Final Report for Determining Effective Management of All UMHS Stretchers

University of Michigan Health Care System

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>2</td>
</tr>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>Goals and Objectives</td>
<td>5</td>
</tr>
<tr>
<td>Background</td>
<td>5</td>
</tr>
<tr>
<td>Project Plan</td>
<td>6</td>
</tr>
<tr>
<td>Project Scope</td>
<td>6</td>
</tr>
<tr>
<td>Approach</td>
<td>6</td>
</tr>
<tr>
<td>Data Collection</td>
<td>6</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>7</td>
</tr>
<tr>
<td>Key Issues</td>
<td>7</td>
</tr>
<tr>
<td>Findings &amp; Conclusions</td>
<td>7</td>
</tr>
<tr>
<td>Alternative Solutions &amp; Recommendations</td>
<td></td>
</tr>
<tr>
<td>Expected Impact</td>
<td>17</td>
</tr>
<tr>
<td>References</td>
<td>20</td>
</tr>
<tr>
<td>Appendices</td>
<td>21</td>
</tr>
</tbody>
</table>
Executive Summary

In the University of Michigan Health Care System (UMHS), Patient Transportation is responsible for managing all stretchers in the hospital. There is currently no process in place to manage or track stretchers in use and Patient Transportation is worried a culture of storing stretchers for later use has developed. An IOE 481 Senior Design team, Team 10, has been asked to create an efficient process to find and replenish stretchers by Patient Transportation. The team has developed solutions on how Patient Transportation can manage the stretchers to improve inventory management of stretchers in UMHS.

Background

The University of Michigan Health Care system previously had 34 types of stretchers, however, this caused multiple complications and UMHS has now reduced the fleet to only five stretcher models. Still, problems such as time associated with finding stretchers and work efficiency arose and multiple departments frequently store stretchers in anticipation of long wait times for stretchers. Patient Transportation suspects that this culture has developed from different departments worrying that they will not have a stretcher ready in sufficient time.

Currently, floors that have stretchers have allocated space in alcoves closest to the elevator. However, the stretchers are not always available in the alcove when requested. Two employees are involved with the stretcher process - Patient Transporters and Equipment Managers. Patient Transporters bring patients on stretchers from one location to another and Equipment Managers are responsible for finding stretchers to refill the alcoves or by request from a department. Sometimes Transporters go to a floor’s alcove to retrieve a stretcher, but cannot find any to take to the patient. Then, the Equipment Manager searches different floors for a stretcher. Frequently, needed stretchers are found stored in empty rooms or departments have stored them throughout their floors expecting higher than actual demand. Conversations with Equipment Managers has revealed that the total search time for a stretcher can range from 1 minute to 30 minutes depending on how scattered or hidden the stretchers are throughout the hospital. UMHS asked the team to standardize the inventory management of stretchers and decrease the probability of a Transporter needing to contact an Equipment employee to search various floors for a stretcher.

Goals & Objectives

The primary project goal was to create a process to find and replace UMHS stretchers. To accomplish this goal, Team 10 observed and recorded flow of stretchers, conducted time studies, performed a literature search, and finally created a pro-con analysis of proposed solutions. This analysis included all stretchers within UMHS and the process of someone or department requiring a stretcher and the Equipment Manager replenishing stretchers on each floor.
Data Collection

During the first phase of data collection, Team 10 identified the number of stretchers in UMHS by requesting for the most recent stretcher inventory report. The team also conducted a literature search, interviewed all 3 Equipment Managers, surveyed 31 Transporters, administered beeper studies with all 3 Equipment Managers, and collected self reported time studies from 33 Transporters. The literature search involved reading through previous IOE 481 reports to better understand how to collect data. Equipment Managers were interviewed during the first week to understand the work process and learn of common issues and all employees were surveyed to understand how long they think it takes to find a stretcher as well as their comfort level with iPod technology. Finally, a beeper study was administered to Equipment Managers to learn what tasks take up the largest percentage of their shift and Patient Transporters self reported how long it took them to find a stretcher when requested.

By analyzing collected data from the surveys and time studies, the team identified a seasonality trend in when stretchers are needed most. The time studies were performed in all 3 shifts, and therefore, Patient Transportation can have a baseline for when stretchers are most required.

