University of Michigan Health System

Programs and Operations Analysis

Analysis of the Discharge Process at Internal Medicine Unit 5B

Department of Internal Medicine

Final Report

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Executive Summary

Background

The purpose of this project was to develop Lean Thinking strategies to identify waste in the processes of discharging a patient from the hospital, and determine some of the root causes of high degrees of variation. The reason for focusing on the discharge process is because it is the most unit specific based set of activities in caring for a patient until they are discharged, thus potential to make an impact at a novel unit in the ideas of Lean Thinking. From our assessments, we have identified non-value-added steps in the discharge process, which will ideally improve the flow of inpatients through their hospitalization.

Project Goal and Expected Impact

The goal of this project was to identify non-value added steps in the discharge process which, when eliminated, will ideally improve the flow of inpatients through their hospitalization.

Methods

To identify non-value added steps in the discharge process, our team used the following methods:

- Observed the discharge process at Unit 5B to understand the process as a whole, to identify qualitative problems with the discharge process as perceived by us, and to develop a process for collecting data that would achieve the goals of the project.
- Informally interviewed physicians, nurses, clerks, and patients
- Developed metrics for the time studies and the current state map of the discharge process.
- Conducted time studies and recorded specific details for 35 discharges of different patients of different parts of the process.
- Created a current state map of the discharge process.
- Performed Pareto analysis and developed control charts.
- Performed a literature search of relevant projects to obtain benchmarking data as well as to identify common sources of waste.

Findings and Conclusions

The average overall discharge time from when the physician first speaks to the patient on the day of discharge to when the clerk enters the DSCG information into the computer is 409 minutes.

<table>
<thead>
<tr>
<th>Table E1 – Time distribution of the discharge process.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician’s Role (min)</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>218</td>
</tr>
</tbody>
</table>

The team has determined the following key non-value added activities that occur in between that time through both qualitative and quantitative findings.
Physician

The physician’s priority in seeing the patients, as well as activities to be done for patients is highly variable, depending on personal preferences. Due to this reason, lack of standardization is a key factor to an inefficient discharge process as well as hidden non-value added processes. As a result, 13% of the time is spent committing to the non-value added process of walking or traveling to destinations during rounding. The physician spends the most time (19%) working on the DC Navigator. The steps that are finished last are 4-8 and 12. A linear regression which tested for the number of days a patient stays in the hospital against the time when step 12 of the DC Navigator is printed indicates a positive relation. The longer the patient stays, the earlier the DC Navigator is completed. Additional correlation tests show that of those 4-8 and 12, steps 4 and 12 have statistically significant positive correlation. Hence, the DC Navigator is not a bottleneck that require a fixed amount of time to complete regardless of when the patient was admitted, but rather a couple of sub processes that may include non-value added activities that resulted in more effort or information to complete. When the physician assigns the DC Navigator of a discharge patient to the physician assistant, it is finished on average more than 1 hour later than when physicians finish the DC Navigator. Despite the parallel processing to save time, the non-value added handoffs required in form of communication between the physician and physician assistant to review the work actually increases the length of the process. Finally, when the physician or physician assistant finally finishes the DC Navigator, there is no standardized step to contact the nurse to start step 11 of the DC Navigator, which results in further non-value added handoff time.

Clerk

The largest form of non-value added time from the patient’s perspective is in the form of waiting waste. The longest process for the clerk’s role is from when the patient leaves to the clerk entering the DSCG information. This non-value added waiting time is greater at unit 5B than at the other units. The clerk also does not have a standardized process in completing the orders written by the physicians, in which discharge orders are not always processed first.

Nurse

As mentioned from the physician’s role, the nurse also suffers from handoff waste in two different ways. In addition to not having knowledge of upcoming discharges, the nurse starts the DC Navigator step after picking up the envelope in 76% of the cases, in which this step could be started immediately after the physician is finished. Furthermore, there is no standardized form of communication from the clerk to the nurse that the envelope is ready. The nurse simply picks the envelope from visual impetus. Thus, the lack of communication is a contributor to the average time of 42 minutes spent on waiting for the nurse to pick up the envelope. After the nurse picks up the envelope, a non-value added activity of copying patient prescription information from the MAR chart must be done for patients requiring prescription medication.

Finally, a fishbone diagram was created by listing the drivers of variation and non-value added activities from both qualitative and quantitative findings (Appendix G).
Introduction

The University of Michigan Health System (UMHS) is experiencing an increasing need for inpatient services. To continue meeting this need, an Instructor of Internal Medicine from Unit 5B, our client, would like to identify opportunities for improving the flow of inpatients through the hospitalization process while maintaining high quality care. The current hospitalization process, which can be broadly divided into three areas – admission, day-to-day care, and discharge – has been experiencing a high degree of variation. Therefore, as a part of a larger project goal to implement Lean Thinking ideas into each of these three areas, our client has asked us to develop Lean Thinking strategies to identify waste in the processes of discharging a patient from the hospital, and determine some of the root causes of those high degrees of variation. The reason for focusing on the discharge process is because it is the most unit specific based set of activities in caring for a patient until they are discharged, thus potential to make an impact at a novel unit in the ideas of Lean Thinking. From our assessments, we have identified non-value-added steps in the discharge process, which will ideally improve the flow of inpatients through their hospitalization. This report presents the findings of the project.

Background

The purpose of this project was to determine the causes of inefficiency of the discharge process, which will improve the process in the future. The results of these improvements will be earlier patient discharge times, shorter lead times to process the discharge sequence of events, and increased patient satisfaction. To achieve the goals of the project, the project team members observed the discharge process by shadowing physicians from the Medicine Faculty Hospitalists (MFH) group and by shadowing nurses and clerks from the internal medicine unit 5B.

Medicine Faculty Hospitalist (MFH) Physician Group

The University of Michigan Hospitalist Program includes 19 faculty members whose clinical work, teaching, research, and administrative responsibilities center on inpatient medicine. The MFH hospitalists have a variety of roles on the inpatient medical wards including teaching on resident services, attending on non-resident services, and providing medical consultation and surgical co-management. The MFH Hospitalist Program is dedicated to maximizing the quality, safety, and efficiency of inpatient care; achieving excellence in inpatient education for trainees; pursuing research and scholarly work that advance the field of hospital medicine and ultimately improving the care of hospitalized patients.

Unit 5B

The Internal Medicine Department, Unit 5B, at the University of Michigan is an extremely active unit primarily concerned with the diagnosis and nonsurgical treatment of diseases in adults.
DC Navigator

The DC Navigator is a secure, web based online tool that creates a virtual workspace for all members of a patient’s in-hospital health care team, and allows physicians and nurses to input information regarding the patient. Currently, 12 steps must be completed before a patient can be discharged, in which steps 1-10 and 12 are completed by the physician, and step 11 is completed by the nurse. The DC Navigator allows the generation of four types of reports - signout reports that must be completed for each patient every time a resident finishes a shift, a discharge report for the patient’s medical record, a discharge summary for the referring physician, and a nursing education report.

Physician Assistant

The physician assistant (PA) helps the physician with the discharge process by completing the DC Navigator and writing the discharge order for certain patients as requested by the physician. Physician Assistants may work on different patients from different teams. When notified by the physician regarding a discharge, the physician assistant fills out steps 1-10 and step 12 of the DC navigator. The physician assistant will then page the physician for proofing and approval, and then sign the discharge order.

