Improving Patient Experience and Processing Times in a Major Metropolitan Hospital Through the Application of a Lean Six Sigma Methodology

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Abstract

AdventHealth's Orlando South Emergency Department's (ED) Pink Pod, or Lean Pod, routinely provides some of the best patient satisfaction and processing time results in AdventHealth EDs in the Central Florida region; however, there are numerous opportunities to improve the process further by addressing systemic bottlenecks within existing operating procedures. The team sought to find opportunities to accomplish this while also establishing best practices and finding weaknesses within the existing system. Here we report the results of our Lean Six Sigma (LSS) effort toward improving an area of the ED that, statistically, is operating well but has the potential to perform even better. The team conducted explorative observations and interviews with Pink Pod medical staff and leadership to get a better understanding of existing procedures as well as employee concerns relating to Pink Pod processes and analyzed historical data collected and provided by AdventHealth to identify trends and key statistics. Ultimately, the team was able to pinpoint several causative factors affecting patient time-in-system and satisfaction, including issues with communication between departments, transportation of patients, the triage process, the implementation of team nursing, and gathering and disposing of equipment for use with or on patients. Remedying these issues helped to alleviate potential areas for delay and led to increased patient satisfaction and less time spent in the ED for patients in the Pink Pod. As a result of the project, AdventHealth has addressed many of the issues the team discovered, including: adding more equipment, such as sharps bins; standardizing staffing with core groups of personnel for Pink Pod; and revisiting their registration and triage process to help ensure patients are evaluated properly before being assigned to their bed in the ED.

Keywords

Healthcare, Lean, Six Sigma, Patient Satisfaction, Process Improvement

1. Introduction

AdventHealth is responsible for the physical, emotional, and spiritual care of many patients. Each Emergency Department (ED) of AdventHealth functions as their own independent system with processes differing from campus to campus. The focus of this project will be to investigate the processes of the Orlando South ED campus. Within each ED there is a multitude of areas a patient can be placed in depending on their ailment. These areas are defined as "Pods." The choice on what Pod a patient is placed in is dependent upon the Emergency Severity Index (ESI) that the patient is assigned. These ESI numbers are defined on a scale of 1 to 5, with 1 being the most urgent and 5 the least urgent, based on acuity and resource needs. Pink Pod, which will be the focus of this project, holds patients assigned with an ESI level of 5, 4 or 3. The ESI level is assigned by the Triage Nurses upon initial evaluation in the ED. From

Triage, the patients are sent to Pink Pod (if ESI is 5, 4, or 3) where a range of 2-6 nurses, an attendant physician and one or two physician's assistant(s) will begin administering the care required by the patient.

1.1 Objectives

This project has two main objectives. The first objective of this project is to lower the door-to-discharge time for the Pink Pod to meet or exceed target levels by identifying bottlenecks within the Pink Pod, identifying bottlenecks at the points of connection between the Pink Pod and other relevant departments within AdventHealth's Orlando Campus, and developing strategies and suggestions for how to overcome any bottlenecks identified The second objective is to identify areas of concern with respect to the layout and organization of the Pink Pod and develop solutions to promote efficient work within it. This will be accomplished by consulting healthcare professionals to understand factors which impact their ability to provide care to patients, collecting data to understand the amount of time a given action by a healthcare professional might take while they are away from their patient (i.e., disposing of sharps (syringes or other medical items with sharp points or edges), and developing strategies and suggestions to lower the amount of time a healthcare professional must spend away from their patient to interface with or dispose of equipment or supplies.

2. Literature Review

Hospitals and the field of healthcare have been very popular topics of discussion over the past few years, thanks in no small part to the ongoing COVID-19 pandemic. The shock to the healthcare system was tremendous and numerous hospitals found themselves scrambling to find ways to handle the surge of patients while their resources remained at the same or lower levels as they were before the onset of the pandemic. Now that vaccines and other preventative measures have become prevalent, COVID-19 isn't the primary concern of many hospitals and their Emergency Departments (EDs) have been able to return their focus to the usual patient concerns they dealt with pre-pandemic. With the slow return to normalcy comes the return of common ED problems, however these are now exacerbated by societal changes due to the pandemic. For example, nurses employed in EDs are often travel nurses, who are paid significantly more and have less loyalty to the hospital than nurses who built their careers at a single hospital location. These travel nurses are signed to time-limited contracts and often request increased salary to stay in their role after the contract has expired. If their salary demands aren't met, the nurses leave and new nurses need to be brought in to fill their place. In a well-functioning job market, this wouldn't be a problem, as there would be many nurses ready and willing to take these newly opened positions. However, the job market that exists today has concerningly few nurses who are looking for positions in EDs and, therefore, when nurses leave the ED, they're often very difficult to replace with experienced nurses. This results in a lack of experience-driven quality from new nurses for the benefit of the patients in the ED. A decrease in quality might affect how a nurse interprets their responsibilities and ultimately how long it might take for services or care to be rendered to a patient. Without a doubt, to the patient, the length of their stay in the ED is among the primary determining factors involved in their assessment of satisfaction—perhaps second only to whether their chief complaint was addressed adequately while they were in the ED. To make matters worse, the longer a patient stays in the ED, the longer their bed is occupied and thus the longer another patient may have to wait to be seen and treated.

