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**Large Scale Organizational Intervention to Improve Emergency Department Throughput
in a Community Hospital**

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Abstract

BACKGROUND: Emergency Department boarding is a well-documented systemic problem across the country. ED-2b, the time from decision to admit a patient to Emergency Department departure, is specified by the Joint Commission as a quality measure for Emergency Department boarding. ED-2b metrics have been a longstanding challenge at this community hospital outside the nation's capital. The aim of this study was to reduce median ED-2b times by 10% compared to fiscal year 2020 (FY20). To accomplish the reduction in time, a multidisciplinary throughput committee was developed with subsequent action plans designed to improve Emergency Department throughput.

METHODS: The Plan Do Study Act method of quality improvement was used for this project. Several tactics were developed to address a variety of known throughput challenges. Baseline assessment included a review of FY20 ED-2b metrics. These times were used as the comparative pre-intervention data. Literature review queries were conducted to identify tactics to improve hospital throughput.

INTERVENTION: A multidisciplinary hospital throughput committee was developed along with a Plan Do Study Act action plan at the beginning of FY21. Improvement tactics included the standardization of workflows for care transitions, compliance with a telemetry discontinuation protocol, implementation of an early warning predictive model for Emergency Department overcrowding, and an inpatient discharge team. In addition, data was collected during the project period comparing bed request to bed assignment, bed assignment to unit arrival, and inpatient discharge order to depart times. Perceptions of the implications associated with Emergency Department boarding were assessed pre and post intervention.

RESULTS: Eight months after implementing various tactics, ED-2b metrics were reviewed to assess effectiveness. Comparative data revealed a statistically significant improvement in ED-2b median times. In addition, implementing a discharge team demonstrated a 21% improvement in inpatient discharge departures by 1700.

CONCLUSION: Implementing a multidisciplinary throughput committee with engaged participants and leaders, creates a forum for process improvement. By implementing several tactics with key stakeholder, the reduction of Emergency Department boarding time is achievable. Accomplishing frontline engagement supports the success of tactics, improvement of patient satisfaction, and aligns with organizational goal achievement.

Keywords: emergency department throughput, emergency department overcrowding, capacity management, telemetry utilization

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Large Scale Organizational Intervention to Improve Emergency Department Throughput in a Community Hospital

Introduction

Problem Description

Emergency Department overcrowding and delays have significant consequences to public health. For years, the systemic issue has been well documented across the nation. Boarding in the Emergency Department, ambulance diversion, left without being seen rates, and the inability for the public to have timely access to care are just a few of the negative consequences associated with the complexity of Emergency Department throughput in most hospital settings.

Although not unique, community hospitals experience the same throughput challenges. These challenges are further complicated by fewer resources to overcome multidisciplinary challenges that contribute to bottlenecks in the Emergency Department. One of the quality measures specified by the Joint Commission is ED-2b metrics. This measure is the median time from the decision to admit a patient to the hospital, to the time of Emergency Department departure (Joint Commission, 2019). At this Maryland community hospital located outside of the nation's capital, ED-2b measures have been a long-standing concern for the organization. In Fiscal Year (FY) 2019, the median ED-2b time was 194 minutes. At the time, the Maryland benchmark was 161 minutes with a National benchmark of 118 minutes. With minimal improvement plans in place, the FY 2020, ED-2b median time was 182.5 minutes. Having times well above the benchmarks contribute to patient dissatisfaction, increase length of stays, and the potential for adverse events (Morely, Unwin, Peterson, Stankovich, & Kinsman, 2018). At this identified community hospital, there are approximately 48,000 Emergency Department visits per

year with a 21-25 % admission rate. In addition, the average Federal Case Mix Index (CMI) is 1.57. CMI is a metric used by the Centers for Medicare and Medicaid Services (CMS). This metric is used to “assess the mixture, clinical complexity, and resource needs of all patients treated in the hospital and reflects the average relative DRG weight of a hospital’s inpatient discharges” (“CMI,” 2020, para. 4). The higher acuity and patient complexity lead to additional strains on the resources available to expedite admissions and discharges.

Available Knowledge

In the state of Maryland, Emergency Department throughput is monitored and measured by the Health Services Cost Review Commission. Hospitals are assessed on their improvement of one measure of Emergency Department (ED) throughput efficiency which is ED-2b. This measure also correlates to the number of boarding hours in the Emergency Department. As part of the Quality-Based Reimbursement (QBR) Program, hospitals are either rewarded or penalized monetarily for their performance.

Additionally, the Maryland Institute for Emergency Medical Services Systems (MIEMSS), monitors diversion hours for each hospital. MIEMSS has instituted four categories of diversion; yellow, red, mini disaster, and re-route (Institute for Emergency Medical Services Systems, n.d.). Each category of diversion has stipulations in place for activation. Diversion hours by each type are monitored on a regular basis by MEIMSS. The goal is to have minimal hours of diversion for each category, so the resources are available to meet the needs of the community.

Emergency Department boarding has been associated with treatment delays, errors, increased inpatient length of stay, and mortality. Sun et al. (2013) found there was a relative

increase in inpatient mortality by 5% for patients admitted to the hospital during periods of Emergency Department overcrowding. Often, delays are due to the lack of inpatient bed availability. Lack of beds are often caused by capacity challenges, overutilization of telemetry beds, and delayed discharges from the inpatient setting.

In one study, significant delays for patients experiencing myocardial infarctions transferring to the cardiac catheterization lab for balloon intervention were attributed to Emergency Department overcrowding and decreased throughput efficiencies (Kulstad & Kelley, 2009). Many organizations have put protocols in place to mitigate these life-threatening delays. However, such protocols involving members from other departments may be effective but do not address the issue of Emergency Department overcrowding itself.

The lack of telemetry beds is frequently caused by the overutilization of the intervention. Acute chest pain is one of the primary reasons for an Emergency Department visit. Subsequently, these patients are admitted to a telemetry bed. This leads to extended days of telemetry monitoring and a perceived substitute for nursing care (Chen, 2013). With extended days of telemetry monitoring, often the allocation of the devices become a challenge and impacts further patient admissions. In response to the overutilization of telemetry and/or monitored beds, the American Heart Association (AHA) published practice standards for electrocardiographic monitoring in the hospital setting. In a study conducted at a tertiary care hospital, out of a sample of 1542 patient days, 1402 of those patient days (85%) were on telemetry. In addition, only 23% of those patient days were deemed appropriate by the AHA practice standards (Chong-Yik, Bennett, Milani, & Morin, 2016).

The overutilization of telemetry not only causes an impact on device resource management, but clinical personnel resources. At minimum, organizations require annual training and validation of staff competence related to interpretations (Bulger et al., 2013). In addition to financial implications, organizations should also be cognizant of the unintended contribution to alarm fatigue.

In other cases, there are significant challenges with the hand-off of care processes. There are varying methods to achieve hand-off transitions and minimal research regarding best practices. The Joint Commission requires organizations to "implement a standardized approach to handoff communications including an opportunity to ask and respond to questions" (Agency for Healthcare Research and Quality [AHRQ], 2019).

The perception of Emergency Department overcrowding can vary among individuals. Often, overcrowding can be subjective versus objective. The National Emergency Department Overcrowding Score (NEDOCS) is an early warning predictive model for overcrowding. The NEDOCS model calculates a score based on multiple values. Number of patients in the department, number of patients on ventilators, and longest admit time are a few of the values that contribute to an overall calculation algorithm (University of New Mexico, n.d.). The use of the NEDOCS value can be useful for the development of surge plans in healthcare organizations. At the Ohio State University Medical Center, the NEDOCS was embedded into their surge protocols which led to patient flow improvements. Scores were evaluated at scheduled intervals and specific interventions took place. Including, "maximizing all treatment spaces, expediting patient transports to the floor or testing, expediting admissions, or calling in an on-call physician

to work in the intake/triage area to see and evaluate patients from the waiting room” (Moseley et al., 2010, p. 456).