Discharge Planner

The Discharge Planner facilitates the transfer of patients from the hospital to the community, home, or any extended health service. The discharge planner also communicates with the medical staff, the patient, and the patient’s family to ensure that the discharge process is as smooth as possible.

Goals and Objectives

The goal of this project was to identify non-value added steps in the discharge process which, when eliminated, will ideally improve the flow of inpatients through their hospitalization. Additionally, we determined some of the root causes of high degrees of variation in the discharge process.

Methods

To identify non-value added steps in the discharge process, our team used the following methods:

- Observed the discharge process at Unit 5B to understand the process as a whole, to identify qualitative problems with the discharge process as perceived by us, and to develop a process for collecting data that would achieve the goals of the project.
- Informally interviewed physicians, nurses, clerks, and patients
- Developed metrics for the time studies and the current state map of the discharge process.
- Conducted time studies and recorded specific details for 35 discharges of different patients of different parts of the process.
• Created a current state map of the discharge process.
• Performed Pareto analysis and developed control charts.
• Performed a literature search of relevant projects to obtain benchmarking data as well as to identify common sources of waste.

Key Findings and Conclusions

The key findings from utilizing the methods described above are presented in this section.

Key Qualitative Findings

The project team members created flowcharts, conducted informal interviews, created a fishbone diagram, and performed a literature search to obtain qualitative findings.

Flowcharts – Tasks of Key Personnel
Observing the discharge process at unit 5B helped the project team members understand the tasks of each party involved in the discharge process. To illustrate the general tasks of four key parties, flowcharts were created for the physician, the physician assistant, the nurse, and the clerk. These flowcharts are located in Appendix A and were created from the perspective of the project team members based on observations. The tasks that are described for each party are not limited to what is shown in the flowcharts. A description of the tasks described by the flowcharts is included below.

Physician’s Flowchart (Appendix A-1)
The physician’s tasks throughout the shift are focused on rounding (seeing patients), and entering patient information into the DC Navigator. The physician starts rounding at the start of the shift. Although the order in which the patients are seen varies depending on the physician, the sickest patients generally have the highest priority. In between morning rounding, generally at a time between 8:45 AM to 9:15 AM, the MFH physician meets with one of two discharge planners and a social worker for an average of 19 minutes to discuss the discharge and overall status of all the patients assigned to them. The physician continues rounding until all of the patients are seen. Before seeing each patient, the physician does some, none, or all of the following tasks, depending on the status and illness of the patient:

1. Looks through the clipboard located outside of the patient’s room to check for updates.
2. Contacts other parties by page, phone, or both.
   a. Contact the physician assistant to finish the DC Navigator for the discharge patient.
3. Looks through the DC Navigator to check for labs, other updates, or to make updates.
4. Manually checks lab result(s) at the lab located in the basement.

After speaking to the patient, the physician does some, none, or all of the following tasks:

1. Contacts other parties by page, phone, or both.
   a. Contacts the physician assistant to finish the DC Navigator for the discharge patient.
b. Contacts the discharge planner or social worker to request or give an update.
c. Contacts consultants, physical therapists, or other parties that may be required.

2. Writes order(s).
3. Updates or finishes the DC Navigator.

After all of the patients have been seen, the physician spends time finishing the DC Navigator steps that have not yet been completed for the discharge patients. In addition, the physician spends time updating the DC Navigator for non discharge patients. After the DC Navigator is completed for a discharge patient, the physician may or may not speak to the patient with a printout of steps 4 and 12, depending on the situation of the patient and how busy the physician is at the moment. The physician then signs the DC order, and returns to the DC Navigator to work on other discharge or non discharge patients, or perform other tasks for the remaining patients. If a physician assistant is handling the discharge, he or she notifies the physician upon completion via the paging system. The physician reviews all the steps and then finalizes it by paging the physician assistant back. If there are alterations, the physician assistant will be notified accordingly. The physician assistant then prints out the discharge summary and the prescriptions and may or may not speak to the patient again. The physician assistant then signs the discharge orders and continues to work on the DC Navigator of other patients.

Clerk’s Flowchart (Appendix A-2)
The clerk is notified that the patient will be discharged by a color coded dial on the outside of the patient’s chart which is turned blue. The clerk takes the patient’s chart from the shelf, pulls the discharge strip from the patient’s chart, and begins preparing a discharge envelope for the nurse to give to the patient. If the patient will be receiving extended care from outside of the hospital, such as a nursing home, the clerk prepares a large brown envelope containing information about the patient that the extended care service needs to continue caring for the patient. If the patient is not going to an extended care service provider, the clerk prepares a smaller brown envelope that contains education information for the patient and a survey for the patient to complete. The clerk then places the prepared envelope nearby (the specific location varies amongst clerks) for the nurse to retrieve. The clerk then enters a discharge request (DSRQ) into the computer. The DSRQ notifies admittance and the cleaning staff that there is a pending discharge in a specific room (the patient’s room). However, from the observations it was found that the DSRQ was entered into the computer only 51.7% of the time. After the clerk has prepared the envelope and placed it nearby, the nurse carries out the remainder of his or her tasks in the discharge process. The clerk continues with other tasks and waits for notification that the patient has left the room. The clerk is notified through one of several different methods including:

1. The clerk sees the clipboard hanging outside of their desk.
2. The clerk is notified by the nurse.
3. The clerk physically observes the patient leave the room, or that the room is empty.
4. In the case when the patient leaves by ambulance, the clerk sees that the large envelope was taken by the paramedics, indicating the patient has left.

When the clerk knows that the patient has left the room, he or she enters into the computer that the patient has been discharged (DSCG), which notifies admittance and the cleaning staff that the discharge has occurred.
**Nurse’s Flowchart (Appendix A-3)**

The nurse’s role in the discharge process begins when he or she is informed that the patient is going to be discharged. From our observations, we found that the nurse can be informed of a discharge through a combination of 3 different sources.

1. The physician, the physician assistant, the discharge planner, or the patient notifies the nurse that the patient is going to be discharged.
2. The clerk notifies the nurse that the patient is going to be discharged.
3. The nurse sees the completed envelope located near the clerk’s desk, signaling that the patient will be discharged.

After the nurse is notified that the patient will be discharged he or she must complete step 11 of the DC Navigator and then print out patient education sheets. If the patient needs prescription medication (either from the hospital pharmacy or an outside pharmacy) the nurse must copy the prescription dosage and frequency of intake by hand onto the prescription printout. The nurse must also retrieve the envelope that the clerk prepared. The time that the nurse retrieves the envelope is variable and can occur either before or after step 11 of the DC Navigator is complete. If the patient will be receiving extended care from outside the hospital, the education information is placed in a large envelope. If the patient is not going to an extended care service provider, the nurse proceeds to the room with a smaller envelope in hand to educate the patient. After the patient has been educated, the nurse has the patient sign one of the copies of the education information and then the nurse places the signed copy in a clipboard. The nurse continues to observe the room until the patient leaves. When the patient has left, the nurse takes the clipboard from outside of the patient’s door and brings it to the clerk and then hangs the clipboard outside of the clerk’s window.

**Informal Interviews – Common Responses**

While observing the discharge process, the project team members asked key personnel as well as discharge patients questions about the discharge process. Some of the common responses are described below.

