Decreasing Emergency Department Boarding Times for the Intensive Care Patient

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Abstract

When critically ill patients arrive in the ED, substantial resources are reallocated to the patient, moving the supplies and hospital personnel away from others. Critically ill patients are remaining in the ED waiting on admission to the ICU, some higher than six hours. The delay in admission to the ICU puts the critically ill patient at risk for harmful outcomes in an environment where the resources are already stretched. This project aimed to decrease the ED boarding time for the patient who requires admission to the ICU. This process ensures high-quality care for critically ill patients in the ED and a fast transfer from the ED to the ICU with a continuous open bed availability in the ICU for critically ill patients arriving in the ED. This process would assist to ensure effective patient throughput and decrease the ED LOS for the patient requiring the ICU higher level of care. In an effort to reduce the time critically ill patients are boarding in the ED, a simple protocol of staying a "bed ahead" in the ICU would be followed during the project period. The ICU would keep a minimum of one bed available for admissions from the ED to immediately accept a patient accepted by the Critical Care Medicine team. With this project there was a decrease in the transfer times from an average of 6.5 hours to 5.0 hours overall, for a 1.6-hour reduction in boarding time. This process allows for the ICU level of care to start sooner, and the orders from the critical care team are carried out and completed more expeditiously.

Keywords: intensive care unit, emergency department, length of stay, patient flow, patient throughput, emergency department boarding

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Section I. Introduction

Emergency department (ED) overcrowding is a significant problem for many hospitals in urban and rural areas, which negatively impacts patient care outcomes. When a critically ill patient arrives in an overcrowded ED, the resources of the department can quickly become overwhelmed (Cohen et al., 2015; DiGiacomo et al., 2018). The quick transfer of critically ill patients to the intensive care unit (ICU) helps to decrease the hospital length of stay (LOS) and reduce the in-hospital mortality rate. This project implemented a protocol to fast track critically ill patients boarding in the ED to the ICU in a timed routine.

Background

The United States is challenged with an issue of ED overcrowding, and the resources being used to manage this overcrowding is being stretched (Reznek et al., 2018). Gunnerson et al. (2019) state several studies show increased boarding time in the ED is related to poor outcomes for patients requiring ICU level of care. Patients who are critically ill and subject to a delay time longer than six hours from arriving in the ED to the ICU have an increase in the overall hospital LOS, along with an increase in intensive care and hospital mortality.

The Institute for Healthcare Improvement (IHI; 2020) triple aim model of improving the patient experience of quality and satisfaction, improving health populations, and reducing the per capita cost of health care serves as a foundation to focus on the improvement of healthcare. Improving the quality of care delivered to the ED can help protect vulnerable populations as they access emergency services in the hospital setting. Decreasing the length of time critically ill patients are in the ED can also reduce the use of resources that are reallocated to these patients the longer they remain in the ED. Regulatory bodies such as Centers for Medicare and Medicaid Services (CMS) and The Joint Commission (TJC) are starting to include patient throughput

standards in their performance and accreditation measurements and requirements (Welch et al., 2011). Improving the throughput of critical care patients in the ED helps to keep resources available and the quality of care high for those waiting for care. Improving quality measures can also enhance the financial implications of the delivery of care to the most critical patients boarding in the ED (Jayaprakash et al., 2020).

Boarding in the ED is an essential measure of the quality of care for hospitals and is reported out as a performance measure for the CMS (2020a) and TJC. Studies are showing a relationship between adverse events and the more prolonged admission to departure to the inpatient units (Boudi et al., 2020). Crowding in the ED and holding intensive care bordering patients are associated with longer ventilator days and increased mortality (Jayaprakash et al., 2020). In the United States, 33% of the intensive care admissions from the ED have a LOS greater than six hours, and of the intensive care patient who boards in the ED for greater than six hours have an increased mortality rate of 10% (Gunnerson et al., 2019; Jayaprakash et al., 2020).

As the metropolitan area continues to grow, the overall census of hospitals has increased. Holding and boarding patients in an ED setting pulls resources away from managing those seeking the services of the ED. Boarding patients are patients who have an admission order to an inpatient setting and are waiting on a space to be available. These patients are held due to a lack of a staffed or a physical bed within the requested location. When patients become critical, they pull even more resources from an already saturated department. An identified area of need is to decrease critically ill patients boarding within the ED.

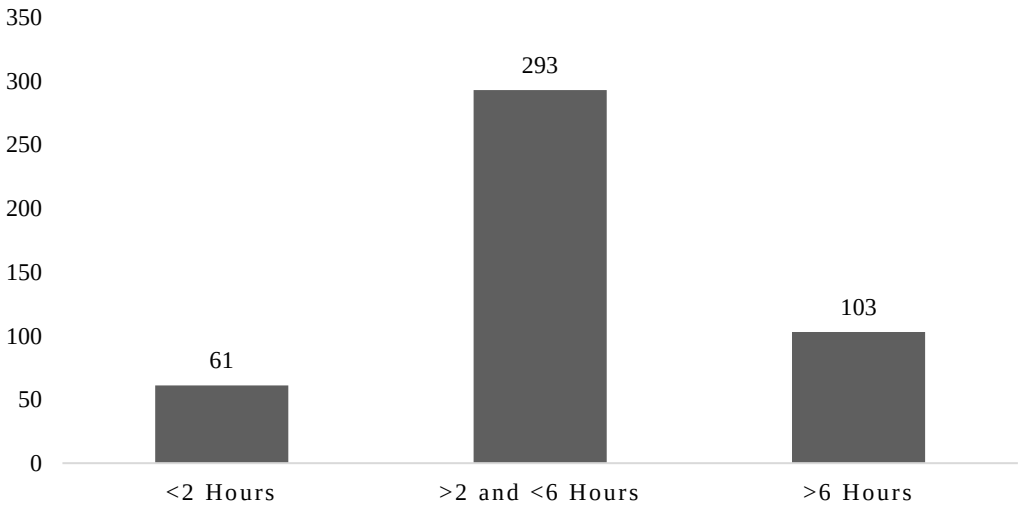
Organizational Needs Statement

Organizationally there is a need to fast track critically ill patients from when they are identified in the ED to the ICU. The average median time from ED arrival until departure to an

inpatient unit for this project site is 265 minutes (CMS; 2020a). CMS monitors the throughput time of patients from admit-order to departure to the inpatient unit from the ED to the inpatient location every quarter (CMS; 2020b). Mohr et al. (2020) reported boarding on critically ill patients in the United States ranged from 1.3 to 8.8 hours. They continue to report the boarding of critically ill patients is common in the United States. For the project site hospital in the fiscal year of July 2019 to July 2020, there were just over 100 admitted patients to the ICU who had a longer than six-hour stay in the ED (see Table 1). There were also 293 critically ill patients boarded in the ED between two and six hours (see Table 1). Eighty-seven percent of the critically ill patients at this project site are held in the ED greater than two hours. This project sought to address and measure the length of time critically ill patients are in the ED from arrival until departure from the ED to the ICU.

Table 1

ED Arrival to ICU Admission - July 2019 to July 2020



Note. N = 457. This table demonstrates the ED boarding times grouped by the number of hours and the number of patients affected in each group.

Problem Statement

When critically ill patients arrive in the ED, substantial resources are reallocated to the patient, moving the supplies and hospital personnel away from others. Critically ill patients are remaining in the ED waiting on admission to the ICU, some higher than six hours. The delay in admission to the ICU puts the critically ill patient at risk for harmful outcomes in an environment where the resources are already stretched.

Purpose Statement

The purpose of this evidence-based project was to develop a standardized protocol to decrease the critically ill patients from boarding in the ED by ensuring there is a critical care bed and staffing available to manage patients as they are identified as needing admission to the ICU. This protocol is to help fast track critically ill patients to the ICU and prevent them from boarding in the ED. This new protocol can ensure high-quality care is given to critically ill patients in the right area at the right time.

Section II. Evidence

Literature Review

A literature search was performed using the academic databases of CINAHL and PubMed. Included within the search were the criteria of less than five years, peer-reviewed, and written in the English language. Articles extracted for this review focused on critically ill patients boarding in emergency rooms as the primary focus. Studies analyzing the effects of ED crowding, ED LOS on mortality, as well as patient transfers from the ED to the ICU, were included. Reviews and editorials were not included. Publications based on pediatric emergency care were not included. Appendix A notes information for search strings, queries, limiters, expanders, and the number of results for the CINHAL academic database.

