University of Michigan Health System
Program and Operations Analysis

Improving the C.S. Mott Children’s Hospital and Von Voigtlander Women’s Hospital Discharge Medication Process

Final Report

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# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>Goals and Objectives</td>
<td>5</td>
</tr>
<tr>
<td>Background</td>
<td>5</td>
</tr>
<tr>
<td>Key Issues</td>
<td>6</td>
</tr>
<tr>
<td>Project Scope</td>
<td>6</td>
</tr>
<tr>
<td>Data Collection and Analysis</td>
<td>6</td>
</tr>
<tr>
<td>Conclusions and Recommendations</td>
<td>10</td>
</tr>
<tr>
<td>Expected Outcome</td>
<td>13</td>
</tr>
<tr>
<td>Appendices</td>
<td>14</td>
</tr>
</tbody>
</table>
Executive Summary

Background

Currently, the new University of Michigan C.S. Mott Children’s Hospital and Von Voigtlander Women’s Hospital (C&W) does not have its own outpatient pharmacy services. If patients at C&W wish to fill their prescriptions, they must go to the Ambulatory Care Pharmacy (ACP), which is located in the Taubman Center Building. As a result, a significant amount of additional work is required of patients and their guardians to receive their medications. Consequently, the Director of Pharmacy Services asked a University of Michigan Industrial & Operations Engineering student team to evaluate the discharge medication process. The Director wanted to understand how the medication process relates to patient satisfaction, and if that satisfaction may be improved by an alteration in the process.

Since C&W opened in December of 2011, the ACP has provided outpatient pharmacy services. This pharmacy is located about a quarter of a mile, or on average 4 minutes 16 seconds of walking time from C&W. This distance, coupled with occasional pharmacy delays, prevent C&W from providing the ideal patient-focused medication experience to patients and their families. Not only are patients unhappy with the amount of time and effort required to obtain their medications, but also 7.8% of patients arrive to the pharmacy only to learn their medication is not ready.

Methods & Findings

The team performed seven tasks to evaluate the discharge medication process for patients of C&W. The studies provided the team with metrics to measure and analyze the status of the current discharge medication process. First, the team studied the results of an existing satisfaction survey conducted by Press Ganey Associates. Their statisticians sent surveys to two-thirds of all discharged patients in FY2011 from UMHS and used the results to create a Kendall’s Tau correlation table. With a correlation coefficient of 0.28, the Kendall’s Tau analysis revealed a weak trend between overall patient satisfaction and the speed of the discharge process.

Next, a capture rate percentage study was performed. Upon being discharged from the hospital, patients have the option of receiving their medication from the ACP, or going to a retail pharmacy such as Walgreens or CVS. The capture rate reflects the ACP’s ability to attract patient customers, and is an important benchmark for this project. A dissatisfying pharmacy experience will lower this rate, while an increase in capture rate would indicate an improvement in either perceived customer satisfaction or convenience. The Coordinator of Ambulatory Pharmacy Initiatives provided a data log with the location and number of prescriptions filled for discharge medications from December 2011 to January 2012, which had 562 entries for C&W.
By dividing the number of prescriptions sent to C&W by the overall number of C&W discharges, the team calculated the patient capture percentage to be 29.3% for the months of December 2011 and January 2012.

The team calculated the walking time from C&W to the ACP through a series of Time-Motion Studies. Walking from the main entrance elevators to the ACP queue area, the team found the average walking time from C&W to the ACP to be 4 minutes 17 seconds. The team also took into account the fact that the ACP will be relocated to a new location closer to C&W in the fourth quarter FY2012, which will decrease the walking time by 1 minute 23 seconds. In addition, Pharmacy performance studies were performed. The team observed the arrival of 30 patients to the ACP on four separate occasions, for a sample size of 120 patients. The observations were performed on four different days, at various times of the day. Pharmacy statistics were measured and calculated, the results of which can be seen below.

