University of Michigan Health System
Program and Operations Analysis

Analysis of the Orthopedic Surgery Taubman Clinic
Final Report

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Executive Summary

The following is a brief overview of the key points and findings in our final report.

Introduction/Background

The current process patients go through at the Orthopedic Surgery Taubman Clinic (OSTC) is believed to create unsatisfactory waiting times for patients to see a provider. In addition, the providers also believe they wait too long to see their patients. Therefore, our team was asked to analyze the current process in the clinic to determine if these problems exist. We were also asked to provide recommendations to reduce patient and doctor wait times, reduce system variability, standardize resource allocation, and increase patient and employee satisfaction. To analyze the current process, we performed time studies using patient data collection sheets, a literature search, staff interviews, observations and a flowchart analysis.

Approach

The following methods were used in our approach to the project.

Developed Metrics and Conducted Literature Search

We developed metrics for the data collection and determined what data to collect and how to collect it, based on information we gathered during the literature search. The literature search allowed us to determine what metrics and methods have worked in previous studies done similar to this one.

Interviewed Staff and Developed Methodology

After meeting with our client and conducting a literature search, our team developed a set of interview questions for the staff. Our team interviewed several key people involved, including providers and midlevel staff, to identify what areas they see as problematic in the process and to create a detailed flowchart of the process.

Collected Data

After interviews, a literature search, and observations, our team developed a data collection sheet in which the patient would record the key metrics in the process. The orthopedic staff and willing patients collected data throughout the day, while our team collected sample data on several days of the week to validate the patient data collected from the patients and staff.

Analyzed Data & Drew Conclusions

We used the data from the data collection sheets and interview responses to create and fill in the metrics on the process flow chart. Using statistical software and through the use of
graphs and tables, we also identified additional areas of value added and non-value added areas/times in the process.

**Developed Recommendations**

After the data analysis phase was complete, we developed recommendations for:

- Reducing or eliminating sources of patient wait times
- Reducing variability in the wait times caused by trips to radiology
- Increasing and/or leveling patient throughput
- Accommodating workloads through standardization
- Increasing patient and employee satisfaction
- Increasing utilization of resources

**Findings and Conclusions**

After our period of data collection was complete, in order to draw conclusions from our data, we compiled a summary of interview responses, gathered a list of our observations, and stratified the data several ways in order to provide the appropriate information desired by our clients.

After conducting interviews, we found the general consensus amongst the staff regarding patient visit durations to be that new patient visits take a substantially longer amount of time than do return visit patient visits. We also found that there were conflicting ideas on ways to prioritize patients on the sign-in sheet in the staffroom. The different methods of prioritization were also known to cause patients to become delayed or even lost in the process.

Our team also gathered a list of observations that may be causing a delay in the process. These observations included the fact that the current scheduling system only allocates 15 minutes per patient, which is not the true amount of time a visit takes. We also observed that many mid-level staff expressed confusion as to where a particular provider was located at any given time. In general, our team determined trips to radiology, the cast room, and the inadequacy of the scheduling system all caused excessive wait times for both patients and providers.

After analysis of the data we collected from the patient data sheets, we came to the following conclusions:

- Total Visit Duration Constant throughout the Day
  Mean: 89 minutes
  Standard Deviation: 52 minutes.

- Total Time Spent in Exam Room Constant throughout the Day
  Mean: 49 minutes
  Standard Deviation: 30 minutes

- Average Exam Room Durations are Longer for New Patients than Return Patients
New Patient Mean: 56 minutes
New Patient Standard Deviation: 25 minutes

Return Patient Mean: 43 minutes
Return Patient Standard Deviation: 30 minutes

• Total Time Spent in Exam Room Varies Amongst Individual Providers
  Mean Time for All Providers Combined: 39 minutes

• Radiology Durations Independent of Time of Day
  Mean: 33 minutes

• Radiology Duration is Independent of Day of Week
  Monday Mean: 37 minutes
  Tuesday Mean: 33 minutes
  Wednesday Mean: 36 minutes
  Thursday Mean: 35 minutes
  Friday Mean: 30 minutes