- Responses concerning the DC Navigator:
  - The amount of information that needs to be filled out in the DC Navigator is very large and time consuming.
  - The DC Navigator does not always have the most updated prescription medication information. Therefore, the nurse must copy the prescription dosage and frequency of intake by hand onto the prescription printout from the DC Navigator, which can be cumbersome.
  - The DC Navigator has a limit of 4,000 characters for each section. This is not always enough space for the information and can result in wasted time due to editing and copying parts of the information to other sections in order to stay below the limit. However, some physicians and physician assistants have given positive feedback because it keeps the sections from becoming unnecessarily long.
The DC Navigator lacks the function to import information. Because of this, the physicians, physician assistants, and nurses must copy and paste much of the information. This can be tedious and has a high potential for mistakes.

There are templates for many steps of the DC Navigator which contain information that may not be necessary for the patient. For instance, there is information for patients who smoke as well as patients who do not smoke. So, if the patient is a smoker then the physician must delete the information for non-smokers and vice versa.

The nurse must discuss two different education sheets (physician’s copy and nurse’s copy) with the patient before the patient can go home. However, most of the content on the nurse’s sheet is the same as the content on the physician’s sheet. Also, the nurse’s copy often refers the patient back to the physician’s copy for certain information. It is suggested by physicians and nurses that these two education sheets be condensed.

- Responses concerning shift change:
  - Patients are often ready to be discharged near the end of the nurse’s and/or clerk’s shift. This can lead to delays because the nurse and/or clerk may not be able to stay beyond the length of their shift to complete the discharge. In this case, the patient information must be handed off to the replacing shift. It is believed that this handoff process delays the discharge. In addition, the patient and nurse may not be familiar with one another which can be inconvenient for each person.

- Responses from the patients:
  - The patients were told early in the day that they would be discharged but had to wait until the afternoon to go home.
  - The project team members asked three different patients for the time that they thought they would be able to leave the hospital (this was an estimated time told to the patient by either the physician or the nurse). In all three cases the time they actually left was later than the estimated time.
  - Patients that were familiar with the discharge process anticipated a lengthy discharge.

- Responses concerning the lack of standardization:
  - On several occasions the physicians, nurses, and clerks stated that the way they carry out their tasks may not be the same as the way others carry out the same tasks.
  - Each physician has his or her own priority in seeing patients (after the most critical are first seen).

- Responses from the clerks:
  - Many discharges occur around the same time in the day. Because of this, the clerk’s receive many tasks in a short amount of time. This can hold up the discharge process and, in addition, can be overwhelming for the clerk.
  - Many times when the clerk goes on lunch break nobody takes over their tasks. Anything that is not urgent is put off until the clerk returns. If a physician or
nurse needs the clerk to perform a specific task, the physician or nurse must ask the other clerk or do it themselves.

- Additional responses from the physicians:
  - The physicians would like to have a designated place to write orders.

**Literature Search – Common Drivers of Waste and Successful Improvement Strategies**

The project team members conducted a literature search of relevant projects to identify common drivers of waste and to identify methods and strategies that have been successfully implemented to improve the discharge processes elsewhere. In the search, the project team members identified six projects that were conducted to improve the discharge processes of other hospitals. A summary of each of these reports appears in Appendix B.

The common drivers of waste that have been identified include:

- Unnecessary handoffs of information between parties.
- Clarification of information regarding a patient that prevented a nurse from continuing with the discharge process.
- Need for aftercare equipment which must be ordered by the social worker.

Some methods and strategies that have been successfully utilized and/or implemented to improve the process at other hospitals include:

- Playing a video on the TV in the patient’s room that explains the discharge process to the patient.
- Creating a poster size version of the flowchart and current state map to place in the nurses’ office for the nurses to add comments for improvement.
- Conducting daily meetings between the key parties involved in the discharge to assess the patients the day before discharge. Topics discussed during the meeting include lines, elimination (Foley’s), activity level, diets/tube feeding, consults, aftercare orders, and medical records. The meetings reduced clarifications and aftercare on the day of discharge.

**Key Quantitative Findings**

To obtain quantitative findings, the project team members, conducted time studies, performed Pareto analysis, created a current state value stream map, created control charts, and performed a literature search to obtain benchmarking data.

**Times Studies**

The project team members have observed a total of 35 discharges and 2 cancelled discharges. However, due to the high variability in the order tasks are completed in the discharge process as well as the length of the discharge process, most of the observed data points were segments of discharges rather than entire discharges. Of the 35 observed discharges, 22 were patients under the care of MFH physicians. A detailed description of the methods used to collect the data is provided in Appendix C and a breakdown of the observed discharges is provided in table 1 below.
Table 1: Breakdown of segmented discharge observations

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Unit 5B observation</td>
<td>1</td>
</tr>
<tr>
<td>Complete non Unit 5B observation</td>
<td>1</td>
</tr>
<tr>
<td>First decision to discharge patient → discharge order written</td>
<td>10</td>
</tr>
<tr>
<td>Talking to patient or discharge planner → discharge order written</td>
<td>5</td>
</tr>
<tr>
<td>Discharge order written → input of DSCG information</td>
<td>18</td>
</tr>
<tr>
<td>Cancelled Discharge</td>
<td>2</td>
</tr>
</tbody>
</table>

The average discharge process time for the physician’s role, which starts when the physician first speaks to the patient and ends when the physician signs the discharge order, takes 218 minutes (3 hours and 38 minutes). The average discharge process time for the nurse’s and clerk’s role is calculated from two methods.

**Method 1:** The average discharge process time is calculated by taking the difference between the time that the discharge order was written and the time that the clerk entered the DSCG into the computer (this point is obtained using the computer logs).

**Method 2:** The average discharge process time is calculated by summing the average process times and wait times for each task that must be completed by the nurse and clerk.

Using the first method, the average discharge process time takes an average of 191 minutes (3 hours and 11 minutes). Using the second method, the average discharge process time takes an average of 203 minutes (3 hours and 23 minutes). The average total discharge time is 409 minutes (6 hours and 49 minutes) according to the first method, and 421 minutes (7 hours and 1 minute) according to the second method. This data can be seen in Table 2.

Table 2: Average discharge times for key personnel’s role in the discharge process

<table>
<thead>
<tr>
<th>Physician’s Role (min)</th>
<th>Clerk and Nurse’s Role (min)</th>
<th>Total Discharge Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Method 1</td>
<td>Method 2</td>
</tr>
<tr>
<td>218</td>
<td>191</td>
<td>203</td>
</tr>
</tbody>
</table>

Pareto Analysis
The project team members created a Pareto chart of the length of each step of the discharge process in correlation to the overall length of the process and, in addition, prioritized the root issues and determined which should be focused on. The Pareto chart can be seen in Figure 1 below.
The longest step in the discharge process takes place during the physician’s role. Specifically, the longest step takes place from the time when the physician starts speaking to the patient to the time when the DC Navigator is completed. This process contributes to approximately 40% of the total discharge time, and includes the sub processes as seen in the physician’s flowchart (Appendix A-1). The project team members decided to congregate such sub processes into one large process due to the following reasons.

1. The starting point of the DC Navigator process occurs when the patient is first admitted. On the day of the discharge, the physician or physician assistant finishes the DC Navigator. The time that it takes to finish the DC Navigator on the last day is also dependent on when the patient is admitted.

2. The physician may choose to complete the DC Navigator for a discharge patient all at once, hand it off to the physician assistant for completion, complete parts intermittently as required information becomes available, or other ways depending on the physician’s personal preference.

These reasons are caused by process variation, which is a form of waste, as identified in the literature search. Of these sub processes, the only entirely value added process (from the perspective of the hospital) is when the physician speaks to the patient and when the nurse
educates the patient. As a result, only about 5% of the total discharge process time is spent on pure value added activities (Table 3).