Findings & Conclusions

Team 10 gathered a large amount of stretcher inventory data. Interviews with Equipment Managers revealed that some departments store stretchers because of anticipated high usage and to avoid long waiting times. During the interviews, the team followed the Equipment Managers around for a shift to understand the work process; additionally the team learned that stretcher orders are sent through iPods. Surveys of 31 employees showed that most employees perceive it takes between 5-10 minutes to find a stretcher and that most of them are comfortable with iPod technology. Self reported time studies for 33 Transporters revealed that the employees perceptions were accurate, with 4.78 minutes being the average time to find a stretcher. Beeper studies of all 3 Equipment Managers in all 3 shifts revealed that they spend most of their time during the morning and afternoon shift either finding a stretcher or using the elevator, and during the night shift they spend most of the time waiting for the elevator and organizing stretchers in the alcove.

From the collected data, Team 10 concluded that a variety of factors needed to be implemented in final recommendations to Patient Transportation. The process to find and replenish stretchers must reduce the time to find a stretcher, know the location of stretchers, be easy to use and consistent with UMHS technology, and remove the culture of departments storing stretchers for future use. Patient Transportation has no budget for the solutions, so two solutions are proposed to offer variety. Team 10 decided to design an iOS app because employees already use iPods and survey results showed employees are comfortable with iPod technology, and Team 10 proposes
an alternative RFID technology because it is already being implemented in the hospital and can also track locations of all stretchers and store important data.

**Alternative Solutions & Recommendations**

The aforementioned findings and conclusions motivated the team to propose two solutions for Patient Transportation. One solution would be an iOS app to track all of the stretchers, and the other solution will be utilizing radio-frequency identification (RFID) technology. After learning employees used iPods during the interviews and that most employees were comfortable with iOS technology, Team 10 determined that an iOS app would be easy to implement and efficient in tracking. Through weekly coordinator meetings, the team also learned that RFID was being implemented in another department in UMHS, so implementing it stretchers would help standardize processes throughout the hospital. Therefore, it would allow employees moving across different departments within UMHS transition quicker to new roles.

The first recommendation was to design an iOS app that would track stretchers throughout the hospital. Patient Transportation would need to hire a developer to create the design Team 10 proposed. This app will use QR codes on the stretchers so that the iPods can scan them and give information on each one. This information will include location and the status of the stretcher. Using this app, transporters and equipment managers can find stretchers easily as well as know when to replenish the alcoves with more stretchers.

Team 10’s second recommendation would be to use RFID technology throughout the hospital. Excitation tags would be placed in alcoves and certain rooms; excitation tags would sense when a stretcher, equipped with a unique identifying tag, is placed nearby. The unique identifying tag on the stretcher will allow the stretcher’s location to be known at all times. When the excitation tags sense the stretchers, it will send information back to the computer the system is installed on, creating what could be used in the future as historical data to foster continuous improvement. Supervisors can establish a fixed quantity of stretchers to always be in designated alcoves, and the RFID excitation tags can alert employees real time when they need to be replenished.

Team 10 recommends that Patient Transportation either adopt the iOS App or RFID method. A budget needs to be allocated to decide the best alternative and necessary equipment purchased. Training modules for employees would need to be prepared as well as a pilot run for the selected method. Long term steps can include using iOS App or RFID data to benchmark against Team 10’s collected data.

A pro-con analysis was done between the two recommendations to analyze which one is the better fit for the hospital. The main difference between the two is that RFID technology will be more costly to implement because of the needed tags; the iOS app can be created through collaboration with a Computer Science Senior Design students or by hiring an app developer.
Also, the iOS app will likely require more employee training and interaction with scanning QR codes, while the RFID technology would automatically sense stretchers and require less employee training. Based on the hospital’s interests and budget, they will be able to make an informed decision on which path they want to take.

Introduction

Stretchers are owned and managed by multiple departments within the University of Michigan Health Care System (UMHS). Stretchers are used across the health system and while one department would have initially purchased a stretcher, the stretcher could be found in the alcove, on a different floor, of another department. While there is one standardized manufacturer (Stryker Medical), there is variability in stretcher pads and features; hence, there are five different models. There are opportunities to create a process to find and replenish stretchers. Team 10 was asked to come up with how Patient Transportation can better manage and maintain this stretcher fleet in order to improve the inventory management of stretchers in UMHS; the purpose of this paper is to reveal Team 10’s findings and recommendations.