• Adult Radiology Duration is Less Than Mott Radiology Duration
  Adult Mean: 26 minutes
  Adult Standard Deviation: 15 minutes

  Pediatrics Mean: 45 minutes
  Pediatrics Standard Deviation: 15 minutes

Recommendations

Based on our findings, we recommend that the OSTC:
  • Decide on an operational definition for what an “appointment time” means
  • Eliminate the ability to overbook the scheduling grid
  • Assign a different amount of time in the scheduling grid to each patient based on whom the patient needs to see and what the patient needs done
  • Limit the amount of rooms a provider uses during his/her clinic to 5
  • Standardize prioritization process in staff room
  • Improve the patient sign-in sheet process in the staff room
  • Implement alternate prioritization system for patients making numerous trips to and from radiology
  • Use light system to identify which room a doctor is in

The expected outcomes of these recommendations are:
  • Decreased patient wait times
  • Decreased doctor wait times
  • Increased patient satisfaction
  • Increased doctor satisfaction
  • Increased clerical staff satisfaction
Introduction

The current process patients go through during their visits at the Orthopedic Surgery Taubman Clinic (OSTC) at The University of Michigan Hospital is felt to be unsatisfactory by both providers and patients. For this reason, our clients, Patrice Seymour, the Administrative Manager of the clinic, Dr. Andrew Urquhart, an orthopedic surgeon at the clinic, and Caroline Cole Brown, MHSA Department Administrator of Orthopedic Surgery, wanted us to analyze the current situation. More specifically, our clients wanted to know what factors contribute to the extended patient and provider wait times that exist in the process.

To address this issue, the Administrative Manager, Orthopedic Surgeon and Department Administrator asked our team to conduct a series of time studies on the processes patients go through at the clinic, identify the amount of wait time the patients experience during their visits, distinguish problem areas within the system contributing to these wait times, and determine ways to increase the patient throughput. Based on our findings and related conclusions, we have recommended changes to increase patient throughput in the OSTC and to address the Administrative Manager’s, Orthopedic Surgeon’s, and Department Administrator’s concerns. This final report presents our findings based on our analysis of the OSTC from January 8, 2007 through April 11, 2007. We have determined specific areas within the system that are contributing to the extended wait times and have developed recommendations that will improve patient throughput.

Goals and Objectives

To determine why patient throughput is not meeting demand in the OSTC, our team has completed the following tasks:

- Determined the metrics in the system that affect the process
- Conducted time studies to determine the value added and non-value added areas/times within the process
- Identified if key differences exist in how providers process their patients and if these differences affect the patient wait times

With this information, we have developed recommendations that will:

- Reduce patient wait times both in the waiting room and in the exam rooms
- Reduce variability in the wait times caused by trips to the radiology department
- Increase and/or level patient throughput
- Accommodate workloads through standardization
- Increase patient and employee satisfaction
- Increase utilization of resources

Background

The OSTC is believed to be one of the busiest clinics at the University of Michigan Hospital. To complicate matters, supposed problems within the clinic have developed over time with very little documentation and no standardization within the process. Also,
the scheduling grid for the clinic, a software program designed to set up appointments for patients and to assign specific providers to those patients on specific days, does not account for all steps a patient may need to follow (i.e. radiology and the cast room) during their visit. These circumstances are perceived to be causing unnecessary wait times for both providers and patients; in addition, the number of exam rooms and providers to serve patients is limited.

Compounding the problem, disagreements have occurred regarding how the exam rooms should be allocated amongst the providers, and it is believed that some providers are overbooking patients and appear to be unable to take on the number of patients scheduled. Moreover, prolonged periods of time pass when patients must travel to radiology for x-rays which causes uncertainty of when they may return and dissatisfaction with the patient process. With these circumstances, patients can wait for lengthened periods of time. Our goal is to determine the underlying cause of these problems and provide recommendations to improve the overall process and reduce patient and provider wait time.