The Joint Commission has an element of performance related to Emergency Department throughput. This element is LD.04.03.11, the hospital manages the flow of patients throughout the hospital. The elements are inclusive of processes, surge beds, and criteria for patient diversion (The Joint Commission, 2011). Improving patient flow in any Emergency Department is complex and requires a multidisciplinary approach. Therefore, any policy/practice changes should involve members from across multiple departments in an organization. An effective way to ensure these elements are met, is with the development of a hospital-wide throughput committee. A multidisciplinary approach can drive process change, develop hospital-wide accountability, and a sense of ownership with performance visibility (Baker & Esbenshade, 2015).

Kane et al, (2020), found success in patient flow with the implementation of active daily management that consisted of Gemba rounds, staff engagement with visibility walls, and standardized huddles. In this study, the Emergency Department achieved a 17% decrease in their median length of stay (Kane et al., 2015). In addition to multidisciplinary approaches, studies have found positive correlations with technology embedded approaches to promote patient flow efficiency (McCaughey, Erwin, & DelliFraine, 2015).

Rationale

The Institute for Healthcare Improvement’s framework for safe, reliable, and effective care was the basis of this quality improvement project. Using this framework as the development guide, the two domains of culture and a learning system was paramount for this initiative

(Frankel, Haraden, Federico, & Lenoci-Edwards, 2017). Teamwork and communication were embedded in this project by developing a shared vision within the organization, anticipating problems, and developing a culture that embraces change. Along with change, was the development of multidisciplinary accountability through different means and methods. Mentoring and influence by senior leadership took place by fostering engagement and psychological safety among hospital associates.

Transparency was an additional key element for this initiative. Sharing current benchmarking performance and related outcomes was a crucial part of the beginning phases of this project. Applying best practices and measuring success over time was an integral piece of this project plan as well.

Hospital data and the qualitative literature review of Emergency Department throughput barriers and interventions were used to develop this quality improvement project. The Plan Do Study Act model was used. Interventions were designed to mitigate workflow barriers. New processes were put into place to enhance communication, multidisciplinary stakeholder involvement, and responsibility.

Specific Aims

The primary aim of this project was to reduce the median time from Emergency Department decision to admit to Emergency Department departure (as defined by ED-2b) by 10%, or by 18.25 minutes compared to FY20, by March 1, 2021. The secondary aims of the project included:

- A multidisciplinary commitment to improving Emergency Department throughput

- Improvement of workflow efficiencies with standardized approaches to decrease times for hand-off of care transitions between the Emergency Department and inpatient units
- Improved compliance with the nurse-driven telemetry discontinuation protocol to mitigate admission delays due to lack of equipment resources
- Creation and implementation of an early warning predictive model to mitigate Emergency Department boarding hours
- Monitoring of inpatient discharge times and identifying barriers to timely departures

Methods

Context

This project took place in a 200+ bed community hospital. This quality improvement project was implemented in the Emergency Department and all in-patient units, excluding Women's Services. In FY20, there were approximately 48,000 Emergency Department visits per year with a 21-25 % generalized admission rate, inclusive of all units. This community hospital has an Emergency Department, 5 medical/surgical units, 3 intensive care units, 1 intermediate care unit, and a behavioral health unit as part of the inpatient setting. All units are staffed with employed registered nurses, technicians, and secretaries. The Emergency Department, medical/surgical units, intermediate care unit, and the intensive care units have contracted registered nurses as well. The behavioral health unit is contracted by a vendor of specialty service in which all hospital policies and recommended processes are followed. In addition, this

community hospital is a non-academic center with a robust and tenured hospital system employed physician group.

In recent years, this hospital has been on the path of becoming a high reliability organization. As part of a larger system, patient safety has been the core value of every activity. The vision is to be the trusted leader in caring for people and advancing health. The vision is supported by a five-pillar framework: excellence, people, service, quality, growth, and fiscal responsibility. The hospital's mission is to serve patients, those that care for them, and the community. The values include service, patient first, integrity, respect, innovation, and teamwork. All operational programs are linked to a value and must be demonstrated during the development phase. Quality and safety program outcomes are reported to the hospital board. The board provides leadership accountability for outcomes. The hospital has an Emergency Department Operations meeting that is held by the hospital President. It is in this venue that metrics are reviewed. Although this is a venue to review throughput metrics and outcomes, there was no framework or workgroup in place to conduct activities for quality improvement related to the metrics.

Strategic plans are developed every fiscal year for the hospital. The development of these plans include participation from across the system. This strategic plan guides the local annual operating plan (AOP), which is developed by senior leadership. After development, the responsible parties are included and expected to develop an action plan for execution. Most action plans are developed using the plan, do, study, act (PDSA) model. ED-2b is a metric that has been part of the hospital's AOP for the past few years with minimal improvement noted.

The hospital has a Director of Patient Experience. This role is critical for gaining insight about our perception within the community and their needs. Large long-term goals are established using the AOP and carried out by the patient satisfaction committee. Additionally, there is a PFACQS (Patient and Family Advisory Council for Quality and Safety) committee comprised of community members that meets regularly to review programs and develop new goals. The community members on this committee have a vested interest in the improvement of the ED-2b metric.

Measurement analysis and knowledge management at the system level is well developed. At this local hospital, there is an opportunity to improve in this domain. Part of this quality improvement project included the partnership with interdisciplinary members along with the development and dissemination of analytics. Key stakeholders in the organization were committed and supported the development of the robust structure that allowed access to data and reports. With this, the management and dissemination of data became further defined and evaluated.

Cost-Benefit Analysis

The cost-benefit of this project had the potential to yield significant positive results. Often, extended stays in the Emergency Department or the inpatient setting without warranted need is a denied claim for hospital reimbursement. In a study conducted at a university hospital, participants found that there was an excess of \$3,855,726 charges per year because of the extensive Emergency Department length of stay with a significant risk of denied recoupment of these expenses. (Foley, Kifaieh, & Mallon, 2011). All administrative cost of the project implementation were assumed by the project lead. The operational cost to implement this project

was minimal compared to the projected gains. Improving Emergency Department efficiency and throughput has potential outcomes which include enhanced revenue and a decrease in denied claims, reduction in ambulance diversion hours, and improved patient satisfaction. The projected cost-benefit analysis can be found in Appendix A.

Interventions

The first intervention of this quality improvement project was to establish a hospital-wide throughput committee. The committee has a chair (DNP student and project lead) and two co-chairs (an ED nurse leader and an inpatient nurse leader) along with a comprehensive charter. The charter can be found in Appendix B. Additional members include representation from the following areas/departments:

- Senior Leadership
- Bed management
- Leaders and associates from the Emergency Department
- Leaders and associates from each inpatient unit
- Radiology
- Laboratory
- Environmental Services
- Intensivist group
- Hospitalist group
- Emergency physicians
- Case Management

- Director of Patient Experience

The overarching goal of the committee was to develop a PDSA model action plan to achieve a 10% decrease in the ED-2b metric. This can be found in Appendix C. Each represented group has established baseline performance benchmarks and FY21 performance goals. During each throughout committee meeting, each department is responsible to report out on their data/metrics and on their respective small-scale action plan for performance improvement. In addition to these action steps, each inpatient unit leader is responsible to report out on three data points; median time from bed assignment to unit arrival, median discharge to depart times for the admitted patients, and compliance with the nurse-driven telemetry discontinuation protocol developed at the system level based on auditing results.

The second intervention was the development of a throughput policy that utilizes the NEDOCS predictive model. This policy outlines the activities at each level that are to be completed and by which responsible party. Monitoring of these activities were tracked by a “NEDOCS response” form and collected by the project lead. This response form includes every action step that must be taken to move patients when Emergency Department overcrowding occurs. This form can be found in Appendix D. Validation of actions were monitored by the Leader assigned to conduct the response form. Compliance and effectiveness of the throughput policy is reported at the monthly committee meetings, along with continuous modification needs.