Goals and Objectives

To improve the inventory management of stretchers in UMHS, the student team has achieved the following tasks:

1. Observed and recorded the flow of the stretchers
2. Recommended multiple quantifiable solutions to improve the process to find stretchers, know their location in the building, and enhance communications between employees
3. Created a pro-con analysis on these solutions

Background

The University of Michigan Health Care system previously had 34 types of stretchers; however, this caused multiple complications and UMHS reduced the fleet to only five stretcher models. Still, more problems arose; Patient Transportation has become increasingly worried that a culture that encourages locally storing stretchers for future use has developed.

Currently, only certain floors have stretchers available in alcoves, but these stretchers are not always readily available when needed. Sometimes Transporters go to a floor’s alcove to retrieve a stretcher, but can’t find any to take to the patient. The Equipment employees then searches the different floors for a stretcher. On multiple occasions, needed stretchers are found stored in empty rooms or departments have stored them throughout their floors expecting higher than actual demand. Introductory conversations with Transporters has revealed that the total search time for a stretcher can range from 1 minute to 30 minutes depending on how scattered or hidden the stretchers are throughout the hospital. UMHS asked the team to standardize the inventory
management of stretchers and decrease the probability of a Transporter needing to contact an Equipment employee to search various floors for a stretcher.

**Project Plan**

The team’s primary goal was to create a process to find and replace UMHS stretchers. The team’s work involved the following parties within Patient Transportation: Supervisor of Patient Transportation, Manager of Patient Transportation, Transporters, Equipment Managers, and Department Head of Patient Transportation.

**Project Scope**

This project included all stretchers within UMHS. The team is interested in the process of someone requiring a stretcher and the Transporter replenishing required stretchers on each floor. This process begins when the demand for a stretcher is placed into Patient Transportation and ends when the patient is physically transferred to his or her final unit.

The team will be also be studying process flows for stretchers that are placed in the “Stretcher Graveyard” and await repair. The broken stretchers have significance because they have been removed from the flow of stretchers that can be utilized throughout UMHS. The team will also be studying delays in patient discharges due to lack of stretcher availability. However, these analyses of broken stretchers and patient discharges will primarily serve to give the team context and are not within the scope of the project.

**Approach**

In order for the team to create a process to find and replenish stretchers in UMHS, the team will perform this project in three phases: data collection, data analysis, and recommendations.

**Data Collection**

During the first phase of data collection, the team conducted interviews. The team then identified the number of stretchers in UMHS by requesting a stretcher inventory report. This report included the number of each stretcher types and how many have been categorized as broken or unusable. Next, the team conducted interviews with Equipment Managers and Transporter employees in order to understand, from their point of view, how a stretcher is demanded and take into consideration suggestions they may have.

During the second phase of data collection, the team conducted time studies in order to establish average time it takes a Transporter employee to find a stretcher and how long Equipment managers spend on their job tasks.
Finally, a literature search has been conducted to find industry best practice solutions that can be modified to help with effective stretcher management throughout the hospital.

**Data Analysis**

The team has looked for a seasonality trend by grouping the number of stretchers a department needs by shift time. For example, one such trend might be that Radiology needs at least 10 stretchers in the daytime shift. By conducting this seasonality trend analysis, a deeper understanding of the current system and staff duties will be gained. The team will analyze this data and identify the reasons that delays are happening around each of the departments. By analyzing stretcher retrieval times in conjunction with information gathered from interviews, the team will develop a set stretcher limit on each floor that will improve flow through the hospital based on the day of the week. This layout will minimize waste time in the stretcher ordering and retrieval process to allow for more simultaneous value-added work to be accomplished.

**Recommendations**

During the final phase, the team has formulated and presented recommendations for improving stretcher flow. These recommendations will include how many stretchers should be stored on each alcove, taking into account each alcove’s storage capacity.

**Key Issues**

The following three key issues were driving the need for this project.

1. The unknown location of stretchers in UMHS means transporters are not using their time in the most effective manner
2. Stretchers are constantly being put out of circulation for repair, reducing the number of units available
3. The unavailability of stretchers is linked to the cancellation or delay of scheduled procedures and tests

**Findings & Conclusions**

The team was able to gather a large amount of data that can be classified as data regarding stretcher inventory control. The details of the results, conclusions, and recommendations based on this data follows.

**Literature Search**

The team conducted a literature search in order to find out what work previous IOE 481 teams have performed. In an article titled “Optimizing PACU Patient Transport Equipment Management at C.S. Mott Children’s Hospital and Von Voigtlander Women’s Hospital” by Dena MacKenzie, William Pozehl, and Alonzo Wilson the authors conducted time studies in order to
find out where bottlenecks are in the equipment cleaning process [1]. This is where the extracted the idea from about conducting a time study.