The PubMed academic database was also used to choose research as evidence on the topic. The same inclusion and exclusion criteria from the CINHAL search was used with PubMed. There were six total articles from PubMed and CINHAL meeting criteria and used for this project. Appendix B highlights search strings, queries, limiters, expanders, and the number of results for the PubMed academic database.

The Current State of Knowledge

Emergency Department-based ICU. Gunnerson et al. (2019) studied the association of an ICU located in the actual ED with the 30-day mortality of ICU admissions. Gunnerson et al. report increased ED boarding times are associated with poor outcomes for patients requiring an ICU-level of care. Gunnerson et al. continue to state patients who are critically ill and are exposed to a delay longer than six hours from arriving in the ED to the ICU admission have a higher mortality rate and a more extended hospital LOS. In this research, Gunnerson et al. were able to show a reduction in the 30-day mortality rate.

Gunnerson et al. (2019) performed a retrospective analysis of the patient outcomes before and after the implementation of the ICU based in the ED. The authors opened a 14 bed ICU with five trauma bays and nine other ICU beds. This ICU was staffed by ED nurses who were ICU trained along with critical care trained intensivists. These staff cared for all critically ill patients as they came into the ED. Gunnerson et al. studied the before and after mortality rates, LOS, and other measures.

With the Gunnerson et al. (2019) research implementation, many of the patients who would customarily be roomed and in an ICU bed were able to stabilize for non-ICU admissions, even discharged home. This process decreased the ICU inpatient utilization of ICU beds. The ICU in the ED approach reduced the short-stay admissions to the inpatient ICU; this reduction in

admissions allows the inpatient ICU to optimize bed resource allocation. This also frees up capacity for patients who are decompensating on non-ICU inpatient units, along with the higher acuity ED patients needed a more prolonged ICU stay.

Limitations to the Gunnerson et al. (2019) study is the before-and-after analysis was unable to control for the acuity of the ED populations. There was a marked increase in the acuity during the study, along with a marked increase in ED volumes. For the 30-day mortality rate, there was an assumption made where unknown mortality statuses were counted as survived for 30 days.

Mortality with ED Boarding Exposure. Patients who remain in the ED after the decision to admit to the inpatient setting was studied by Reznek et al. (2018). This research looked into patients boarding in the ED, and the mortality rates for patients admitted to ICU and non-ICU units. This research examined the difference in patients who were exposed to ED boarding and whether they survived to their discharge from the hospital or if they experienced in-hospital mortality (Reznek et al., 2018).

For the Reznek et al. (2018) study, the authors found patients who were exposed to boarding in the ED experienced a higher mortality rate. For ICU patients, they did not see a significant increase in the mortality rate. However, Reznek et al. found with the ICU patients, intensivists from the ICU unit determined the bed placement and based the allocation on the patients who had the highest acuity fast-tracking them to a bed in the respective ICU. So with resources limited, the sickest patients were prioritized for a bed placement first. Reznek et al. believed this prioritization mitigated the potential for mortality.

One of the limitations of the Reznek et al. (2018) study was the ICU patients at the highest risk of death were prioritized for fast placement to the ICU, limiting the ED boarding

exposure. Reznek et al. do note the resources required to care for critically ill patients while they are in the process of moving the ICU adversely affect the care of the other non-ICU patients in the ED at that current time. Another limitation was this study was limited to two hospitals within one health system.

Quality Improvement to Decrease Transfer Times. Delayed patient transfers from the ED to the ICU are associated with a longer hospital LOS and higher mortality, according to Cohen et al. (2015). Cohen et al. continue to report major factors causing delays in transfers from the ED to the ICU as a lack of available beds in the ICU and a lack of bed on the non-ICU inpatient units for stable transfers out of the ICU. Patient transfer is made more complicated by the multiple high acuity demands pulling on the processes of each department in the ED and ICU settings (Cohen et al., 2015).

Cohen et al. (2015) used the Plan-Do-Study-Act (PDSA) model for this quality improvement project. The project used several PDSA adjustment cycles, identifying several interventions focused on reducing transfer delays from the ED to the ICU. The group tasked with identifying interventions consisted of ED, ICU, providers, bed management, and respiratory therapy. The team was able to achieve a 48% reduction in the transfer times from the ED to the ICU. The team in this quality improvement project worked through several PDSA cycles. It developed a streamlined process aimed at reducing the delays inflow of the critically ill patient moving from the ED to the ICU. There were two process interventions they used in this project. The first was a streamlined process mapped out in flowchart form for the ED patient to move to the ICU. The second process of what to do when there was not an immediate ICU bed available, and there is a critically ill patient in the ED. This process was mapped out in flowchart form for the ICU team to guide the process of freeing up space for the critically ill patient to move to the

ICU (Cohen et al., 2015). These interventions streamlined the process by allowing the microsystems of the ED and ICU to test each PDSA to find and change processes to streamline the transfer process.

Limitations to this quality improvement project were that the process changes were specific to the hospital system. Replicating the project may not yield the same results as some of the changes were specific to the hospital systems processes. Cohen et al. (2015) stated there were multiple factors identified as a cause of delay, and narrowing down to which intervention had the most significant impact would be difficult.

Impact of a "Bed Ahead" Policy. The research by DiGiacomo et al. (2018) assessed the impact of implementing a policy of identifying and making a single bed available at all times in the ICU for admissions from the ED. The authors preassigned an open bed for the anticipated decompensating patient in the ED. When the bed is used, they gave themselves 60 minutes to free up or identify another open bed for the next admission from the ED (DiGiacomo et al., 2018). This impact from the implementation of the policy was studied and showed an increasing number of patients admitted to the ICU. DiGiacomo et al. also showed a reduction in the ED-LOS from 3.3 hours to 2.6 hours.

The availability of ICU beds traditionally has been on an impromptu basis. When the call that a bed was needed from the ED is when the process would start to find a patient in the ICU who could be downgraded and moved to another inpatient unit. This all too often would happen at night and is stressful to the patient being moved, along with stress added to the ED and ICU teams trying to care for a critically ill patient in an off service location. Having the bed available at all times or within the 60 minutes provides the ability for the ED teams and the ICU teams to focus on the critically ill patient at the time freeing up the time usually spent managing finding

an open bed. Interestingly this research showed an increase in the bed utilization of the ICU, so they were able to increase the at the same time as they were holding an open bed (DiGiacomo et al., 2018)

The focus of this study is on trauma patients arriving in the ED, and this study needs to be replicated in a non-trauma setting to see if the results would be similar. The authors state they never measured the total ED-LOS for non-ICU patients during this project. There was not a reported reduction in the mortality rates with the population measured, the authors the small sample size as a possibility (DiGiacomo et al., 2018).

Boarding of Critically Ill patient in the ED. Mohr et al. (2020) conducted a systematic review to describe the frequency of critically ill patients boarding in EDs. The authors also set a goal of summarizing the outcomes associated with boarding in the ED. Lastly, they explore strategies developed to reduce the boarding of the critically ill patient in the ED (Mohr et al., 2020).

Mohr et al. (2020) review of the research suggested boarding of critically ill in the ED is common with a range of 1.3 to 8.8 hours. Mohr et al. reported an incident rate of 2.1% to 87.6%, which suggests that the definition of boarding may need to be standardized. The authors cautioned that the incident rates might not be clear due to this.

There are multiple strategies listed in this review. A system-wide approach to managing the boarding of patients in the ED, with the majority of the strategies involving matching the demand of patient flow to the capacity of the hospital. Active bed management can help prevent the impact of surges in multiple areas simultaneously. Another common method was where health systems reserve beds for emergency admissions such as traumas, myocardial infarctions, cardiac arrest, and acute strokes. The reservation of beds, along with the active facilitation of

timely movement of downgraded patients out of the ICU, helps to create this open bed for emergencies (Mohr et al., 2020).

Limitations identified in this research are the lack of a universal definition for ED boarding, which is preventing the standardization of the research. Mohr et al. (2020) also discuss the local variability with each hospital system and the different locations. This variability makes the frequencies difficult to measure, and the effects on the different patient populations difficult to quantify (Mohr et al., 2020).

