University of Michigan Health System
Programs and Operations Analysis

Time-Out Data Verification and First Case of Day Late Starts in the Cardiac Procedures Unit

Final Report

Submitted To:

Robert Keast
Director of Cardiovascular Medicine at UMHS Cardiovascular Center
University of Michigan Health Systems

Janice Norville
Director of Clinical Operations at UMHS Cardiovascular Center
University of Michigan Health Systems

Andrei Duma
Industrial Engineer
University of Michigan Health Systems

Katie Schwalm
Industrial Engineer
University of Michigan Health Systems

Professor Mark Van Oyen
IOE 481 Professor
University of Michigan Industrial and Operations Engineering Department

Submitted By:

Team 11
Jasmine Johnson
Jessica Liang
Luke Stumpos

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Executive Summary
A team of physicians, nurses, and technicians in the Cardiac Procedures Unit (CPU) at the University of Michigan Health System (UMHS) conduct time-out procedures for patients undergoing catheterization (Cath) and electrophysiology (EP) procedures. Low time-out compliance rate and delayed EP first cases of the day start times are driving concerns at the CPU. Directors from UMHS asked an IOE 481 student team to determine current compliance rates for the time-out procedures for both Cath and EP labs and root causes to EP late starts. The team observed current processes and time stamped the main activities during the EP first case prep process to analyze and provide recommendations to these problems.

Background
Nurses lead time-outs in Cath and EP procedures by providing the procedure team with information regarding the patient and the procedure from an audit checklist. Items from the checklist are not always fully executed as some nurses rely on memory or personal judgment of what is necessary to address, which leads to incomplete compliance by the Directors’ standards. This poses safety risks as the procedure team is not receiving thorough information on the case. The other problem at the CPU is the late starts that EP first cases of the day often experience. Patients are expected to be wheeled into the procedure room at 7:30AM (except on Thursdays when the expected time is 8:30AM), but due to multiple factors in the preparation process, patients enter the procedure room as late as 50 minutes past expected time. The staff has thoughts on the causes of delay, but a defined root cause has not been determined and resolved.

Methodology
The student team performed the following four types of tasks to address the Directors’ concerns:

- Observing current processes: The student team performed over 50 hours of observation in the Cath and EP labs. Observations consisted of watching nurses perform time-outs on 16 EP and 15 Cath procedures and time stamping main activities in 16 EP first cases of the day. Main activities consist of nurse gathering patient information, fellow gaining consent, CRNA performing consultation, and nurse practitioner visiting the patient.

- Performing literature search: Two past IOE 481 reports were reviewed to provide the team guidance about possible recommendations to increase time-out compliance and ensure timely EP first case start times. Specifically, the literature searches validated recommendations that the team created.

- Interviewing key staff in EP first cases of the day: Due to the limited time the student team could observe, certain cultural aspects and prevalent causes of delays could not have been plainly observed. Nurses, fellows, CRNAs, and technicians involved in EP first cases of the day provided rich insight as to what they think is the root cause of delay as the team conducted interviews with them individually. A total of 10 staff members participated in the interview.

- Analyzing data: The team analyzed the compliance rate of each item on the time-out checklist and the overall compliance rate for Cath and EP labs. From the time stamps gathered from observing EP first cases, the team graphed the occurrences of the prep process’s main activities – specifically when the nurse, fellow, CRNA, and nurse practitioner entered and left the patient room and the wait time, or non-value added time, that incurred between the activities.
**Findings and Conclusions**

Based on the team’s time-out observations, 43% of the time-out items for Cath procedures fall below 50% compliance while only 8% of the items do so for EP, thus time-outs in Cath provide less thorough information than EP procedures. This also means that EP procedures experience a higher overall compliance rate of 69% while Cath procedures have an overall compliance rate of 57%. Nonetheless, both overall compliance rates fall short of the Directors’ expectation of 100% compliance.

There was an average of 48 minutes of non-value added time between the main activities and late EP first cases primarily consisted of non-overlapping main activities. Therefore, the root cause to late starts drawn from the student team’s observations is that main activities are not occurring sequentially or simultaneously enough.

To resolve these issues, the student team relied on literature search, clinical strategies used elsewhere in the hospital, and LEAN principles to develop recommendations.