Because 40% of the discharge time is spent on the step that starts when the physician starts speaking to the patient and ends when the DC Navigator is finished, the project team members have performed a deeper analysis on this step. From one sample observation of a physician’s activities on a Thursday from meeting with the discharge planner (9:05) to finish rounding (12:34), the team has identified all the different activities performed by the physician, distributed by time (Figure 2). The physician was expecting four discharge patients out of eight total patients. From the perspective of the physician, the only current non-value added process is walking, in which the physician spent 26 minutes traveling between floors in order to see the patients. The physician spent time working on patients on every floor from four to eight. Currently, the physician has no set priority to complete the activities as seen in Figure 2. Nearly 20% of the time was spent working on the DC Navigator, in which none of the DC Navigators of any of the discharge patients were finished between the start and end of the observation. Due to the large percentage of time spent on the DC Navigator and the fact that this step must be

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<table>
<thead>
<tr>
<th>Process</th>
<th>Average Duration (min)</th>
<th>Total (min)</th>
<th>% of Total</th>
<th>Person Involved</th>
<th>Value added type (To hospital)</th>
<th>Waste Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician starts speaking to patient -&gt; DC Nav finished</td>
<td>171</td>
<td>421</td>
<td>40.62</td>
<td>Physician</td>
<td>NVA, VA, NVABN</td>
<td>Motion, Waiting, Correction</td>
</tr>
<tr>
<td>Physician starts speaking to patient -&gt; finish speaking to patient</td>
<td>9</td>
<td>421</td>
<td>2.14</td>
<td>Physician</td>
<td>VA</td>
<td>-</td>
</tr>
<tr>
<td>Patient leaves -&gt; DSCG entered</td>
<td>69</td>
<td>421</td>
<td>16.39</td>
<td>Clerk</td>
<td>NVA</td>
<td>Waiting</td>
</tr>
<tr>
<td>Envelope ready -&gt; Nurse picks up envelope</td>
<td>42</td>
<td>421</td>
<td>9.98</td>
<td>Nurse</td>
<td>NVA</td>
<td>Waiting</td>
</tr>
<tr>
<td>Nurse finishes education -&gt; Patient leaves</td>
<td>34</td>
<td>421</td>
<td>8.08</td>
<td>Patient</td>
<td>NVA</td>
<td>Waiting</td>
</tr>
<tr>
<td>Nurse picks up envelope -&gt; Nurse starts education</td>
<td>24</td>
<td>421</td>
<td>5.70</td>
<td>Nurse</td>
<td>NVA</td>
<td>Process</td>
</tr>
<tr>
<td>DC order signed -&gt; Clerk takes DC order</td>
<td>23</td>
<td>421</td>
<td>5.46</td>
<td>Clerk</td>
<td>NVA</td>
<td>Waiting</td>
</tr>
<tr>
<td>Start meeting w/ DC planner -&gt; Finish meeting w/ DC planner</td>
<td>19</td>
<td>421</td>
<td>4.51</td>
<td>Physician</td>
<td>NVABN¹</td>
<td>-</td>
</tr>
<tr>
<td>Finish DC Nav -&gt;DC order signed</td>
<td>18</td>
<td>421</td>
<td>4.28</td>
<td>Physician</td>
<td>NVA²</td>
<td>Waiting</td>
</tr>
<tr>
<td>Nurse starts education -&gt; Nurse finishes education</td>
<td>8</td>
<td>421</td>
<td>1.90</td>
<td>Nurse</td>
<td>VA³</td>
<td>-</td>
</tr>
<tr>
<td>Clerk takes DC order -&gt; Envelope ready</td>
<td>4</td>
<td>421</td>
<td>0.95</td>
<td>Clerk</td>
<td>NVABN</td>
<td>-</td>
</tr>
</tbody>
</table>

---

¹ Non Value Added, but necessary
² Non Value Added
³ Value Added
completed before the discharge order can be signed, the team further analyzed the DC Navigator process through time studies.

Figure 2: Distribution of a physician’s activities in a single day

From the DC Navigator data logs collected, the project team members determined the amount of time that existed between the last save of each of the 12 steps of the DC Navigator and the time the discharge order was written in order to identify which steps require the most amount of time to finish from admittance. From a total of 13 different discharges, Figure 3 shows that steps 1, 2, 9, and 10 are finished with an average of at least 1,000 minutes before the DC order is written. However, steps 3 through 8 are all finished within 4 hours before the order is written, and step 12 is finished only 12 minutes before. In addition, step 11 isn’t completed by the nurse until about one hour after the discharge order is written. The earlier the step is finished, the less time and effort it takes to finalize the step. Thus, the steps that are closest to when the DC order is written require the most effort, and/or require the most amount of information in order to complete.
The team also determined a relationship between the length of hospital stay and the time at which step 12 of the DC Navigator for a patient is finished by performing linear regression analysis (Figure 4). The analysis gave a p value of 0.03 (Appendix D) indicating that there is a correlation between the predictor, the length of stay in the hospital, and the response, the time of day at which the discharge order is written. Hence, the longer the stay of the patient in the hospital, the more time the physician or physician assistant has to finish the DC Navigator, which leads to earlier discharge orders written.
A correlation test was used to determine if a correlation exists between the length of hospital stay and the number of minutes before that step is finished to when the DC order is written. From table 4, only steps 4 and 12 show statistically significant correlations. Hence, the positive correlation of these two steps indicates that the longer the patient stays in the hospital, the earlier these two steps are finished.

**Table 4: Correlation tests of length of hospital stay vs DC Navigator step.**

<table>
<thead>
<tr>
<th>DC Navigator Step</th>
<th>Correlation</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.342</td>
<td>0.423</td>
</tr>
<tr>
<td>2</td>
<td>0.223</td>
<td>0.423</td>
</tr>
<tr>
<td>3</td>
<td>0.487</td>
<td>0.066</td>
</tr>
<tr>
<td>4</td>
<td><strong>0.805</strong></td>
<td><strong>0.00</strong></td>
</tr>
<tr>
<td>5</td>
<td>0.281</td>
<td>0.310</td>
</tr>
<tr>
<td>6</td>
<td>0.389</td>
<td>0.152</td>
</tr>
<tr>
<td>7</td>
<td>0.384</td>
<td>0.158</td>
</tr>
<tr>
<td>8</td>
<td>-0.063</td>
<td>0.832</td>
</tr>
<tr>
<td>9</td>
<td>0.145</td>
<td>0.636</td>
</tr>
<tr>
<td>10</td>
<td>0.394</td>
<td>0.183</td>
</tr>
<tr>
<td>11</td>
<td>-0.118</td>
<td>0.674</td>
</tr>
<tr>
<td>12</td>
<td><strong>0.675</strong></td>
<td><strong>0.011</strong></td>
</tr>
</tbody>
</table>
The non-value added waste areas of the process from when the physician first speaks to the patient to when the physician completes the DC Navigator only include walking, and the DC Navigator itself. The amount of time spent walking is contributed to by the variation in the order that the patients are seen, and also on the location of the patients assigned to the physician. Although the total length of time spent working on the DC Navigator could not be determined from the time study, the correlation between the length of hospital stay and the time when step 12 of the DC Navigator combined with the latest finished steps 3 through 8 and 12 indicates that these steps are not bottle necks that require a fixed amount of time for each discharge patient. Thus, the entire DC Navigator can be finished early. However, the correlation tests indicate that of those last steps completed, only steps 4 and 12 are statistically significant. These tests are an indication that those two steps may contain waste which causes them to take more time than actually necessary.