**Interviews**
The team spoke with two Transporter employees during an informal interview. Interviewing the Transporter employees has given the team key insights for this project and the process flow. In this interview, the Transporter employees explained their role and tasks a transporter regularly does outside of the formal job description. From these interviews, the team characterized the transporter role. In particular, the team gained insight on the multiple ways that an order for a stretcher can be placed. These interviews have helped the team in the later stages of forming recommendations on how to improve the current process.

**Transporter Survey Data**
The purpose of the survey was to gain insight into the transporter employees’ day-day experiences with stretchers at UMHS. A copy of this survey can be found in the appendix section of this report. The sample size for this survey was 31 responses. The main questions of interest of in this survey were 1) how long the perceived time to find a stretcher was, 2) how often unusable stretchers are found, and 3) how comfortable the transporter employees were with using iPod technology.

The survey results for these questions can be seen below in the figures. Figure 1 shows that about ⅔ of transporter employees feel as though the perceived time to find a stretcher is between 5 and 10 minutes. Figure 2 shows how often Transporter employees encounter a stretcher that they cannot use. The survey revealed that this is not an issue which affects Transporter workflow, as most Transporter employees only encounter unusable stretchers between 2-5 times per day. Two to five times per day is not significant in comparison to a daily maximum of twenty stretchers which transporter employees could come into contact with during an eight hour shift. Figure 3 shows how comfortable Transporter Employees are using iPod technology. This question was asked to see if using mobile application technology to solve the stretcher inventory problem could be a possibility. The survey revealed that most Transporter employees are very comfortable with using an iPod, implying that mobile application technology would be well accepted. The goal of the time studies that the team has conducted was to verify these perceptions.
The first of the two times studies conducted was a time study with equipment employees. This time data collected information about the stretcher ordering process at UMHS. Specifically, this time study gained insight on which parts of the equipment employee job are the most time-consuming. 
consuming. These time studies were anonymous and self driven and conducted from Monday November 16 to Thursday November 19. The team helped to pilot the first rounds of the time study. The sample size for these times studies was all equipment employees of 1st, 2nd, and 3rd shifts, ie: two for 1st and 2nd shift, and one for 3rd shift.

The team has conducted these time studies by instructing equipment employees to fill out a card that lists possible tasks during the stretcher search process. This card was filled out with a single tally mark every time a beeper went off (see Figure 4 below). This beeper went off randomly at a rate of approximately four times per hour and equipment employees had this beeper with them during job performance.

The findings of this time study can be seen in Figure 5 below. These results show that for 1st and 2nd shift, the majority of equipment employees’ time is spent finding a stretcher. However, for 3rd shift the majority of equipment employees’ time is spent organizing stretchers in the alcoves. These findings make sense considering the fact that there are less patients being moved at night, hence less orders for stretchers and less time spent finding a stretcher during a shift.

This time study also revealed that for 1st and 2nd shift the second most time consuming task was waiting for an elevator or being inside an elevator. For 3rd shift, elevators were not as much of an issue. This was most likely the case because there is less foot traffic within UMHS at night. These time study results verify what the team was told during the interviews conducted as five employees mentioned that the elevators were a source of trouble for their work flow.

<table>
<thead>
<tr>
<th>TASK</th>
<th>HOUR (tally)</th>
<th></th>
<th></th>
<th>Shift Start/End Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Receiving Order for Stretcher</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Finding Stretcher</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Waiting for Elevator</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Inside Elevator</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Transporting Stretcher to Alcove</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Interacting with Management</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Moving Broken Stretchers</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Organizing Stretchers in Alcove</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Idle Time</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Lunch/Break</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Other (Record on back)</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4: Equipment Employee Time Card

The findings of this time study can be seen in Figure 5 below. These results show that for 1st and 2nd shift, the majority of equipment employees’ time is spent finding a stretcher. However, for 3rd shift the majority of equipment employees’ time is spent organizing stretchers in the alcoves. These findings make sense considering the fact that there are less patients being moved at night, hence less orders for stretchers and less time spent finding a stretcher during a shift.

This time study also revealed that for 1st and 2nd shift the second most time consuming task was waiting for an elevator or being inside an elevator. For 3rd shift, elevators were not as much of an issue. This was most likely the case because there is less foot traffic within UMHS at night. These time study results verify what the team was told during the interviews conducted as five employees mentioned that the elevators were a source of trouble for their work flow.