The third intervention was to create performance visibility by creating performance boards designed by the associates. All inpatient units and the Emergency Department have these throughput boards visible at the nurse’s station. Each inpatient unit board includes the following elements of data monthly: 1) median time from bed assignment to unit arrival 2) unit compliance

rate with the nurse-driven telemetry discontinuation protocol 3) median time from discharge order to unit departure. The Emergency Department boards include the following elements of data: 1) median time from bed assignment to ED departure 2) median time from discharge order to ED departure. The goal of the boards was to depict data elements related to performance. In addition, the goal was to have associates from the Throughput Committee utilize these boards, along with leaders, during unit meetings, huddles, and in-services.

The fourth intervention was to establish a small taskforce of frontline associates throughout the organization to update the “hand-off” policy and incorporate methods to achieve a culture where there are no delays in hand-off of care. This was monitored by the bed-board coordinator and project lead. To achieve a successful monitoring method, we utilized the Emergency Department tracking board of the EHR (electronic health record). With the help of the informatics team, when a bed has been assigned for greater than 30 minutes, there is a red icon that flashes. This signals the bed-board coordinator or project lead, to call and resolve the delay in hand-off and patient movement.

The fifth and final intervention was to include an education plan. This plan was inclusive of a variety of in-services for committee member expectations, the throughput policy, the hand-off policy, auditing expectations, and performance reporting. The education plan was planned to take place once all policies and processes were developed.

Study of Interventions

Interval level measures were used to compare ED-2b median times pre- and post-interventions. In addition to ED-2b times, we compared Emergency Department diversion hours. Additional interval level measures were used to compare median times during the project period

for bed request to bed assignment, bed assignment to unit arrival, inpatient discharge order to depart times, and compliance rates with the nurse-driven telemetry discontinuation protocol.

To measure the perceptions of the interventions on Emergency Department throughput, a survey was administered to committee members and associates pre interventions and after the implementation of all tactics. This form can be found in Appendix E.

Measures

Pre and post-test intervention ED-2b data were collected and compared. Monthly ED-2b metrics are provided by the system Emergency Physician's analytic division, collected by using data points from the electronic health record. The other interval level measures were obtained and compared using reports generated from the electronic health record as well. To measure perceptions, a 5-point Likert scale questionnaire was developed. This survey of Emergency Department patient boarding perceptions was conducted pre and post interventions.

Analysis

Quantitative data was analyzed using inferential statistics. Specifically, the independent t-test was used to analyze the statistical difference of means between the pre-intervention group and the intervention group for ED-2b metrics. FY21 YTD ED-2b means were compared to FY20 means. Using the independent t-test, we also compared FY21 YTD to FY20, Emergency Department diversion hours.

Additional quantitative data was used for comparison for various project tactics. Comparative graphs were used to depict the pre and post perception survey results.

Ethical Considerations

The University of New Hampshire (UNH) Internal Review Board (IRB) approval was not required. This project was a quality improvement project and not research based. Ethical considerations for this project included protection of personal health information (PHI). Organizational policy was followed as outlined in the internal hospital-wide policy “Confidentiality of Patient Records”, and in accordance with Maryland Law (Health-General 4-301 through 4-309). All data collected as part of this project was collected according to the standards of privacy and confidentiality as outlined in the organizational internal policy. Transcription of data was de-identified. No patient-identifying information left the building. The risks to patients participating in this project was no different than the risks of patients receiving standard care. All electronic files of patient information were password protected and only accessible to the project implementation team.

Results

Over the course of this quality improvement project, eight months of data was collected and compared to FY20 data. During the eight months of FY21, several interventions, as outlined in the intervention section, were implemented as part of this quality improvement project. By the beginning of FY21, a hospital-wide throughput committee was in place. By October of 2020, the charter was revised and led by the project lead (Appendix B). The revised charter with stakeholders and objectives were approved and supported by senior leadership. The multidisciplinary committee of stakeholders agreed to the Plan Do Study Act action plan developed to meet the goals of this project (Appendix C).

The overarching goal of this project was to decrease ED-2b times by 10% compared to FY20. The ED-2b median time for FY20 was 182.5 (183) minutes. Therefore, the goal was to decrease by 18.25 minutes, a 10% reduction. The results are displayed below.

Figure 1a

FY20 ED-2b Median Times

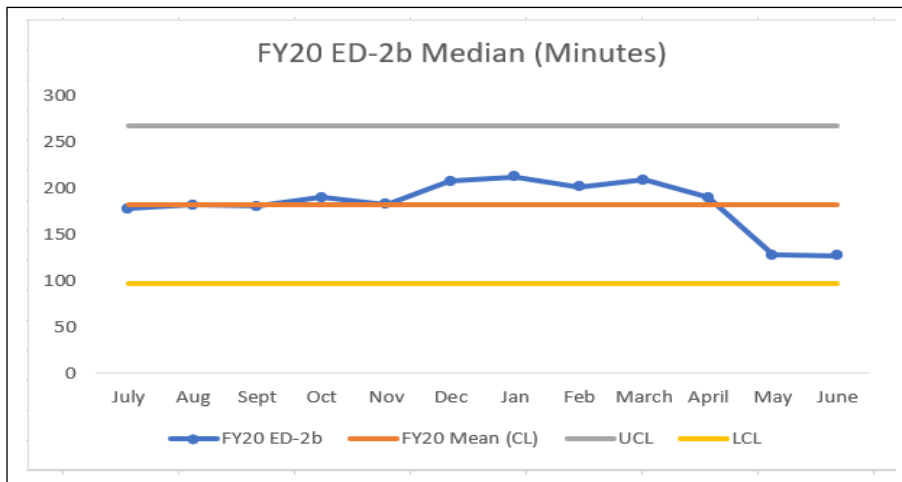
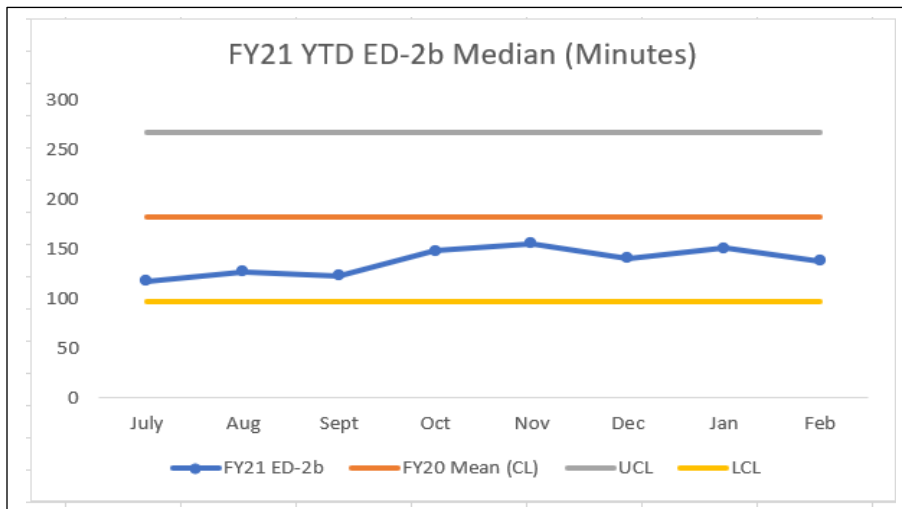


Figure 1b

FY21 YTD ED-2b Median Times



The control charts above demonstrate that both processes in FY 20 and FY21 YTD are stable with common cause variation. However, FY21 YTD data indicates that the altered processes remain stable, with predictable common cause variation. All data points are below the FY20 mean as sought after.

An independent-samples t-test was conducted to compare FY20 median ED-2b times to FY21 YTD median ED-2b times. There was a significant difference in median ED-2b times for FY20 ($M=182.58$, $SD=28.363$) and FY21 YTD ($M=137.88$, $SD=13.984$) conditions; $t(18)=4.111$, $p=.001$. Emergency Department volumes were considered when conducting the analysis. FY20 and FY21 YTD have comparable volumes for the purpose of the project.