**Recommendations**

Based on the team’s findings and conclusions, the following recommendation is provided for improving time-out compliance:

- *Standardize the method of executing time-outs:* As validated by “Intraoperative Process and Time Analysis: Mott Operating Room” [1], standardizing how time-outs are performed can increase overall compliance. Specifically, staff should read every item in the checklist even if the item is not applicable or deemed necessary.

The following recommendations are provided for alleviating EP first case late starts:

- *Team rounding:* A team rounding system is usually performed in inpatients units across hospital systems as an attending and residents visit patients together to collectively review patient status and treatment plan. Implementing that into the EP prep process requires the CRNA, fellow, and nurse practitioner to enter into a patient room together to perform their prep process activities. Being there together will eliminate repetitive questions asked and non-value added times in between main activities. Nurses will not be included in rounding because their prep process activity is usually completed before the rest of the staff performs their activities.

- *Team huddle:* Improving communication to induce teamwork and reduce waste is a great LEAN goal. The team of nurses, fellows, CRNAs, and nurse practitioners will discuss the prep process plan by committing to a time in which they will individually see the patient. This should create a sense of individual responsibility and an accountability system as an individual’s contribution publicly affects the overall flow.

- *Flag system:* As seen in clinics in health systems, flags outside patient rooms serve as visuals about patient status for clinicians. In the EP unit, four colored flags (each indicating a staff involved in the prep process) initially are pointing outwards into the hallway to indicate who has yet to see the patient. Staff will put their color down when they go into the room to indicate the completion of a main activity. Any remaining flags pointing outwards will induce public awareness and accountability of who is delaying their service.
**Introduction**
The team of physicians, nurses, and technicians in the Cardiac Procedures Unit (CPU) at the University of Michigan Health System (UMHS) conduct time-out procedures for patients undergoing catheterization (Cath) and electrophysiology (EP) procedures. Nurses lead time-outs by updating the procedure’s staff on the patient’s medical information and the procedure’s information. There is concern that the time-outs are not always done with full compliance; thus, the Director of Clinical Operations and the Director of Cardiovascular Medicine asked an IOE 481 student team from the University of Michigan to observe and record the Cath and EP procedures’ time-out compliance rates. Furthermore, the Directors also asked the team to assess the causes to EP first case of the day delays. The purpose of this report is to review the student team’s work in addressing the Directors’ concerns and their recommendations.

**Background**
Time-outs are vital to the patient's’ safety and everyone involved in the procedure because it covers questions that verify the patient is correctly matched with the procedure. At the CPU, compliance and lack of standardization in how time-outs are performed in Cath and EP procedures cause concerns for the Director of Clinical Operations and Director of Cardiovascular Medicine because safety should never be compromised in medical procedures. Furthermore, the Directors are concerned with late starts in EP first cases of the day. Late starts are triggered by prep delays, which causes unpredictable procedure start times and a downstream effect that make sequential cases late. This leads to patient and family dissatisfaction, faculty and staff overtime, and sometimes rescheduling of cases.

**Project Scope**
This project was only concerned with the time-out process in EP and Cath procedures. The time-out process starts when the nurse declares “Time-out” and ends when the procedure team raises no further questions or comments. This student team also studied EP first case late starts by observing the preparation process up until the procedure team was done with the time-out. Throughout the observation, the student team time stamped main activities to identify the bottlenecks in the process.

The project team did not analyze the compliance rate of the pre-verification process for the EP and Cath procedures. Cath first cases of the day were also out of scope. Additionally, all pre-cardioversion time-outs for the EP lab were not observed or analyzed.

**Goals and Objectives**
To assess the EP and Cath time-out compliance rates and determine the root causes of EP first case late starts, the team achieved the following primary goals:
- Capture Cath and EP time-out compliance rate
- Identify bottlenecks in the EP procedure preparation process

With this information, the team performed the following:
- Developed recommendations to increase the current time-out compliance rate
- Identified bottleneck trends in EP first case of the day late starts
- Developed recommendations to prevent late starts
Approach
The team performed this project with four methods: observations of current processes, literature search, interviews with key staff, data analysis, and recommendations.