Table 1: Equipment Time Study Results
Transporter Time Study

The team has also conducted a time study on the transporter employees. This time data strived to collect information about how long it takes a transporter employee to find a stretcher, and to see if this number was similar to the perception data collected from the survey. These time studies were anonymous and self driven, similar to the equipment employee time study conducted. This time study was conducted from Monday November 16 to Thursday November 19. The initial first rounds of the time study were piloted with the team present. The sample size for these times studies were 20 for 1st shift, 10 from 2nd shift, and 3 from third shift.

This time study was conducted by having transporter employees fill out a timecard (Figure 6 below) which logged the start time and end times when obtaining a stretcher. The start time was defined as the moment when an order for a stretcher was received on their iPod through teletracking. The end time was defined as the moment when the employee had their hands on a stretcher. These instructions were given verbally to all employees, as well as printed on the timecard. The maximum number of runs on a single time card was twenty because this was the maximum the transporter employees could do during an eight hour shift.

<table>
<thead>
<tr>
<th>TASK</th>
<th>1st Shift (Morning)</th>
<th>2nd Shift (Afternoon)</th>
<th>3rd Shift (Night)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving Order for Stretcher</td>
<td>10.3</td>
<td>1.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Finding Stretcher</td>
<td>22.4</td>
<td>35.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Waiting for Elevator</td>
<td>14.3</td>
<td>15.2</td>
<td>11.3</td>
</tr>
<tr>
<td>Inside Elevator</td>
<td>15.2</td>
<td>8</td>
<td>5.7</td>
</tr>
<tr>
<td>Transporting Stretcher to Alcove</td>
<td>9</td>
<td>17</td>
<td>7.5</td>
</tr>
<tr>
<td>Interacting with Management</td>
<td>3.1</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td>Moving Broken Stretchers</td>
<td>7.2</td>
<td>2.7</td>
<td>0</td>
</tr>
<tr>
<td>Organizing Stretchers in Alcove</td>
<td>10.3</td>
<td>8</td>
<td>13.2</td>
</tr>
<tr>
<td>Idle Time</td>
<td>3.1</td>
<td>0</td>
<td>1.9</td>
</tr>
<tr>
<td>Lunch/Break</td>
<td>4.9</td>
<td>3.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Other</td>
<td>2.2</td>
<td>7.1</td>
<td>54.7</td>
</tr>
</tbody>
</table>
The findings of this time study are summarized below in Table 2. The results of this time study do match the survey results. Across all three shifts, the average amount of time to find a stretcher was just under 5 minutes. The average amount of time to find a stretcher was the highest for 1st shift, followed by 2nd, then 3rd shift. These time study results also revealed that the difference in minutes between the morning and afternoon shift was the lowest .34 minutes (about 18 seconds). However, the difference between the night shift and afternoon shift is one minute (60 seconds) and the difference between the night shift and the morning shift is 1 minute 18 seconds (78 seconds).

Table 2: Transporter Time Study Results

<table>
<thead>
<tr>
<th>Shift</th>
<th>Average Time To Find Stretcher (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st (Morning)</td>
<td>5.34</td>
</tr>
<tr>
<td>2nd (Afternoon)</td>
<td>5.00</td>
</tr>
<tr>
<td>3rd (Night)</td>
<td>4.00</td>
</tr>
<tr>
<td>Average</td>
<td>4.78</td>
</tr>
</tbody>
</table>

Conclusions
Team 10 learned through data collection that by reducing the time to find stretchers, Patient Transportation would become more efficient. A new process needed to be proposed that would know the location of the stretchers at any given time; with this process, Patient Transporters and Equipment Managers would find stretchers sooner than the current average of 4.78 minutes. Currently, Equipment Managers spend 29.5% of the morning shift waiting and being inside of an elevator, 23.2% in the afternoon shift, and 17% in the night shift - these percentages can be significantly decreased if Equipment Managers knew exactly which floors had stretchers available. With Patient Transportation’s current process, Equipment Managers must blindly check different floors to find stretchers, thus, creating long wait times with elevators.

Additionally, Team 10 recognized that Patient Transportation would benefit from solutions that would be easy to learn and consistent with UMHS technology because of the standardization that would begin to develop. Training will be minimal and employees would be able to work cross functionally if asked. Finally, Team 10 concluded that if the aforementioned factors were included in the proposed solutions, Patient Transportation would develop a reputation of quick stretcher recovery, which would eliminate the culture of storing stretchers for future use. Departments would be comfortable with trusting the stretcher finding process and would not be inclined to keep stretchers stored.

