University of Michigan Pharmacy Department:  
Analysis of Prescription Turnaround Time  

Final Report  

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Executive Summary

The Manager of Process and Service Quality of the Taubman Center Pharmacy at the University of Michigan Health System believes that the prescription turnaround process is inefficient and taking too long. The pharmacy would like to better understand the current state of their process as well as ways to improve the process and the workflow at the pharmacy. They asked a team of three senior Industrial and Operation Engineering (IOE) students from the University of Michigan to analyze the current state of the prescription turnaround process for “waiter” type prescriptions and recommend areas of improvement.

Project Goals

The primary project goal is to identify inefficiencies and bottlenecks in the current state of the prescription turnaround process and develop recommendations that will achieve an improved future state. Recommendations will eliminate delays and waste in the prescription turnaround process and increase satisfaction for patients and pharmacy staff. The secondary project goals are to:

- Create process flow maps for each stage of the prescription filling process
- Create a value stream map of the current process to identify value added and non-value added activities

Background

The prescription turnaround process at Taubman Center Pharmacy occurs in four main stages: (1) order entry, (2) prescription filling, (3) quality assurance, and (4) front end. Order entry begins when a prescription order is received by the pharmacy. “Waiter” type prescriptions are sent to the waiter data entry station where the technician uses the prescription order information to process insurance approvals, correct dosages, and any prior authorizations required for the medication. When order entry is completed, the prescription is printed and placed in a red basket, indicating priority, and sent to the filler station.

At prescription filling, medicine is gathered from inventory, measured, and fulfilled for a corresponding order by a pharmacy technician. The order is then given to quality assurance where a pharmacist measures and confirms proper medicine dosage. Additionally, pharmacists finish bottling, labeling, and packaging of medicine. The final prescription package is placed in a ‘light’ bag that has flashing light sensors and given to the front end for eventual pick up by the patient. The pharmacy would like to have this entire process be completed in 15 to 30 minutes.

Methodology

In order to identify inefficiencies and bottlenecks in the current state of the prescription turnaround process, the team conducted preliminary observations of the pharmacy’s process for 40 collective hours; conducted a literature search; performed a time study over the course of nearly 50 hours, resulting in 120 usable data points; interviewed four pharmacists and eight pharmacy technicians; and distributed a survey to the pharmacists and pharmacy technicians, resulting in seven responses. The team analyzed the data using Microsoft Excel and Minitab and developed conclusions and recommendations from the findings.
Findings

The team identified opportunities for improvements within the pharmacy prescription turnaround process related to prescription handoffs between the stations, staffing concerns at the filler station, and order entry processing. Staff interviews revealed nine key issues in the prescription turnaround process. The most popular key issue is performing other tasks, 100% of staff identified this. When staff interview results were compared by job role, the types of tasks that staff members found to distract them from fulfilling their roles differed slightly. The team found the source of these key issues to lie in out of scope factors and order entry the majority of the time. Staff survey results revealed that staffing levels and doing other jobs are most important to the Taubman pharmacy staff. These two issues were confirmed by the team throughout the weighted importance value, the average survey rating multiplied by the number of times the issues was mentioned in staff interview. Staffing levels and doing other jobs resulted in weighted importance values of 75 and 64, respectively, out of a total 120. Time studies evaluated and validated prescription processing time. Prescription processing time averages are within Taubman Pharmacy limits of 15 to 30 minutes. The sum of all of the average process times is 16.00 min and the average total process time of a prescription through the entire process is 18.62 min. The critical statistic is the high standard deviation values for each of the stages of the process. The average standard deviation is 25.55 minutes. Large standard deviation values at each station and in the overall process are indicative of high variability within the prescription turnaround process. Lastly, eScribe processing times differ from non-eScribe processing time. eScribe prescriptions have a noticeably lower cycle time at the two handoffs, yet all other stages of the process have similar cycle times to those of the non-eScribes.

Conclusions and Recommendations

The following conclusions and recommendations provided by the team will help the Taubman Center Pharmacy identify inefficiencies and bottlenecks in the current state of the prescription turnaround process and help the pharmacy to work towards an improved future state. The team identified four main conclusions as a result of our study:

- Excessive Handoff Times - Communication breakdowns increase processing time; 75% of pharmacists express concerns with staff communication. Handoffs between stations take on average 4.49 minutes and 2.28 minutes, Handoff 1 and Handoff 2 respectively. 12% of prescriptions take over 30 minutes.
- Excessive Multitasking - Working on other jobs while processing a prescription is a key issue expressed by 100% of staff. 75% of staff thinks training can be improved.
- Error Resolution - Taubman Pharmacy has not been fully staffed in the past year leading to lack of experienced pharmacy technicians. 28.2% of prescriptions undergo rework.
- Processing Time - Meets pharmacy goals, however high variability is leading to concerns with the prescription turnaround process.

Short Term Recommendations

1. Standardized Communication and Work - Standardized work practices will create improved communication between staff as far as what has already been done, and what has yet to be done in each stage of the prescription turnaround process.
2. Improve pharmacy technician turnover - Discrepancies in the rate at which a pharmacy technician is hired or replaced leads to the staffing issues that is affecting Taubman. By addressing the staffing levels, staff members will spend more time doing their primary jobs and have fewer distractions, which will improve the prescription turnaround time.

3. Analyze training needs - Standardized training will lead to a reduction of errors and improved staff perception that they are not meeting patient needs.