We wanted to compare mean times for time of bed request to bed assignment as well as times for bed assignment to unit arrival. FY20 data was not available for these two metrics. Therefore, we wanted to achieve a decrease in both measures over the project period. To monitor times, we set internal benchmarks. The goal was to have a median time of 30 minutes for bed request to bed assignment. This timeframe was selected to provide sufficient time for our bed-board coordinators to conduct a brief medical record review. They do this to ensure appropriate bed allocation based on diagnosis, sex, and isolation requirements. Then, our goal was to have a median time of 45 minutes from bed assignment to unit arrival. This timeframe was selected to align with our hand-off policy. Over the course of this project, the median bed request to bed assignment was 54.75 minutes and the median time for bed assignment to unit arrival was 67.75 minutes.

Another comparative data source was Emergency Department diversion hours. The Maryland Institute for Emergency Medical Services has instituted four categories of diversion.

Yellow diversion is used by the Emergency Department when it is overwhelmed, and they have requested temporary ambulance diversion for non-life-threatening complaints/injuries. Red diversion is used by the Emergency Department when the hospital no longer has cardiac monitoring capabilities for admitted patients and they are requesting ambulance diversion for any patient with non-life-threatening complaints that may need that service (Institute for Emergency Medical Services Systems, n.d.). Yellow and red diversion is influenced by the management of hospital throughput. Therefore, these were the two types of diversion considered during this project. FY21 YTD data was compared to FY20.

Figure 2a

Yellow Diversion FY21 YTD vs FY20

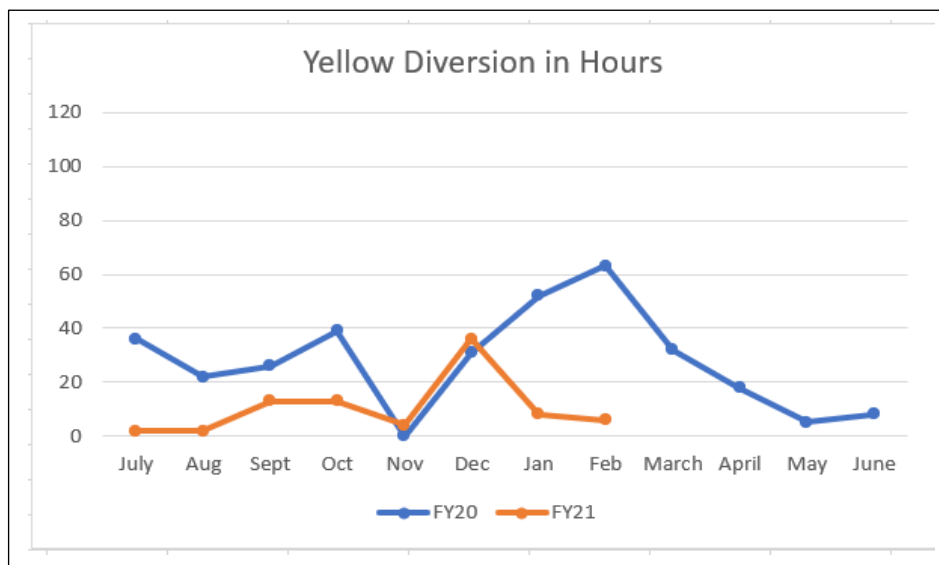
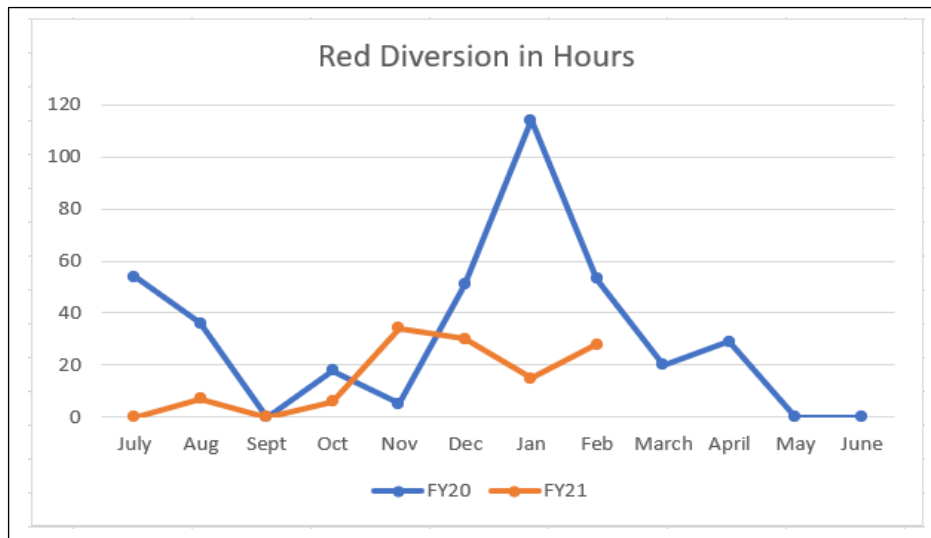


Figure 2b

Red Diversion FY21 YTD vs FY20

An independent-samples t-test was conducted to compare FY20 median yellow diversion hours to FY21 YTD median yellow diversion hours. There was a significant difference in median yellow diversion hours for FY20 ($M=31.67$, $SD=33.268$) and FY21 YTD ($M=15.00$, $SD=13.887$) conditions; $t(18)=2.318$, $p=.032$.

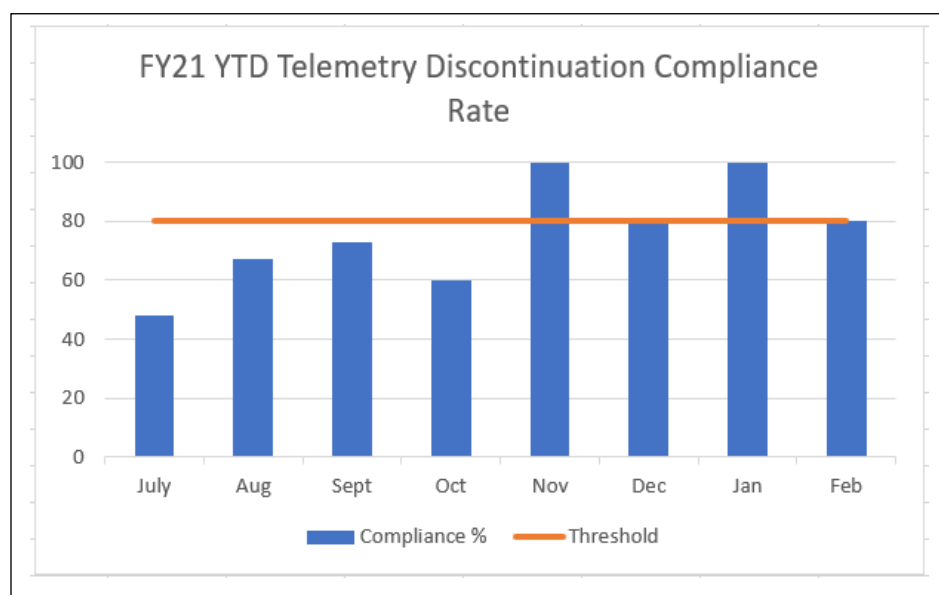
When comparing red diversion hours, an independent-samples t-test was conducted to compare FY20 median red diversion hours to FY21 YTD median red diversion hours. There was no significant difference in median red diversion hours for FY20 ($M=27.67$, $SD=18.739$) and FY21 YTD ($M=10.50$, $SD=11.187$) conditions; $t(18)=1.332$, $p=.199$.

As part of the monthly hospital-wide throughput committee, inpatient departments report out on their compliance with the nurse-driven telemetry discontinuation protocol. The tactic of real-time auditing of protocol compliance was initiated. The unit-level leaders are responsible for conducting a minimum number of random audits per month. The protocol requires telemetry

monitoring orders to have an indication, otherwise providers are unable to proceed with an order in our electronic medical record. Each indication has time intervals associated with it. Once the time intervals are reached and a new order is not initiated, nursing is permitted to discontinue the monitoring. The auditing process was hardwired the end of October 2020. At this point, compliance rates started to increase and maintain at or above an 80% threshold. Below is a graphical depiction of compliance rates.