Evolving Models of Care for ICU Boarders. Jayaprakash et al. (2020) studied the different models of caring for ICU boarding patients. The authors followed geography-based models along with personnel-focuses models. Jayaprakash et al. reported an interesting finding that ICU admissions from the ED increased by 48%, but the number of hospital ICU beds has decreased by 17% across the United States (US). This is along with the US population, increasing by 9.6% (Jayaprakash et al., 2020).

With the geography themed models, there is a heavy dependence on the capacity of the hospital. Enhancing the patient flow from the ED to the ICU for the available existing beds is a quick solution. The capacity of the hospital quickly becomes the constraint on the flow of patients from the ED (Jayaprakash et al., 2020)

The personnel-focus model is where the critical care medicine team takes over the care of the patient no matter where the patient is located. There are ICU based critical care teams, along with ED-based critical care teams. For the ICU patients boarding in the ED, this patient population would receive the same care as they would if they were located in the ICU. This model required the critical care consulting teams to be mobile and provide remote care across multiple unit locations (Jayaprakash et al., 2020).

Jayaprakash et al. (2020) report financial limitations to the implementation of many of the different models of care for ICU patients boarding in the ED. This burden may be more than the hospital systems can cover during the current times. Jayaprakash et al. also talk about workforce limitations with the staffing of the critical care medicine physicians who would require Critical Care Medicine board-certifications. These areas of focus need more research (Jayaprakash et al., 2020)

Current Approaches to Solving Population Problem

The risk associated with the boarding of ICU patients in the ED include increased mortality, increased ICU-LOS, increased overall hospital LOS, and overall poor patient outcomes (Cohen et al.,2015; DiGiacomo et al., 2018; Gunnerson et al., 2019; Jayaprakash et al., 2020; Mohr et al., 2020). Helping to provide high-quality care in the right location can promote better patient outcomes for the critical care patient population (Jayaprakash et al., 2020). There are multiple approaches to solving the problem of ICU patients boarding in the ED. Best practices are in the beginning stages as out regulatory agencies begin to include ED patient throughput standards in their performance measurements. The importance of healthcare systems to improve the efficiency of the throughput of their ED patients is critical to the patient's safety (Welch et al., 2011).

One strategy for managing ICU patient boarding in the ED is location or geographically based management of the ICU patient. This method involves the care of the patient happening where ever the patient is located. Early ICU level of care ensures high-quality, specialized care is able to be provided. This level of care diminishes the risk of mortality in these high-risk patients (Gunnerson et al., 2019).

In the personnel focused models, the treatment team moves to the location of the patient, as in the critical care team will manage the patient in the ED until the bed is available in the unit. This can involve the ICU critical care consulting team managing the patient or establishing an ED critical care medicine trained group. This group can work in both emergency medicine and critical care medicine simultaneously (Jayaprakash et al., 2020).

Admissions to the hospital are heavily dependent on the hospital's capacity, and early ICU admissions are complicated as a result. The intervention selected for this project was a mix of a geographical method of managing and expediting admissions to the ICU for critically ill patients (DiaGiacomo et al., 2018; Jayaprakash et al., 2020). To reduce the amount of time critically ill patients are boarded in the ED, the ICU will keep a minimum of one bed available for admissions from the ED to immediately accept a patient accepted by the Critical Care Medicine (CCM) team. When there is not an available physical bed in the ICU, there will be a plan to overflow the ICU patient to an approved alternate location, with an ICU trained registered nurse (RN) and the CCM managing the patient. Ensuring an ICU bed is readily available for patients will expedite the admission process for patients coming from the ED.

Evidence to Support the Intervention

The recommendations from the literature vary from the location. Still, the commonality is the need to expedite the transfer of care from the ED to the ICU as quickly and safely as possible (Mohr et al., 2020). Recognition of the need for critical care interventions on arrival to the ED needs to be a priority. The quicker the critical care team is consulted, the earlier the process can start of transferring care to an appropriate area. The delivery of safe and appropriate care is key to patient survival to discharge from the hospital setting (DiGiacomo et al., 2018; Mohr et al., 2020).

Expediting the admission process to the ICU for the critically ill patient in the ED helps to improve the quality of care along with decreasing the mortality rate in this high-risk population. Providing a unidirectional patient flow into the ICU and removing the need to board in the ED preplans the bed placement for all critically ill patients who arrive in the ED. Early ICU admission is heavily dependent on the capacity of the hospital. This process to streamline the throughput of the patient will help to ensure the right team is caring for the patient in the right location (Cohen et al., 2015; DiGiacomo et al., 2018; Gunnerson et al., 2020; Jayaprakash et al., 2020).

Using both the geographic and the personnel based model can help to ensure when the ICU or the hospital reached capacity, there is still a method to quickly expedite the care for the ICU patients in the ED. Early recognition of ICU patients in the ED, and having an open ICU bed available, can expedite the flow of the ICU patient out of the ED. Adding in the geographical location for when capacity is an issue in the ICU or hospital will help to ensure their care is not delayed by boarding in an overburdened area (Cohen et al., 2015; DiGiacomo et al., 2018; Gunnerson et al., 2020; Jayaprakash et al., 2020).

Evidence-based Framework

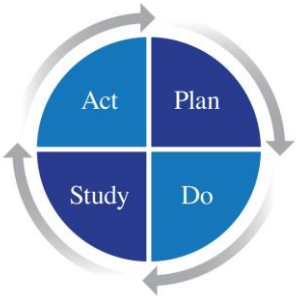
The W. Edward Deming (2020) Model of Improvement Plan-Do-Study-Act (PDSA; see Figure 1) was used for the conceptual framework for this quality improvement project. The PDSA is a systemic process where knowledge is gained and used as continual improvement of a process, product, or service. The cycle starts with the Plan step where the goal and purpose are identified, the theory is framed, and defining the metrics to put a plan in place. The next step is the Do section, where the components of the project are carried out. The Study phase is where the outcomes are monitored to ensure they are producing the desired result. The last step is the

Act section or the Adjust step, where all the data is reviewed and studied to see if there needs to be an adjustment to the goal, change the method, or readapt the theory overall (The W. Edwards Deming Institute, 2020).

This project was aimed at decreasing the ED boarding times for ICU patients. This PDSA framework helped to focus the project on the desired outcome for the care of critically ill patients boarding in the ED. The Deming PDSA cycle kept the goals of the project at the center and helped guide the information gathered as we work toward the expected outcomes. This model allowed for the measurement of the anticipated results with quick change and adjustments if we drift off course (The W. Edwards Deming Institute, 2020). Leis and Shojania (2017) report every PDSA cycle helps to bring the goal closer to the desired and expected outcomes. Leis and Shojania continue to state that PDSA cycles help quality improvement groups communicate the goals clearly and show the progress in real-time. This method assists the team see where the work is being done, along with identifying where adjustments need to be made. The Deming PDSA cycle is broadly used in quality improvement projects and is a model where the goals are continuously visible and discussed as the project develops (The W. Edwards Deming Institute, 2020).

Figure 1

Plan-Do-Study-Act (PDSA) Cycle



Note. The Deming Cycle consist of 4 repeated phases of Plan, Do, Study, and Act.

Ethical Consideration & Protection of Human subjects

The aim and goal of this project was to decrease the length of time a critically ill patient is boarding in the ED. Patients are not identifiable in the data collected for this project. Within this data, the patients' records were not accessed; only the metrics of time were tracked and managed. Anonymity, confidentiality, and security of any data collected were maintained following the policies of the Institutional Review Board (IRB).

Ethics training through the Collaborative Institutional Training Initiative (CITI) was completed to ensure the promotion of ethical research with this project. This training helped to guide and enhance the knowledge of professionalism with the implementation of this project. Following the guidance of the CITI training fostered compliance and professional ethics standards in carrying out this project.

This project followed the ethical principles of non-malice and beneficence. All efforts were made to have no physical, social, or economic risk with the project. This project's core commitment was to decrease the risk of harm for patients maximizing the benefits of high-quality care as they transition from the ED to the ICU care environment.

This project followed and practiced the ethics from the *American Association of Nurses Code of Ethics for Nurses with Interpretive Statements* (American Nurses Association [ANA], 2015). These ethics provide a guide and model to help the project adhere to the goals of the project while at the same time giving guidance when ensuring the values and ideals of the nursing profession are followed. These codes of ethics guided the project to bring high-quality care to the bedside of the patient.