**Long Term Recommendations**

1. Update MiChart and QS/1 to reflect Taubman prescription turnaround needs.
   a. Accurate time stamp data is needed to validate current state and create metrics for improvement.
   b. Ability to differentiate prescription between patient type (Ambulatory vs. Discharge)
   c. Ability to see prescription deadlines

2. Inventory Control
   a. PAR levels are not up-to-date at the Taubman Pharmacy. A future IOE 481 project team could be assigned to further analyze the effects of inventory control on prescription turnaround time.
Introduction

The Taubman Center Pharmacy is part of the Pharmacy Department within the University of Michigan Health System (UMHS) that fulfills the prescription processing for discharge and ambulatory patients, as well as University of Michigan employees. The current prescription turnaround process, from the time a prescription order is placed to the time it is ready to be picked up, is perceived to be taking much longer than expected. Discharge prescriptions, which, according to the client, account for roughly 50-60% of total prescriptions, have evolved into eScribes, or electronic prescriptions, in a recent conversion to MiChart (Epic). MiChart is an electronic medical record that the University of Michigan Health System has recently implemented to replace their previous electronic medical record. In turn, the entire prescription process has changed and has led to inefficiencies. Due to these inefficiencies, if prescriptions are not ready for discharge patients in a timely manner, patients are forced to either extend their hospital stay or return later for their medications.

The Manager of Process and Service Quality wanted to determine the reason for extensive prescription turnaround time specifically for “waiter” type prescriptions. “Waiter” type prescriptions are those that belong to patients that are currently waiting in the pharmacy lobby to receive their medication. An Industrial & Operations Engineering (IOE) student team from the University of Michigan was asked to observe and conduct a study on the current system for these types of prescriptions and determine where delays are occurring, evaluate wastes during the order entry process, and find bottlenecks at peak processing times.

Background

Taubman Pharmacy Overview
The Taubman Center Pharmacy, located in the Taubman Center, is part of the Pharmacy Department within UMHS that fulfills the prescriptions processing for discharge and ambulatory patients, as well as UMHS employees. The Taubman Pharmacy also houses a portion of the Specialty/Transplant Pharmacy; their processes were outside the scope of this project.

The Taubman Center Pharmacy prescription turnaround process occurs in four main stages: (1) order entry, (2) prescription filling, (3) quality assurance, and (4) front end. In the current process, order entry begins when a prescriber (i.e. physician/nurse practitioner/physician assistant) places a prescription order. Prescribers may place orders via fax, telephone, eScribe, pneumatic tube system, or paper. Patients or healthcare providers may also visit the front end with paper prescription orders given to them by a prescriber. Patients that bring orders or request their prescription at the front end before it is processed, and subsequently must wait in the lobby, are known as “waiters.” When received, orders are entered into QS/1, the computer prescription processing application, by a pharmacy technician. Technicians are located at three different order entry stations and a phone station, each station with a differing set of colored baskets to signify the order entry method and/or type of prescription.

Waiter Type Prescriptions: Order Entry
“Waiter” type prescriptions are sent to the technician assigned to the waiter data entry station. Waiter prescriptions can be eScribes and/or paper prescriptions received at the front end. The
The technician uses the prescription order information to process insurance approval, correct dosage, and prior authorizations. After a waiter prescription is finished processing at order entry, the prescription is printed and placed in a red basket (to signify urgency) and sent to the filler station.

**Waiter Type Prescriptions: Filling**
In prescription filling, medicine is gathered from inventory, measured twice (in the case of a controlled substance), and fulfilled for a corresponding order by a technician in the filler role. Fillers bottle and label the medicine, and then pass the prescription to the pharmacist in Quality Assurance. When filling, fillers must give priority to prescriptions in red baskets. Red basket prescriptions can be either waiter prescriptions or Mott Children’s Hospital surgical discharge patient prescriptions.

**Waiter Type Prescriptions: Quality Assurance**
The order is then given to Quality Assurance, which is performed by a pharmacist. Pharmacists count (in the case of a controlled substance) and confirm proper medicine dosage and directions. Additionally, pharmacists package the medicine and then place the order in a “light” bag, which has flashing light sensors for identification purposes. Afterward, the prescription order is ready and passed to the front end for pick up.

**Waiter Type Prescriptions: Front End Pick Up**
Upon pick up, patient name and date of birth or patient name and address are requested by the front end technician to confirm patient identity electronically. If the prescription is ready for pick up, a button is pressed to trigger the flashing light sensor on the designated prescription light bag. Once the bag is retrieved, the technician finalizes and checks out the prescription order. Figure 1 displays this workflow process. The process flow diagrams for each station within the prescription turnaround process can be found in Appendix A.
**Current Staffing Levels**

When fully staffed, the pharmacy functions with one technician at each of the three order entry stations and one technician manning the phone station. Two technicians operate as fillers at the filler station and four pharmacists operate at the quality assurance stations. Two technicians operate the front end station. According to the Manager of Process and Service Quality, the pharmacy is currently understaffed by three pharmacy technician positions.

**Conversion to MiChart**

In 2013, a time study was performed at the Taubman Center Pharmacy that illustrated the prescription turnaround time. Since that study, discharge prescriptions, which are 50-60% of the total prescription volume at the Taubman Pharmacy, have begun to be electronically prescribed as eScribes via MiChart (Epic), an electronic medical record.

As a result of the conversion to MiChart, the pharmacy now notices inefficiencies in the prescription turnaround time, specifically at the order entry stage involving insurance approval, improper dosages or medications prescribed by the prescriber, and inadequate prior authorizations. The eScribe process can involve prescriptions failing to be sent to the correct pharmacies or not all, due to prescriber error. Within MiChart, all ambulatory and discharge prescriptions are entered into the same queue leading to difficulties in differentiating processing priority. The time taken to address these inefficiencies have caused delays and increased the prescription processing time.