Key Issues

The following key issues drove the need for this project.

- The belief there is poor allocation of resources causing patient wait times
- The knowledge that X-ray demand is occurring randomly within the system which appears to discourage the flow of the patient in the system and is not accounted for in the clinic’s scheduling grid
- The idea that overbooking seems to be resulting in an overloading of the clinic’s capacity to see incoming patients
- The awareness that patients and providers appear dissatisfied with wait times

Project Scope

This project included the process patients follow through in both the adult and pediatric portions of the OSTC. The primary parties involved in this project included administrative staff, residents, nurse practitioners, attending physicians and patients. The process begins when a patient is checked in to the clinic’s computer system and ends when the patient is checked out. We also analyzed the effects of the scheduling grid on patient and provider wait times. We also looked into the Health and Physicals (H&P) rooms which are rooms assigned to providers in the clinic to see patients who only need to discuss their histories or get a physical in preparation for surgery.

Any task not directly connected to the process the patient goes through in the OSTC was not included in this project. Specifically, we did not study tasks or activities in the emergency room (even though some patients may have entered it and then the clinic in the same visit) or any tasks or activities in the radiology department other than recording times when the patients left for radiology and returned from radiology.
**Approach**

We performed this project in five phases while keeping in constant contact with our client and coordinator: developed metrics, conducted interviews, collected data, analyzed data, and developed recommendations.

**Developed Metrics and Conducted Literature Search**

We developed metrics for the data collection and determined what data to collect and how to collect it, based on information we gathered during the literature search. Sources found during the literature search (see Appendix F) allowed us to determine what metrics had been used successfully (time studies and interviews) in similar studies, and what methodologies should have been most successful in this case. With this information in mind the methodologies we used are:

- Observational Analysis
- Organizational Analysis
- Flow Chart Analysis

**Interviewed Staff and Developed Methodology**

We developed interview questions (see Appendix B) after speaking with our client and conducting our literature search, and, using the questions, we interviewed the key people involved—providers and midlevel care—to identify their input and the actual flow of the process. These interviews were arranged by availability and willingness to contribute.

**Collected Data**

We completed data collection for each day of the work week (Monday through Friday) for three weeks. We developed a data collection sheet (see Appendix C) which we used to record the identified metrics. To meet the project schedule, we developed and implemented a data collection method in which the orthopedic staff and willing patients collected data throughout the day, while our team collected a much smaller sample on our own to verify the data collection was adequate. The data collection method included the following steps:

- Patient was asked to participate in wait time study upon check-in
- Patient was given clipboard with data collection sheet and clock for recording times
- Patient recorded enter and leave times listed on sheet applicable to his/her visit
- Patient returned clipboard with sheet upon check-out
- Our analysis team picked up data collection sheets once each week for later analysis
We used this data to identify value added and non-value added times (patient wait times) within the process and to analyze sources of variance in the process that can be reduced through standardization.

**Analyzed Data & Drew Conclusions**

We used the data from the data collection sheets and interview responses to create and fill in the metrics on our flow chart (see Appendix A). This chart helped us determine how the process currently operates (how patients are entered into the system, how and when they go to radiology, when they see a provider, etc.) and how it needs to operate in the future (changes needed to make the process more efficient). We modeled some of the variance in statistical software. These models of variance helped us to identify the value added and non-value added areas/times in the process patients and providers follow in the OSTC and how to address them.

**Developed Recommendations**

After the data analysis, we developed recommendations for:

- Reducing or eliminating sources of patient wait times
- Reducing variability in the wait times caused by trips to radiology
- Increasing and/or leveling patient throughput
- Accommodating workloads through standardization
- Increasing patient and employee satisfaction
- Increasing utilization of resources

**Findings and Conclusions**

After our period of data collection was complete, in order to draw conclusions from our data, we compiled a summary of interview responses, gathered a list of our observations, and stratified the data several ways in order to provide the appropriate information desired by our clients.