Table 1. Means for several queuing metrics of the ACP

<table>
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<th>ACP metrics</th>
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<td>Service time</td>
<td>3:32</td>
</tr>
<tr>
<td>Interarrival rate</td>
<td>2:36</td>
</tr>
</tbody>
</table>

The team also calculated the percentage of prescriptions that were not ready for pick-up when patients arrived to the ACP, which was found to be 7.8%. With the objective of lowering that figure, the team explored opportunities to notify patients when their medication was ready for pick-up, preventing any unnecessary trips to the ACP. Patients at C&W have access to a new interactive patient care tools system that is connected to a 42-inch flat-panel monitor in each patient room. The GetWell Network enables clinicians, Child and Family Life Program staff, and other members of the care team to interact and communicate with their patients and families. Based on discussions with the U-M Health System’s representative from the GetWell Network, the team determined that using the GetWell Network system would be an efficient, non-intrusive way to alert patients that their medications are ready for pick-up. Technicians would only require about half a minute per order to send a message, since only two database windows need to be accessed per message, and room numbers can easily be searched by patient name. Thus, incorporating this system would be a seamless change in terms of labor.

Lastly, to find less labor-intensive alternatives of delivering medication from the ACP to C&W, the team explored the option of shipping prescriptions via the pneumatic tube system. After consulting with a UMHS Industrial Electrician and performing a time study in which 51 tubes
were sent between the ACP and C&W 10th floor inpatient pharmacy, the team concluded that the delivery of medication by pneumatic tube is feasible and would take an average of 6 minutes and 16 seconds per trip.

**Recommendations**

Based on the findings from the studies performed and an evaluation of the current discharge medication process, the team recommends the hospital implement one of the three options below. These recommendations are in order of increasing labor intensity for the hospital. Detailed flowcharts for the recommendations are available in the appendix.

*Patient Notified via GetWell Network*
Patients are notified while in their rooms through GetWell when their medications are ready. This contact prevents patients from arriving to the ACP while their medications are still being prepared.

*Medications Prepared in the ACP and Sent to C&W for Pick-up*
Patient prescriptions and insurance information are collected and sent to the ACP. Once the information is received, the prescriptions are filled, sent to C&W via pneumatic tube, and the patient/parent is contacted via GetWell that the medications are ready for pickup at the 10th floor pharmacy in C&W. Lastly, the patient/parent signs and receives the medications and is given the option of talking to a pharmacist. This alternative saves patients from walking to the ACP, having to leave C&W and to wait in line.

*Medications Delivered from the ACP Directly to Patient*
The option that requires the least amount of work for patients, and is the most labor intensive for the hospital, is the delivery recommendation. This recommendation originates from the need to provide the highest level of service to patients in C&W. The delivery recommendation gives the patients the option to decide if they would like their medications delivered directly to their room, or if they would like to pick them up at the ACP themselves. This option is very attractive from the patients’ point of view, because they are not required to leave their room. However, it does provide some timing limitations in that patients will have to wait until the top of the hour to receive their medications after processing. This drawback is why the team recommends giving the patients the option of picking up their medications as soon as they are completed from the ACP. This way if patients are in a rush to leave C&W, they can walk to the ACP and pick up their prescriptions whenever they would like.
Introduction

The new University of Michigan C.S. Mott Children’s Hospital and Von Voigtlander Women’s Hospital (C&W) does not have its own outpatient pharmacy services. The Ambulatory Care Pharmacy (ACP) provides discharge medications, which is located in the Taubman Center Building. As a result, a significant amount of additional work is required of patients and their guardians to receive their medications. Consequently, the Director of Pharmacy Services asked a University of Michigan Industrial & Operations Engineering student team to evaluate the discharge medication process. The Director wanted to understand how the medication process affects patient satisfaction, and if that satisfaction may be improved by an alteration in the process. The work has been completed. This report presents the team’s findings, conclusions, and recommendations on how to optimize this process.

Goals and Objectives

To create an efficient and feasible system for delivering discharge medications from the ACP to the patients at C&W, the student team performed the following tasks:

- Observed and analyzed the current discharge medication process
- Studied the impact of the Pharmacy Department’s various proposed solutions on overall patient satisfaction

With this information, the team developed recommendations to:

- Provide three detailed processes for delivering discharge medications to patients
- Increase patient satisfaction with the discharge medication process
- Decrease the amount of work required for patients to receive their medications
- Provide recommendations on the number of staff members that would be required under the proposed plans

Background

Since C&W opened in December of 2011, the ACP has provided outpatient pharmacy services for its patients. This pharmacy is located about a quarter of a mile, or on average 4 minutes 17 seconds of walking time from C&W. This distance, coupled with occasional pharmacy delays, prevent C&W from providing the ideal patient-focused medication experience to patients and their families. Not only are patients unhappy with the amount of time and effort required for retrieval of medicine, but also 7.8% of the patients arrive to the pharmacy only to learn their medication is not ready.