The student team observed the prescription turnaround process with their focus on identifying and observing variation, non-standard work, and non-value added work as it relates to the “waiter” type of prescriptions. The primary parties affected by this project are the pharmacy technicians, pharmacists, and patients.

**Key Issues**

The pharmacy customer and staff dissatisfaction issues that are driving the need for this project include:
- Long wait times for customers due to inability by the pharmacy to process and fill prescriptions in a timely manner
- Delay in patient discharges due to late prescription fulfillment
- Complaints by pharmacy technicians and pharmacists about workflow waste and inefficiencies

**Project Goals**

The primary project goal was to identify inefficiencies and bottlenecks in the current state of the prescription turnaround process and develop recommendations that would achieve an improved future state. Recommendations are designed eliminate delays and waste in the prescription turnaround process and increase satisfaction for patients and pharmacy staff. The secondary project goals were to:
- Create process flow maps for each stage of the prescription turnaround process
Create a value stream map of the current process to identify value added and non-value added activities

Project Scope

The project examined the current processes that the “waiter” type prescriptions follow: order entry, prescription filling, quality assurance, and front end customer service. The prescription turnaround process starts when the prescription enters the QS/1 system queue and ends when the prescription goes through quality assurance and is ready to be picked up by the patient. In addition, the team placed emphasis on the “normal” prescription movement through each process rather than unique and outlying cases that had the potential to arise. A normal prescription was considered one that was not a “compound” prescription; one that the pharmacy has to mix itself, as these prescriptions take longer to complete.

The project scope did not include external interactions that occur outside of the pharmacy’s control such as the interaction between doctors, insurance, and patients with the pharmacists and pharmacy technicians. The team did not study tasks or activities of the Transplant section of the Taubman Pharmacy.

Data Collection and Analysis

The University of Michigan Taubman Center Pharmacy was the main entity involved in this project. Those who stand to be affected by the project include the Taubman Center pharmacists, pharmacy technicians, and the patients who frequent the Pharmacy.

To achieve the primary goal of the project, the team performed a time study over nearly 50 hours, resulting in 120 usable data points; conducted staff interviews with four pharmacists and eight pharmacy technicians; and distributed a survey to the pharmacists and pharmacy technicians, resulting in seven responses. The team analyzed the data using Microsoft Excel and Minitab and developed conclusions and recommendations from the findings. The recommendations provided by the team will assist the Taubman Center Pharmacy in identifying inefficiencies and bottlenecks in the current state of the prescription turnaround process and help the pharmacy to work towards an improved future state.

Preliminary Observations

Initially, each team member observed the Taubman Center Pharmacy prescription turnaround process to gain an understanding as to the current state of the pharmacy and the filling process. Members of the team observed two or three times per week and shadowed different staff members doing a variety of jobs throughout the pharmacy. The team collectively observed the prescription turnaround process at the Taubman Pharmacy for 40 hours spanning from September 17th to October 3rd. Observations included all steps in the prescription turnaround process: Order Entry, Filling, Quality Assurance, and Front End. The observations allowed the team to properly define the stations and tasks within the prescription turnaround process that needed to be examined with time studies for this project. Potential bottlenecks were identified and the project scope was defined accordingly.
Time Studies:
The team performed time studies on the prescription turnaround process for “waiter” prescriptions at the three main stages of the process: Order Entry, Filling, and Quality Assurance. The time study data was collected by using a Microsoft Excel file that had the ability to input a clickable time stamp macro embedded in its cells. The team collected the start and stop times at the Filling and Quality Assurance stations and received the same data for the Order Entry station from the computerized records of the Taubman Pharmacy. A sample timestamp data collection sheet can be found in Appendix B. The collected data was used to provide metrics about the current state of the prescription turnaround process at Taubman Pharmacy for the value stream map. The team collected 120 usable data points over nearly 50 hours from October 2, 2014 to October 31, 2014.

The Manager of Process Service & Quality at Taubman Pharmacy provided Order Entry timestamp data from their computer system so the team could validate their data collection method by comparing the two data sets. The data collection method was validated using 85 data points collected from the computer system. The team also validated the manually collected timestamp against itself to ensure the lack of collection bias.

Staff Interviews
The team interviewed Taubman Pharmacy staff over a two-day period, October 13th and 14th. The team developed interview questions based from findings documented during initial observations. Individual interviews with eight pharmacy technicians and four pharmacists occurred during that time. The Manager of Process & Service Quality scheduled these interviews with staff. Questions were asked to confirm the team’s understanding of job roles within the pharmacy, to identify issues in the prescription turnaround process, and to receive staff suggestions for improvement.

The team discovered recurring issues and suggested solutions, which were then tallied to be analyzed and quantified. These results were used to identify the largest sources of waste in the order entry processes and to identify persistent bottlenecks in the prescription turnaround process. Staff suggested solutions recorded in the interviews were analyzed and combined with the team’s observations and applied towards the development of recommendations. Key recurring issues were formed into a follow-up survey intended to further quantify recurring issues found in interviews. A sample of the questions posed to the pharmacists and pharmacy technicians can be found in Appendix C.