Observing Current Processes
For the time-out data collection, the team observed and audited 15 Cath and 16 EP time-outs at the CVC. The team used the time-out audit forms, “CPU CATH Verification and Time-Out Audit” and “CPU EP Pre-Anesthesia Verification and Time-Out Audit,” provided by the EP/Cath lab supervisor and nurse manager to compare how the staff’s performance compares with what is expected. The team recorded the completion of each individual item in the time-out checklist by marking “Yes” or “No” on the form. Following the time-out, the team conferred with the time-out’s lead nurse over any uncertainties pertaining to the completion of individual items in the process.

For the EP first cases of the day data collection, the team observed 16 cases and time stamped the main activities in the preparation of EP first cases of the day. Preparation begins with patient arrival and ends with the time-out completion. The project team recorded the start and end times for the following main activities: nurse completes patient preparation care, fellow gains consent, CRNA provides consultation, and nurse practitioner visits patient. The project team also recorded additional causes of delay made apparent by plain observation or staff members sharing insight. The team actively engaged with staff involved with the specific EP case to ask for clarifications on possible causes.

Performing Literature Search
Two articles provided background knowledge and validation for recommendations for the two parts of the project: CPU Time-Out Compliance and EP First Case of Day Late Starts. Both literature searches were pulled from previous IOE 481 team final reports. The first is entitled “Improving First Case On-Time Starts at East Ann Arbor Surgery Center” [2] and the second is entitled “Intraoperative Process and Time Analysis: Mott Operating Room” [1].

Interviewing Key Staff of the EP First Cases of the Day
The team interviewed the key staff involved with the EP lab first cases of the day: nurses, technicians, CRNAs, and fellows. A total of 10 staff members participated in the interviews. These interviews occurred when the staff member had downtime and has consented to the interview. These interviews consisted of short questions about the first case prep processes such as “What do you think is a probable cause of delay?”, “What would help you with timeliness?”, and “What type of visual cue should be implemented to alleviate confusion?” The information gathered from the interviews was used to pinpoint possible root causes of delay and inspire recommendations.

Analyzing Data
For the time-out data analysis, the team compiled the data collected on Cath and EP time-outs separately and input the data into an Excel file. For every checklist item that was asked during the time-out, a 1 was given. The team summed the binary inputs of each individual item and divided it by the number of cases observed to determine the average compliance for each individual step in the time-out. By summing over all the binary inputs and dividing it by the total
number of items across all cases, the team determined the average overall compliance for the EP and Cath time-outs.

For EP first cases of the day late starts analysis, the team used the data collected from the time studies to develop a graph displaying each main activities’ order of occurrence for each case. With this figure, information gathered from the observations and interviews, the team identified trends in cases with late starts. The team was also provided historical data on EP cases from July 1st, 2015 to November 13th, 2015. The data included each case’s room, attending, case type, day of week, and scheduled and actual load times. The team sorted the data to focus only on first cases of the day and developed graphs and visuals displaying delay averages and standard deviations to observe historical trends in EP first case late starts.

**Findings and Conclusions**
Based on the previously stated methods, findings and conclusions were drawn from each.

*Observing Time-Out Compliance Rates: Lack of Standardization*
43% of the time-out items for Cath procedures fall below 50% compliance while only 8% of the items do so for EP. These results show that time-outs in Cath procedures are performed with less thorough information than EP procedures. The compliance rate for each time-out item for Cath and EP can be found in Table 1 and 2 respectively.

**Table 1: 93% of the items do not have 100% compliance for Cath Procedures**

<table>
<thead>
<tr>
<th>Checklist Item</th>
<th>Compliance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>43.75</td>
</tr>
<tr>
<td>Patient identifiers</td>
<td>100.00</td>
</tr>
<tr>
<td>Side, Site, Laterality - when applicable</td>
<td>31.25</td>
</tr>
<tr>
<td>Allergy review</td>
<td>87.50</td>
</tr>
<tr>
<td>Sedation plan</td>
<td>81.25</td>
</tr>
<tr>
<td>Confirmation of GFR and suitable contrast dosing triggers</td>
<td>75.00</td>
</tr>
<tr>
<td>Correct Antibiotics administered - if applicable</td>
<td>62.50</td>
</tr>
<tr>
<td>Special drug plan</td>
<td>56.25</td>
</tr>
<tr>
<td>Patient correctly positioned</td>
<td>37.50</td>
</tr>
<tr>
<td>Required blood products, correct implants, devices, and any special</td>
<td>43.75</td>
</tr>
</tbody>
</table>
Table 2: 75% of the items do not have 100% compliance for EP procedures