**Current State Value Stream Map**

From the analysis, a current state value stream map was created of the discharge process. This value stream map is located in Appendix E. in combination with the flow charts, the team determined that steps in the discharge process occur both in series and parallel format. For the physician’s role, parallel processes in the discharge occur in the following ways:

- When the physician contacts the physician assistant to finish the DC Navigator of discharge patients, while the physician continues to round to see other patients.

- While the physician is rounding, the discharge planner and social worker resolves the discharge needs of the patient.

If the physician chooses instead to complete the DC Navigator him or herself, then that process will occur in series. The team observed from the current state map that out of a sample size of 15 discharges, the physician assistant completed the DC Navigator and wrote the discharge order for the patient in 8 (53.3%) discharges, whereas the physician completed the DC Navigator and wrote the discharge order in 7 of the discharges (46.6%).

<table>
<thead>
<tr>
<th>Person in charge of DC Navigator and writing discharge order</th>
<th>Number of occurrences (out of 15 total)</th>
<th>Average time discharge order is signed</th>
<th>Number who spoke to patient after DC Navigator completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>7 (46.6%)</td>
<td>11:38 AM</td>
<td>4 (57%)</td>
</tr>
<tr>
<td>Physician Assistant</td>
<td>8 (53.3%)</td>
<td>1:21 PM</td>
<td>2 (25%)</td>
</tr>
</tbody>
</table>

As can be seen in Table 5, the average time that the discharge order was written under the charge of the physician assistant was 1:21 PM. The average time that the discharge order was written under the charge of the physician was 11:38 AM. This 1 hour and 43 minute difference is likely due to the extra steps that the physician assistant must take to complete the DC Navigator. Thus, despite the parallel format of the process, the physician assistant on average writes the discharge order at a later time. As previously mentioned in the literature search, handoff is a considerable form of waste, and even though the physician assistant’s help in completing the DC Navigator
may appear to save time and expedite the process, the communication required between the physician and the physician assistant in finalizing the DC Navigator are hand off wastes that actually increase the overall time required to finish the DC Navigator and write the discharge order. The extra time needed by the physician assistant to complete the DC Navigator and write the DC order can be seen in Table 6.

<table>
<thead>
<tr>
<th>Person in charge of DC Navigator and signing discharge order</th>
<th>Sample Size</th>
<th>Avg Time from Physician starts talking to patient → DC Navigator finished</th>
<th>Avg time from DC Navigator finished -&gt; Order written</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>5</td>
<td>135 Minutes</td>
<td>12 Minutes</td>
</tr>
<tr>
<td>Physician Assistant</td>
<td>13</td>
<td>193 Minutes</td>
<td>18 minutes</td>
</tr>
</tbody>
</table>

In addition, of the 8 discharges assigned to the physician assistant, only 2 spoke to the patient after completing the DC Navigator (with the printout from steps 4 and 12). In contrast, of the 7 discharges under the physician, 4 spoke to the patient after completing the DC Navigator. From the flowchart, the decision of whether to speak to the patient once more after printing out the DC Navigator depends on the physician or physician’s preference, and needs of the patient.

The project team members recorded 12 discharges in which the first data point was the time that the first decision was made to discharge the patient (this point is an estimated time provided by the physician). Of the 12 discharges, 7 were decided on the day before the discharge occurred (Table 7). The mean lead time from when the first decision was made to discharge the patient to when the physician speaks with the discharge planner is 17.5 hours, with a median of 16 hours.

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>On the day of discharge</th>
<th>1 day before discharge</th>
<th>2 days before discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>3</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

For the clerk’s and nurse’s role in the discharge process, the parallel process occurs in the following way:

- The nurse is informed through some sort of communication method to start on step 11 of the DC Navigator after the physician completes his or her part of the DC Navigator and before the nurse takes the envelope. In 5 of the 21 discharges (24%), the nurse started the DC Navigator process before the envelope was ready.

When the parallel process occurs, the team discovered that the patient leaves the hospital on an average 83 minutes earlier, than if the nurse picks up the envelope and starts the DC Navigator afterwards in a series process (Table 8). Moreover, as the nurse does not have to wait for the envelope to be ready in the parallel process, the time between when the envelope is ready and when the envelope is picked up reduces by an average of 35 minutes.
Table 8: Time when patient leaves hospital depending on when the nurse starts DC Navigator

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Envelope Ready -&gt; Envelope picked up</th>
<th>Sample Size</th>
<th>Nurse picks up envelope → Time patient leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>7 minutes</td>
<td>3</td>
<td>23 minutes</td>
</tr>
<tr>
<td>11</td>
<td>42 minutes</td>
<td>9</td>
<td>106 minutes</td>
</tr>
</tbody>
</table>

The second highest amount of time spent in the discharge process is 17% (69 minutes). This occurs between the time when the patient leaves and the time when the DSCG information is entered by the clerk (refer to Figure 1). The reason for this large amount of time is likely due to the non-standardized method of notifying the clerk that the patient has left. Because the clerk is often unaware that the patient has left the room, the clerk will not enter the DSCG into the computer, thus causing a delay in the process (from the perspective of the hospital).

The third highest amount of time spent in the discharge process is 9% (42 Minutes). This occurs between the time that the envelope is ready and the time when the nurse picks up the envelope. Currently, there is no standardized method of contacting the nurse in advance to inform the nurse that a patient will be discharged. However, when the nurse is informed early that a patient will be discharged, the nurse can often begin working on step 11 of the DC Navigator which shortens the length of the discharge process (refer to Table 8). If the nurse is not informed in advance of the discharge, the nurse then relies on the clerk to inform him or her of the discharge. The clerk informs the nurse either by the paging system, by direct conversation, or by placing the discharge envelope in a place for the nurse to visually observe. This lack of standard communication is likely the cause of the large amount of time spent in this process.

The process of the nurse picking up the envelope to the time when the nurse starts educating the patient includes the non-value added step of copying information from the patient MAR onto the prescription printout two times by hand for patients who require prescription medication. In 8 of the 21 discharges (38 %), the nurse spent an average of 7 minutes copying prescription medication information from the patient chart onto both copies of the prescription printouts. This process is a form of non-value added waste, as it can be automated in the DC Navigator.

Control Charts

The team has also utilized x-bar/ range control charts to determine whether or not the current processes from Table 3 are in control for the mean, range, or both for the entire discharge process. The upper and lower specification limits are $\pm 3\sigma$ of the data points.\(^4\) From the control charts...

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\(^4\) Assessing Process “stability” – Statistical Process Control, Lecture #7, Pat Hammet, University of Michigan
charts in Appendix F, 3 processes are currently out of control. These 3 processes are described below:

1. Order written by physician or physician assistant → Clerk takes order
   a. Mean, Range
2. Envelope prepared → Enveloped picked up by the nurse
   a. Mean
3. Nurse finishes education → Patient leaving the hospital
   a. Mean, Range

The findings from the control charts indicate that these processes contain the most variation. The team observed a few reasons which may explain the variation in the three processes above. For the first process, the team observed that the patients’ folders are sometimes not color coded correctly. After a discharge order is written, the patient’s folder should have a blue color code which would let the clerk know of the scheduled discharge. This does not always happen, and consequently leads to the clerk’s delay on taking the discharge order. In addition, the clerk does not have a standardized process or priority in taking the orders. Orders other than the DC order may be processed first.