Pharmacy Technician Turnover Rate Data
The team was given data from the Manager of Process Service & Quality at Taubman Pharmacy regarding pharmacy technician turnover rate at the pharmacy. The data given to the team were stored records accessed by the manager at the pharmacy. It showed that the average turnover rate in the US for pharmacy technician is 12.7% and at the University of Michigan Hospital, the turnover rate is 23.7%. In addition, the Taubman Center Pharmacy has not been fully staffed in the past year and 4 technicians have left in the past 6 months.
**Literature Search**

The team conducted a literature search on other pharmacy related projects that were similar to this project. The team reviewed the following articles regarding pharmacy related projects in areas of workflow and prescription process:

- [3] “Riverside Medical Center Pharmacy uses Lean to recover workspace, reduce stockout by 81%” by ValuMetrix Services

The team examined recurring issues in pharmacies and ways to solve these issues, which include improving repeat prescription processes, preventing incorrect medication distribution, and optimizing workspace in a pharmacy. The literature search provided an insight on how a pharmacy was able to improve the efficiency of the prescription turnaround process by isolating necessary tasks without distractions. The insights the articles provide assisted the team in developing recommendations. In addition, the team reviewed the previous IOE 481 project that was done in Taubman Center Pharmacy to understand how past issues have led to the current state of the Taubman Center Pharmacy.

**Surveys**

Based on the information gathered from the staff interviews, the team created a brief survey in regards to recurring staff concerns about the key issues that affect the prescription turnaround process. The survey listed the nine issues (and one “Other” option) that came up during the staff interviews the most often and asked the staff members to rank each on a scale of 1 to 10 as to which issue they considered to be the most prevalent. The results of these surveys were used to quantify and compare the perspectives of staff that experiences the presented key issues the most. The Manager of Process Service & Quality distributed the survey to each pharmacy staff member on November 19, 2014 and collected later in the day. A copy of the distributed survey can be found in Appendix D.

**Data Analysis**

The team used the time study data to analyze the overall processing time of the waiter prescriptions in addition to the processing times at each of the three stages of the prescription turnaround process. This data was added to the current Value Stream Map (Figure XX, below) for the waiter prescription turnaround process and shows where the largest sources of value added and non-value added time are within the process. Additionally, the team compiled the results of the staff interviews to find recurring problems brought forth by and subsequent potential solutions suggested by the pharmacists and pharmacy technicians.

The analysis for this project was performed with the use of Excel and Minitab. Minitab was used primarily for statistical analysis of the data for this project; including validation of the time study data against itself and Pareto Analysis of the time study data. Excel charts and tables were used
to quantify and illustrate the responses from the pharmacist and pharmacy technician surveys and to calculate statistics for the time study data.

Data Validation
The data received from the time study was validated against itself as a way to ensure nonbias amongst the group members having done the data collection. The individual processing times were randomly split into two data sets using Microsoft Excel’s RAND() function and analyzed in Minitab to see if the data collection had a lack of bias. Comparative box plots were created and the showed that the randomly split collected data properly mimicked itself, validating the collection method for a lack of bias. This process was performed for the order entry, filling, and Q/A stations and for the processing times for Handoff 1 and Handoff 2 (the times in between order entry and filling as well as filling and Q/A) as well as the total process time. The validating graphs for each step in the process can be found in Appendix E.

Findings from Staff Interviews
The interview asked the Taubman Pharmacy staff what they believed was the most prevalent issues that interfered with the prescription turnaround process. Questions were also asked to compile the most effective ways to improve the prescription turnaround process. The staff addressed the questions according to their role in the pharmacy. Staff roles were confirmed with a primary question asking a staff member to list their responsibilities and job description.

Staff Interview Results: Performing other tasks hinders prescription turnaround process
Going through each interview, the team created the following categories of issues that the pharmacy staff identified.

- Doing other jobs refers to the staff member working on tasks outside of their primary job description. This includes pharmacy technician doing work outside of their current station.
- The quality of training of a technician is how well prepared in handling the job at order entry, filler, and front end. Lack of training is evident when a situation arises that a technician is unfamiliar with and requires help from another staff member.
- Staffing levels indicates if the Taubman Pharmacy is fully staffed with 12 staff members working at a given time. There should be four pharmacists and eight technicians but currently the pharmacy is short three pharmacy technicians.
- Catching errors should occur as early as possible in the prescription turnaround process. When an error is not caught early on, such as wrong medication or incorrect instruction label, it requires the prescription order to be reworked.
- Interruptions from phone calls refer to the issues that pharmacists and technicians have when they must stop their current work in order to answer phone calls.
- The attitude of staff member towards the works which results in carelessness while performing their job.
- Communication between staff members creates misunderstandings such as multiple staff member working on the same prescription or nobody working on a particular prescription at all.
Organization of pharmacy refers to how easily a staff member can find what they need in the current layout of the pharmacy.

Inventory problems refer to prescriptions that cannot be filled as a result of medication not properly stocked.

All 12 staff interviews revealed that performing other jobs outside of the scope of a respective job description is the most prevalent key issue in the prescription turnaround process. The second and third most prevalent issues preventing an efficient prescription turnaround process are the quality of pharmacy technician training at the order entry and filler stations and staffing levels, respectively.

Figure 2, shown below, suggests several issues that affect the prescription turnaround time. The first issue that all 12 staff members raised was doing work outside of their primary job. When a pharmacists or technician work outside of their primary job, they are forced to stop processing a prescription in order to answer a phone call, rework a previous prescription, or clear up miscommunications with other staff members.

**Staff Interview Comparison: Differing most relevant issues**
The interviews demonstrated a difference in responses to questions regarding working outside of staff role. In the interview, the team asked the same question to both the pharmacists and pharmacy technicians: “Do you find yourself working outside of your role? If so, what other things do you find yourself doing? How often?”

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Sample Size of 12 (4 pharmacists, 8 technician) from Staff Interview. Collected on Oct. 13th and 14th, 2014

Figure 2: Key Issues identified by Staff in the Prescription Turnaround Process
Figure 3, shown below, stratifies the key issues identified by staff role in the prescription turnaround process. It shows the percentage of each subgroup that stated that the each issue was in fact an issue. The interviews found that pharmacists found the following issues to be most prevalent:

- Performing other jobs
- Training technicians
- Staffing level
- Communicating with staff

Comparatively, pharmacy technicians thought the most prevalent issues were:

- Performing other jobs
- Being on the phone
- Training of technicians
- Staffing levels
- Catching errors

Both pharmacists and technicians both agreed that inefficiencies are caused by performing other jobs, training for technicians can be improved and not being fully staffed.