This project was reviewed by the project site IRB and approved on September 13, 2020 (see Appendix C for the letter of declaration). The implementation of the protocol was deemed to

constitute quality improvement by the institution. The IRB stated the project meets the review board's declaration of the study not involving human subjects.

After approval from the project site, the project was submitted to the East Carolina University IRB for approval on September 17, 2020. This IRB also deemed the project to be a quality improvement and does not need IRB approval. The exemption was received on September 21, 2020 (see Appendix D for the statement of exemption and program evaluation).

Section III. Project Design

Project Site and Population

The site where this project was a 186-bed acute community-based hospital located in a large metropolitan area in the state of North Carolina. The hospital is a nonprofit hospital with a comprehensive array of specialty services offered within the health system. This hospital is contained within a more extensive health system.

The metropolitan areas of North Carolina continue to grow, as well as the overall census of the hospital systems within these urban areas. Holding and boarding patients in an ED setting pulls resources away from managing those seeking the services of the ED. Boarding patients are patients who have an admission order to an inpatient setting and are waiting on a space to become available in the inpatient units. These patients are held due to a lack of a physical bed, or a staffed bed, within the requested location. When patients become critical, they pull even more resources from an already saturated department. The project proposed was to decrease the boarding times of critically ill patients in the ED.

Description of the Setting

This project took place in two areas of the project site. The first location for this project would be the ED. The ED is where the first contact is, and the identification of whether the patient would need critical care services. The second location area was the ICU. This area

focused on the continual planning for the open bed for the next patient needing ICU level of care from the ED.

Project Site ED Description. The project site ED is part of a 186-bed acute community-based hospital affiliated with a sizeable university-based health care system. This ED has 36 acute beds with four other low acuity fast track beds called PIT (Physician in Triage). There are approximately 40,000 to 50,000 visits per year, with the patient population consisting mainly of adults. The project site is a Thrombectomy-Capable Stroke Center and a large oncology hospital-based clinic attached to the hospital. There are also many other hospital-based specialty clinics located on the campus.

Project Site ICU Description. The ICU in this project site is a 15-bed unit handling medical and surgical patients requiring intense critical care. The ICU is part of the 186-bed acute community-based hospital. There is only one ICU located on the project site campus leading to various medical conditions treated in the unit. The average daily census for the ICU is 11.9 for the last 12 months.

Description of the Population

The focus of the open ICU bed was for all ED patients who met the criteria for admission to the project site ICU. There were 457 patient admissions from the ED to the ICU from July 1, 2019, to June 30, 2020. There would not be any patient population exclusions who meet the criteria for admission from the ED to the ICU.

Project Team

The project site committee was composed of a multidisciplinary team with focused expertise in ICU and ED level of care for patients from the respective departments. There was also expertise in the throughput of bed flow management from the Operations Administration

(OA) team. These teams had weekly meetings discussing the project and any issues where there was a delay in the open bed. This team provided the knowledge of the workflow patterns from the ED to the ICU, along with the skills to remap the process when there are risks for delays in the throughput process. The Associate Chief Nursing Officer for General Medicine, Critical Care, and Emergency Services served as the project site champion. They provided oversight and professional guidance throughout the project.

The ED and ICU Nurse Managers of Operations (NMO) provided the expertise in the care and management of the critically ill patient during the transition from the ED phase of care to the ICU phase of care. This group collaborated with the identification of patients who needed an ICU level of care. The ICU NMO collaborated with the various teams and managed opening a bed and to keep an open bed for ED patients within the ICU.

The Operation Administration team was tasked with the management of the bed flow from the ED to the ICU and, most importantly, the bed flow from the ICU to the inpatient units to keep the open bed available for the next patient. The collaboration between the ICU team and the Operation Administration team was frequent due to the continuous need for bed movement and placement for patient admissions from the ED. See Appendix E for the list of project team members.

Project Goals and Outcome Measures

This project aimed to decrease the ED boarding time for the patient who requires admission to the ICU. This process ensures high-quality care for critically ill patients in the ED and a fast transfer from the ED to the ICU with a continuous open bed availability in the ICU for critically ill patients arriving in the ED. This process would assist to ensure effective patient throughput and decrease the ED LOS for the patient requiring the ICU higher level of care.

Bed Ahead Protocol

In an effort to reduce the time critically ill patients are boarding in the ED, a simple protocol of staying a "bed ahead" in the ICU would be followed during the project period. Moving critically ill patients out of the ED to the ICU rapidly helps lower overall hospital LOS, the ICU LOS, and reduces the in-hospital mortality rate (DiGiacomo et al., 2018; Mohr et al., 2020). The ICU would keep a minimum of one bed available for admissions from the ED to immediately accept a patient accepted by the Critical Care Medicine team. When the last bed is taken, the ICU leadership team, along with the leadership team with Operation Administration (bed placement and throughput), would evaluate and move a downgraded patient out of the ICU to free up the next bed. When there was no available physical bed in the ICU, there would be a plan to overflow the ICU patient to an approved alternate location. When the patient was bedded in an alternate area, the Critical Care Medicine team would manage the patient along with an ICU trained registered nurse. This nurse to patient ratio would not exceed one nurse to two patients (1:2). This open bed would be kept available for the timely transfer of patients accepted by the Critical Care Medicine team. If an admission takes the last bed available in the ICU, an additional ICU bed would be made within 60 minutes and kept open for the next ED patient. This would be done by ICU leadership, determining if patients are eligible for downgrade and will communicate with the OA the patient who can be moved to the stepdown or intermediate inpatient unit. If there are no patients who meet the criteria to downgrade, ICU leadership along with the OA would determine the next area where the open bed would be available in the order of the Post-Anesthesia Care Unit (PACU) then the Short-Stay Unit (SSU). In the rare case where there were no overflow beds available in the PACU or SSU, the ICU team would manage the patient in the ED with an ICU trained RN with the Critical Care Medicine team coordinating the

medical and therapeutic treatment of the patient. See Appendix F for the Bed Ahead protocol process map.

Description of the Methods and Measurement

Retrospective baseline trend data was collected from July 1, 2019, to November 30, 2020. Before the project implementation, data was analyzed for trends on the transfer and change in phase of care from the ED to the ICU. This project would follow critically ill patients as they arrived in the ED through their stay in the ICU and analyze the trend in the time stamp data for the project duration. This project would follow the ED arrival to ICU admission time, along with the overall ED LOS and the overall ICU LOS. The ED to ICU admission time was measured in hours, and the ED LOS and the ICU LOS was collected in days. The target goal for the ED arrival to the ICU admission for this project was 2-hours or less, as the overall LOS shows a remarkable rise in regards to the ED boarding time. Jayaprakash et al. (2020) reported a 1.6% increase in hospital mortality with each hour of delay.

Discussion of the Data Collection Process

Data collected for this project includes the time stamp data measured from arrival time to the ED through the time of arrival to the ICU. The data of the overall LOS for the ED and ICU would also be monitored. This project's data was collected by the Performance Service Department, which manages and maintains the project site's data, as the project site continually collects this data. There would not be any data collected by the project team implementing the project protocol due to this data already being tracked and easily obtained from the project site Performance Services Department. This data would be sent to the project manager every week during implementation. Any data collected would adhere to the IRB regulations. The data was stored in an Excel file in two locations. The backup file would be held in the project site's

electronic data storage. The data would also be on a password-protected and encrypted computer. Both methods were maintained by the project site's system servers that are encrypted and behind the firewall system.

Implementation Plan

Operations Administration Bed Flow and Throughput

The bed ahead protocol goals were presented to the OA group first, with the intention of ensuring the throughput of the stepdown and intermediate patients out of the ICU would help with the open bed in the ICU. Weekly meetings were starting on November 2, 2020. The OA team is on-site 24 hours, seven days a week. They were integral in coordinating bed flow from the ED to the ICU and from the ICU out to the stepdown and intermediate units. This group would also help when the ICU needs to overflow to other off-site areas maintaining the open bed protocol.

ICU Team

The ICU leadership team was integral in the development of the bed ahead protocol. The ICU leadership team consisted of the Nurse Manager of operations and three clinical team leaders. This team set the process map of monitoring the throughput of the patient's from the ED to the ICU. This group was integral in tracking the process and guiding the team through the decision-making process to keep the one bed and ICU staff available for the next patient.