**Interview Summary**

After conducting our interviews, we assembled the following responses and general ideas of the key persons interviewed regarding the definition of the appointment time, common threads between return patient verses new patient visit durations, prioritization process for seeing patients, and how the patient sign-in sheet is used in the staff room along with additional comments or concerns the providers may have had regarding these issues.

*Appointment Time*

Several of the staff members had conflicting ideas on what the appointment time specifically is once entered into the scheduling grid. Some staff members believe that it
is the time when a patient checks in to the front desk at the OSTC, while others believe it is the time when patients go to radiology, and others still believe it to be the time when the patient is actually seen by a provider in the exam room.

*Return Patient vs. New Patient Visit Durations*

The general consensus amongst the staff regarding patient visit durations is that new patient visits take a substantially longer amount of time than do return visit patient visits. Some providers try to stagger new patient visits with returning patient visits to avoid overloading one type or another during the day. Other providers try and schedule all new patients in the morning knowing that return visit patients are more inclined to wait should back-up occur in the process later in the day.

*Patient Prioritization Process*

Each provider uses his/her own prioritization process when seeing patients throughout the clinic day. Some stick strictly to the order in which the patients arrive in the exam rooms, while others make exceptions for younger children, elderly patients, or patients who seem to be in distress. A few providers also said at times they will see a patient whom they know will be a quick visit before one they know will take a significantly longer amount of time.

*Patient Sign-In Sheet*

Some of the staff members expressed concern that the current staff sign-in sheet is inadequate. A few of the providers also expressed a concern that in some cases, patients are lost in the system if they leave for radiology. Many of the providers also agreed that it was difficult to determine how long an individual patient had been waiting in an exam room based on the information that was provided on the sign-in sheet.

*Observations*

During data collection and on several days where our group visited the clinic, our team observed the following:

- The current scheduling system only allot s 15 minutes per visit for each patient. It is clear by observing many patients that almost all visits lasted longer than 15 minutes.
- There is no system in place for a mid-level staff person to find a provider when they are needed. During data collection, many mid-level staff members expressed confusion about where a particular provider was located at any given time. Because of this, our team assumed that the current sign-in sheet and prioritization process lacked consistency, which caused issues with locating the primary provider when they were needed.
- We observed that trips to radiology, the cast room, and the inadequacy of the scheduling system all caused wait times for both providers and patients to be excessive.
Total Patient Visit Duration Constant Throughout the Day

Figure 1: Patient Check-In Time vs. Total Duration of Patient Visit

The median total time a patient existed in the process was 83 minutes, with a mean of 89 minutes and a standard deviation of 52 minutes. There appears to be a slight increase in cases of extremely long visit durations during 9:00-11:00am. This appears to be caused by the large number of check-in times earlier in the day, mostly before 10:00am. However, some of the larger wait times can be explained by patients exiting and returning to the process more than once. These patients are in essence being cycled through the process two or more times.

Tuesdays and Thursdays Have Shortest Average Total Visit Time

Figure 2: Total Duration of Patient Visit vs. Day of the Week

Monday, Wednesday, and Friday have the longest total visit durations throughout the week with average total durations equal to 95 minutes, 96 minutes, and 102 minutes.
respectively, whereas Tuesday has an average total duration of 80 minutes and Thursday has an average total duration of 64 minutes. The large standard deviation on Monday is due to the slightly smaller sample size of patient duration times collected for that particular day.