Sample Size of 12 (4 pharmacists, 8 technician) from Staff Interview. Collected on Oct. 13th and 14th, 2014

Figure 3: Comparison of Key Issues Suggested by Pharmacists and Pharmacy Technicians
Staff Interview Key Issue Source Comparison

Additionally, the team contrasted the sources of these key issues as suggested by the pharmacy staff. Figure 4 refers to where these key issues are occurring according to pharmacists and pharmacy technicians, respectively.

![Pie Chart: Where Issues Are Occurring, Pharmacists](image1)

![Pie Chart: Where Issues Are Occurring, Pharmacy Technicians](image2)

Sample Size of 12 (4 pharmacists, 8 technician) from Staff Interview. Collected on Oct. 13th and 14th, 2014

Figure 4: Comparing Pharmacy Staff Key Issue Sources

Results demonstrate that pharmacists suggest the plurality of key issues occur in the “Other” category receiving 30% of tallies. “Other” includes all issues that are outside the scope of the team’s project that affect the efficiency of the prescription turnaround process such as prior authorization protocols, the staff interview process, staff meetings, empowering the customer, and staff morale. Tied for second highest according to pharmacists, the next areas where errors were said to occur were in order entry and inventory control. To contrast, pharmacy technicians suggest the majority of key issues stem from the Order Entry station with 42% of tallies. The second highest key issue source is “Other” according to pharmacy technicians.

Findings from Survey Analysis

The survey asked the Taubman Pharmacy staff to rank the prevalence of key issues in the prescription turnaround process. The staff ranked the list of key issues, determined from previous interviews, according to their role in the pharmacy. Staff roles were confirmed with a primary question asking a staff member to circle their role in the Pharmacy.

Staff Survey Results: Staffing Levels and Doing Other Jobs are Most Important

The team compounded the results from the staff interviews with the results from the staff surveys. The team created a weighted importance value to determine the overall most prevalent issues affecting the prescription turnaround process. The weighted performance value is comprised of the tallied number of times the key issue was identified in staff interviews multiplied by the averaged ranked value from the staff survey. For example, if an issue came up
twice during the staff interviews, but was ranked, on average, as a value of 9 on a scale of one to 10, 10 being the most important, then the corresponding weighted importance value would be 18.

Figure 5, shown below, ranks the weighted importance value for each key issue identified by the staff interviews. The results suggest Staffing Levels is the most important issue affecting the prescription turnaround process with a weighted importance value of 75.

Findings from Time Studies

The team analyzed the time study data collected in the four-week period. From the time study data, the team understood the current prescription turnaround process, identified where the bottlenecks occur, and found correlations between the time and the expressed key issues from the surveys.

Prescription Processing Time: Averages are within Taubman Pharmacy Limits

Currently, the time study data shows that the average prescription turnaround time is within the expected range of 15-30 minutes. As seen in Figure 6, the value stream map for the waiter prescription turnaround time gives a total process cycle time of 16 minutes. Of those 16 minutes, from the pharmacy standpoint, 9.23 minutes are value added and 6.77 minutes are non-value added. This equates to 57.7% value added time. If one looks at the process from the patient’s point of view, where only the actual act of filling a prescription is considered to be value added to the process, then the value added time of the process is only 3.15 minutes, or 19.7%.
Table 1, below, shows the summary statistics for the different steps within the prescription turnaround process for waiter type prescriptions. Handoff 1 refers to the time the prescription is waiting in between the Order Entry and Filling stations, and Handoff 2 refers to the time a prescription spends in between the Filling and Q/A stations. Both the addition of all of the average process times (16.00 min) and the average total process time of a prescription through the entire process (18.62 min) are both within the allowable range of the pharmacy. The telling statistic in the below table is the high standard deviation values for each of the stages of the process. These large standard deviation values, coupled with the large ranges within the data at each stage are indicative of high variability within the prescription turnaround process. To put this in perspective, all stages of the process have ranges that are at least five times as large as their average process time.
<table>
<thead>
<tr>
<th></th>
<th>Order Entry (min)</th>
<th>Filling (min)</th>
<th>Quality Assurance (min)</th>
<th>Handoff 1 (min)</th>
<th>Handoff 2 (min)</th>
<th>Total (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>2.76</td>
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<td>0.17</td>
<td>0.42</td>
<td>0.21</td>
<td>0.02</td>
<td>0.00</td>
<td>2.91</td>
</tr>
<tr>
<td>Maximum</td>
<td>17.07</td>
<td>16.32</td>
<td>22.20</td>
<td>34.40</td>
<td>13.78</td>
<td>166.20</td>
</tr>
<tr>
<td>Sample Size</td>
<td>41</td>
<td>71</td>
<td>61</td>
<td>47</td>
<td>56</td>
<td>60</td>
</tr>
</tbody>
</table>

Data collected 10/2/14 - 10/31/14

Table 1: Summary Statistics of Stages Within Waiter Prescription Turnaround Process

Although the average processing time of a waiter type prescription is within the 15-30 minute range that the pharmacy would like, there are at times prescriptions that take longer than the acceptable range. Table 2, below shows the number and percentage of observations that took greater than the listed time to be processed by the pharmacy. The numbers and percentages of observations in the below chart are cumulative, meaning that while there were three prescriptions that took longer than 60 minutes, those three are also considered to have taken more than 45 minutes. This table shows that only 12% of prescriptions observed had a total processing time of greater than the 30 minute window that the pharmacy would prefer it to be done within.