The ICU team education was on October 26, 2020, this included education to the ICU charge nurses. The education for the ICU charge nurses was an online virtual meeting. The bed ahead/open bed protocol was reviewed along with the goal of reducing the ED boarding times of critically ill patients. This education on the protocol also included the process of enforcing the

nurse to patient ratio of one nurse to two patients (1:2). The method of overflowing to alternate locations was also covered with the standard being to move to PACU, SSU, and lastly, the ED.

ED Team

The ED leadership team was also integral in the bed ahead protocol implementation plan. Weekly meetings were held starting on November 2, 2020, through the project implementation. This team would be essential in alerting the ICU and OA teams on the need or arrival of a patient requiring ICU level of care. The ED leadership team would help coordinate the transition from the ED phase of care to the ICU phase of care.

The ED staff were educated on the bed ahead protocol through their start of shift huddle. The ED charge nurses were educated virtually during their monthly charge nurse meetings. The bed ahead protocol was reviewed for the awareness that during high census days, the ICU team may manage a patient in the ED.

Critical Care Medicine Team (CCM)

There would not be any changes to the CCM team workflow. The only difference would be providing education to the CCM team on the new bed ahead protocol. This education occurred on November 20, 2020, and was provided virtually with the team. The education would be for their knowledge of an open bed available to them for their ED patients. In the past, the CCM team has treated patients in the ED, knowing there were no available beds or staffing for the admission.

Section IV. Results and Findings

Results

The project followed critical care patients as they arrived in the ED through to their arrival to the ICU. The times were trended to determine if the Bed Ahead Protocol had an impact

on decreasing the time the critical care patient spent in the ED. There were 394 transfers from the ED to ICU during the data collection period with 229 of these transfers occurring after the project implementation.

Outcomes Data

ED Arrival to ICU Arrival Times. The transfer times for the ED to ICU admissions were tracked and trended with a run chart. Five months of ED to ICU transfer times were trended before the start of the project, from June 28, 2020, to November 30, 2020. The project began on December 1, 2020, with the project data collection completed on May 31, 2021. The overall goal was set at a transfer time of two hours by the project team. The benchmark was based on the work from DiGiacomo et al. (2020). The goal of two hours from the ED to ICU was based on trauma admissions, and this project included all ICU level admissions from the ED. The project did not yield this goal of two hours; however, there was a decrease in the overall transfer time from the ED to the ICU of 1.6 hours during the project implementation.

The overall median value for the data from the ED to ICU transfer time was calculated to be 5.2 hours from ED arrival to ICU transfer. This median was used for the interpretations with the run chart. There was not a data shift in time below the median for the data collected. There were also not any observed trends in the data using the run chart in Table 2.

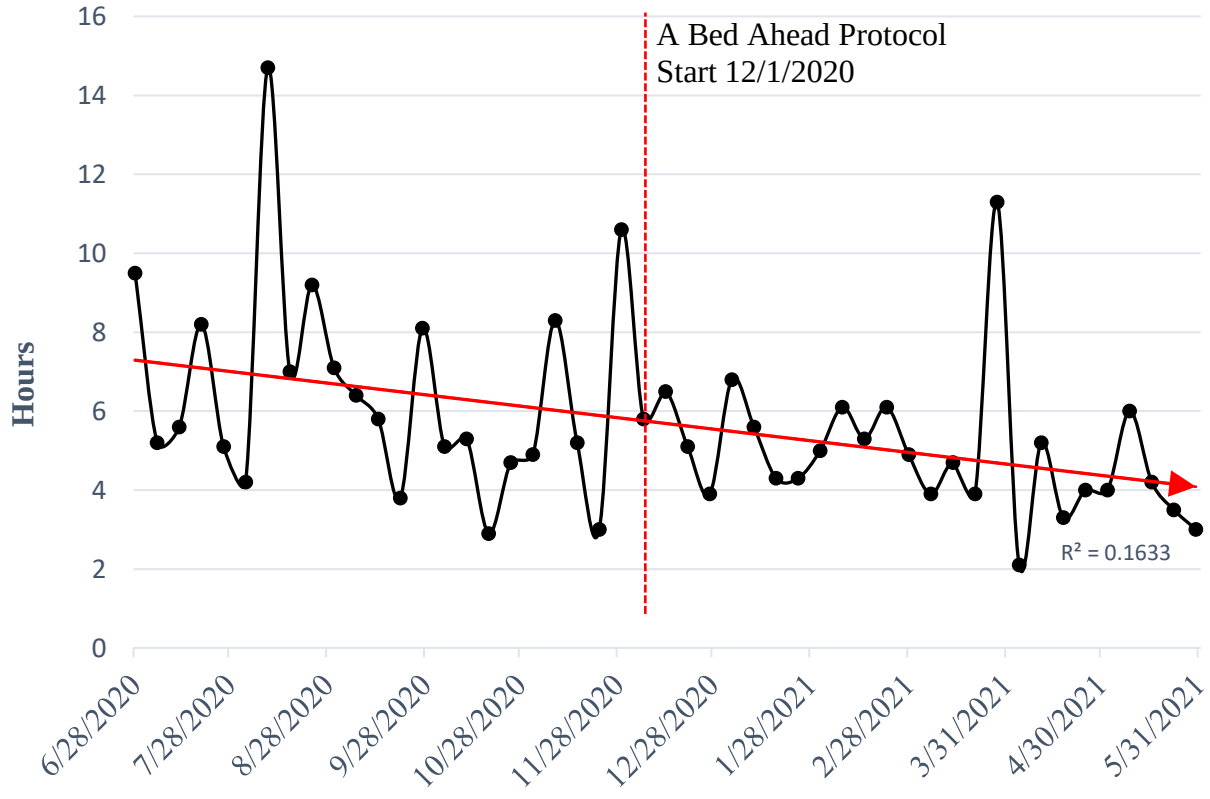
The data points were trended using a linear trend line from the collected ED to ICU transfer times. There is a negative linear regression with a value of $R^2 = 0.1622$. The trend for the ED to ICU transfer times had a slight 16% trend after the implementation of the Bed Ahead protocol.

Table 2 displayed the project measurements for June 28, 2020, through April 30, 2021. The process of decreasing the boarding times of the critically ill patient is proving to be a slow

process, with the goal of two hours or less not being met. There was a slight decrease in the number of hours critically ill patients are boarding in the ED of 1.6 hours.