Many studies have been conducted on the implementation of Lean and Six Sigma methodologies in EDs with the goal of increasing patient throughput without sacrificing patient care or patient satisfaction. However, there exists a gap with respect to how hospitals have handled this problem since the COVID-19 pandemic began and changed the nature of how healthcare organizations provide for their patients as well as how healthcare organizations deal with shortages of nurses and other essential healthcare personnel and the effect of the shortages on patient care, satisfaction, and throughput. In addition, there is another aspect of EDs that the pandemic has brought under an investigative spotlight: structural and physical non-optimalities that were stressed and exposed during these past two years. It is the hope of the authors of the present study that illumination will be provided with regard to each of these pressing issues and their deleterious effects on the performance of the ED under study.

3. Methods

The team initiated the work for this project by first meeting with Emergency Department (ED) Leadership to establish their perspective on the problems facing the Pink Pod. After the initial meeting, the team was given a tour of the facility and a high-level explanation of how a patient moves through the Pink Pod, from walking in the door and registering to their discharge after being seen by a provider. The team used this tour as well as subsequent visits to the Pink Pod to further define the problems; in addition, surveys of Pink Pod staff consisting of nurses, medics, and technicians to identify what sources of delays or other inefficiencies they came across during the performance of their

duties were performed. This information was populated into a Pareto chart for analysis and returned several high frequency complaints from staff including improper patient triage, lack of supplies, lack of organization, and staffing issues.

The team then developed a Failure Mode & Effects Analysis (FMEA) and Cause-and-Effect Diagram to identify the key failure modes and what aspects of the Pink Pod processes may contribute to the complaints observed in the surveys. As a result, the team was able to highlight the root causes for the inefficiencies in the Pink Pod: the lack of beds in the ED, leading to patients who should be in a different pod being placed in the Pink Pod and a lack of staff, which places increased pressure on the staff that is present in the Pink Pod as well as staff that interfaces with the Pink Pod, such as transport staff. The team moved to develop a list of recommendations and generated a Cost vs. Impact Analysis to demonstrate how the recommendations could benefit the Pink Pod, based on the concerns of Pink Pod staff.

4. Data Collection

For the initial observations, it was determined that the best time for their conduction would be during peak load times to see the system under peak stress; in this way, any weaknesses would be more prominent and easier to notice without repeated exposure and/or rigorous statistical analysis. During these observations, attention was paid to the flow of patients from the ingresses through the processes by which they began to receive treatment, as well as to the tasks performed by the staff that were facilitating those processes. Similar observations were conducted of the treatment area as well, and in this way a qualitative understanding of the steps taken from patient ingress through treatment and discharge was obtained. The understanding gained by this process was also useful for helping the team to formulate questions to be asked of leadership that would help prepare the plan for the remainder of the project.

Upon completion of these initial observations, it was then decided that the next best course of action in finding potential issues in the system beyond what was reasonable for direct observation was to “go to Gemba” and ask the healthcare workers to elucidate further about their jobs via an eight-question survey that was constituted of questions with varying levels of open-endedness. In this way we were able to get data that, while qualitative in nature, was amenable to making quantitative through categorization. The questions asked during the surveys were:

1. What do you think of team nursing?
2. Is there anything in your regular duties that you feel just "doesn't make sense?" If so, what is it and why?
3. Do you feel like you're adequately equipped to do your job to the best of your abilities? If not, what could be better?
4. Is there anything you spend a lot of time waiting on?
5. What are some things that stand out to you that could help in improving efficiency?
6. What challenges are unique to Pink Pod?
7. What is the procedure to transport patients from Pink Pod to wherever they may need to go? For example, transporting a patient to Radiology.
8. Do you have any suggestions for improvement or areas of concern not covered in any other questions?