**Alternative Solutions & Recommendations**

Team 10 decided to recommend two solutions for Patient Transportation - an iOS app and a system where stretchers are tracked using radio-frequency identification (RFID). Both solutions will reduce the time to find a stretcher by knowing stretchers’ exact location, be easy to learn and consistent with UMHS technology, require minimal training, and remove the stretcher storing culture.

**iOS App**

Based on the team’s findings and conclusions, two recommendations have been developed. The first recommendation is to create an iOS app to track and find the stretchers in an efficient way. As shown below, the app icon would look like this on the iPods for each transporter and equipment manager.
Once the app is opened, it will show the number of stretchers in each alcove. For example, if seven stretchers are available in the alcove on floor 3, the transporter can maneuver their way to the floor 3 and pick up a stretcher. Once the stretcher has been picked up, the transporter will sign the stretcher out using the app’s QR compatibility. The built-in photo capability will have a QR scanner. Now, the stretcher will be marked “in use” instead of “in alcove”. If a transporter finds a stretcher in the halls of the hospital, they will take it to an alcove. When the stretcher is taken to an alcove, the stretcher will be marked “in use” by the transporter. However, once the stretcher is taken to an alcove, the transporter will sign the stretcher in using QR and type into the iPod which alcove they have put it in.

Another functionality of the app will be error checking. For example, if five stretchers are in an alcove but the app shows four, the app can show the last ten times a stretcher has been scanned. By looking at these last ten times, the transporters should be able to figure out which stretcher has not been scanned with QR. On the other hand, if three stretchers are in an alcove but the app shows four, it will be simple to check which is not actually in the alcove. Again, the app will show the last ten times that stretcher has been scanned and the transporters will be able to find it. This error checking part of the app can be done during the transporter’s break time.

This app will also be connected with teletracking. Teletracking is how the transporters currently receive requests for a stretcher. In addition, the app will also show floors in red when replenishment is needed in the alcoves. So, if a transporter does not currently have a request for a stretcher, they can help replenish alcoves with more stretchers. The app can also motivate the transporters to work faster with timestamps and they can check how long it takes them to find a stretcher. Employees will be greeted by a screen that states statistics on their performance, i.e. how many jobs they completed and the length of time to find a stretcher; the culture of self-improvement is cultivated and can be used as a metric to review employee performance.

Some prerequisites need to be completed before the app can go online. First, training must be completed for each of the transporters. In the survey results, many of the participants claimed that they were not experienced in using an iPod. This training session should go over how to use an iPod and the app. MLearning could be used as the server for the training session. Second,
security should be strongly enforced. No one should be able to download the app other than the employees in the hospital. The download can be done on a login basis and the login should only work with the wifi in the hospital. If the login is implemented, it can also be easily used to track if someone is using the app incorrectly.

**RFID Alternative**

Team 10’s second recommendation is using radio-frequency identification (RFID) technology to track stretchers. RFID is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. Through weekly meetings with coordinators, Team 10 learned that RFID was being implemented in another department at UMHS. In order to correctly use RFID, excitation tags will be strategically placed throughout UMHS; excitation tags will sense whenever a unique identifying tag on an object is placed in range. Unique identifying tags will be placed on all stretchers; the stretcher tags’ communication with the excitation tags will enable the tracking system. The Team determined adoption of RFID would be beneficial for Patient Transportation because the technology would standardize technology across the hospital and allow any employees that switch departments to feel comfortable with the technology. The other department that has begun to implement RFID in UMHS has already mapped the entire hospital; the map of the hospital allows a visual map to show location of stretchers on a computer screen or iPod device. Therefore, Patient Transportation would only need to buy the excitation and unique identifying tags to use RFID. The application can be installed on iPods and desktop computers quickly during setup. Patient Transportation could ask for the other department’s supplier to purchase the same equipment. Also, beeper studies show that the majority of an Equipment Manager’s shift is finding a stretcher and RFID would allow the location of all stretchers to be known at all times.

RFID excitation tags will eliminate the culture of storing stretchers for future use because employees can only place stretchers near the excitation tags. If stretchers are not placed near the excitation tags, a real time alert will be sent to all users that a stretcher is out of place. Using RFID tags would standardize the jobs for all employees involved because there would be a standard procedure for placing stretchers in approved locations.