In the second out of control process, variation may be high due to the fact that the nurse could learn about a scheduled discharge through three different ways explained above in the Nurse Flowchart section. As mentioned previously, there is no standardized way for the nurse to know about which patients are going to be discharged. Another possible reason is the variations on the times that patients could leave the hospital. As the envelope mainly contains information for patient’s education before being discharged, the nurse usually only picks up the envelope when it is near the time for the patient to leave. Sometimes the patient’s ride from the hospital could only arrive very late in the day, so the nurse would not pick up the envelope until the patient is ready to leave.

In the third out of control process, the variation is dependent on the patient’s own choice if he or she is being picked up by a family member, or the scheduling of when the patient leaves by the discharge planner. Likewise, the time from when the nurse finishes education to the time when the patient leaves the hospital is also dependent on when the patient’s ride will come.

In comparison with other units within the hospital, unit 5B has a larger discharge time from when the discharge order is written to the time when the DSCG information is entered into the computer, as shown in Table 9. The average time that the DSCG is entered into the computer is also about one hour later than the other units.

<table>
<thead>
<tr>
<th>Table 9: Average times of unit 5B vs other units</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Table" /></td>
</tr>
<tr>
<td><strong>Sample Size</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Unit 5B</td>
</tr>
<tr>
<td>Other Units</td>
</tr>
</tbody>
</table>
Since the team has only collected the nurse’s and clerk’s role for the discharge at 5B, only the finish time of step 12 of the DC Navigator and the time when the DC order is written are used. From table 10, the times of when the DC Navigator is finished and the time when the DC order is written is on average 18 minutes earlier for unit 5B, however the standard deviation is higher by about one minute.

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Time DC Navigator Finished</th>
<th>Standard Deviation</th>
<th>Time DC order written</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 5B</td>
<td>11:57</td>
<td>2:08</td>
<td>12:08</td>
<td>2:07</td>
</tr>
<tr>
<td>Other</td>
<td>12:15</td>
<td>1:22</td>
<td>12:24</td>
<td>1:16</td>
</tr>
</tbody>
</table>

**Table 10: Average time of DC Navigator finished and DC order written by unit**

---

**Literature Search – Obtaining Benchmarking Data**

The project team members researched improvements in the discharge process by other hospitals in order to obtain benchmark data. The Valley Baptist Medical Center in Harlingen, Texas has observed a mean improvement of 74% from when the discharge order is written to when the patient leaves, with a 70% decrease in standard deviation. In order to reach the decrease, they reworked the current process involving the clerk and nurse and developed a new standard operating procedure. The new process incorporated the clerk calling the nurse to notify of a discharge, and then the nurse completing the rest of the discharge tasks until the patient signs the education form. In addition, a daily meeting which discussed the discharges for the next day would be held for the nurses and other professionals to increase awareness and responsibilities. At the UMHS, the current time from when the discharge order is written to when the patient leaves is 191 minutes, based on 5 data points.

**Table 11: Benchmarking analysis for the Valley Baptist Medical Center**

<table>
<thead>
<tr>
<th></th>
<th>From Discharge order Entry to Patient Leaving (minutes)</th>
<th>From Patient Leaving to Discharge in Computer (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>184.8</td>
<td>47.8</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>128.7</td>
<td>37.2</td>
</tr>
</tbody>
</table>

**Table 12: Analysis of UMHS patient discharge times**

<table>
<thead>
<tr>
<th></th>
<th>From Discharge order Entry to Patient Leaving (minutes)</th>
<th>From Patient Leaving to Discharge in Computer (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>134.8</td>
<td>Current 69</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>109.5</td>
<td></td>
</tr>
</tbody>
</table>

In order to maintain the improvement, the hospital used the change acceleration process (CAP) and an ongoing tracking system, in which they were guide by a Black Belt six sigma team and the process owner. Sessions were held to include exercises to help participants better understand and appreciate Lean and Six Sigma.
**Fishbone Diagram**

As the final part of the analysis, the team created a fishbone diagram utilizing both the qualitative and quantitative data from observations and computer logs to identify the drivers of waste and variability. This diagram is located in Appendix C. The team has separated the drivers into six different categories. Categories include the physician, the clerk, the nurse, the discharge planner and patient, the social worker, and transportation issues. Each of the categories contains issues which act as the symptoms that cause an inefficient discharge process. The identification of these symptoms serves to surface the underlying problems, which in effect allows solutions to be implemented in the future.
Appendix A -1: Flowchart of the Physician’s Role in the Discharge Process

Flow chart of the physician's role in the discharge process

START

Yes

Go home

End

Physician makes contacts.

No

Physician speaks to DC planner?

Yes

Meet DC planner?

Physician Rounds (See patient)

No

As my shift over?

Anymore patients to see?

Physician makes contacts.

Yes

No

Work on patient(s)

Does additional work need to be done for this patient?

Yes

No

Sign DC order for patient

No

Yes

Sign DC order now?

Yes

No

Talk to patient with printout

Speak to patient?

Write non-DC Order(s) to patient

Complete additional tasks for patient

Yes

No

Print out prescriptions and DC summary report

No

Yes

Sign DC order now?

Yes

No

Page Nurse to get started on step 11 of DC nav.

Finish OR work on DC nav of patient

If finishing includes all sub processes required to finish DC nav?

Yes

No

Notify nurse of completion of DC nav?

Yes

No

Page PA to FINISH DC Nav

Does the PA need to be notified to finish OR work on the DC nav?

Yes

No

PA INVOLVED

End

Is this a discharge patient?

Yes

No

Page PA to FINISH DC Nav

Do non-DC orders need to be written for this patient?

Yes

No

Write non-DC Order(s) for the patient

Yes

No

Notify nurse of completion of DC nav?

Yes

No

Page Nurse to get started on step 11 of DC nav.

Finish OR work on DC nav now?

Yes

No

End

*Check labs, call consultants, call DC planner, oxygen tank requirements, etc.

Legend

○ Start/End

△ Decision

□ Process

CLERK INVOLVED

TALKING TO PATIENT WITH PRINTOUT

PA INVOLVED

NURSE INVOLVED
Appendix A -2: Flowchart of the Clerk’s Role in the Discharge Process
Appendix A-3: Flowchart of the Nurse’s role in the discharge process

Flow chart of the nurse’s role in the discharge process

Legend
- Start / End
- Decision
- Process

1. Did physician, PA, DC planner or patient notify about DC?
   - Yes → Did clerk notify about DC
   - No → Is there a DC envelope on clerk’s desk?

2. Did clerk notify about DC?
   - Yes → Pick up envelope?
   - No → Work on step 11 on DC Navigator

3. Pick up envelope?
   - Yes → Print step 11 from DC Navigator
   - No → Does the patient need discharge medication?

4. Does the patient need discharge medication?
   - Yes → Copy discharge medication education (dosage) from patient MAR onto both printed copies
   - No → Is it near the time for scheduled DC?