Design of a new delivery process took place within several constraints, due to legal, pharmaceutical, and hospital regulations. For example, each patient must be given the option to speak with a pharmacist, and patients must physically sign off to receive medications.
This report provides three alternatives for improving the discharge medication process. Each recommendation commands a varying level of patient/family work, as well as labor cost to the hospital. A greater improvement in the current medication process will equate to a higher labor cost. For instance, direct delivery to the patient rooms requires minimal effort for patients, but demands much additional staffing allocation.

**Key Issues**

The following key issues prompted the need for this project:
- The lack of an outpatient pharmacy in C&W
- Perceived patient dissatisfaction with the current discharge medication process
- Walking times from the C&W to the ACP

**Project Scope**

This project investigated the discharge medication delivery process to patients in C&W. The team did not analyze the medication filling process within the pharmacy. Only patients from C&W and their experiences were used in the analysis. However, the recommendations provided could be extended to any other unit in the Hospital facing similar problems. Due to space and monetary constraints, no consideration of adding a new pharmacy in C&W was made.

**Data Collection and Analysis**

The team performed seven tasks to evaluate the discharge medication process for patients of C&W. The studies provided the team with metrics to measure and analyze the status of the current process. In addition, quantitative and qualitative data was gathered to benchmark the impact of the proposed solutions. Below is a summary of the units observed, the tasks performed, and the results of our data collection.

*Survey Correlation Study*

In collaboration with Press Ganey Associates, the University of Michigan Health System solicits feedback from patients to evaluate how satisfied they were with the care their loved ones received. Two group members met with a statistician for the hospital to discuss the results of an existing satisfaction survey conducted by Press Ganey Associates. The objective of the meeting was to determine the extent to which patients are dissatisfied with the speed of the current discharge process. Statisticians sent surveys to two-thirds of all discharged patients in FY 2011 from UMHS and used the results to create a Kendall’s Tau correlation table. This analysis determined the correlation between patient satisfaction and the speed of patient discharge, among other factors unrelated to this project.

With a correlation coefficient of 0.28, the Kendall’s Tau analysis revealed a weak trend between overall patient satisfaction and the speed of the discharge process.
Capture Percentage Study
Upon being discharged from the hospital, the patients have the option of receiving medication from the ACP, or going to a retail pharmacy such as Walgreens or CVS. The capture rate reflects the ACP’s ability to attract patient customers, and is an important benchmark for this project. A dissatisfying pharmacy experience will lower this rate, while an increase in capture rate would indicate an improvement in either customer satisfaction or convenience. The Coordinator of Ambulatory Pharmacy Initiatives provided a data log with the location and number of prescriptions filled for discharge medications from December 2011 to January 2012, which had 562 entries for C&W. By dividing the number of prescriptions sent to C&W by the overall number of C&W discharges, the team calculated the patient capture percentage.

By dividing the number of prescriptions sent to C&W by the overall number of C&W discharges, the team calculated the capture rate to be 29.3% for the months of December 2011 and January 2012. Furthermore, the average number of outpatient prescriptions per patient was calculated and found to be 3.16 prescriptions per patient for C&W.

Time-Motion Studies and Observations
The team calculated the walking time from C&W to the ACP. Team members walked from the main entrance elevators in C&W to the ACP queue area while keeping time with a stopwatch. Four separate routes were considered in the calculation to account for many walking scenarios, incorporating both the stairs and elevators. The team completed the route pushing both a cart and a wheelchair, adding 20 seconds and 1 minute 7 seconds to the trip duration time, respectively.

The average walking time from C&W to the ACP was found to be 4 minutes 17 seconds. The addition of a cart added roughly one minute to each trip. The ACP will be relocated to a new location closer to the C&W in fourth quarter FY2012, which will decrease the walking time by one minute 23 seconds.