**Total Time Spent in Exam Room Constant Throughout the Day**

Figure 3: Exam Room Duration vs. Time Entered Exam Room

![Exam Room Duration vs. Time Entered Exam Room](image)

The mean total time a patient spent in an exam room (wait time plus time spent with provider/midlevel staff) was 49 minutes, with standard deviation of 30 minutes. There appears to be no correlation between how long a patient waits in an exam room and the time of day in which he/she entered the exam room.
Visits on Fridays Have Longest Average Exam Room Duration

Figure 4: Exam Room Duration vs. Day of the Week

The average amount of time spent in an exam room on Fridays was 61 minutes, the largest out of any other day. Mondays had an average of 52 minutes with a large standard deviation of 26 minutes. Tuesday, Wednesday and Thursday all had relatively low exam room durations with averages of 41 minutes, 40 minutes and 39 minutes respectively.

Average Exam Room Durations are Longer for New Patients than Return Patients

Figure 5: Exam Room Duration for Return vs. New Patients
The exam room wait time for a new patient had a median wait time of 52 minutes, a mean of 56 minutes, and a standard deviation of 25 minutes. The exam room wait time for a return patient had a median of 37 minutes, mean of 43 minutes, and a standard deviation of 30 minutes. From these average durations, it is clear that on average a return visit patient’s duration in the clinic is shorter by 13 minutes.

**Total Time Spent in Exam Room Varies Amongst Each Individual Provider**

Figure 6: Exam Room Duration vs. Provider

The average time spent by a patient in an exam room for all providers was 39 minutes. The following providers had patients that spent more than 39 minutes in the exam room.

Table 2: Providers with Greater than Average Patient Duration in Exam Room

<table>
<thead>
<tr>
<th>Provider</th>
<th>Mean Patient Duration in Exam Room (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Farley</td>
<td>61</td>
</tr>
<tr>
<td>Dr. Goulet</td>
<td>55</td>
</tr>
<tr>
<td>Dr. Graziano</td>
<td>60</td>
</tr>
<tr>
<td>Dr. Lee</td>
<td>42</td>
</tr>
<tr>
<td>Dr. Urquhart</td>
<td>50</td>
</tr>
</tbody>
</table>

Reasons why some providers had a longer time that their patient was in their room could be caused by factors such as the type of patient, what the patients aliment was, the number of mid-level providers, or simply just differences in the way a provider practices.
The following providers had patients that spent less than 30 minutes in the exam room.

Table 3: Providers with Less than Average Patient Duration in Exam Room

<table>
<thead>
<tr>
<th>Provider</th>
<th>Mean Patient Duration in Exam Room (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Biermann</td>
<td>14</td>
</tr>
<tr>
<td>Dr. Craig</td>
<td>24</td>
</tr>
<tr>
<td>Dr. Hensinger</td>
<td>35</td>
</tr>
<tr>
<td>Dr. Karunakar</td>
<td>32</td>
</tr>
<tr>
<td>Dr. VanderHave</td>
<td>29</td>
</tr>
</tbody>
</table>

Dr. Biermann had the shortest mean patient duration in an exam room, but this is based off of only a sample size of 1. Because of this, we cannot say with confidence that 14 minutes is a representative mean patient duration in an exam room. Dr. Craig had the second shortest mean patient duration in an exam room. This small mean duration may be related to the fact that Dr. Craig does not have any residents, nurse practitioners, or physician’s assistants working with him. Because he does not work with any of these people, he does not have to spend time teaching other providers, which could explain why his mean patient duration in an exam room is so small.

**Time Spent at Radiology Independent on Time of day**

Figure 7: Radiology Duration vs. Check-In Time at OSTC

The total average time spent by a patient in radiology was 33 minutes, which is much lower than otherwise anticipated. Ignoring the outlier at 8:45am, there was a slight increase in average radiology duration between the hours of 11:00am and 1:30pm where radiology durations became longer. As a whole however, the time a patient spends in radiology does not depend on the time of day.
Time Spent at Radiology is Independent of Day

Figure 8: Radiology Duration vs. Day of the Week

The average radiology wait times are similar for each individual day of the week with times averaging 37 minutes, 33 minutes, 36 minutes, 35 minutes, and 30 minutes for Monday – Friday respectively. Because the duration of a visit to radiology is similar throughout the week, the duration of a patient’s trip to radiology can be assumed to not cause the variation in total visit times on different days of the week.