Table 2

ED to ICU Transfer Time Run Chart

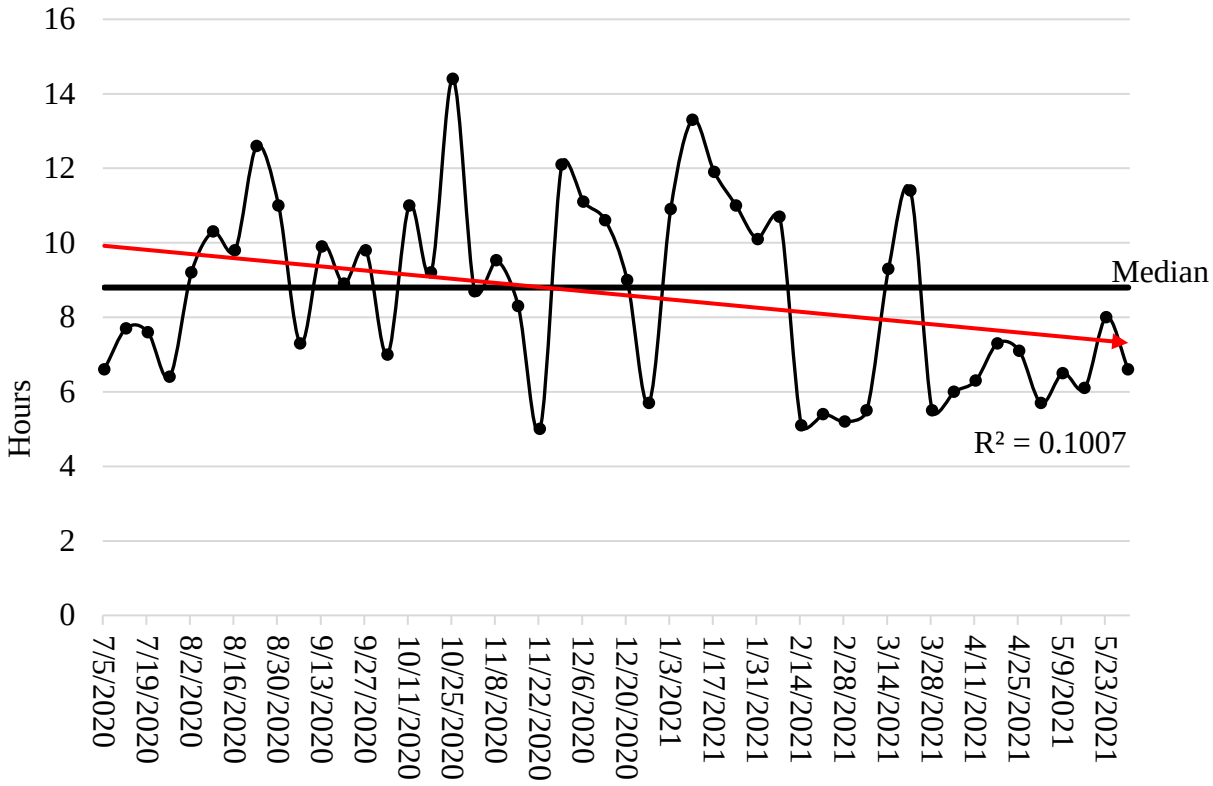


Note. This table represents the average weekly ED to ICU transfer times from July 1, 2020, to April 30, 2021.

Overall ED Boarding Times. The boarding times for all patients were tracked during the project period. The average boarding time decreased from 9.2 hours to 8.5 hours, with a decrease of 0.70 hours or 42 minutes. From the run chart in Table 3, one trend was noted in the numbers below the median of 8.8 hours from March 28, 2021, to April 25, 2021. There is a negative linear regression with a value of $R^2 = 0.1007$

Table 3

ED Overall Boarding Times Run Chart

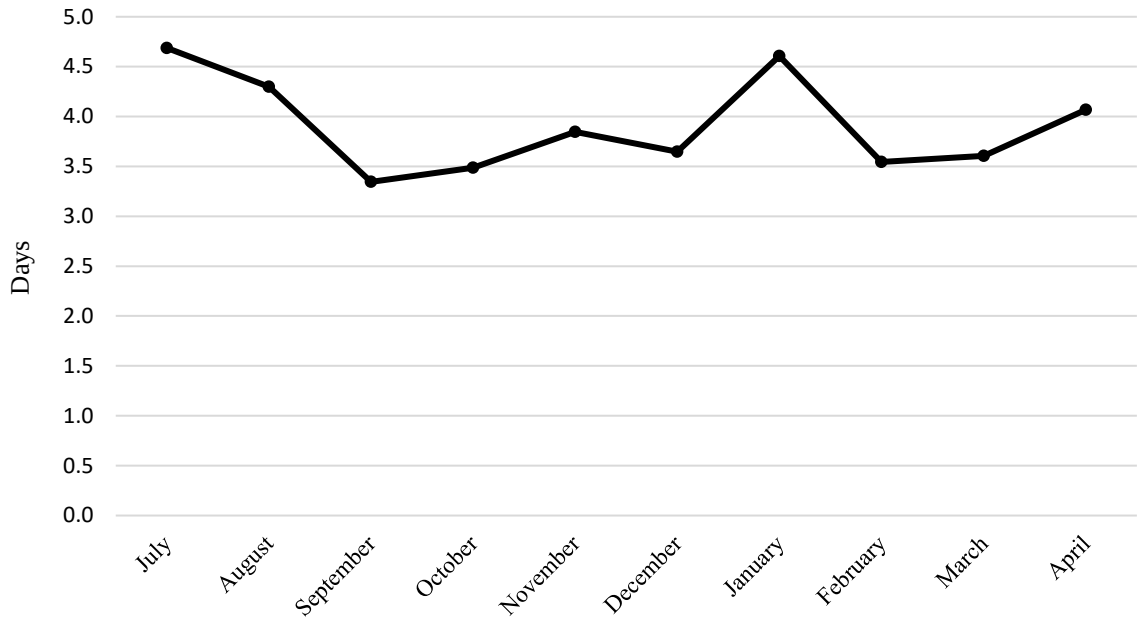


Note. This table represents the weekly boarding time average for all patients in the ED.

ICU LOS. The overall LOS for the ICU was measured for the project period. This included all patients from admission areas. The average LOS for the pre-project and post-project periods were the same. The project did not have an impact on the ICU LOS. Keeping an open bed in the unit did not increase the moderate risk for ICU level of care admissions (soft admissions). There was also not decrease in the utilization of the ICU beds while keeping the open bed available. The average LOS for the measured period was 3.9 days. See Table 4 for the graph of the overall LOS for the ICU.

Table 4

ICU Overall LOS



Note. This line graph represents the LOS for patients in the ICU by the average number of days grouped by month from July 1, 2020 to April 30, 2021.

Discussion of Major Findings

The Bed Ahead protocol for the ICU ignited communication between the teams involved in the project. The goal of transferring critically ill patients to the ICU within two hours was not meet, with the median time being 5.2 hours. The teams worked closely with each other to keep the communication loop open to identify patients needing ICU level of care. There was not the ability to hold an empty bed exclusively for ED patients. This lead to competition for the open bed from the inpatient medical patients and the surgical services patient using the Bed Ahead protocol as well. However, there was a decrease in the transfer times from an average of 6.5 hours to 5.0 hours overall, for a 1.6-hour reduction in boarding time.

Section V. Interpretation and Implications

Cost-Benefit Analysis

Assessing and following the cost of quality improvement projects helps process the implications of adjusting the project to a permanent part of the health system. This process can be from setting a policy or ensuring the project stays part of the unit practice. Leaders of healthcare organizations should implement quality improvement projects, which yield safe and high-value patient care.

Financial Impact of ED Boarding

Overcrowding in the ED harms both the ED and the hospital system's financial health. Kenny et al. (2020) reported ED overcrowding was linked with an increase in cost for admitted patients in addition to a loss in hospital revenue. Kenny et al. continue to state ED boarding is associated with an increased total cost of $6.8 million spread across three years. They also noted that reducing the ED boarding times by only one hour would increase hospital profits by $13,298 per day, or $4.9 million per year. ED boarding is a negative financial implication for the hospital, and working to decrease this will help the economic viability of our health systems.

Financial Impact of ICU Length of Stay

ICUs are complex and one of the most expensive departments in our healthcare systems. In the United States, the cost of critical care medicine nearly doubled from 2000 to 2010, from $56.6 to around $108 billion (van der Sluijs et al., 2017). Halper and Pastores (2015) describe the cost per day in an ICU in the United States as estimated to be $4,300. Halper and Pastores continue to report maximizing the patient throughput, patient flow and dealing with capacity constraints early to decrease the length of stay will have a positive economic impact on our

health systems. Reducing the LOS for ICU patients will help our health systems operate at a more efficient level (van der Sluijs et al., 2017).

Resource Management

Patient Throughput Management

For this Bed Ahead project, the patient bed flow management was shifted from the OA leadership team to the ICU Leadership team. Most of the responsibility was on the ICU charge nurse who managed the bed placement within the ICU. When the ICU charge nurse was alerted of an ICU admission from the ED team or the CCM team, they would move the patient to the ICU and start the process of letting the OA know where the next bed would be. Within the electronic medical record system, the charge nurse is able to mark which bed will be the next open ICU bed for the bed management team to see. The ICU charge nurse also alerted the ICU leadership team when there are no physical beds in the unit to begin locating the area the ICU will start to overflow. Appendix F shows the Bed Ahead Protocol for the process flow map.

Practice Change of Open Bed

There was a shift in the management of the bed flow for the ICU with this project. Before this project, the charge nurses for the ICU would save a “code bed” as they were working with bed management. The Bed Ahead protocol defined this practice and aligned this throughout all the ICU charge nurses. The project also leads to a defined process for when the ICU census was more significant than the number of available beds. The Bed Ahead protocol mapped out the areas to overflow first. This process allowed the charge nurses to accept patients to the last bed available, knowing there would be the availability of space for the next patient needing ICU level of care.