Pharmacy Performance Studies
The team observed the arrival of 30 patients to the ACP on four occasions, for a total sample size of 120 patients. Each set of observations represents a different time of day, ensuring an accurate representation of overall patient arrival time, since some hours may be busier than others. Interarrival time of patients to the ACP and the service time were gathered. These numbers were used to extrapolate the average length of time in the queue and queue length.

Per the team’s request, the ACP conducted a one-week study, between March 14 and March 21, to determine how often orders are not ready when the patients attempt to pick them up. In the one-week span, 410 discharge prescriptions were processed at the ACP. A pharmacy technician in the ACP was asked to record each time a medication was not prepared for pick-up in the discharge medication log. The data revealed 7.8% of patients arrive at the ACP to learn their medications are not ready.
Assuming a utilization of two pharmacy servers, the team found the following pharmacy statistics (times in min:sec). Interarrival rate represents the mean time between each separate customer arrival.

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<td>3:32</td>
</tr>
<tr>
<td>Interarrival rate</td>
<td>2:36</td>
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</tbody>
</table>

GetWell Network TV System

Patients at C&W have access to a new interactive patient care tools system that is connected to a 42-inch flat-panel monitor in each patient room. The GetWell Network enables clinicians, Child and Family Life Program staff, and other members of the care team to interact and communicate with their patients and families. The team met with the sales representative at GetWell for C&W to determine the feasibility of using the GetWell Network to alert patients when their prescriptions are ready for pick-up.

Based on discussions with the U-M Health System’s representative from the GetWell Network, the team determined that using the GetWell Network system would be an efficient, non-intrusive way to alert patients that their medication is ready for pick-up. Technicians would only require about half a minute per order to send messages, since only two database windows need to be accessed per message, and room numbers can easily be searched by patient name. Thus, incorporating this system would be a seamless change in terms of labor.

Pneumatic Tube System

To find less labor-intensive alternatives of medication delivery from the ACP to C&W, the team explored the option of transporting prescriptions via the Pneumatic Tube System. The team consulted with a UMHS Industrial Electrician and a time study was performed to determine how quickly a tube could be sent from the ACP to the C&W 10th floor pharmacy for patient pick-up or delivery. Fifty-one tubes were sent between the two secure locations over a four-day span.

The team concluded that the delivery of medication by pneumatic tube is physically possible. However, there are concerns regarding the security of sending narcotics through the tube system. With the help of plant maintenance, the team would implement a security code for each pneumatic tube that is sent with narcotics. Only the delivering and receiving pharmacist will know the code and be able to access the medications. The team found the average time for a pneumatic tube to travel from the ACP to the 10th floor pharmacy in C&W to be 6 minutes 16 seconds per trip.
Parent Survey on Discharge Medication Process

A 5-question survey regarding satisfaction with discharge medication was sent out to the members of the Patient-Family Centered Care program. This program is a forum for the families of Mott patients to share their personal experiences with the hospital staff in an effort to improve care. The purpose of the survey was to understand the families’ experiences with the ACP and to see how receptive they would be to proposed changes to the discharge medication process.

In one question, survey respondents ranked their experiences using the ACP from 1 to 5, 5 being very satisfied. The weighted mean value of 34 responses was 3.15. The next question asked the respondents to classify the length of the walk from C&W to the ACP as manageable, moderate, or excessive. The results for each choice are listed below in Table 2, gathered from the 33 respondents who answered this question.

Table 2. How respondents classified walk from C&W to the ACP

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Manageable</td>
<td>15.2%</td>
</tr>
<tr>
<td>Moderate</td>
<td>48.5%</td>
</tr>
<tr>
<td>Excessive</td>
<td>36.4%</td>
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</table>

The last question of the survey was aimed to gauge the opinion of the respondents to different possible changes to the discharge medication process. Table 3 shows proposed improvements, and how the 37 respondents for this question rated each of these changes. The rating scale was from 1 to 5, 5 indicating the change would lead to a great improvement.

Table 3. Survey response for three proposed improvements to the medication discharge process

<table>
<thead>
<tr>
<th>Proposed Improvement</th>
<th>Weighted Mean</th>
</tr>
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<tbody>
<tr>
<td>Use the Get Well Network to notify patients when medications are ready for pickup</td>
<td>3.81</td>
</tr>
<tr>
<td>Have medication pick-up at a pharmacy on the 10th floor of the C&amp;W hospital instead</td>
<td>4.41</td>
</tr>
<tr>
<td>Have medications delivered to patient bedside on the hour as they become available</td>
<td>4.73</td>
</tr>
</tbody>
</table>
Conclusions and Recommendations

The team recommends the hospital implement one of the three options below. These recommendations are in order of increasing labor intensity for the hospital. Detailed flowcharts for the recommendations are available in the appendix.