The team was able to gather twelve complete survey responses in total. It was noted that the nurses were generally open—if not excited—to speak about potential issues and improvements within Pink Pod. The responses seemed to yield a good degree of conformance with one another, with the biggest difference observed being between newer nurses and more veteran nurses.

Exploratory time studies were then conducted in an attempt to quantify the time spend on—and thus potential delays associated with—routine treatment activities. These were conducted by simple observations of healthcare staff activities and timing (with single-minute precision) their duration. These measurements were taken on the basis of twelve patients.

The team also interfaced with the transport department in order to obtain data from them on the typical times it takes to perform their services on patients; these services are to transport patients (usually in hospital beds or wheelchairs)

from one area of the hospital to another to have services in different departments performed for them. In this way, additional context was given with respect to the magnitude of the times observed in our time studies.

5. Results and Discussion

5.1 Numerical Results

The exploratory time studies that were performed sought to find a rough size and variance of typical treatment tasks that most or all patients receive to help quantify the differences between those delays that may be said to be due to inefficiencies associated with processes, equipment, or interfaces with external resources compared to them. The results of these studies can be found in Table 1 below.

Table 1. Results of exploratory time studies on typical treatment tasks

Activity	Average	Median	Std. Dev.
Arrival To Assessment (N = 12)	0:03	0:02	0:03
Initial Assessment (N = 12)	0:03	0:02	0:01
Iv Installed (N = 8)	0:08	0:07	0:03
Assorted Nurse Interactions (N = 11)	0:05	0:03	0:06

Data was obtained from the transport department outlining the median and mean times for a typical day. The data shown here in particular are those times associated with transporting patients to get a CT scan; this is the one type of imaging scan that the imaging department always comes to get the patient for (rather than the nurse bringing them in for), and as such is a good representation of how long transport takes when totally under the control of the transport department. For a representation of this data in table format, see Table 2 below.

Table 2. Data from the transport department giving the median and mean time for different legs of transport over a day (N = 8972)

Transport Milestone Status Interval	Median (Mm:Ss)	Average (Mm:Ss)
Transport Request To Transport Start	06:39	10:20
Transport Start To Transport Complete	12:30	16:02
Transport Request To Transport Complete	22:55	26:29

5.2 Graphical Results

Process maps (PMAPs) were developed as a result of the qualitative process observations. Upon completion of the PMAPs developed directly from observation, ED leadership was then consulted for input, and fine adjustments made to them were necessary. In total, five process maps were created: registration, triage, bed traffic control (BTC), treatment, and discharge; these PMAPs will each be given in turn below in figure 1-figure 5.