5. Is it near the time for scheduled DC?
   - Yes → Place clipboard outside of clerk’s desk
   - No → Do other tasks

6. Place clipboard outside of clerk’s desk
   - Yes → Educate Patient
   - No → Prepare clipboard

7. Prepare clipboard
   - Yes → Has the patient left room?
   - No → Do other tasks

8. Has the patient left room?
   - Yes → Pick up envelope
   - No → Educate Patient

9. Educate Patient
   - Yes → Was envelope picked up yet?
   - No → Pick up envelope

10. Was envelope picked up yet?
    - Yes → Educate Patient
    - No → Do other tasks
Appendix B: Literature Search - Summary

Literature Search Results
IOE 481 - Team 3
Analysis of the Discharge Process
at Internal Medicine Unit 5B
3/15/2007

Summary of Findings

Interactive Care Network and Skylight Healthcare Systems Partner to Streamline the Discharge Process for Hospitals and Patients\(^5\) 3/12/2007

- Interactive Care Network (Columbus, Ohio) will collaborate with Skylight Healthcare Systems to provide “search database”.
- Transform television into an interactive information, communication, and education resource which includes Nine categories of post acute care services.
- Overall goal: Allow patients to research and learn on their own for a better mutual understanding of the sickness.

Our Situation: Our television currently only shows cable TV.

The Discharge Improvement at Duke University Medical Center & Health System\(^6\) 7/1/2002

Goal: Discharge 60% of surgical patients and 40% of medical patients by 11:00 am each day.

Plan: “Patient Resource Managers” (PRM)
- Work with physicians to identify patients who are expected to be discharged at least 24 hrs in advance.
- Communicate with physicians
- Pend expected discharge into a computer information system
- Track reasons of cancellations of pended discharges in browser

“Health Unit Coordinator” (HUC)
- Cancel pending discharges when the physician has written it in the patient chart.
- Enter lab and radiology orders as “priority” when requested by the physician
- Collect discharge hand passes from patients when they vacate room.
- Enter discharge into computer information system within 15 minutes of patient vacating the room.

Certain lab tests ordered by 4:00 AM to be returned by 9:00 AM

Results: 9.8% of patients discharge by 11:00 AM before, 12% after implementation.

Our Situation: The closest person we have to the PRM is the DISCHARGE planner. However, the PRM is more specialized. Our clerk’s duties are similar to the HUC.

The Satisfaction Monitor\(^7\) 3/2002

Using patient survey card as a measure

Developed > 40 different pre-printed diagnosis-specific discharge instruction with input from patients reviewed by staff.
Give patients home care information, for those who need medical equipment.
Follow up patients with phone calls within 48 hours.
7 minute discharge video
- Transportation, care instructions, medications, and after discharge rehabilitation.

\(^7\) [http://pressganey.com/products_services/readings_findings/satmon/article.php?article_id=47](http://pressganey.com/products_services/readings_findings/satmon/article.php?article_id=47)
Results: Patient discharge satisfaction before: 15th percentile. After: 60th percentile.

Literature Search Results
IOE 481 - Team 3
Analysis of the Discharge Process
at Internal Medicine Unit 5B
3/15/2007

How a “ticket home” can help streamline the discharge process
3/2004

- Install message boards in patient rooms.
- Provide areas for hospital staff, patients, and family members to write messages to each other and ask questions about the patient’s progress.
- Help everyone understand what needs to be accomplished before patients can go home.
- Three portions of the board
  - Cork board – hang cards and notes, clock.
  - “large type” – to track patient progress in functional areas. E.g. lists goals such as “I can feed myself”
  - Comments from patients

Results: Increased communication between family, patient, and staff. No study on if it actually reduced discharge time.

Our situation: Supply boards on unit 5B as a test. Cost?

Literature Search Results
IOE 481 - Team 3
Analysis of the Discharge Process
at Internal Medicine Unit 5B
2/25/2007

Key points:

- Lean process map was the most important tool for determining critical drivers of waste and variation.¹
- Physician clarifications and aftercare as largest causes for delays.
- Scope: (1) From discharge order entry to discharge instructions signed. (2) to patient leaving.

Problems Identified:

- Lack of standard operating procedures led to widespread process variation.¹
- Clarification needed from nurses to clerks before entering info onto computer (21%) → wasted time (12-45 min).
- No handoff (9 min) → Handoff (73 min) No Aftercare (121 min) → Aftercare (160 min)

Measure:

- Discharge Process:
  1. Physician writes discharge order to discharge instructions signed.
  2. Discharge instructions signed to patient leaving.
  3. From patient leaving to room cleaned
  4. From room cleaned to discharge entered in the computer. (Ready for next patient)

- Our scope: 1 and 2.
- Manual time studies.
- Developed and printed a large copy of the representative process map and placed it in nurses’ lounge for comments.

¹ Creating a Lean Six Sigma hospital Discharge Process Case Study (http://healthcare.isixsigma.com/library/content/c040915a.asp)
Analyze:

- Fishbone diagram to visualize drivers of variability ➔ controllable vs uncontrollable ➔ Effort to fix vs Benefit from fix
- Stakeholder analysis

Improvement:

- Improved process (from clerk taking discharge slip to patient signature) is very similar to our current process.\(^8\)
- Daily meetings to coordinate discharge activities for the day. Patients would also be assessed the day BEFORE discharge.
- “Discharge Slip” given to clerk to signify the leaving of a patient. Similar to our survey card.
- Priority for discharge patients who need x-ray, lab work, supplies/equipment added onto computer.\(^9\)
- Add the question: “How will you get home at discharge” at the time of ADMISSION.
- Discharge video for patient.

Control:

- Daily report of prior day’s discharges ➔ discharge times, nurses and secretary responsible.\(^8\)
- Performance tracker for each clerk, nurse. (Dashboard)
- Control chart tracking means and standard deviation.

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\(^8\) Leveraging Six Sigma to Improve Hospital Bed Availability (http://www.isixsigma.com/library/content/c030708a.asp)

\(^9\) Leveraging Six Sigma to Improve Hospital Bed Availability (http://www.isixsigma.com/library/content/c030708a.asp)
Appendix C: Data Collection Method – A Detailed Description

The data collection was divided into two parts: the role of the MFH physicians in the discharge process and the role of the clerks and nurses of unit 5B in the discharge process. If an MFH physician discharged a patient from unit 5B, then the project team member observed the entire discharge process for that patient. If the MFH physician discharged a patient from anywhere other than unit 5B, the project team member observed the discharge process up to the time that the physician wrote the discharge order and placed it in the cabinet near the clerk. However, on some days no MFH patients were discharged on unit 5B. This situation presented a problem for collecting enough data points. To address this problem, the project team members observed the patients of all physician groups (not just MFH) being discharged on unit 5B from the point that the discharge order was placed in the cabinet near the clerk. If the patient was not an MFH patient then whatever happened before the discharge order was placed in the cabinet near the clerk was not recorded.

Collecting Data on the Role of MFH Physicians in the Discharge Process

The project team members shadowed the MFH physicians and manually collected the data. To do this the project team member contacted the MFH physicians via the paging system, preferably when the physicians were conducting their discharge rounds (this is the time that most discharges begin). The MFH physicians responded to the page and informed the project team member of any discharges that would occur. If a patient was going to be discharged, the project team member asked permission to shadow the physician. If given permission, the project team member followed the physicians through all units. The starting point for observing the MFH physicians was the time at which the physician decided to have the patient discharged. If this decision was made on a previous day then the physician was asked if he or she could recall the approximate time of the decision. During the shadowing process, the project team member recorded data points using a spiral notebook. The notebook was used to collect specific times and details about the discharge such as reasons for delays. All times were recorded to the nearest minute using a standard wrist watch or a cellular phone. The data points that were collected include the following times:

- The physician decides to discharge the patient (may be an estimate from the day before).
- The physician first speaks to the patient during discharge rounds.
- The physician speaks with the discharge planner.
- The physician speaks to the patient with the DC Navigator printout.
- The physician writes the discharge order.
- The physician or physician assistant places the order in the cabinet near the clerk.