Patient Notified via GetWell Network
Patients are notified while in their rooms through GetWell when their medications are ready. This contact prevents patients from arriving to the ACP while their medications are still being prepared.

Messages through GetWell appear as a pop-up window, and materialize regardless of how the television is used, such as for watching movies or playing video games. If the television is off, the Network can be programmed to show the message once the television is turned on.

Very little additional labor is necessary to put GetWell notifications into effect. Nursing staff should inform the patient not to leave for the ACP until a GetWell message is received. Messages should be sent by the pharmacy technician in the ACP, which takes about half a minute per message. The GetWell database is available online, so no additional software is necessary at the ACP.

The expected costs and FTEs needed for this recommendation are:

- ACP pharmacy technician FTEs needed: 0.01
- ACP pharmacy technician minutes per day needed: 5.4 minutes
- Initial investment: none

Medications Prepared in the ACP and Sent to C&W for Pick-up
Patient prescriptions and insurance information are collected and sent to the ACP. Once the information is received, the prescriptions are filled and the patient/parent is contacted via GetWell that the medications are ready for pickup at the 10th floor pharmacy in C&W. Lastly, the patient/parent signs and receives the medications and is given the option of talking to a pharmacist. This alternative saves patients from walking to the ACP and waiting in line. Filling the medications in the ACP and sending them to the 10th floor pharmacy avoids the need to have inventory in two locations, which would be a substantial cost increase. The window at the 10th floor pharmacy would require a QS/1 point-of-sale station, which costs $9,813. Additional investments may be necessary if the proper power outlets and data ports are not available.

The medications will be delivered to the 10th floor pharmacy in C&W either through the pneumatic tube system or by a delivery using secure carts. Pneumatic tubes require less work for delivery and offer a higher level of security; however, they are prone to traffic congestion and rare downtimes due to system errors.
This recommendation allows patients to avoid leaving C&W to pick up medications. Patients will not be subjected to the three-minute wait at the ACP pharmacy queue. The walk to the 10th floor pharmacy is substantially shorter than the walk to the ACP. However, the new ACP location is about 1 minute 23 seconds in walking time to C&W than the current location in Taubman. Thus, decision-makers must judge if this improvement in walking time from the inclusion of the 10th floor pharmacy becomes marginal after the pharmacy is moved.

The FTEs needed for this recommendation depends on the volume of narcotics used for outpatients, since protocol for these medications is different. The team gives a range of FTE values to account for this uncertainty in volume. The FTEs listed below assume no narcotics are handled for outpatients:

- ACP pharmacy technician FTEs needed: 0.01
- ACP pharmacy technician minutes per day needed: 5.4 minutes
- 10th floor pharmacy technician FTEs needed: 0.12
- 10th floor pharmacy technician minutes per day needed: 48.6 minutes

The following statistics reflect medications that include narcotics:

- ACP pharmacy technician FTEs needed: 0.04
- ACP pharmacy technician minutes per day needed: 16.2 minutes
- 10th floor pharmacy technician FTEs needed: 0.10
- 10th floor pharmacy technician minutes per day needed: 43.2 minutes
- 10th floor pharmacist FTEs needed: 0.03
- 10th floor pharmacist minutes per day needed: 10.8 minutes

Medications Delivered from the ACP Directly to Patient

The option that requires the least amount of work for patients, and is the most labor intensive for the hospital is the delivery recommendation. This recommendation originates from the need to provide the highest level of service to patients in C&W. The delivery recommendation gives the patients the option to decide if they would like their medications delivered directly to their room, or if they would like to pick them up at the ACP themselves.

