STAT medication times also had high standard deviation and the median calculations were used again for statistical analysis. The time required for medication to arrive at the units after being requested did not meet the 20 minute turnaround time target. The mean value was about 200% higher than the target although our analysis showed that this is largely due to high standard deviation and several outliers. Unit sit time was again longer than any other step in the process. For STAT medications, unit sit time cannot be accounted for by early medication arrival and should be reduced to below the mean value of 54 minutes (Appendix D). The team also determined that part of the reason for not meeting the turnaround time target was due to inadequate STAT indications on medication labels. While stickers are available for use on STAT medication labels, this depends on the pharmacy technician noticing this notation. Improved STAT notations on printed medication order slips should help eliminate outliers which result from STAT medications not being treated as such.

In addition, the computer system does not distinguish between “STAT” and “NOW” orders. Currently, when an order is entered as either STAT or NOW, the pharmacist and pharmacy technicians see both of these represented as STAT. This causes a much higher volume of indicated STAT medications than is correct. It places an unnecessary priority on NOW medications and distracts from the true priority of STAT medications. This issue could be addressed by either eliminating the NOW medication category or by adding notation for NOW medications in the system. This would improve the focus that is spent on STAT medications and should improve their turnaround time.

Entire Process Timeliness
The team calculated a large number of outliers in the entire turnaround process for both Non-STAT and STAT medications. High standard deviation causes these outliers and can be explain
by the high unit sit times and high standard deviation throughout the process. While these numbers are insightful, there are no standard requirements for entire process turnaround time, so quantitative performance evaluation may be performed.

**Shift Similarities and Differences**
From the data analysis, the team was able to compare medication turnaround time by shift. Though there were a few differences between shifts, one noticeable difference was the increased unit sit time in the evening shift. This statistic is partially explained because medications that are scheduled to be administered the following morning may be made the evening before, leaving the medications to sit at the unit overnight and therefore increasing evening unit sit time. Another issue with preparing medications in the evening before their morning administration is the overlap with an automated medication order fulfillment system in the B2 pharmacy. This system creates batches of medications to be administered at the routine morning administration times. However, medications are often prepared by both this system and the 6th floor satellite pharmacy. In these cases, two medications are prepared for one order and one medication is wasted.

The standard deviations for each step in the medication turnaround process were higher than desired (Appendix D). This is due to several outlier medications being factored into the data from the time studies (i.e. medications that must be filled by the B2 main pharmacy, medications sitting overnight, etc.).

**Recommendations**
Based on the findings from observations and data analyses, the team developed recommendations. These recommendations should improve the current medication turnaround process.

**Qualitative Recommendations**
From observation and informal interviews with pharmacy staff the developed qualitative recommendations. The team recommends the following actions:

- Ensure delivery runs leave on the half hour of every hour
- Create a standard method to notify nursing units when medications arrive at floor
- Reevaluate delivery route and standardize hourly delivery run
- Put process in place to enforce the use of delivery carts as a standard
- Assess reallocations of pharmacy personnel before the start of shift and standardize the communication at shift changes to team members

**Quantitative Recommendations**
From the time study conducted developed quantitative recommendations. The team recommends the following actions:

- Develop process to recreate data in a useable form for dashboard purposes
- Reduce time medications sit in the units
  - Ensure nurses are aware of when medications arrive at unit
- Use barcode technology to track medications through the system
• Increase awareness of STAT medications in the process
• Develop standard process to ensure meeting of STAT time expectations of delivery for less than 20 minutes
• Distinguish between STAT and NOW medications in computer system
• Evaluate causes related to percentage of medications dispensed from the 6th floor pharmacy satellite that are not administered

**Expected Impact**

The team used both time studies and observation to identify parts of the current medication turnaround process which are inefficient and provided recommendations to improve medication turnaround time. The team hopes the recommendations developed for the 6th floor pharmacy satellite with will improve:

• Medication turnaround time
• Communication between pharmacy and nursing personnel
• Standardization of process to reduce failure rates
• Satisfaction of patients and employees
### General Medication Information Form

<table>
<thead>
<tr>
<th>Patient Name</th>
<th>Medication</th>
<th>Delivery Bin Time or IV</th>
<th>Delivery Unit</th>
<th>Nurse or PT</th>
<th>Arrive at Unit</th>
<th>STAT or NOW</th>
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Appendix C. Current Medication Delivery Routes

There are two medication delivery routes: A and B. The delivery sequence for route A starts with unit 6D and ends with unit 6C. The delivery sequence for route B starts with unit 5D and ends with unit 5C.

**Route A:** 6D, 8D, 7D, 7C, 7B, 7A, 6A, 6B, 6C

**Route B:** 5D, 4D, 4C, 4B, 4A, TBICU, OPS, AMOU, 5A, 5B, 5C
Appendix D. Statistical findings of medication turnaround time

Analysis of Delivery Type

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Analysis of STAT Turnaround Time

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Analysis of Entire Medication Turnaround Process

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Analysis of Turnaround Time by Shift

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