Adult Radiology Visit is Less Than Mott Radiology Visit Time

Figure 9: Radiology Duration vs. Type of Radiology Visit
The radiology wait time for pediatrics is significantly longer than the wait time for adult radiology. The wait time for Mott’s radiology has a median of 46 minutes, mean of 45 minutes, and a standard deviation of 15 minutes. The wait time for adult radiology has a median of 26 minutes, mean of 28 minutes, and a standard deviation of 15 minutes.

**Equal Variation in Cast Room Visit Durations throughout the Day**

Figure 10: Cast Room Duration vs. Time Enter Cast Room

The wait time in the cast room has a median of 30 minutes, mean of 30 minutes, and a standard deviation of 18 minutes. There is also no observable trend between the time of day and the amount of time a patient waits in the cast room.

**Number of Exam Rooms Effects Patient Wait Time in Exam Room**

Figure 11: Number of Rooms a Provider uses vs. Wait Time in Exam Room
This graph shows us that on average, the more room a provider uses, the longer a patient wait. The distance between the top line and the bottom line can be viewed as value added time, or time a patient is seeing a provider. If these lines are close, this means that large portions of time, patients are waiting a long time for a smaller amount of value added time. Again, differences in the provider’s times can also be attributed to the fact that some providers do not have mid-level staff, some see different types of patients, and some simply spend longer with each patient.

Recommendations

Based on our findings, we recommend that the OSTC:

- Decide on an operational definition for what an “appointment time” means
  - After conducting interviews, it has been discovered that there is no common definition for what appointment time qualifies as. It is recommended that a standardized definition of “appointment time” be decided upon so that all providers and clerical staff will have a common perception of what the appointment time means. Our team suggests that the definition of appointment time be defined as the time that a patient arrives at the front desk and checks into the clinic.

- Eliminate the ability to overbook the grid
  - Overbooking the grid is contributing to the backlog of patients waiting to see doctors. After analysis of the data, it can be seen that the current practice of scheduling patients 15 minutes apart is causing patients to incur unsatisfactory wait times in their exam rooms as well as radiology.

- Assign a different amount of time in the scheduling grid to each patient based on whom the patient needs to see and what the patient needs done
  - After analysis of the data, it can clearly been seen that not all patients spend the same amount of time in a clinic visit. Therefore, we recommend that each patient be assigned an appointment time that is appropriate for their visit. Currently the base appoint duration for a patient in the scheduling grid is 15 minutes, we recommend this time be viewed as the amount of time a patient spends in an exam room and be changed to 45 minutes to better model the current average exam room duration time. Based on our average duration data, we recommend additional time be added per activity based on the average times determined from data collection and are as follows:

Table 4: Specific Times to be allotted for Patient Visits in Scheduling Grid

<table>
<thead>
<tr>
<th>Visit Activity</th>
<th>Time Allotted In Scheduling Grid (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Room</td>
<td>30</td>
</tr>
<tr>
<td>Adult Radiology</td>
<td>30</td>
</tr>
<tr>
<td>Mott’s Radiology</td>
<td>45</td>
</tr>
</tbody>
</table>
• Put a limit of 5 on the number of rooms a provider uses during his/her clinic
  o It was observed on average from the data provided in Figure 11 that providers who used fewer exam rooms had shorter patient wait times than providers who used more exam rooms. Because of this finding, we recommend that a provider have no more than 5 exam rooms assigned to him or her in any given day. This will ensure that the provider has a more manageable amount of rooms to oversee so that more patients will be cycled through each room in a given amount of time. By having fewer exam rooms, this will also ensure that if patients do experience wait times, it will be in the main waiting room rather than in the exam room. From comments on several data collection sheets, patients would rather wait in the main waiting room than wait in an exam room.