<table>
<thead>
<tr>
<th>Time-out Item</th>
<th>Compliance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductions</td>
<td>86.67</td>
</tr>
<tr>
<td>Patient Identification/Procedure/Consent</td>
<td>100.00</td>
</tr>
<tr>
<td>Diagnostic Tests Results</td>
<td>86.67</td>
</tr>
<tr>
<td>Allergies</td>
<td>100</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>73.33</td>
</tr>
<tr>
<td>Sedation Plan</td>
<td>100</td>
</tr>
<tr>
<td>Blood/Special Drug Plan</td>
<td>73.33</td>
</tr>
<tr>
<td>Special Equipment/Specialty Services</td>
<td>60.00</td>
</tr>
<tr>
<td>Specimen and Explant Handling</td>
<td>26.67</td>
</tr>
<tr>
<td>EBL and Transfusion Trigger</td>
<td>53.33</td>
</tr>
<tr>
<td>Patient Position</td>
<td>53.33</td>
</tr>
<tr>
<td>Concerns regarding the case</td>
<td>80.00</td>
</tr>
</tbody>
</table>

EP procedures’ overall compliance is 12% higher than that of Cath procedures. The overall compliance for EP and Cath procedures can be found in Table 3. The compliance rates were computed from a sample size of 15 and 16 procedures for EP and Cath respectively.

Table 3: EP procedure has higher overall compliance than Cath procedures

<table>
<thead>
<tr>
<th></th>
<th>Overall Compliance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP</td>
<td>69.79</td>
</tr>
<tr>
<td>Cath</td>
<td>57.14</td>
</tr>
</tbody>
</table>
The difference between EP and Cath time-outs shows a drastic difference in process variation and time-out methodology. Even though EP time-outs are higher in compliance rates, both types of procedures fall short of the Directors’ standard of 100% compliance.

**Observing EP First Case of the Day: Non-Value Added Time Prevents Timely Starts**

Observations from EP first cases of the day are recorded in Figure 1. The figure illustrates the duration and occurrences of the main activities performed by the nurse, fellow, anesthesia, and nurse practitioner and the wait time, or non-value added time, in between the activities.

![Timeline of EP First Case of the Day](image)

*Figure 1: Overlapping activities alleviate delay*

Cases 1, 7, 8, and 13 show how overlapping activities alleviates delay in EP first cases of the day. Many delays occur because of excessive wait time in between activities (i.e. cases 4, 10, and 11). Not only does concurrency shorten prep process time, but ensuring that activities proceed shortly after another will decrease the non-value added time to the process thus helping patients load in a timely manner. This problem has existed before the team’s observations. Table 4 displays how extensive late starts were by EP procedure room number with red being high late starts and green being low late starts. Figure 2 classifies lateness by the minutes past when the patient should enter the room. Both consist of cases from July 1st 2015 to November 13th 2015.
Table 4: Rooms experience more high than low late starts

<table>
<thead>
<tr>
<th>Room</th>
<th>MON</th>
<th>TUES</th>
<th>WED</th>
<th>THURS</th>
<th>FRI</th>
<th>Room Total</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVC-EP 01</td>
<td>48 ± 24</td>
<td>32 ± 12</td>
<td>27 ± 16</td>
<td>20 ± 12</td>
<td>31 ± 12</td>
<td>32 ± 16</td>
<td>65</td>
</tr>
<tr>
<td>CVC-EP 02</td>
<td>48 ± 32</td>
<td>32 ± 27</td>
<td>42 ± 34</td>
<td>16 ± 8</td>
<td>28 ± 13</td>
<td>37 ± 28</td>
<td>78</td>
</tr>
<tr>
<td>CVC-EP 03</td>
<td>31 ± 24</td>
<td>29 ± 11</td>
<td>37 ± 27</td>
<td>17 ± 15</td>
<td>29 ± 17</td>
<td>32 ± 21</td>
<td>80</td>
</tr>
<tr>
<td>CVC-EP 04</td>
<td>19 ± 8</td>
<td>22 ± 12</td>
<td>32 ± 36</td>
<td>28 ± 19</td>
<td>28 ± 18</td>
<td>25 ± 21</td>
<td>84</td>
</tr>
<tr>
<td>CVC-EP 05</td>
<td>41 ± 29</td>
<td>21 ± 13</td>
<td>26 ± 13</td>
<td>20 ± 8</td>
<td>21 ± 5</td>
<td>27 ± 19</td>
<td>30</td>
</tr>
<tr>
<td>Day Total</td>
<td>34 ± 26</td>
<td>28 ± 17</td>
<td>34 ± 28</td>
<td>20 ± 14</td>
<td>28 ± 15</td>
<td>32 ± 21</td>
<td>337</td>
</tr>
<tr>
<td>n</td>
<td>56</td>
<td>75</td>
<td>70</td>
<td>68</td>
<td>68</td>
<td>337</td>
<td></td>
</tr>
</tbody>
</table>