Tagging stretchers with a unique identifying tag will have multiple benefits. Unique identifying tags will allow UMHS to track every stretcher individually; if employees want a certain type of stretcher, they can look up its unique tag and know exactly where the stretcher has been and where it currently is. Figure 2 is an example of what supervisors tracking stretchers or employees using the RFID app on their iPod will see:
Utilizing unique identifying tags and using a map view like seen in Figure 7 will eliminate repetitive usage of the same stretcher because other stretchers cannot be found. Also, from data collection seen in Table 1, Equipment Managers spend 29.5% of the morning shift waiting and being inside of an elevator, 23.2% in the afternoon shift, and 17% in the night shift; the map view will allow Equipment Managers to know exactly which floors have stretchers and avoid checking empty floors, which would significantly reduce elevator times.

Patient Transportation currently has no tracking mechanism in place, and RFID technology will help establish a standardized work process for Patient Transportation that can locate any stretcher. Employees need to make sure stretchers are placed in range of excitation tags to complete their work process. The technology will automatically communicate with the desktop computer and will alert employees if needed. RFID will also allow employees to know who was last person to use a stretcher. Therefore, employees can decide to locate a specific stretcher and if the stretcher is not there, they can communicate with the last person who utilized that stretcher.

The RFID system will also help benchmark future employee performance and data collection. The RFID excitation tags will send a signal to a desktop computer in UMHS anytime a stretcher is in range, and information will be recorded. This data, over time, will create historical data that will improve the overall process in the future. Because Team 10 is providing Patient Transportation with a baseline of employee performance, historical data from the RFID can be compared to see the degree of improvement.

Using RFID will be beneficial because only fixed costs can be expected and it will help reduce long term costs. The tags will be one time expenses, and the only other high expense would be equipment damage. Furthermore, training will not be expensive because employees just need to
be aware of where excitation tags are placed. Management will need to set up the RFID on the computer, but the setup process can also be installed professionally by the company where the RFID is purchased. Because stretcher locations will always be known, supervisors can check stretchers daily to look for damage and take immediate action that could possibly salvage a stretcher from becoming worse and paying for a new stretcher.

RFID will also reduce the culture of storing stretchers because every department can be assured stretchers can be delivered in a timely manner. With RFID, departments can be assured that whenever stretchers are needed, an employee can check their RFID app and instantly know where the nearest stretcher is. Also, even though UMHS only has 5 types of stretchers, departments might prefer a specific stretcher; the RFID system will be able to accommodate specific stretcher requests because of the unique identifiers. However, Team 10 suggests Patient Transportation assure every department that all the stretchers have the same capabilities.

Because alcoves will have excitation tags, a minimal number of stretchers to be stored can also be established. For instance, Figure 5, shows that during every shift, at least 10% of time is being spent waiting for the elevator. The alcoves are conveniently placed right next to the elevator, so managers can keep a fixed quantity there at all times for easy access to transport it into the elevator. Employees at any time can see how many stretchers are in the alcove and during their downtime they can bring more stretchers to have an adequate amount of stretchers in the alcove. The RFID can also be set up to automatically alert an employee that replenishment is needed and pinpoint exactly where the nearest available stretchers are to it.

The team suggests a two pronged approach for training employees with RFID. First, Patient Transportation will have a week-long training session to help employees become more familiar with all the location tags and to understand that the rooms or alcoves with tags are the only places that stretchers can be returned. Next, an M Learning module can be recorded for future training purposes. A quick mobile phone video can be created of the employees using the RFID technology to be shown to all new employees.

Expected Impact

Team 10 conducted a pro-con analysis to help Patient Transportation understand the similarities and differences between the two proposed solutions. The expected impact of both the iOS app and RFID solutions can be seen below, in Table 3.

Table 3: Comparison of Alternative Recommendations

<table>
<thead>
<tr>
<th></th>
<th>iOS App</th>
<th>RFID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pros</td>
<td>Cons</td>
<td>Pros</td>
</tr>
<tr>
<td>Employees already carry iPods</td>
<td>Transport process doesn’t force use of the app</td>
<td>Real time locations of all tagged stretchers</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>Increase transporter productivity by decreasing time to find stretchers</td>
<td>Room for human error which will render the app inaccurate</td>
<td>Can be used to locate stretchers by all areas that use them</td>
</tr>
<tr>
<td>Motivate employees with statistics</td>
<td>Other areas that use stretchers do not use iPods</td>
<td>Real time alerts to all users</td>
</tr>
<tr>
<td>Unique identification of stretchers</td>
<td>QR codes may become damaged</td>
<td>Use historical data for insight</td>
</tr>
</tbody>
</table>

Table 3 shows the pros and cons of both the iOS App and RFID method. Using either method will require training that will be intuitive and long lasting; new employees can use MLearning videos to become acquainted with the technology and current employees can participate in a week long training session. Both methods will be able to self motivate employees and offer a metric for management to use when evaluating their performances.