• Standardize prioritization process in staff room
  o Through interviews and observations, it was determined that every provider has a unique way to prioritize his or her patients. In order to streamline the process, we recommend that all providers adopt the same policy for prioritizing patients. This will be beneficial because no matter what day a provider is practicing, his or her colleagues will have a common understanding on how the patients are prioritized, thus avoiding any unnecessary confusion between providers.

• Improve the patient sign-in sheet process in the staff room
  o Through observations and interviews, it was determined that the sign-in sheet currently used in the staff room is causing confusion amongst midlevel and provider staff as to what patients to see and where they are to be seen. Therefore the sign-in sheet is insufficient for the current process in the OSTC. We recommend a whiteboard be used in place of the sheet so the list of patients waiting to be seen is clearer to providers. We also recommend, in addition to the information currently logged on the sheet by the runner, a column with the arrival time of the patient, for the runner to fill in, and a column for comments, for the provider to fill in, be added to the whiteboard. The arrival time column will show how long a patient has been waiting in an exam room. This evidence will help to avoid leaving patients in their exam rooms for extended periods of time. The column on the whiteboard for comments will allow the providers to communicate any additional information to their colleagues regarding a patient. We also recommend patients who leave the system for any reason (i.e. additional X-ray) be removed from the board, and upon re-entry into the process, be added back onto the board. This new improved patient
sign-in sheet process will eliminate the possibility that a patient is lost in the system.

- Implement alternate prioritization system for patients making numerous trips to and from radiology
  - If a patient first sees a provider, and then needs additional x-rays, the patient should have first priority on an available exam room upon return from radiology. This can be done by moving the patient’s information to the front of the queue, ahead of patients currently entering the process.

- Use light system to identify which room a doctor is in
  - From our observations we found that several times during the day, the primary provider could not be located by his or her midlevel staff. To avoid this confusion, we recommend that the red light on the outside of exam room doors be turned on when a provider is in the room with a patient, the white light be turned on when a patient is in a room with no provider, and the light be turned off when no patient or provider is in the room. This way, midlevel staff can quickly and easily locate his or her provider saving time within the process.

The expected outcomes of these recommendations are:
- Decreased patient wait times
- Decreased doctor wait times
- Increased patient satisfaction
- Increased doctor satisfaction
Appendices

Appendix A: Flow Chart

Simplified View of the Taubman Orthopedic Clinic

Cast Room Process of the Taubman Orthopedic Clinic
Main Patient Process at the Taubman Orthopedic Clinic
Appendix B: Staff Interview Questions

University of Michigan Health Systems
Orthopedic Surgery Taubman Clinic

Staff Interview Questions

Midlevel Staff:

1. When do you know it is your time to talk to the patient?

2. How do you find the next patient you are supposed to see?

3. What is your daily work process like?

4. How and when do you communicate with the provider about the patient you are seeing?

5. Do you determine if the patient needs to go to radiology or the cast room? If so how?

6. How do you know if a patient is in the cast room?

7. Do you ever address the patients in the cast room in your process? If so how?

8. How does the cast room process usually work? Is the patient seen in the cast room or do they usually need to proceed to other areas beforehand?

9. What is done with the patients if the cast room is backed up (too full)?

10. Do you ever see a patient in the exam room more than once?

Provider Staff:

1. Please describe, in your own words, your system for seeing a patient.

2. We will be looking at the times patients are in the exam rooms, along with the number of patients in the waiting and cast rooms, and how these numbers change over time. Do you feel there are other issues with the system that these metrics will not address? If so what are they?

3. When do you experience the largest amount wait time within your daily work process? In your opinion, what are the conditions that lead to this?

4. How and when do you communicate with your midlevel staff about a patient you are seeing?
5. How do you know which patient to see next?

6. Do you determine if the patient needs to go to radiology or the cast room? If so how?

7. Is there ever a time that you do not need to meet with your patient? Under what circumstances would this be?

8. Do you ever address the patients in the cast room in your process? If so how?

8a. If so, when does this happen and how do you know you have a patient there?