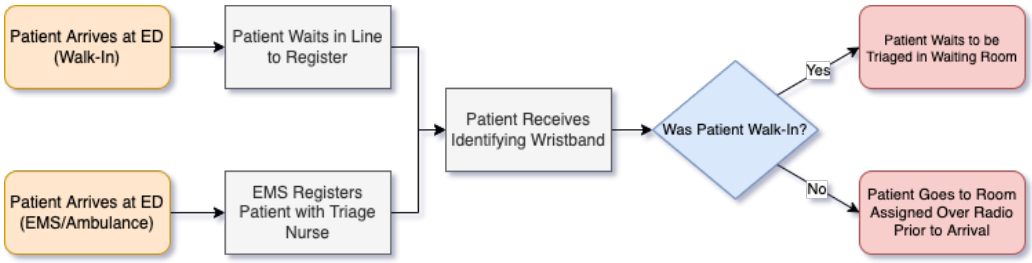

Figure **1**. PMAP of the registration process

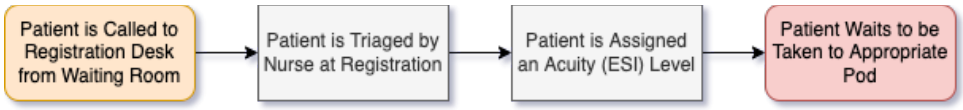

Figure **2**. PMAP of the triage process

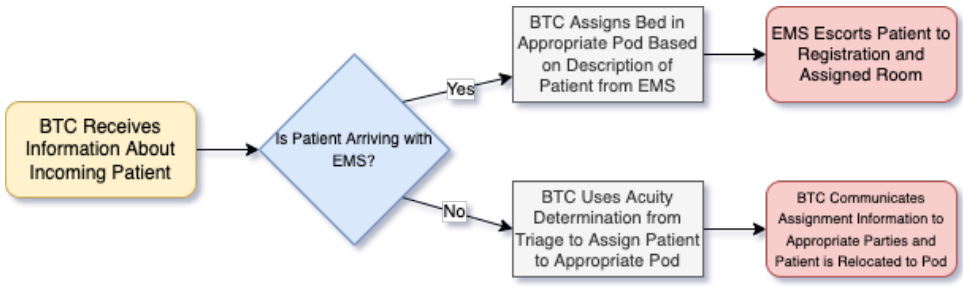

Figure **3**. PMAP of the BTC process

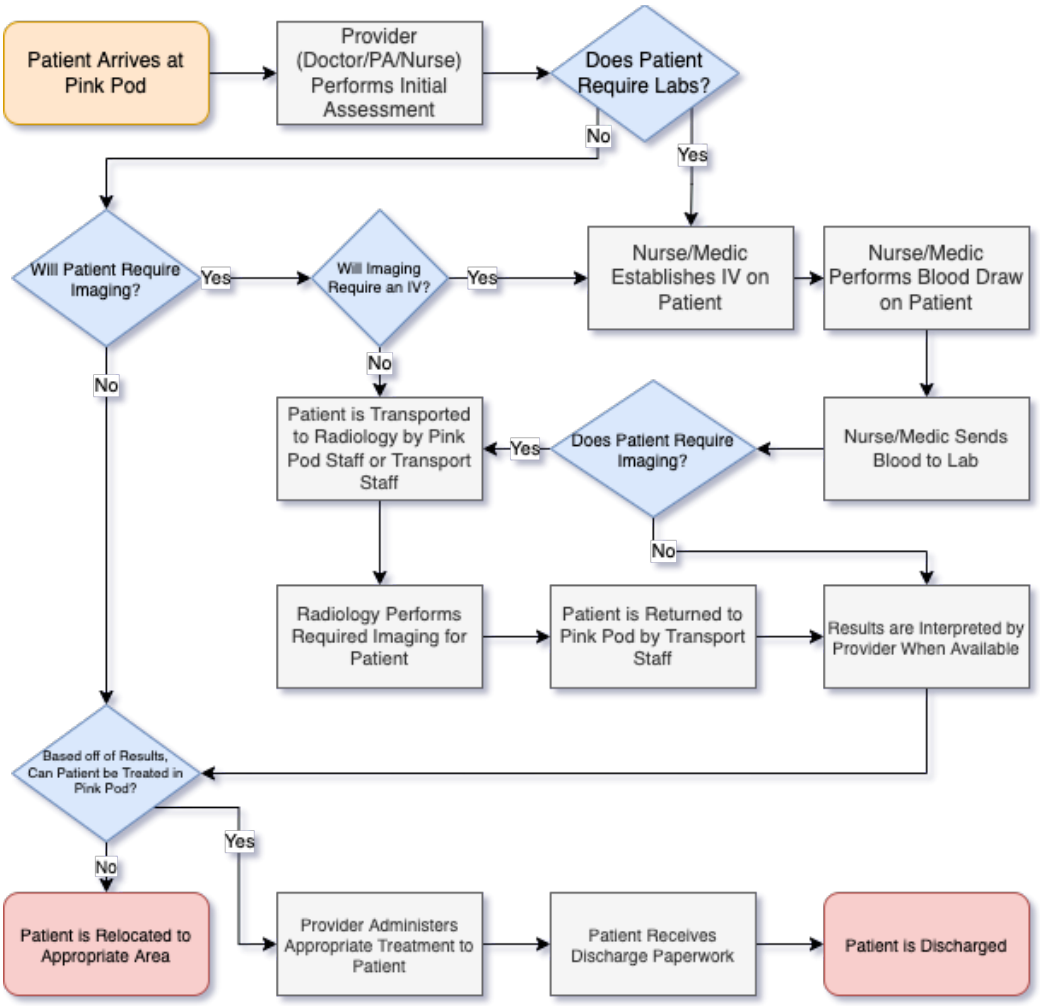

Figure 4. PMAP of the treatment process

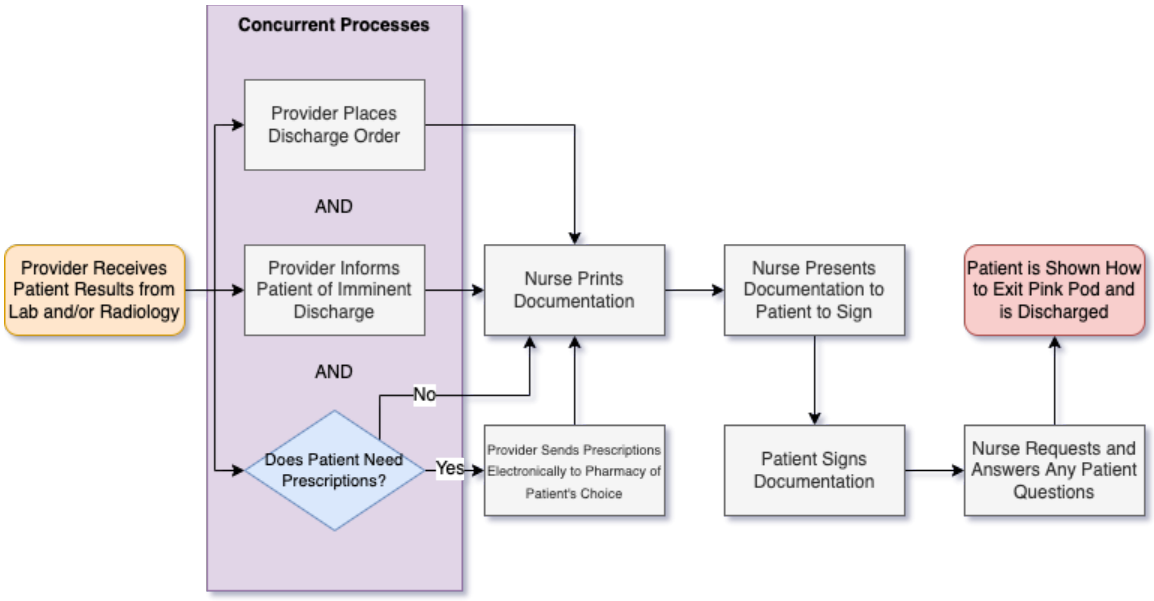

Figure 5. PMAP of the discharge process

The results of the interviews conducted with the nursing staff were analyzed for common trends that could be used to form the basis of categories. The result of the analysis of the interviews was then split into three areas: items for improvement, major causes of wait time, and equipment needs (Figure 6-8). These results are given below in the form of a Pareto chart and two pie charts.