Either method will be beneficial to UMHS Patient Transportation because there is currently no tracking mechanism in place and the methods will allow stretchers to be found at any time. Stretchers and locations will always be easily identified and the culture of storing stretchers for future use will be completely eliminated. The about 5 minute average that employees spent on finding stretchers will be depleted and hospital productivity can increase.

By implementing either of these methods, UMHS Patient Transportation will be able to collect much more historical data, which they can then compare to Team 10’s survey and time study results. This will offer more insight into how much process improvement there has been as well as a benchmark to any future improvements. The iOS App will require funding to create the actual app, but that should be a fixed cost; additionally, all employees are currently using iPod technology, so there will be no need for extra hardware.

Also, another department in UMHS is beginning to use RFID, so it might be possible to replicate their pilot of the technology to better ease into the new process. In summary, either recommendation is strongly considered to better the overall process of finding and replenishing.
stretchers at UMHS Patient Transportation and will better the work experience for both supervisors and employees.
References:

Appendices

“Optimizing PACU Patient Transport Equipment Management at C.S. Mott Children’s Hospital and Von Voigtlander Women’s Hospital”

Executive Summary

The staff of the Preoperative Unit and Post-Anesthesia Care Unit (PACU) at C.S. Mott Children’s Hospital and Von Voigtlander Women’s Hospital (CW Hospital) reported experiencing bottlenecks and delays in delivering the correct Patient Transport Equipment (PTE) to its assigned location in a timely manner. To better understand the causes for the PTE delivery delays and improve PTE flow, the CW Hospital Administration asked an IOE 481 student team at the University of Michigan, the CW PACU Equipment Team, to identify the cause of the bottlenecks in the current process and quantify the baseline losses associated with inefficient PTE flow. To address this task, the team conducted observations, interviews, time studies, and data analysis. The findings and conclusions led to recommendations to improve the PTE flow.

Background

The CW Hospital Operating Room (OR) services patients ranging from newborns to senior citizens. Depending on the patient’s age, size, and length of stay, the appropriate PTE provided for a patient at a given stage of the perioperative process may be a stretcher, bed, crib, recliner, or wheelchair. Beyond the variations in the type of PTE essential to support patient flow, limited storage space is available at the Preoperative Unit and PACU for temporarily unused PTE and several operational restrictions constrain where PTE may be stored. Concerns for delayed delivery of PTE stem from the needs to meet scheduled operation times, enable nursing staff to dedicate more time to direct patient care, and reduce excessive workload on PACU Transporters.

Goals and Objectives

The team’s goal was to optimize PTE flow such that the CW Hospital OR will “always have the right equipment, for the right patient, in the right place, at the right time,” as stated by CW Hospital Administration. The team’s conclusions and recommendations:

- Quantify the amounts of each type of PTE needed on a day-to-day basis
- Standardize the PTE cleaning, dressing, and storage policies to minimize non-value-added work, bottlenecks, and confusion in the PTE flow process
- Consider staff satisfaction related to potential process changes
- Quantify baseline loss associated with current PTE flow
- Determine the expected impact and quantify benefit of recommendations
University of Michigan Hospital Stretcher Survey

**Purpose of this survey:** The purpose of this survey is to gain insight into your day-to-day experiences with stretchers. Thank you for taking the time to answer these questions to the best of your ability.

1. From your personal experience, how long does it usually take you to find a stretcher?
   a. 5 minutes
   b. 5-10 minutes
   c. 10-15 minutes
   d. >15 minutes

2. Please list the largest problems relating to locating stretchers that you face on a daily basis.

3. How many times a day do you run into a stretcher that you can’t use?
   a. 1
   b. 2-5 times
   c. 5-10 times
   d. >10 times

4. How comfortable are you with using an iPod? Please rate on a scale of 1-6 (1 being not comfortable at all to 6 being most comfortable)
   1  2  3  4  5  6

5. Do you have any personal recommendations to how stretcher usage/storage should be changed? Please be detailed in your response.