Prescriptions are sent and filled just as they are under the current process. After all of the prescriptions in a patient’s order are filled, a technician places a phone call to the patient’s room. The first reason for this call is to confirm that the patient’s order is now complete and to ask if they would like their medications delivered. If patients choose the delivery option, they will be asked if they would like to speak with a pharmacist, and finally will be told that their medications will be delivered at the top of the hour. This scheduling provides the patients an estimate of when their medications will be delivered, so that they are available in their room at this time. Conversations with a pharmacist can either happen over the phone, via videoconference, or through the on-floor clinical pharmacist.
At the top of each hour, a pharmacy technician from the ACP will load all of the prescriptions to be delivered onto a secure cart. A technician will then deliver the completed orders to the patients’ rooms in the ACP. Upon arrival, the technician will deliver medications to the patients, and receive signatures for the medications using a handheld QS/1 device. If a payment is due, it will also be collected using the point-of-sale feature on the QS/1 device. The QS/1 device will not be available for purchase until roughly August of 2012.

While the delivering pharmacy technician is at the ACP, he or she would be calling for each completed prescription, and then delivering those prescriptions on the hour. Based on the number of prescriptions processed by the ACP each day, the technician would have to deliver to about 1.2 different rooms per hour on average, taking roughly 23 minutes for every trip. This figure of 1.2 was calculated by dividing the total number of orders sent to the ACP in two months (562 orders) by the total number of hours the ACP is open in a two-month span (472.5 hours). This calculation assumes the technician will deliver to two rooms per trip, and this time will fluctuate depending on the actual patient orders for each trip. Upon further review of this employee utilization rate, the delivery schedule could be modified to determine if more or less deliveries should be made each day. A breakdown of time allocation per delivery is shown below in Figure 1.

4:37 (ACP to C&W Elevators with cart)  
+ 2:23 (Elevators to Room #1)  
+ 3:00 (service time)  
+ 3:00 (walk to Room #2)  
+ 3:00 (service time)  
+ 2:23 (walk to elevator)  
+ 4:37 (Elevators to ACP)  

23 Minutes  

Figure 1. Expected Time Per Delivery (minutes)  

This option is very attractive from the patients’ point of view, because they are not required to leave their room. However, it does provide some timing limitations in that patients will have to wait until the top of the hour to receive their medications after ACP processing. This drawback is why the team recommends giving the patients the option of picking up their medications as soon as they are completed from the ACP. This way if patients are in a rush to leave C&W, they can walk to the ACP and pick up their prescriptions whenever they would like. This method is also the most labor intensive for the hospital, as seen by the estimated costs below:
- ACP pharmacy technician FTEs needed: 0.59
- ACP pharmacy technician hours per day needed: 4 hours
- Initial investment: one handheld point-of-sale device (price unreleased)

**Expected Outcome**

Regardless of which recommendation the Hospital chooses, the expected outcome of this project is to make improvements to the current discharge medication process. These improvements are measured by the survey results regarding perceived patient satisfaction with each of the proposed recommendations. Each of the proposed processes warranted a perceived satisfaction score of a minimum of 3.81 out of 5. These findings show that each of the proposed solutions will be of some benefit to the Hospital. In contrast to the expected increase in patient satisfaction, each recommendation comes at some cost to the hospital, as seen in Figure 2. It will be up to the decision makers in the Pharmacy Department to determine the necessary tradeoff between patient satisfaction and the investment required for each proposal.

![Figure 2. The tradeoff between cost and expected patient satisfaction for each recommendation](image-url)
Appendices

Appendix A: Patient notified via GetWell network

Time needed to complete tasks:

- Pharmacy technician sends notification via GetWell: 0.5 minutes
Appendix B: Medication prepared in ACP and sent to C&W for pickup

Time needed to complete tasks:

- Technician calls 10th floor to alert of incoming Narcotics carrier: 1 minute
- ACP technician sends carrier: 0.5 minutes
- 10th floor pharmacist enters password and releases carrier: 0.5 minutes
- 10th floor pharmacist completes narcotics log: 0.5 minutes
- 10th floor pharmacy technician sends notification via GetWell: 0.5 minutes
- Patient pays and receives medication at 10th floor pharmacy: 3.5 minutes
Appendix C: Medications delivered from ACP directly to patient

Time needed to complete tasks:

- ACP pharmacy technician calls patient room: 2 minutes
- ACP pharmacy technician alerts on-floor pharmacist to meet with patient: 1 minute
- ACP delivers meds on the hour using QS/1 device: 23 minutes