EP First Case Delay July 1st - November 13th, 2015 (338 cases)

Includes only cases scheduled at 7:30 AM, 7:40 AM and 8:30 AM on Thursdays. Excludes cardioversions and cases in room EP 06.

Figure 2: No EP first case July 1st - November 13th, 2015 (338 cases) was on time
Table 4 shows that there are more seriously and close to seriously late cases than there are mildly late cases. Figure 2 shows that the majority of cases are 10-30 minutes past the expected time of when the patient enters the procedure, which is similar to the team’s observations.

**Literature Search: Standardization Increases Timeliness and Compliance**

The literature searches gave the team a guideline to make the recommendations feasible for the Cardiac Procedures Unit. From the April 2015 final report “Improving First Case On-Time Starts at East Ann Arbor Surgery Center” [2], the team concludes:

- Standardizing pre-operative tasks for each patient by surgery type can help decrease overall wait time and confusion amongst staff
- Causes of delay are not consistent from day to day as there are many factors that contribute to the delay(s)

Within “Improving First Case On-Time Starts at East Ann Arbor Surgery Center”, the conclusion, “…having a surgeon arrive and visit their patient early has a positive effect on case start times, and increases the portion of cases that start on-time for a surgeon” [2] was made. This conclusion led to the recommendation of “standardizing the surgeon pre-operative process which includes a standardized surgeon arrival time at the EAASC” [2]. This recommendation can be directly applied to the team’s project of EP First Case of Day Late Starts, because it provides validation that delays occur but can be avoided if structure exists within the process. In addition to standardization, the final report addressed the issue of multiple factors causing delay. The report stated, “Patients have different factors surrounding their personal case and situation. These factors can result in extra attention being needed during the pre-operative process. Some of these factors cannot be anticipated…” [2]. This statement provides the team with reassurance regarding recommendations and the unfortunate fact that the perfect scenario will not happen every day. This means that the team’s recommendations will decrease the overall delay, however the recommendations will not be able to capture every scenario of delay.

From the April 2007 final report “Intraoperative Process and Time Analysis: Mott Operating Room” [1], the team found:

- Standardizing the time-out process and stressing their importance will help increase overall compliance with time-outs.
- Continuing with random time-out auditing will help make sure that compliance increases to 100%

Within “Intraoperative Process and Time Analysis: Mott Operating Room”, the following conclusion was made, “…time-outs were performed just to state that one was completed, with no emphasis on having the correct patient or performing the correct procedure. Time-outs should be standardized so that everyone in the room agrees on the procedure…” [1]. One of the main recommendations made by this 2007 IOE 481 team was to standardize the time-out process, focusing on which staff should perform the time-out. This recommendation was made based on observations that the 2007 IOE 481 team made throughout the project, similar to the observations made by Fall 2015 IOE 481 Team 11. In addition, the final report briefly that the Mott Operating Room should, “Monitor time-outs more closely and perform periodic auditing (perhaps quarterly)” [1]. Based on both literature sources, standardization is an effective method of ensuring timely first case start times and increasing time-out compliance.
Interviewing Key Staff: Disagreement on Root Cause of Delay

Through six interviews with nurses, five out of the six interviews answered that anesthesia is the cause of delay. Specifically nurses gave the following reasons:

1. Since CRNAs’ schedules won’t be affected by delays, there is no urgency in seeing patients.
2. There is too much traveling. CRNAs must get their lead apron from the main hospital, go to the CVC to drop it off, go to the pharmacy on the fourth floor to get the procedure’s drugs, then finally see the patient.
3. Lack of staffing in technicians to help prepare the procedure room causes CRNAs to help set up the procedure room instead of seeing patients.