9. How does the cast room process usually work? Is the patient seen in the cast room or do they usually need to proceed to other areas beforehand?

9a. If so, what is done if the cast room is backed up (too full)?

10. Are you always the last person to see the patients in the exam room?

11. Do you ever see the patient in the exam room more than once?
Appendix C: Data Collection Sheet

University of Michigan Health System
Program and Operations Analysis
Orthopedic Surgery Taubman Clinic Analysis

Dear Patients,

We are a quality assurance project team from the University of Michigan. Our purpose here is to offer recommendations to help reduce wait times and to better streamline your experience at the Orthopedic Surgery Taubman Clinic. To address this issue, our team will conduct a series of time studies, which will allow us to identify the amount of wait time patients experience during their visit.

The following is a data collection sheet that includes different times throughout the patient process we would like to gather in order to help in our analysis. We greatly appreciate your help with this collection of data. Improving your overall experience here is our highest priority of this study. We apologize for any inconvenience and thank you for your help and involvement.

---

**Patient Data Collection**

Please write down times in appropriate slots or answer the questions asked.

Today’s Date: _____ \ _____ \ _____

<table>
<thead>
<tr>
<th>Area</th>
<th>Time Enter</th>
<th>Time Leave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthopedic Clinic Desk Check-in:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Do you require X-Ray(s) today?: Yes / No</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Radiology Wait Time:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Did your visit require the Cast Room?: Yes / No</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Cast Room Wait Time:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Cast Room Revisit: (if applicable)</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>What is/are your Exam Room Number(s)?:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Exam Room Wait Time:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>1\textsuperscript{st} Medical Provider</td>
<td>(Nurse/Physician Assistant/Resident):</td>
<td>_______________</td>
</tr>
<tr>
<td>2\textsuperscript{nd} Medical Provider</td>
<td>(Physician/M.D.):</td>
<td>_______________</td>
</tr>
<tr>
<td>3\textsuperscript{rd} Medical Provider</td>
<td>(If Applicable):</td>
<td>_______________</td>
</tr>
<tr>
<td>Orthopedic Clinic Desk Check-out:</td>
<td>_______________</td>
<td>_______________</td>
</tr>
</tbody>
</table>
Please include any other times spent in areas not listed above or feel free to provide us with any additional comments on the backside of this sheet.

*Upon Check-out please give this sheet to the clerk who checks you out.*
## Appendix E: Clinic Room Assignment Schedule

<table>
<thead>
<tr>
<th>Day &amp; Time</th>
<th>Room #</th>
<th>Who</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afternoon</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Room # 1
- **Monday:**
  - 22, 24, 26, 28, 26, 28, 76, 26
  - 11, 14, 20, 18, 16
- **Tuesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Wednesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Thursday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Friday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16

### Room # 2
- **Monday:**
  - 22, 24, 26, 28, 26, 28, 76, 26
  - 11, 14, 20, 18, 16
- **Tuesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Wednesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Thursday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Friday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16

### Room # 3
- **Monday:**
  - 22, 24, 26, 28, 26, 28, 76, 26
  - 11, 14, 20, 18, 16
- **Tuesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Wednesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Thursday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Friday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16

### Room # 4
- **Monday:**
  - 22, 24, 26, 28, 26, 28, 76, 26
  - 11, 14, 20, 18, 16
- **Tuesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Wednesday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Thursday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
- **Friday:**
  - 22, 22, 24, 26, 28, 26, 28
  - 9, 11, 14, 20, 18, 16
Appendix F: Literature Search Source(s)

PROPOSALS TO REDUCE OVER-CROWDING, LENGTHY STAYS AND IMPROVE PATIENT CARE: STUDY OF THE GERIATRIC DEPARTMENT IN NORWAY’S LARGEST HOSPITAL
Proceedings of the 2003 Winter Simulation Conference
S. Chick, P. J. Sánchez, D. Ferrin, and D. J. Morrice, eds.