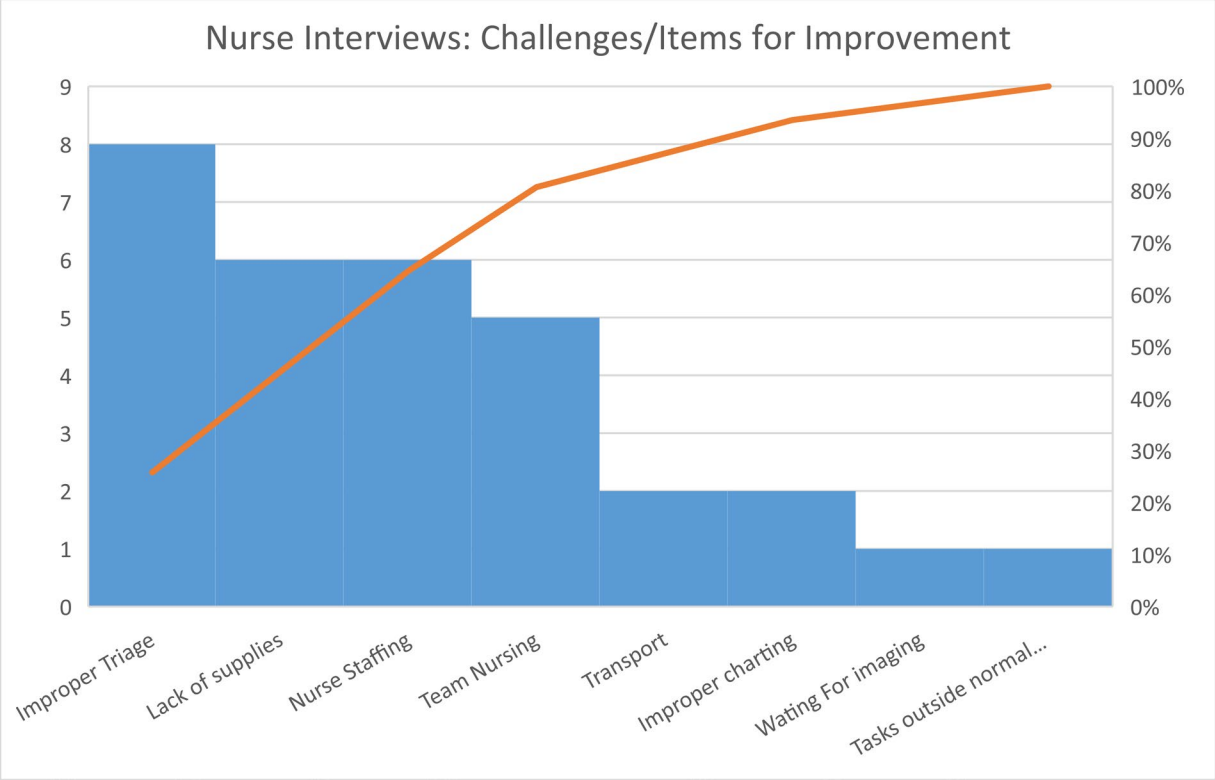

Figure 6. Pareto chart of improvement items from nurse interviews

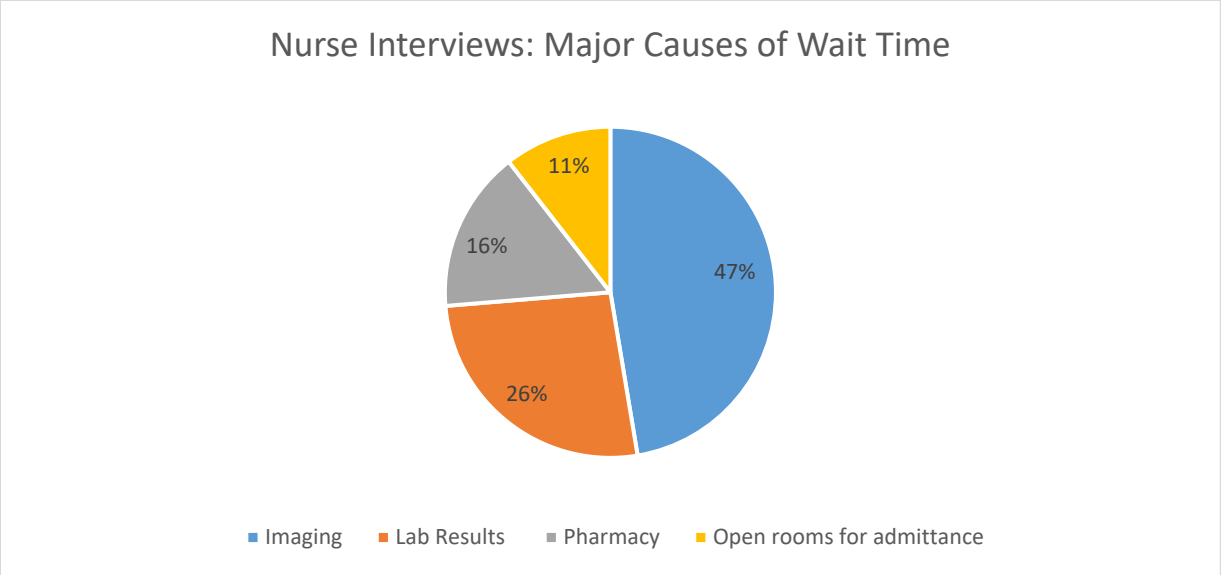

Figure 7. Pie chart of the major causes of wait time identified from the nurse interviews