At the completion of data collection, 23 discharges were observed that include some or all of the data points described above which, were obtained from shadowing the MFH physicians.

Collecting Data on the Role of Clerks and Nurses of Unit 5B in the Discharge Process

To collect data on the role of the clerks of unit 5B in the discharge process, the project team member first introduced them self to the clerk. The clerk was then informed about the project and the project team member asked permission to sit with the clerk and observe the process. If granted permission, the project team member sat with the clerk to observe the discharge process and recorded the following times:

- The physician or physician assistant places the order in the cabinet near the clerk.
- The clerk takes the order from the cabinet and pulls the strip.
- The clerk enters the discharge request (DSRQ) into the computer.
- The clerk finishes preparing the envelope and places it in a location nearby.
• The nurse picks up the envelope.

When the envelope was picked up by the nurse, the project team member introduced them self to the nurse, and explained the project and why it is important. The project team member then asked permission to shadow the nurse to observe the discharge. If granted permission, the project team member recorded the following times:

• The nurse completes step 11 of the DC Navigator.
• The nurse begins educating the patient.
• The nurse finishes educating the patient.
• The patient leaves their room.
• The nurse hangs the clipboard with the signed patient sheet outside of the clerk’s window.
• The clerk enters the discharge (DSCG) into the computer

At the completion of data collection, 14 discharges were observed that include some or all of the data points described above, which were obtained from shadowing the clerks and nurses in unit 5B.

Collecting Data from Computer Logs

In addition to manually collecting data, the project team members obtained computer logs for analysis. The project team members used these logs to verify the times recorded during the manual data collection process as well as to provide official times for determining the total length of each discharge. The project team members obtained this data through the assistance of Dr. Robert Chang, Instructor of the Non-Housestaff Hospitalist Service, and Kate Bombach, Lean Coach for Michigan Quality Systems. The DC Navigator was used to obtain the time that the last step of the DC Navigator was finished and the MCIT med-info web file server was used to obtain the DSRQ and DSCG computer logs. Using these logs, we obtained the following times:

• The physician completed steps 1-10 and step 12 of the DC Navigator.
• The clerk entered the discharge request (DSRQ) into the computer.
• The nurse completed step 11 in the DC Navigator.
• The clerk entered that the patient was discharged (DSCG) into the computer
Appendix D: Linear Regression Output

Regression Analysis: step 12 finished versus hospital stay

The regression equation is
step 12 finished = 0.575 - 0.0111 hospital stay

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<tr>
<th>Predictor</th>
<th>Coef</th>
<th>SE Coef</th>
<th>T</th>
<th>P</th>
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S = 0.0642343  R-Sq = 37.8%  R-Sq(adj) = 34.6%

Analysis of Variance

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<tr>
<th>Source</th>
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<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
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</table>
Appendix E: Current state value stream map

[Diagram of the current state value stream map showing the process from patient encounter to discharge, with detailed steps for each role involved.]
Appendix E-1: The Physicians’, PAs’, Discharge Planners’, and Social Workers’ Roles in the Discharge Process

**Physician speaks to patient during rounds → Physician or Physician Assistant finishes dis. Nav**

**Physician finishes DC Navigator → Physician or Physician Assistant signs DC Order**

**Physician** contacts PA to finish dis. Nav of patient

**Physician** finishes DC Nav

**Physician Assistant** pages Physician for approval

**Physician Assistant** prints DC Nav steps (4L2)

**Physician** speaks to pt w/ patient

**Physician** writes DC order for patient

**Physician Assistant** reads pt’s chart

**Physician** speaks to patient → Order written by pa or p:

- **Mean:** 189 Minutes
- **Best Case:** 37 Minutes
- **Worst:** 383 Minutes

**Discharge Planner**

Arranges transportation for patient, continued therapy.

**Social Worker**

Take care of insurance issues

**First decision of dc → speaking with dis. planner**

**Physician**

- First decision made to discharge patient

**N=9**

Mean: 171 Minutes

Median: 164 Minutes

Max: 332 Minutes

Min: 36 Minutes

StdDev: 1 Hour, 43 Minutes

**N=8**

Mean: 181 Minutes

Median: 123 Minutes

Max: 511 Minutes

Min: 1 Minute

StdDev: 15 Minutes

**N=6**

Mean: 193 Minutes

Median: 119 Minutes

Max: 322 Minutes

Min: 63 Minutes

StdDev: 101 minutes

**Physician speaks to patient during rounds → Physician Assistant finishes dis. Nav**

**Physician finishes DC Navigator → Physician or Physician Assistant signs DC Order**

**Physician**

- Takes the order

- Pulls strip

- Clerk

- Signs DC order

**N=7**

Mean: 190 Minutes

Median: 201 Minutes

Max: 322 Minutes

Min: 63 Minutes

StdDev: 101 minutes

**N=9**

Mean: 174 Minutes

Median: 156 Minutes

Max: 38 Minutes

Min: 0 Minutes

StdDev: 140 Minutes

**N=6**

Mean: 181 Minutes

Median: 119 Minutes

Max: 511 Minutes

Min: 1 Minute

StdDev: 15 Minutes

**N=5**

Mean: 12 Minutes

Median: 13 Minutes

Max: 17 Minutes

Min: 3 Minutes

StdDev: 4 Minutes, 30 seconds

**N=8**

Mean: 23 Minutes

Median: 14 Minutes

Max: 66 Minutes

Min: 2 Minutes
Appendix E-2: The Nurses’ and Clerks’ roles in the Discharge Process
Appendix F: Control Chart (in minutes)

**I-MR Chart of d/c planner meeting**

- Individual Value
  - Observation: 987654321
  - Mean: 19.6
  - UCL: 29.57
  - LCL: 9.63
- Moving Range
  - Observation: 4321
  - Mean: 3.75
  - UCL: 12.25
  - LCL: 0

**I-MR Chart of finish speaking to patient -> finish DC Nav**

- Individual Value
  - Observation: 987654321
  - Mean: 180.3
  - UCL: 534.1
  - LCL: -173.4
- Moving Range
  - Observation: 4321
  - Mean: 133
  - UCL: 434.5
  - LCL: 0
I-MR Chart of DC Nav finished -> Order written

Observation Individual Value
15131197531
60 40 20 0

X=18.3
UC L=66.0
LC L=-29.4

I-MR Chart of Order written -> Clerk takes order

Observation Individual Value
987654321
100 50 0

X=23.3
UC L=96.5
LC L=-49.8

Observation Moving Range
987654321
80 60 40 20 0

MR=27.5
UC L=89.9
LC L=0
I-MR Chart of Clerk takes order -> Envelope ready

I-MR Chart of Envelope ready -> Envelope picked up
I-MR Chart of Env picked up -> Start Education

I-MR Chart of Education time
I-MR Chart of Finish education -> Patient leaves

- Individual Value
  - X = 32.9
  - UC L = 126.0
  - LC L = -60.2

- Moving Range
  - MR = 35
  - UC L = 114.4
  - LC L = 0

I-MR Chart of Patient leaves -> DSCG

- Individual Value
  - X = 69.1
  - UC L = 315.3
  - LC L = -177.2

- Moving Range
  - MR = 92.6
  - UC L = 302.5
  - LC L = 0