Figure 3

Telemetry Protocol Compliance

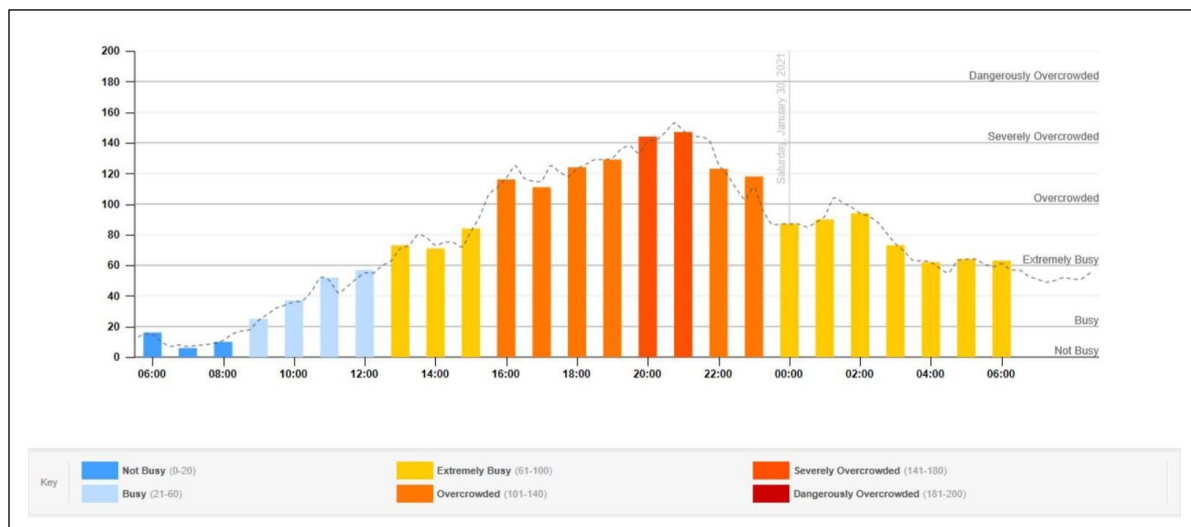


By monitoring compliance, appropriate telemetry monitoring device utilization has mitigated the delays associate with device allocation. In addition to randomized auditing, a daily report of telemetry utilization is sent to each inpatient leader. The report highlights any patient with an expired telemetry order allowing for early device removal. During this project period, there were no incidents of delayed admissions associated with lack of telemetry device resources.

A throughput policy that utilizes the NEDOCS predictive model was implemented and the monitoring process utilizing the response form was hardwired by October 2020 (Appendix D). The NEDOCS predictive model is embedded in the Emergency Department electronic tracking board. It allows for real-time monitoring of the overcrowding in the department. The model provides graphical data over a course of time. This data is used to track days of the week and times with higher scores, allowing for proactive resource planning. A visual example is depicted below.

Figure 4

NEDOC System



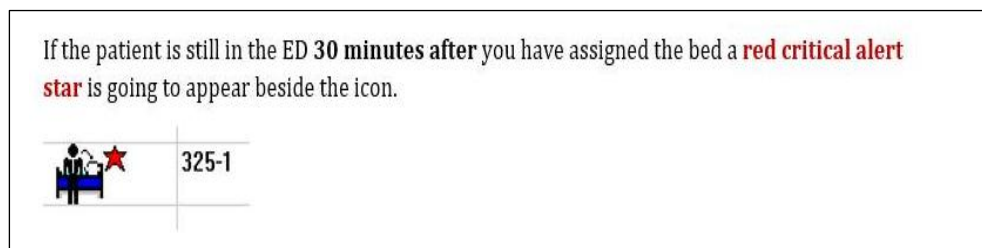
The above example demonstrates a day in time where the NEDOC level was fluctuating between 3 and 4 during the hours of 1600 to 2300. The response checklist has allowed for a standardized approach to management of Emergency Department overcrowding. When the Emergency Department reaches a NEDOC level of 3 or greater, communication is sent via our emergency response system, notifying a multidisciplinary team to act. This aids in the

completion of the checklist and minimizes the time that the Emergency Department remains at the high NEDOC level. The team was able to closely monitor the effectiveness of intervention real-time. During the project period, we were able to maintain a low number of hours at a NEDOC level of greater than 3.

To embrace the technology we had at hand, the Nursing Informatics team created a “red star” icon in our bed management system. An example is provided below.

Figure 5

Bed Assignment Icon



Hardwiring this technology in our bed management system called “visibility”, allowed for real-time bed assignment monitoring. Bed management and the project lead have been able to monitor the assignment times and manage the expectation for Emergency Department departures within 30 minutes. Bed management is responsible to notify the Emergency Department and the respective inpatient unit when the 30- minute threshold has been reached. This technology has allowed for real-time management versus retrospective monitoring.

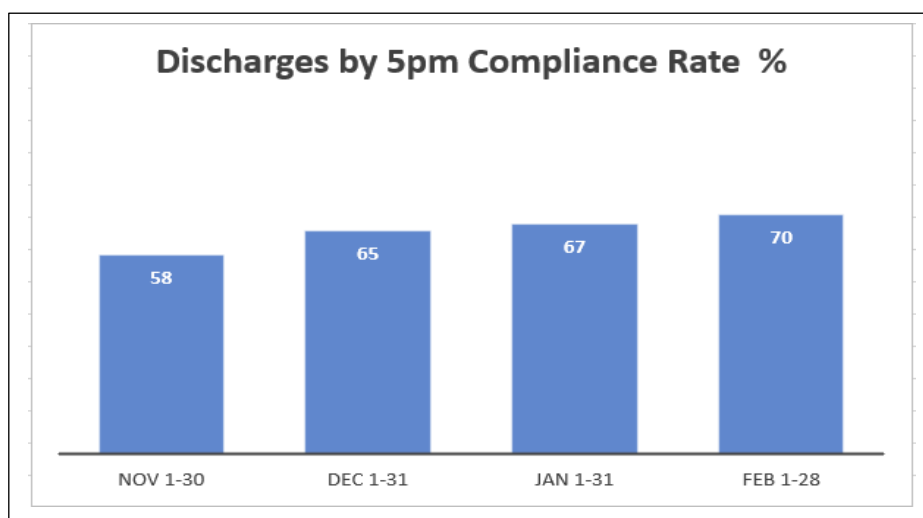
By November of 2020, the hand-off policy review with frontline associates was conducted. No further recommendations were made to the hand-off policy. The policy has an embedded escalation process for timely transitions of care. Once a bed is assigned, the Emergency Department is expected to call report to the inpatient nurse. If the nurse is not

available, the Emergency Department attempts again within 15 minutes. At that point, the primary nurse, charge nurse, or Nursing Director must take report. This escalation process is monitored by the bed management team and/or Nursing Supervisors. If any further delays occurred during this project implementation, the project lead was notified.

By November of 2020, an inpatient discharge team was developed as indicated in the PDSA action plan. This team was led by the project lead and Hospitalist Medical Director. This team was supported by case management and senior leadership. This team met daily, 7 days a week, to review daily discharges to expedite departures and address barriers such as home health needs, transportation needs, or durable medical equipment needs as an example. In addition to the daily discharges, we worked with the inpatient teams to predict next-day discharges and address barriers early. Along the way, we set a goal to increase compliance with discharges prior to 1700 (5pm). Data is displayed below.

Figure 6

FY21 Discharge Compliance



As depicted by the graph above, there was a 21% increase from November 2020 to February 2021, in compliance with patients discharged by 5pm. Increasing the compliance had an impact on the ability to admit from the Emergency Department. The bulk of admissions occur in the late afternoon. Therefore, it is vital that discharged patients leave the facility as soon as possible.