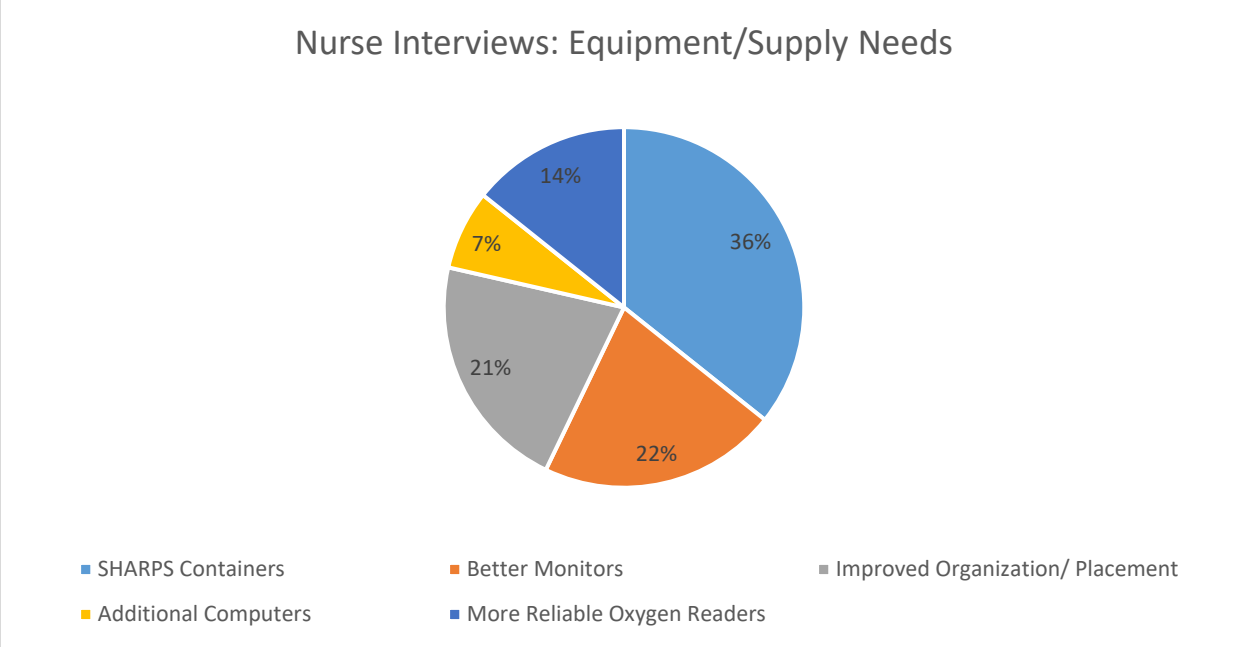

Figure 8. Pie chart of the equipment and supply needs identified from the nurse interviews

Through a combination of the observations of failure modes as well as brainstorming and discussions with staff, a failure mode effect analysis (FMEA) was conducted to identify potential failure modes and their severity within the system with respect to the frequency of occurrence and current controls that exist to prevent the failure mode; the results can be found in Figure 9 below.

Process Step	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN
Triage Patient	Wrong ESI Rating is Assessed	Patients requiring more resources are sent to Pink Pod	8	Pod Capacity and discretion of the triage nurses are causes	6	Blue Ball Assessment but this is done after the patient enters the pod	6	288
Register Patient	Patient is Sent to Pink Pod with a disqualifying condition	Pod care spot is occupied while patient waits to move. Patient exposed to open air setting	7	Patients do not disclose pre-existing conditions at registration. At peak times the registration desk will move patients to pink pod to alleviate triage and process patients "faster"	4	Blue Ball Assessment but this is done after the patient enters the pod	10	280
Assess Patient	Excessive Wait for Imaging	Delays in Treatment; Patient Discomfort; Patient Condition Worsens	8	Imaging has a priority system and ESI 3 gets trumped by higher ratings; Peak times see a surge in imaging demand	5	BTC may see patient status & escalate	7	280
Assess Patient	Resources needed for assessment are missing or broken	Delays in treatment; Nurse must leave pod to search for items	5	Equipment repair requests are not submitted or followed up on. Much of the equipment is shared	7	Recently more dedicated monitors added	8	280
Treat Patient	Pod is out of necessary supplies	Delays in care; Nurse must leave pod	5	Replenishment is not standardized. Some supplies are in short supply	7	End of Shift Supposed to Restock	8	280

Figure 9. FMEA developed over the course of the study

Brainstorming was performed to determine potential causes of decreased patient throughput; after this, the most important factors were identified in accordance the results of our observations and nurse surveys. The results of these efforts can be found in Fig. 10 below (note causes identified as most important are highlighted) (Figure 10).