<table>
<thead>
<tr>
<th>Total Process Time</th>
<th>Number of Observations</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 15 min</td>
<td>23</td>
<td>38%</td>
</tr>
<tr>
<td>Over 20 min</td>
<td>12</td>
<td>20%</td>
</tr>
<tr>
<td>Over 30 min</td>
<td>7</td>
<td>12%</td>
</tr>
<tr>
<td>Over 45 min</td>
<td>4</td>
<td>7%</td>
</tr>
<tr>
<td>Over 60 min</td>
<td>3</td>
<td>5%</td>
</tr>
</tbody>
</table>

Sample size of 60 data points, Collected 10/2/14 - 10/31/14

Table 2: Number and Percentage of Observations over Total Process Time
The Pareto Chart, shown below in Figure 7, shows a visual representation of the average processing times at each step of the prescription turnaround process. It shows that the largest average amount of time in the prescription turnaround process is spent at Handoff 1, and the addition of both the handoff times account for nearly 45% of the overall process time of a waiter type prescription. 

![Pareto Chart of Step_of_Process](image)

Sample Size of 121 data points, Collected 10/2/14 - 10/31/14

Figure 7: Pareto Chart of Steps in Waiter Prescription Turnaround Time

Table 3, below shows the number and percentage of observations at each process step that exceeded five minutes. The five minute time value is an arbitrary time set as a potential maximum time that a prescription should be at any one step of the process. Processing prescriptions at or better than this arbitrary time would theoretically produce a prescription turnaround time that is within the ideal bounds of the Taubman Pharmacy. Based on this arbitrary benchmark value of five minutes, Order Entry is the station that exceeds this time amount the least percentage of the time (nearly 10%), and Handoff 1 does so the most (25%). The other three stages in the process exceed this value roughly 15% of the time.
<table>
<thead>
<tr>
<th>Process Step</th>
<th>Number of Observations over 5 min</th>
<th>Percentage over 5 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order Entry</td>
<td>4</td>
<td>9.8%</td>
</tr>
<tr>
<td>Handoff 1</td>
<td>12</td>
<td>25.5%</td>
</tr>
<tr>
<td>Filling</td>
<td>12</td>
<td>16.9%</td>
</tr>
<tr>
<td>Handoff 2</td>
<td>9</td>
<td>16.1%</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>9</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

Sample sizes of 41, 71, 61, 47, and 56, data points, respectively. Collected 10/2/14 - 10/31/14

Table 3: Number and Percentage of Observations Over 5 Minutes at Each Stage of Process

Below in Figure 8 is a histogram of the processing time at the Quality Assurance stage of the prescription turnaround process. The histogram shows that the majority of the processing times are confined to shorter times. While there are some much larger processing times, which could potentially skew the averages at the stage of the process, a large portion of individual processing times fall on the shorter side of the average processing time of 3.33 min. Similar histograms for the Order Entry and Filling stations can be seen in Appendix F.
eScribe Prescriptions: Processing times differ from non-eScribes

Of the waiter type prescriptions observed by the team, a subset of them came to the pharmacy via eScribe. Table 4, below, shows the amount of time that they spent in the electronic queue before their processing began. The eScribes enter the queue when they are prescribed by the prescriber and exit the queue once a member of the Taubman Pharmacy starts processing them at Order Entry.

<table>
<thead>
<tr>
<th>eScribe Statistic</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>84.71</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>76.73</td>
</tr>
<tr>
<td>Minimum</td>
<td>18</td>
</tr>
<tr>
<td>Maximum</td>
<td>257</td>
</tr>
</tbody>
</table>

Table 4: Statistics for Amount of Time eScribe Waiter Prescription Spent in Electronic Queue

Table 5 below shows the processing times of eScribe waiter prescriptions compared against the processing time of all observations. The eScribe prescriptions have a noticeably lower cycle time at the two handoffs, yet all other stages of the process have similar cycle times to those of the
non-eScribes, including the Total Time, with the exception of the Filling station, which actually has a higher cycle time for eScribe prescriptions.

<table>
<thead>
<tr>
<th>Process Stage</th>
<th>Average Processing Time (eScribe)</th>
<th>Average Processing Time (non-eScribes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order Entry</td>
<td>2.44 min</td>
<td>2.84 min</td>
</tr>
<tr>
<td>Filling</td>
<td>3.94 min</td>
<td>2.95 min</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>2.54 min</td>
<td>3.56 min</td>
</tr>
<tr>
<td>Handoff 1</td>
<td>1.54 min</td>
<td>5.00 min</td>
</tr>
<tr>
<td>Handoff 2</td>
<td>1.43 min</td>
<td>2.45 min</td>
</tr>
<tr>
<td>Total Time</td>
<td>19.83 min</td>
<td>18.25 min</td>
</tr>
</tbody>
</table>

Sample size of 21 data points, Collected 10/2/14 - 10/31/14

Table 5: Comparing Average Processing Times for eScribe and non-eScribes by Stage of Process

Conclusions and Recommendations

The following conclusions and recommendations provided by the team will help the Taubman Center Pharmacy identify inefficiencies and bottlenecks in the current state of the prescription turnaround process and help the pharmacy to work towards an improved future state.

Excessive Handoff Times

Conclusion
Time studies led to data results which demonstrated prescriptions spend the most time waiting in between stations at Handoff 1 and 2. These excessive handoffs lead to increased non-value added time in the prescription turnaround process. The value stream map further supports this with true value added work only consisting of 19.7% of the end-to-end process.