Perception of the interventions were important to evaluate. A survey (Appendix E) was administered to frontline registered nurses during the project phase and several months later after all tactics were implemented. A random selection of nurses (N=45) was surveyed pre-interventions from the inpatient units and the Emergency Department. Then a random selection of nurses (N=40) was surveyed post-interventions from the inpatient units and the Emergency Department.

We were interested in determining if perceptions changed over time as tactics were implemented and hardwired. Of particular interest, we wanted more participants to answer questions 2-8 as agree or strongly agree. Question 1 was intended to provide us with a baseline of organizational knowledge.

There was an increase in agree and strongly agree responses for each question post-interventions, except for question 4. Individual survey question results can be found in Appendix F. Pre and post survey comparative results are listed below.

Figure 8

Survey Results

	Question1	Question2	Question3	Question4	Question5	Question6	Question7	Question8
% Increase of agree or strongly agree compared to pre-survey results	31.4%	72.5%	34.0%	-9.3%	8.7%	100%	87.2%	12.1%

Discussion**Summary**

Over the course of this 8-month quality improvement project, the goal of a 10% reduction in ED-2b times was far exceeded. The goal for FY21 YTD was to achieve an 18.25- minute reduction in mean times. By the end of the project, a 44.50-minute reduction occurred, equating to a 24.38% improvement versus the 10% that was set forth.

The successful management of factors that contribute to Emergency Department bottlenecks were considered for the project interventions. Several tactics were implemented under the umbrella goal of implementing a multidisciplinary hospital throughput committee. As a result, there was a significant reduction in FY21 YTD yellow diversion hours compared to FY20. A 40% reduction in diversion time was achieved during the project period. Compliance with a nurse-driven telemetry discontinuation protocol was initiated and maintained. This resulted in no incidents of delays in bed assignments due to a lack of equipment resources during the intervention period. Additionally, we were able to achieve an increase in compliance with discharged patients leaving the facility by 1700. Specifically, a 21% increase in compliance.

There were unanticipated achievements associated with this project. Although we did not specifically monitor hospital payment denials, there was a considerable improvement. FY20 denial costs were \$8,364,464, inclusive of technical and clinical denials. For FY21 TYD, denials decreased to a current total of \$3,860,610. Although it has not been proven, we believe there is an association between the decrease in denials and the hospital throughput initiatives.

Interpretation

Implementing a multidisciplinary hospital throughput committee has improved several throughput metrics. The multiple stakeholder engagement has proven to be a key element for success, along with senior leadership support. The improvement in ED-2b far exceeded our goal. The statistical analysis confirms the perceptions that individual stakeholders held. Maintaining an engaged team with clear goals was a driving success factor, parallel to the literature reviews.

The project team encountered challenges associated with the COVID-19 pandemic and maintained efforts during an Emergency Department renovation project that took place during the project period. The throughput improvement does not appear to be associated with one intervention, but rather multiple interventions that capture the complexity associated with efficient hospital throughput. Hardwiring a response to NEDOCS levels not only contributed to the overall improvement in ED-2b metrics, but also contributed to the statistically significant decrease in yellow diversion. The same significance was not seen with red diversion but could have been caused by the increase in patient acuity, patients requiring higher levels of care during multiple surges of the COVID-19 pandemic.

Limitations

During this project's implementation period, unexpected limitations were faced. The COVID-19 pandemic created unprecedented challenges. Some of which included healthcare management changes, volume changes, and nursing practice changes. All these limitations were compounded with strict PPE (personal protective equipment) and social distancing requirements.

Significant challenges were presented when monitoring bed request to bed assignment times. During the project, bed assignments times were compromised by the pandemic. After we initiated the project, admitted patients were required to have a COVID-19 test result before a bed could be assigned. We had multiple testing platforms throughout this time leading to variation in timing of test results. We were dependent on the results for bed assignments and were unable to apply additional tactics for improvement.

Another challenge worth mentioning is the amount of travel nurses that the organization employed due to the increase demand of the pandemic. This required increased communication from the nurse leaders to maintain throughput expectations. However, by doing so, we have been able to maintain efficient throughput and not open any surge spaces like many other hospitals have had to open to meet the demands.

As outlined in the project's interventions, we were unable to conduct formal educational rollouts as desired. Social distancing requirements prohibited us from having classroom sessions with frontline associates. We relied on Nursing Directors to set expectations during change of shift huddles and virtual staff meetings.

Another limiting factor for this project was patient volumes, both Emergency Department visits and inpatient/observation admissions. Volumes were variable during the project

implementation period due to the pandemic. Fluctuations may be attributed to community members fear of hospital visits, increases in demand, and an increase in the case mix index due to COVID-19.

Conclusion

We have found that implementing a robust multidisciplinary hospital throughput committee significantly impacted hospital throughput. Engaging key stakeholders creates a shared vision and promotes workflow efficiencies. Although many challenges contribute to the familiar Emergency Department bottlenecks, creating goals and internal metrics are key elements to success and sustainment.

While our interventions suggest improvement, there are implications associated with these tactics. Organizations need to consider the breadth and commitment to sustain and monitor multiple interventions while creating an organizational culture that understands and values the impact of hospital throughput.

Further, hospitals should consider a dedicated team for monitoring and improving inpatient discharges. While our efforts continue to evolve, the time and resource allocation to maintain a program is challenging with limited resources available.

Funding

There were no sources of funding associated with the conduction of this quality improvement project.

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Appendix A

Cost-Benefit Analysis

Cost-Benefit Analysis Table			
Throughput Improvement Project			
Project Title: Large Scale Organizational Intervention to Improve Emergency Department Throughput in a Community Hospital			
Project Lead: Karen Elliott		Date: October 25, 2020	Version: 1.0
Cost-Benefit Table			
Proposed Action:	Benefit:	Cost:	Comments:
Hardwire the expectations of all members of the Throughput Committee and their responsibility to report relevant data and develop action plans	Organizational involvement Stakeholder performance standards	N/A	Monthly meetings are part of normal workflow
Revise Hand-off policy with frontline associates and educate all associates	Standardized performance Frontline associate engagement	\$511 (Cost of 7 frontline nurses participating in 2- one-hour meetings at an average hourly rate of \$36.50)	Education will be incorporated into daily unit huddles
Hardwire the technology in "Visibility" for monitoring bed assignment times and develop an escalation process.	Standardized performance Escalation process to meet bed assignment metrics	N/A	
Continue to hardwire nurse-driven telemetry protocol, create accountability boards for inpatient units that include compliance and discharge data.	Visible data Boards to be utilized during huddles	\$1,050 (Cost of 7 boards for all units at an average cost of \$150/each)	
Hardwire NEDOCs Capacity Protocol and mitigation tactics to decrease ED boarding hours, including revisions to the policy if needed.	Organizational participation to responds to ED overcrowding	N/A	Expectations embedded in normal workflow
Develop a "Discharge Taskforce" to review discharge challenges/barriers and make recommendations for improvement	Taskforce will include stakeholders and frontline associates	\$730 (Cost of 5 frontline nurses participating in 2-two-hour meetings at an average hourly rate of \$36.50)	No additional cost for salaried stakeholder members

Appendix B

Throughput Committee Charter			Start Date: October 1, 2020 Projected End Date: TBD
Problem / Opportunity Statement (Why initiate this effort)	Mission- to ensure access to quality healthcare through collaborative approaches for the population we serve. We will demonstrate teamwork and creativity to foster a safe environment for patients, families, and associates. Key throughput measures are below targeted performance (ED-2b)		
Business Case (economic impact of the project)	For FY20, the hospital did not meet or sustain Maryland Benchmarks. The long-term goal is to meet and surpass National benchmarks. Patients experiencing a delay in their progression of care is not optimal, the hospital strives to deliver quality and expeditious care.		
Strategic Alignment	Patient Experience Committee, ED operations, and the Safety Committee		
Team Members / Stakeholders	Chair: Karen Elliott, MHA, RN, NEA-BC, Senior Director of Nursing Co-chair: Emergency Department Nursing Director Co-chair: 3E/W Nursing Director Administrative Assistant: O.H. Hospital Liaison: VP Medical Affairs, VP of Nursing/Chief Nursing Officer		
	Primary Team Members		
	Bed-board Coordinator/Supervisor		
	Hospitalist		
	ED Physician		
	Behavior Health Director		
	Intensivist		
	Educator-ED		
	Director of Case Management		
	Director of Environmental Services		
	Director of Laboratory Services		
	Director of Radiology		
	Informatics- Clinical Systems Analyst		
	Supervisor- Monitor Technicians		
	Director of Quality		
	Nursing Director 2N/S		
	Nursing Director ICU		
	Nursing Director 2E/2W		
	Frontline associates		
	Secondary Team Members		
	Director of Admitting		
	Educators		
	Nursing Informatics		
	Nursing Director Cardiology		
	Assistant Director PACU		
Performance Improvement Aim (Mission) Keep it SMART (simple, measurable, attainable, results oriented, time bound)	Decrease FY21 Throughput measure ED-2b by 10% compared to FY20.		