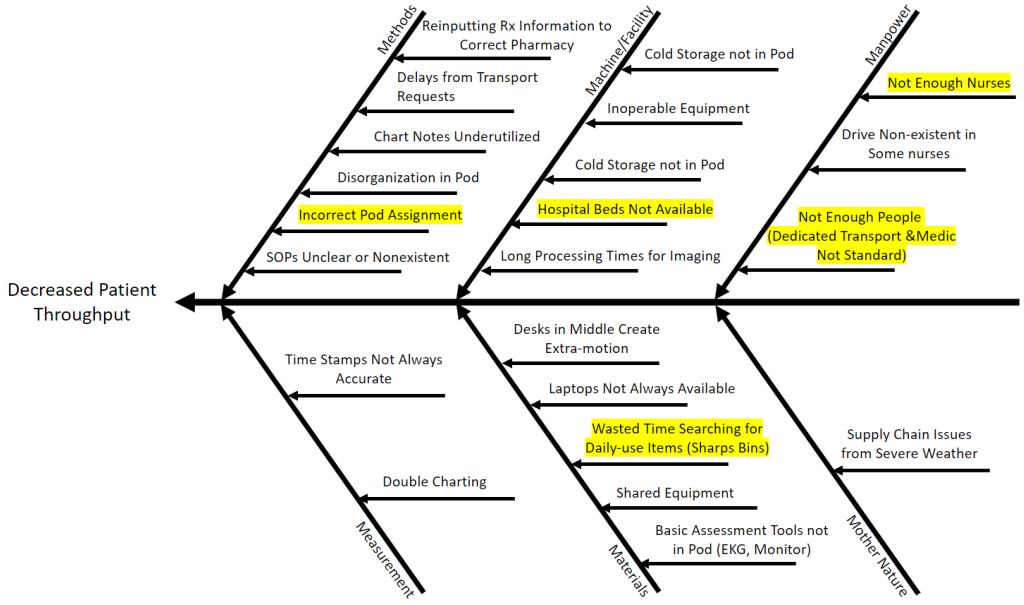

Figure 11. Cause-and-effect diagram developed over the course of the study

5.3 Proposed Improvements

The team proposed several improvements as a result of our analysis. These included:

- Keeping core groups of workers in the Pink Pod who want to be there
- New doors for patients in the Pink Pod to provide privacy and as a health safeguard
- Increased Sharps bin availability
- More laptops for Pink Pod staff
- More CT machines
- Revise registration process to check for patients with conditions excluding them from care in Pink Pod
- And improvements to the triage process

With the implementation of these improvements, we believe that patients will experience reduced wait times while in Pink Pod. Pink Pod staff will spend less time trying to find specific forms and equipment throughout the ED and will be able to provide care to patients in a timelier manner. The team also believes that effectively explaining to employees in the Pink Pod expectations and how to achieve them will ultimately aid them in meeting expectations as everyone will be aligned to the department's vision; likewise, should this prove to be insufficient for helping to meet expectations, some sort of accountability system could be implemented. Keeping core groups of employees in the Pink Pod is beneficial as they work together better as a team that has good chemistry rather than a seemingly random group of employees who rotate in and out of the Pink Pod as their schedules, or the department's schedules, allow. Ultimately, tight cohesion and high performance of the group on both the individual and group level is of the utmost importance due to the team nursing arrangement present in the ED.

6. Conclusion

The results of our study provided several areas for improvement for the Pink Pod as well as for the ED and AdventHealth as a whole. The team recommends an improvement to the onboarding process for new employees which will introduce them to Standard Operating Procedures (SOPs) based on the PMAPs the team developed for the key processes a patient will pass through during their time at the ED. Recommendations also include providing a binder in the Pink Pod with these SOPs as well as any relevant common health or safety information in case an employee is unsure of how a task is completed or how to deal with a certain situation they may face in the Pink Pod.

Difficulties were encountered in attempting to obtain and utilize data for certain time-based metrics; specifically, the time taken for the imaging process (excluding transport time). This was identified as a major item that the nurses waited on in the treating of patients as per Fig. 7, thus motivating investigation into the time associated with this time item. However, it was found over the course of the study that this data was recorded manually, and thus was sufficiently low fidelity as to warrant its dismissal during the course of the performed analysis. This then presented the team with difficulties in placing numerical values on the savings to be had through the implementation of various measures as a share of the magnitude of the patients' time-in-system.

Communication problems were evident between leadership and the workforce. In several instances, employees were asked to explain the process behind certain tasks. There was a high level of variance in response depending on the level of experience of the employee as well as how long they've worked within Pink Pod. This contrasts with what was explained to the team by leadership, which is that everyone is expected to know what they're doing or what they're supposed to be doing. During our surveys of the employees, we encountered someone who claimed they did not know what the proper procedure for a certain task. We believe this could be remedied by a combination of the solutions provided in Section 5.3 as well as townhall style meetings between leadership and employees to ensure everyone is on the same page and knows what is expected of them.

Overall, the study identified several weak areas within the ED. It can be reported that the ED has already begun the process of implementing some of these changes, and to very positive effect. The largest change so far has been the implementation of core groups or teams of nurses that work together within Pink Pod regularly. The increase in satisfaction among the nurses has been reported by leadership to have been improved, as well as the patient throughput—though statistics on these improvements are lacking at the time of writing. Other small improvements including additional sharps bins and a revised registration have also been rolled out, though the effects of these changes are also yet to be quantified.

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