When CRNAs were asked what are their thoughts on the cause of delay, they responded with the following answer:

1. The process to obtain drugs from the pharmacy for every case requires too many steps. The line may also be long, and it’s no longer convenient when they can’t get the whole day’s supply in one visit, but rather they must visit the pharmacy before every case.
2. Sometimes they are notified last minute about a case. They lack the time to prepare.
3. Other people are delaying the process. Specifically, one CRNA said “We must always hurry and wait.”

The answers from the staff reveal that nobody agrees on one common cause of delay.

To resolve these issues, the student team relied on literature search, clinical strategies used elsewhere in the hospital, and LEAN principles to develop recommendations.

Recommendations

Through observation and data analysis, the team makes the following recommendations for the two parts of the project.

Time-Out Compliance Rates

As validated by “Intraoperative Process and Time Analysis: Mott Operating Room” [1], standardizing time-out performance is crucial in ensuring that perfect compliance is carried out in every procedure. Directors should readdress the importance of reading off of from the audit forms instead of relying on memorization or what the nurse deems as necessary. Even if an item on the checklist is not applicable or seemingly unnecessary to the procedure, the nurse should still address that item.

EP First Case of the Day Late Starts

Based on Table 4 and Figure 2, late starts have been occurring before the student team’s intervention, which has created an expectation for cases to be late. This makes resolving this issue a crucial matter. Based on Figure 1, it is clear to see that non-value added time contributes to the lateness of EP first cases of the day. In order to minimize non-value added time, a team rounding, team huddle, and flag system should be used. A team rounding system is usually performed in inpatients units across hospital systems as an attending and residents visit patients together to collectively review patient status and treatment plan. Implementing that into the EP prep process requires the nurse, CRNA, fellow, and nurse practitioner (if applicable) to enter into a patient room together to perform their prep process activities. This will eliminate repetitive questions asked and wait times in between main activities. This will also ensure that all personnel are available to answer the patient’s question, which prevents non-value added time in
trying to find the appropriate staff to answer the question and offers rich insight to patients as they receive well-rounded answers. Nurses will not be included in rounding because their prep process activity is usually completed before the rest of the staff performs their activities.

Another team approach is to have team huddles before the first case each day because improving communication to induce teamwork and reduce waste is a great LEAN goal. The team of nurses, fellows, CRNAs, and nurse practitioners (if applicable) will discuss the prep process plan by committing to a time in which they will individually see the patient. Specifically, the huddle address the following questions:

- When will each staff see the patient?
- Is there an opportunity for anyone to go together?
- What questions will you address that can be shared with the rest of the team to avoid repetition?

By committing a time to see the patient, the individuals will have a sense of responsibility and an accountability system is created as an individual’s contribution publicly affects the overall flow. The nurse will also be appointed as the team leader. As team leader, the nurse will oversee the prep process to ensure that it is proceeding in a timely manner by making sure team members are seeing the patient according their committed time. The prep process requires multidisciplinary teams to work with each other and both these methods strive to create a team mentality. As a supplement to both methods, the staff will receive lean coaching to learn how to integrate teamwork and effective communication into their daily tasks.

The last recommendation is to use a flag system outside the patient room. As seen in clinics in health systems, flags outside patient rooms serve as visuals about patient status for clinicians. There will be four colors to indicate each main activity. The flags will be placed at two different positions to indicate different statuses. 90 degrees indicates “Patient not seen”, and 0 degrees indicates “In progress/Patient seen”. In other words, the flags initially are pointing outwards into the hallway to indicate who has yet to see the patient, and the staff will put their color down when they go into the room to indicate completion of a main activity. Any remaining flags pointing outwards will induce public awareness and accountability of who is delaying their service. This method aims to increase responsibility at an individual level, which is the core motivator of any kind of change.

**Expected Impact**
The student team’s primary goal was to capture the current time-out compliance rate for Cath and EP procedures and identify the root cause of EP first case of the day delays so that improvements can be made. By considering the recommendations as previously explained, the CVC at UMHS will see increased overall compliance rate in time-outs as execution is standardized and shorter delay time in EP first cases of the day as staff experience improved communication and an efficient and organized patient-visiting system.
Works Cited