Staffing Implications

Staffing Limited Implications. With the Bed Ahead protocol establishing an available ICU bed at all times, there also had to be an ICU nurse available to manage the admission. There was an impact with staffing to ensure an ICU-trained nurse available to manage the admission along with the bed. Before the project, nurses from the ICU were available for the just-in-time staffing for the entire hospital. ICU nurses would float to help other areas that had a last-minute need for nursing staff. After the project, the ICU established a protected ICU RN who would either be on-call for an admission or work as a "helping" nurse until the subsequent admission. The protection of the ICU nurse enabled the nurse to start the care of the patient in the ED when the room in the ICU was being cleaned or was not readily available.

Change in Help Chain. The help chain did not change with this project. The help chain is defined as a standard path of individuals to ask for help to solve a problem. However, those in the help chain had a clearer picture of the need to move critically ill patients out of the ED. The process map (see Appendix F) was used when the ICU census was more than the available beds in the physical ICU. Those in the help chain could make decisions quicker, knowing where the next overflow area would be.

Implications of the Findings

Overcrowding in the ED is an issue that will take a lot of work. The Bed Ahead project demonstrated the ability to fast-track critically ill patients to the ICU from the ED. Lowering the time the critically ill patient spends in the ED will help ensure the patient is cared for in the team trained in critical care medicine. The project defined the transfer process for patients needing the ICU level of care.

Implications for Patients

This project addressed the need to move patients out of the ED to specialty areas as fast as possible. When there is a scarcity of beds and the overcrowding in the ED is overwhelming the resources of the ED, ensuring those who are most sick are moved to areas with trained providers and staff is critical. The project mapped out the process for moving critically ill patients through the ED and into the ICU with a bed ready for an admission. Using this protocol there was an ICU trained nurse assigned to the patient quicker. This process allows for the ICU level of care to start sooner, and the orders from the CCM team are carried out and completed more expeditiously.

Implications for Nursing Practice

The Bed Ahead project allowed nursing to be more prompt in transferring critically ill patients to a higher level of care areas in a more rapid manner. Nurses advocate for patients, and developing a process where there is always a plan for patients requiring an ICU level of care to move quickly out of the ED and to the ICU is beneficial to this group. Having the Bed Ahead protocol allowed for standard practice that crosses from the ED to the ICU and across the OA and bed management team.

Impact for Healthcare System(s)

Overcrowding in the ED is an issue for many healthcare systems across our nation. The Bed Ahead project allowed the ICU, ED, and the OA leadership team to create a standardized work flow to fast-track critically ill patients to a higher level of care. Working to move the patients who are taking up more resources in an area already heavily taxed with overcrowding allows the resources to be redirected to other patients.

Utilizing the Bed Ahead protocol to fast track critically ill patients out to the ED aids to free up more space to increase the utilization of the ED beds. This would lean toward the team being able to increase the overall ED visits by increasing the throughput of the patients being able to be seen. Using the Bed Ahead protocol to fast track these patients to the ICU will add a pathway to standardize the throughput to the inpatient setting (Kenny et al., 2020).

Sustainability

A Bed Ahead Protocol Workability and Longevity

The standard work created with this project will be maintained within the health system for the fast-tracking of critically ill patients to the ICU from the ED. Creating standard work builds in a method so it can be replicated and taught to others (Anderson et al., 2019). There are parts of this project that have already merged into other units. Other units are marking beds within the electronic medical record system, indicating where their next bed is open, available, and staffed. Continuing with the Bed Ahead project will allow the standard work with the protocol for the empty bed to fast track patients out of the ED who are in need of the ICU level of care. Merging this project into the workflow of other units creates a system throughout the hospital units where the teams are preparing for the next admission before the admission is needed.

The Shift of a Bed Ahead Protocol Ownership

The shift of the ownership to the ICU charge nurse allowed the ICU team to control the patient throughput. Communication between the ED and the ICU shifted from the ED pushing the ICU patients out of the ED to the ICU pulling the patients out of the ED who needed the higher level of care. The charge nurses who had the least charge nurse experience trusted the protocol more, using the protocol when there was a bed scarcity, and patients were slow to move

out of the ICU. The charge nurses who had the most experience were more skeptical of the new protocol holding soft ICU admissions outside of the physical unit, keeping the open bed for a more critical case. The shift is seen as a positive change from both the ED team and the ICU team. The ED sees the ICU team helping to decompress the sicker patients out of the ED environment allowing the ED to focus on other patients.

Dissemination Plan

The project findings will be disseminated through committee meetings within the organization. The data from the project will be presented to the ED provider's quarterly meeting along with the ICU quarterly providers meeting. The project findings will also be presented to the Nursing Executive Council as this project crossed over several units and leadership teams. These presentations will be in a virtual setting due to the distance between participants.

An abstract for this project will be submitted to the health system's annual Quality and Safety Conference. The abstract will also be submitted to the National Teaching Institute and Critical-Care Exposition (NTI) by the American Association of Critical-Care Nurses. Posters for both conferences will be shared throughout the conference, with exclusive poster viewing sessions worked in the conference schedules.

Section VI. Conclusion

Project Strengths and Limitations

Limitations

Clear Admission Criteria. There are times where the CCM team wanted to see if a few interventions would work and allow the patient to be admitted as a step-down patient. These soft admissions added to the time patient spent in the ED environment. These patients will be admitted, but they are delayed for admission while the medical teams determine if they will need

ICU level of care or step-down level of care after interventions in the ED. These patients still require a lower patient-to-nurse ratio and pull the ED providers from other patients as they continue to stabilize the patient. Clear admission criteria for all levels of care would help guide providers from multiple specialty backgrounds on which area would be best to manage the next phase of care for patients in between needing ICU level of care or step-down level of care.

Non-ICU Bed Capacity. There were multiple times during the project where there were surges in the non-ICU patient population. Between, March 15, 2021, to March 21, 2021, was an example of a week where inpatient step-down and intermediate level beds were scarce. This lead to competition between the ED, ICU, PACU, and outside direct admissions for non-ICU beds. These surges lead to the boarding of patient who no longer needed ICU level of care boarding in the ICU waiting on bed in other units.

Early Consult to the Intensivist. Consultation to the CCM Intensivist is integral to engaging the Bed Ahead protocol. The process was not straightforward until the admission order came from the CCM team. A delay from the ED provider alerting the CCM team that a potential patient needed the ICU level of care postponed the activation of the protocol. The earlier the consult was placed, the earlier the protocol was initiated, and the ED and ICU teams began planning the transfer to the ICU.

Strengths

Clear Pathway. One of the strengths of this project was establishing clear standardized work flow for transferring patients out of the ED to ICU. Pathway framework facilitates the spread of standard work, monitors for drift, and supports continuous improvement (Anderson et al., 2019). This pathway helped to shift the culture of the ED pushing ICU level patients out of the ED to the ICU staff pulling the patients out of the ICU to the open bed. The RN in the ICU

assigned to the open bed would often go to the ED and transport the patient from the ED up to the ICU room.

Bed Management. The project shifted the management of an open bed in the ICU with a new standard work around the management of the open bed. Before this project charge nurses were afraid to use the last ICU bed due to the fear of another bed not opening up in time for the next patient requiring ICU. This project placed definitions around the use of the open bed and mapped out the steps to take when all beds in the physical ICU were in use. This process was also beneficial to the OA and bed management team, there was not a question of where the next ICU level patient would be placed. The project also helped activate the bed management team to move out patients who no longer required the ICU level of care. When they were not create availability of an open bed, they called together the leadership teams to determine the area to overflow the next patient. Before this project, this process did not start until there was a patient would be waiting for admission.

Recommendations for Others

The recommendation for future projects is to map out the different types of admissions coming from the ED to the ICU. Using clinical pathways to map out the throughput of the patient from the ED to the inpatient setting aids to standardize the process of admissions from the ED. The patients who clearly meet the ICU admission criteria moved faster through the system. Some patients came through the ED and did not need ICU care but went straight to an interventional area and continued to decompensated in the interventional area. The process of moving these patients to other areas was not as straightforward. Embedding care coordination and bed flow advocate who knew how to navigate the complex medical system will help to identify open beds,

bed availability, and alert surge plans when demand is predicted to outpace the supply of open beds (Kenny et al., 2020).