Scope (boundaries of the project; time frames, process steps)	Review metric data and establish new metrics. Develop an action plan. Establish meeting cadence – team will meet bi-monthly at a minimum.	
Objectives (specific and measurable)	<ol style="list-style-type: none">1. Decrease FY21 Median ED2 time compared to FY20; 10% by end of FY21 Q3.2. Improve workflow efficiencies with standardized approaches to decrease times for hand-off of care transitions between the Emergency Department and inpatient units, including the revision of the policy.3. Improve compliance with the nurse-driven telemetry discontinuation protocol to mitigate admission delays due to lack of equipment resources.4. Hardwire the mitigation tactics of an early warning predictive model (NEDOCS) to mitigate Emergency Department boarding hours.5. Develop departmental action plans to improve workflow efficiencies to meet the performance improvement aim.	
Measures of Effectiveness (identify key indicators to measure)	The goal of a 10% decrease in the ED-2b throughput measure is met.	
Accountable / Reports To	Leader	Frequency
	VPMA:	quarterly
	CNO:	quarterly
Meeting Schedule	The Throughput Committee will meet, at least six times per year. Additional meetings may arise for subcommittee work. Participants are expected to attend 80% of all meetings. Meetings will last one and a half hours to two hours.	

Appendix C

PDSA Action Plan

Title: Throughput Improvement Project		Owners: Karen Elliott MHA, RN, NEA-BC					
Stat date: October 2020		Revision Date: 10/1/2020		Revision Number 4.0			
Problem Statement: Throughput metrics are below benchmark		Goal Statement: To decrease FY21 throughput measure by 10% compared to FY20					
PLAN	Background/Root Cause analysis:	DO	What	Who	When	% Complete	Goal %
	1. FY 20 average median time for decision to admit ED patients (admitted patients/ED2B) was 182.5 minutes (Maryland benchmark 161 minutes/National benchmark 118 minutes).		Hardwire the expectations of all members of the Throughput Committee and their responsibility to report relevant data and develop action plans	Karen Elliott	October 31, 2020		100%
	Causes:		Revise Hand-off policy with frontline associates and educate all associates	Primary- Karen Elliott Secondary- Marcia Friend	December 15, 2020		100%
	1. Hand-off process is not hardwired		Hardwire the technology in "Visibility" for monitoring bed assignment times and develop an escalation process.	Primary- Kristin Quade Secondary- Rose Sanford/ Dawn Morgan	December 2, 2020		100%
	2. Over-utilization of telemetry		Continue to hardwire nurse-driven telemetry protocol, create accountability boards for inpatient units that include compliance and discharge data.	Primary- Kim Brown-Gross Secondary- Asheena Tucker	December 16, 2020		100%
	3. Varying practices for escalation of ED boarding		Hardwire NEDOCs Capacity Protocol and mitigation tactics to decrease ED boarding hours, including revisions to the policy if needed.	Primary- Kristin Quade Secondary- Elena Arellano/Dana Greenwood	November 18, 2020		100%
	4. Unclear reasons for inpatient discharge delays		Develop a "Discharge Taskforce" to review discharge challenges/barriers and make recommendations for improvement	Primary- Kim Brown-Gross Secondary- Nicole Smith/Dr. Brown	December 22, 2020		100%
ACT		STUDY/CHECK					

Appendix D

NEDOC Response Form

Response to NEDOC Scores \geq Level 2 (Busy 61-100)			
Please indicate which shift the NEDOC \geq Level 2: (circle one) 0700 1100 1500 1900 2300 0300		Date: _____	Director/Supervisor: _____
Please check that all actions were taken based on the NEDOC Score:			
Level 2 (Busy 61-100)	Level 3 (Overcrowded 101-140)	Level 4 (Extremely Overcrowded 141-180)	Level 5 (Dangerously Overcrowded 181+)
<input type="checkbox"/> Expedite ED admissions to bed assignments and transfers out of department <input type="checkbox"/> Expedite cleaning of discharged patient rooms and pull resources to where needed most <input type="checkbox"/> Notify inpatient nursing units of ED status and need to accept patients within 30 minutes of bed assignment <input type="checkbox"/> Ensure all expired telemetry orders have been reviewed and boxes removed from patients <input type="checkbox"/> Assess all patients and cohort where possible <input type="checkbox"/> Communicate to the Hospitalists the need for admission orders placed within 60 minutes of bed request	<input type="checkbox"/> Notify AOC then notify Operator to send a text message via Everbridge system <input type="checkbox"/> Implement patients waiting in hall for assigned room cleaning completion. <input type="checkbox"/> Consider opening additional inpatient beds when resources are available <input type="checkbox"/> Assess staffing levels- evaluation should include determination if schedule will allow staff to be redirected <input type="checkbox"/> Continue to identify any telemetry discharge orders and ensure boxes are removed from patient <input type="checkbox"/> Ensure inpatient nurse receives report on first call from ED RN. If unavailable, Charge Nurse to receive report; if Charge Nurse unavailable House Supervisor or Unit Director/Manger to receive report <input type="checkbox"/> For any ICU admissions the ICU staff will come to the ED and transport the patient to the ICU <input type="checkbox"/> All known potential discharges should be expedited. <input type="checkbox"/> Redeploy any available resources to the ED <input type="checkbox"/> Ensure Monitor staff round on each inpatient unit for telemetry boxes <input type="checkbox"/> Communicate to the Hospitalists the need for admission orders placed within 30 minutes of bed request, d/c tele if possible, and round with CM for discharges <input type="checkbox"/> Ensure Supply Chain has stocked <input type="checkbox"/> Ensure FNS has provided meals and food is stocked in the ED	<input type="checkbox"/> Notify AOC then notify Operator to make overhead paging announcement "NEDOC Level 4" <input type="checkbox"/> Ensure all activities in Level 3 have been met (indicate by checking all in Level 3) <input type="checkbox"/> Ensure priority placement to move ED admissions to inpatient bed location as soon as the bed is vacated, e.g., hold on PACU admissions to floor <input type="checkbox"/> Communicate to the Hospitalist that they should report to ED to expedite admit orders to within 15 minutes of bed request <input type="checkbox"/> Ensure CM has arranged transportation for discharges and transfers to other facilities (or assist) <input type="checkbox"/> Round on patients/families to ensure basic needs of comfort are being met <input type="checkbox"/> Ensure that the Patient Liaison and Director of Patient Experience frequently round on ED patients and communicate updates <input type="checkbox"/> Ensure all other activities are met as outlined in the policy	<input type="checkbox"/> Notify AOC then notify Operator to make overhead paging announcement "NEDOC Level 5" <input type="checkbox"/> Ensure all activities in Level 3 and 4 have been met (indicate by checking all in Level 3 and 4) <input type="checkbox"/> Ensure Administration cancels all non-urgent meetings <input type="checkbox"/> Ensure administrative rounding is initiated to identify opportunities <input type="checkbox"/> Ensure all other activities are met as outlined in the policy

Appendix E

Survey

Emergency Department Throughput Survey

Date: _____

Emergency Department Throughput Survey: Please indicate your response to each statement.