These excessive handoff times can be attributed to breakdowns in communication. Communication breakdowns occur when prescription information is not completely transferred to a staff member who may be at the next station. Breakdowns may also occur when a staff member is tasked to finish an incomplete prescription previously being process by a different staff member. Most importantly, these breakdowns result in the 12% of waiter prescriptions take more than 30 minutes. Potential processing errors must be communicated between staff members. When prescriptions have errors, they must be reprocessed and/or corrected leading to increased handoff times. Communication received only the sixth highest weight importance value, however, the 75% of pharmacists expressed concerns with staff communication during interviews. This comparison demonstrates the need for staff communication to be further evaluated.
**Recommendation**
Establish standardized communication and work in order to reduce the time prescriptions are spending at handoffs. Currently there are communication breakdowns that occasionally occur when prescriptions are handed off to the next person. Additionally, standardized work practices will allow the Taubman Pharmacy staff to better communicate with each other as far as what has already been done, and what has yet to be done in each stage of the prescription turnaround process.

**Excessive Multitasking**

**Conclusion**
The staff interview data revealed that all staff members felt that they were doing multiple jobs at once. The weighted importance value of 64.0 for doing other jobs suggests that it prohibits them from doing their assigned jobs for the day and that this is an important issue to the staff members.

Multitasking may be also attributed to lack of prescription differentiation in MiChart and QS/1. Interviews revealed that previous to the implementation of MiChart, prescription were categorized and processed either by a Discharge Team or Ambulatory Team. During this time, prescription processing was less likely to overlap by type, therefore multitasking was limited.

**Recommendation**
Further analyze the need to improve the current pharmacy technician turnover rate. The pharmacy technician turnover rate at Taubman Center Pharmacy is currently at 23.7% which is over the national average. In addition, the current hiring process takes roughly two months and a technician is able to leave with a two week notice. There is a discrepancy in the rate at which a pharmacy technician can be replaced which is leading to the staffing issues that is affecting Taubman. A pharmacy technician after being hired needs an additional six to twelve months to be self-sufficient which also slows the prescription turnaround process. The team suggests that by addressing the staffing levels, staff members will spend more time doing their primary jobs and have fewer distractions, which will improve the prescription turnaround time. Implement changes to MiChart and QS/1 that allow staff to identify prescription by either ambulatory or discharge. Furthermore, options to be available for a prescription to be flagged in the computer program if it is a waiter-type prescription or if the processing deadline within a critical time. This will allow staff to prioritize and focus prescription processing and subsequently decrease processing times and multitasking.

**Error Resolution**

**Conclusion**
Error resolution, as known as rework or catching errors, occurs when a prescription must be reevaluated by staff causing delays in the prescription turnaround process. Error resolution is documented via time stamp data and staffing level statistics provided to the team by the client. Time stamp data provided by the client revealed an error rate of 28.2%. These errors increase the processing time of a given prescription and may affect the timely processing of other prescriptions.
Frequency of error resolution is also identified in the inconsistent staff levels at Taubman pharmacy. Taubman has not been fully staffed over the past year. Four pharmacy technicians have rotated out of the pharmacy in the last 6 months alone. Inconsistent staffing levels have been confirmed by documentation provided by the client. The average turnover rate for pharmacy technicians at the University of Michigan Hospital is 23.7%, double the national average. As a result of high staff turnover, pharmacy technicians are prevented from gaining experience with a consistent staff. Conversations with senior staff members have revealed that lack of job experience leads to increased error resolution during prescription processing. Major issues in a prescription are often left to pharmacists since they are the most tenured and most familiar with the multitude of issues that may occur.

**Recommendation**
Further analyze the training needs of pharmacy technicians. The current training methods may be improved to reflect the need for standardized work and communication. With standardized work and communication, staff members new to Taubman may be able to establish metrics of processing goals. These metrics create a necessary self-check and team check of work completed while processing a prescription. The standardized work and training can be created in many ways. Standardized communication will require errors to be identified early in the prescription process. The goal of standardization can be developed through experienced staff members knowledge of error types, and new staff member knowledge of new hire requirements to be successful. Standardized training may lead to a reduction of errors and improved staff perception that they are not meeting patient needs.

**Processing Time**

**Conclusion**
The results of the time studies indicate that the current prescription turnaround time meets the goals set by the pharmacy. The concern that the prescription turnaround time is excessive is due to high variance in the prescription turnaround time. The standard deviation is greater than the average, which indicates that the outliers are most likely contribution to the complaints from patients. As shown earlier in our finding, excessive prescription turnaround time only account for 12% of all prescriptions and only 5% account for prescriptions that take over an hour. Although the percentage of prescriptions that do not meet the target goal of the pharmacy is very low, the amount of errors can still be further reduced which will also decrease the overall prescription process time.

Currently eScribe prescriptions are waiting an average of 84.71 minutes in the queue. The eScribe prescriptions that wait in the queue are also showing a high variance. However, there is no clear set deadline for eScribe prescriptions and e-Scribe prescriptions can enter the queue while the pharmacy is closed. As a result the high average wait time in the queue is not indicative of the processing time for e-Scribe prescriptions. In addition when e-Scribes actually enter the process, the process time resembles the averages of the process time that the team discovered through the time studies.

**Recommendations**
Update MiChart and QS/1 to match the needs of the pharmacy. Currently MiChart and QS/1 are not providing the necessary information for the pharmacy technicians and pharmacists. In
MiChart and QS/1, there is a need for accurate time stamp data. During data collection, the team ran into issues confirming accuracy of processing times at each station. Due to inaccurate Taubman Pharmacy timestamps, there is no methodology to accurately measure processing times for constant evaluation by pharmacy staff. Time stamp data should reflect processing time from when a prescription is prescribed to when it is ready and picked up by the patient. Additionally, processing times at each station, and between stations, should be tracked and readily available in MiChart and QS/1 in the future. Additionally, the ability to track prescription deadlines, the expected time a prescription is ready for a patient, should be implemented in MiChart and QS/1. This will lead to a decrease in processing time variability, and the ability for staff to prioritize prescriptions based on true time urgency.

Out of Scope

Conclusion
Staff interviews revealed a station known as Inventory Control. Inventory Control is located next to the Transplant station in Taubman pharmacy. The pharmacy technician assigned to this station is responsible for keeping medication adequately stocked to meet any prescription demand. Currently, the pharmacy technician assigned to this role performs these duties manually since PAR levels are not up-to-date.

Recommendation
Further investigate the inventory levels. The team discovered that PAR levels are no longer up-to-date. One staff member manually keeps track of the medication stock. The team was not able to further investigate the level of critical effect on the turnaround of prescriptions. The team recommends that a future IOE 481 project team should be assigned to Taubman pharmacy to further analyze the effects of inventory control on prescription turnaround time.

Expected Impact

As a result of this project, the Taubman Center Pharmacy gained an understanding of the staff dynamic. The staff interviews and survey revealed the importance of staffing levels, communication breakdowns and training needs as issues that are prohibiting the staff from completing the prescription process in an efficient manner. These documented issues will serve as areas of important potential future improvements for the pharmacy.

In addition, the pharmacy also gained an understanding that there is a high variability in the prescription turnaround process. This project revealed that there is a lack of accuracy in data collection and combined with complaints are leading to false perceptions of the prescription turnaround time. Future projects on the data collection method done by the pharmacy can lead to further improvements in the quality and efficiency of the prescription turnaround process.

The team also documented other potential issues that are out of scope that impacted the prescription turnaround process. These include distractions that are caused by phone calls and inventory control of the medications. By creating awareness of these issues, future projects can be implemented to reduce the delays to the prescription process caused by these issues.
Appendices
Appendix A-1: Waiter Prescription Process Flow Maps

Order Entry

Filler
Appendix A-3: Waiter Prescription Process Flow Maps

Quality Assurance
Appendix B: Sample Timestamp Data Collection Sheet

Our Excel Sheet

<table>
<thead>
<tr>
<th>Basket Number</th>
<th># of prescriptions in order</th>
<th>Prescription ID #</th>
<th>Prescription Received at Pharmacy</th>
<th>Waiter Data Entry Start</th>
<th>Filler Starts Work</th>
<th>Filler Finishes Work</th>
<th>Quality Assurance Starts</th>
<th>Quality Assurance Ends</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
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<td>1234567</td>
<td>11/04/2014 02:23:10 PM</td>
<td>11/04/2014 02:23:34 PM</td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Zoomed in view of our data collection sheet (1)

<table>
<thead>
<tr>
<th>Basket Number</th>
<th># of prescriptions in order</th>
<th>Prescription ID #</th>
<th>Prescription Received at Pharmacy</th>
<th>Waiter Data Entry Start</th>
<th>Filler Starts Work</th>
<th>Filler Finishes Work</th>
<th>Quality Assurance Starts</th>
<th>Quality Assurance Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>1</td>
<td>1234567</td>
<td>11/04/2014 02:23:10 PM</td>
<td>11/04/2014 02:23:34 PM</td>
<td></td>
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</tr>
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<td>9</td>
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<td>11/04/2014 02:23:37 PM</td>
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<td>11/04/2014 02:29:30 PM</td>
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<td></td>
</tr>
</tbody>
</table>

Zoomed in view of our data collection sheet (2)

<table>
<thead>
<tr>
<th>Filler Starts Work</th>
<th>Filler Finishes Work</th>
<th>Quality Assurance Starts</th>
<th>Quality Assurance Ends</th>
<th>Notes</th>
</tr>
</thead>
</table>
Appendix C: Interview Question Sheet

Interviewer Name: XXXX
Person Being Interviewed: XXXX
Position(s) Being Interviewed as: Pharmacy Technician / Pharmacist

How would you describe your job description/role? (data entry/filler, pharmacist)

Data Entry:

Filler:

Pharmacist:

Do you find yourself working outside of your job role? If so, what other things do you find yourself doing? How often?

Do you feel that doing other jobs prevents you from accomplishing your primary work?

What do you feel could be most improved as part of the data entry process? The filler process?

What do you feel could be most improved as part of the quality assurance process?

When you do the filling as well as the quality assurance processes, what problems do you notice, and how do you feel they could be mitigated?

What do you feel would be the most effective ways to improve the prescription filling process as a whole?

Do you have any other suggestions, comments, concerns, or other things you would like to mention?
Appendix D: Key Issues Survey

Taubman Pharmacy Staff: Please complete the following as accurately and completely as possible to help us with our industrial engineering project.

My role in the Taubman Pharmacy is (circle one):
- Pharmacist / Pharmacy Technician

The following list regards the prevalence of key issues in the prescription turnaround process. Please rank the following in order of prevalence from 1 to 10 where 1 is most prevalent to you and 10 is least prevalent to you:

___ Staffing Levels
___ Quality of Training
___ Inventory
___ Communication
___ Organization of Pharmacy
___ Doing other Jobs
___ Phone Calls
___ Catching Errors
___ Attitude
___ Other (not listed) IF SO, explain:

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Appendix E: Validating Graphs For Each Step in the Prescription Turnaround Process

**Boxplot of order entry time**

**Boxplot of fill time**
Appendix F: Histograms of Processing Times at Order Entry and Filling Stations

Histogram of order entry time

Histogram of fill time