At our hospital, the time from ED admission to inpatient bed arrival is better than the National benchmark.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○
ED boarding hours contribute to treatment delays and adverse events.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○
The extended use of telemetry for inpatients contribute to ED boarding hours.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○
The Joint Commission requires a standardized hand-off process between the ED and inpatient units.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○
Inpatient discharge delays contribute to ED boarding times.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○
ED boarding has a negative impact on patient satisfaction.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○
A multidisciplinary team would help improve throughput.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○
Admitted patients that wait in the ED have a financial impact for the hospital.	Strongly Disagree ○	Disagree ○	Neutral ○	Agree ○	Strongly Agree ○

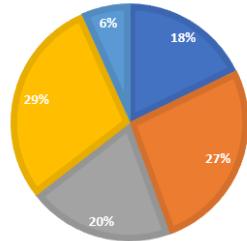
Appendix F

Survey Results

Pre-Interventions

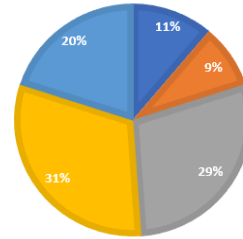
QUESTION 1 PRE-INTERVENTIONS: AT THIS HOSPITAL, THE TIME FROM ED ADMISSION TO INPATIENT BED ARRIVAL IS BETTER THAN THE NATIONAL BENCHMARK

Strongly Disagree Disagree Neutral Agree Strongly Agree



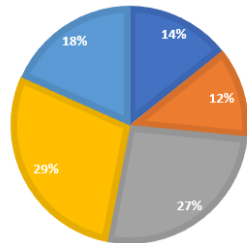
QUESTION 2 PRE-INTERVENTIONS: ED BOARDING HOURS CONTRIBUTE TO TREATMENT DELAYS AND ADVERSE EVENTS

Strongly Disagree Disagree Neutral Agree Strongly Agree



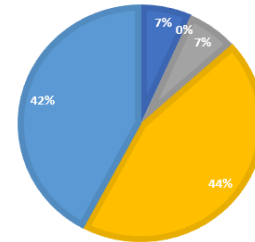
QUESTION 3 PRE-INTERVENTIONS: THE EXTENDED USE OF TELEMETRY FOR INPATIENTS CONTRIBUTE TO ED BOARDING HOURS

Strongly Disagree Disagree Neutral Agree Strongly Agree



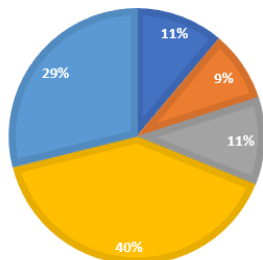
QUESTION 4 PRE-INTERVENTIONS: THE JOINT COMMISSION REQUIRES A STANDARDIZED HAND-OFF PROCESS BETWEEN THE ED AND INPATIENT UNITS

Strongly Disagree Disagree Neutral Agree Strongly Agree



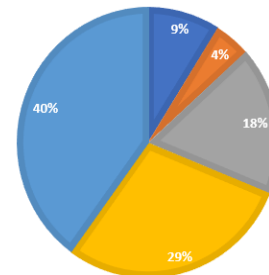
QUESTION 5 PRE-INTERVENTIONS: INPATIENT DISCHARGE DELAYS CONTRIBUTE TO ED BOARDING TIMES

Strongly Disagree Disagree Neutral Agree Strongly Agree



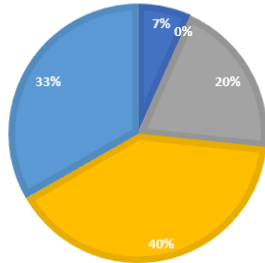
QUESTION 6 PRE-INTERVENTIONS: ED BOARDING HAS A NEGATIVE IMPACT ON PATIENT SATISFACTION

Strongly Disagree Disagree Neutral Agree Strongly Agree



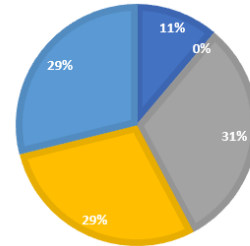
QUESTION 7 PRE-INTERVENTIONS: A MULTIDISCIPLINARY TEAM WOULD HELP IMPROVE THROUGHPUT

Strongly Disagree Disagree Neutral Agree Strongly Agree



QUESTION 8 PRE-INTERVENTIONS: ADMITTED PATIENTS THAT WAIT IN THE ED HAVE A FINANCIAL IMPACT FOR THE HOSPITAL

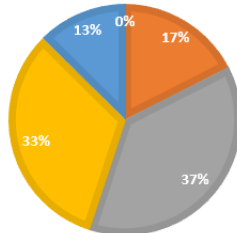
Strongly Disagree Disagree Neutral Agree Strongly Agree



Post-Interventions

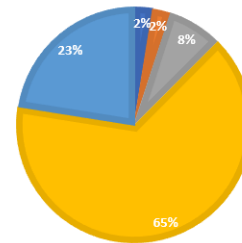
QUESTION 1 POST-INTERVENTIONS: AT THIS HOSPITAL, THE TIME FROM ED ADMISSION TO INPATIENT BED ARRIVAL IS BETTER THAN THE NATIONAL BENCHMARK

Strongly Disagree Disagree Neutral Agree Strongly Agree



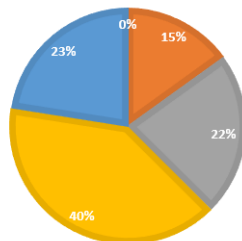
QUESTION 2 POST-INTERVENTIONS: ED BOARDING HOURS CONTRIBUTE TO TREATMENT DELAYS AND ADVERSE EVENTS

Strongly Disagree Disagree Neutral Agree Strongly Agree



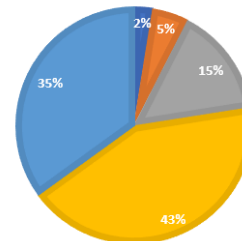
QUESTION 3 POST-INTERVENTIONS: THE EXTENDED USE OF TELEMETRY FOR INPATIENTS CONTRIBUTE TO ED BOARDING HOURS

Strongly Disagree Disagree Neutral Agree Strongly Agree



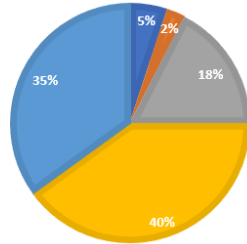
QUESTION 4 POST-INTERVENTIONS: THE JOINT COMMISSION REQUIRES A STANDARDIZED HAND-OFF PROCESS BETWEEN THE ED AND INPATIENT UNITS

Strongly Disagree Disagree Neutral Agree Strongly Agree

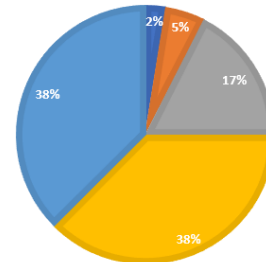


QUESTION 5 POST-INTERVENTIONS: INPATIENT DISCHARGE DELAYS CONTRIBUTE TO ED BOARDING TIMES

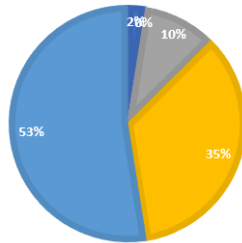
Strongly Disagree Disagree Neutral Agree Strongly Agree

**QUESTION 6 POST-INTERVENTIONS: ED BOARDING HAS A NEGATIVE IMPACT ON PATIENT SATISFACTION**

Strongly Disagree Disagree Neutral Agree Strongly Agree

**QUESTION 7 POST-INTERVENTIONS: A MULTIDISCIPLINARY TEAM WOULD HELP IMPROVE THROUGHPUT**

Strongly Disagree Disagree Neutral Agree Strongly Agree

**QUESTION 8 POST-INTERVENTIONS: ADMITTED PATIENTS THAT WAIT IN THE ED HAVE A FINANCIAL IMPACT FOR THE HOSPITAL**

Strongly Disagree Disagree Neutral Agree Strongly Agree