Recommendations Further Study

Consult to the ICU Criteria

Establishing clear and open criteria for when to consult the CCM team would help identify patients who need the ICU level of care quicker. The time around the decision to admit to the ICU including the ED team evaluating and providing interventions, using a model or protocol to determine which patients should get a consult from the CCM team will help to speed up the patient throughput. It is important to identify patients quickly who need critical care expertise (Jayaprakash et al., 2020). Studies around quick consults to the CCM team and tracking to see if the transfer times decrease will help to improve throughput. The CCM team makes recommendations for treatment for all the patients they review, and the early consult may deter the soft ICU admissions.

ICU in the ED

Future studies for having an Intensivist trained provider manage an ICU located in the ED to hold patients who are soft admissions for critical care would help to decrease admission to the ICU. The ICU in the ED would manage the patients who only need a few hours of intensive care to then would be able to be downgraded to a step-down bed. This would allow beds in the ICU to be used for the patients who would require a more extended period of ICU level of care (Gunnerson et al., 2019).

Bed Ahead in the Step-down Units

The patient throughput for a stepdown level of care is also an area of study, as this is an area of congestion within the patient flow from admission to discharge. Working with the

stepdown leadership groups to map out a process for where the next open bed will be, similar to the ICU Bed Ahead protocol. Hospitals need a system wide approach to decreasing the boarding times for patients in the ED. Matching demand with capacity with staying a bed ahead of admission will help with this issue (Mohr et al., 2020). Future studies of the patient throughput of patients requiring a step-down level of care would benefit the health system as we continue to combat overcrowding in the emergency departments.

Final Conclusions

Overcrowding in the ED is a significant problem for many health systems, and this overcrowding can prove to elicit poor outcomes on the ICU patient who is being held. Recognition of the need for critical care interventions on arrival to the ED and having a clear pathway for the quick transfer of the critical patient to the ICU can ensure the high quality of care is given in the right area at the right time. The bed ahead protocol provided a clear pathway for the teams to fast track critical patients and then start the process for preparing for the next ICU admission before boarding an ICU patient in the ED.

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Appendix A

The Search Query for CINHAL Academic Database

Number	Query	Limiters and Expanders	Results
S12	S7 AND S10	Limiters - English Language; Published Date: 20150101-20201231 Expanders - Apply equivalent subjects Search modes - Find all my search terms	47
S11	S7 AND S10	Expanders - Apply equivalent subjects Search modes - Find all my search terms	152
S10	S8 OR S9	Expanders - Apply equivalent subjects Search modes - Find all my search terms	14,412
S9	(MH "Transfer, Discharge")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	5,898
S8	TI ("board* time*" or "board*expos*" or "transfer* time*" or "patient* transfer*" or "length of stay" or boarding or bed or beds)	Expanders - Apply equivalent subjects Search modes - Find all my search terms	8,776
S7	S3 AND S6	Expanders - Apply equivalent subjects Search modes - Find all my search terms	1,995
S6	S4 OR S5	Expanders - Apply equivalent subjects Search modes - Find all my search terms	91,376
S5	TI "emergenc* service*" or "emergenc* depart*"	Expanders - Apply equivalent subjects Search modes - Find all my search terms	25,328
S4	(MH "Emergency Service+") OR (MH "Emergency Medical Services")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	84,988
S3	S1 OR S2	Expanders - Apply equivalent subjects Search modes - Find all my search terms	70,829
S2	TI (ICU or "intensive care")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	31,124
S1	(MH "Intensive Care Units+")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	61,484

Note. This table includes the search criteria and terms used to select literature for evidence.

Appendix B

The Search Query for PubMed Academic Database

Search Number	Query	Filters	Results
6	("intensive care units"[MeSH Terms] OR "intensive care"[tw] OR "icu" [tw]) AND ("emergency medical services"[MeSH Terms] OR "emergency services"[tw] OR "emergency department"[tw] OR "emergency room"[tw] OR "emergency service, hospital"[MeSH Terms])) AND (("board time" [tw] OR "boarding" [tw] OR "board times" [tw] OR "boarder times" [tw] OR "boarder time" [tw] OR "ED boarders" [tw] OR "transfer" [tw] OR "length of stay" [tw] OR "bed" [tw] OR "beds" [tw]) OR ("length of stay"[MeSH Terms] OR patient transfer"[MeSH Terms]))	In the last five years, English	1161
5	(("intensive care units"[MeSH Terms] OR "intensive care"[tw] OR "icu" [tw]) AND ("emergency medical services"[MeSH Terms] OR "emergency services"[tw] OR "emergency department"[tw] OR "emergency room"[tw] OR "emergency service, hospital"[MeSH Terms])) AND (("board time" [tw] OR "boarding" [tw] OR "board times" [tw] OR "boarder times" [tw] OR "boarder time" [tw] OR "ED boarders" [tw] OR "transfer" [tw] OR "length of stay" [tw] OR "bed" [tw] OR "beds" [tw]) OR ("length of stay"[MeSH Terms] OR patient transfer"[MeSH Terms]))	English	3,097
4	(("intensive care units"[MeSH Terms] OR "intensive care"[tw] OR "icu" [tw]) AND ("emergency medical services"[MeSH Terms] OR "emergency services"[tw] OR "emergency department"[tw] OR "emergency room"[tw] OR "emergency service, hospital"[MeSH Terms])) AND (("board time" [tw] OR "boarding" [tw] OR "board times" [tw] OR "boarder times" [tw] OR "boarder time" [tw] OR "ED boarders" [tw] OR "transfer" [tw] OR "length of stay" [tw] OR "bed" [tw] OR "beds" [tw]) OR ("length of stay"[MeSH Terms] OR patient transfer"[MeSH Terms]))	None	3,289
3	("board time" [tw] OR "boarding" [tw] OR "board times" [tw] OR "boarder times" [tw] OR "boarder time" [tw] OR "ED boarders" [tw] OR "transfer" [tw] OR "length of stay" [tw] OR "bed" [tw] OR "beds" [tw]) OR ("length of stay"[MeSH Terms] OR patient transfer"[MeSH Terms])	None	754,987
2	"emergency medical services"[MeSH Terms] OR "emergency services"[tw] OR "emergency department"[tw] OR "emergency room"[tw] OR "emergency service, hospital"[MeSH Terms]	None	197,184
1	"intensive care units"[MeSH Terms] OR "intensive care"[tw] OR "icu" [tw]	None	195,777

Note. This table includes the search criteria and terms used to select literature for evidence.

Appendix C

Institutional Review Board Approval for Project Site

[redacted]**EVIEW BOARD DECLARATION OF RESEARCH NOT INVOLVING HUMAN SUBJECTS**

The [redacted] IRB has determined that the following protocol meets the definition of research not involving human subjects as described in 45 CFR 46.102(f), 21 CFR 56.102(e) and 21 CFR 812.3(p) and satisfies the Privacy Rule as described in 45CFR164.514.

Protocol ID: Pro00106770

Reference ID: Pro00106770-INIT-1.0

Protocol Title: Decreasing Emergency Department Boarding Times for the Intensive Care Patient

Principal Investigator: Deborah Allen

This IRB Declaration is in effect from September 13, 2020 and does not expire. However, please be advised that any changes to the proposed research will require re-review by the IRB.

[redacted]

Appendix D

Institutional Review Board Approval for East Carolina University

Based on your responses, the project appears to constitute QI and/or Program Evaluation and IRB review is not required because, in accordance with federal regulations, your project does not constitute research as defined under 45 CFR 46.102(d). If the project results are disseminated, they should be characterized as QI and/or Program Evaluation findings. Finally, if the project changes in any way that might affect the intent or design, please complete this self-certification again to ensure that IRB review is still not required. Click the button below to view a printable version of this form to save with your files, as it serves as documentation that IRB review is not required for this project. 9/21/2020

Appendix E

Project Site Committee List of Members

Project Site Committee Plan			
Project Committee	**Role/Expertise**	**Implementation Steps**	**Meeting Schedule**
Associate Chief Nursing Officer (ACNO)	The ACNO will serve as the site champion for this project.	The ACNO will provide overall project oversight and provide professional guidance throughout the project implementation.	We will meet weekly in-person or virtual via Zoom.
Emergency Department (ED) Nurse Manager	The ED Nurse Manager is an expert in the clinical care of the ED patient and will manage all aspects of the ED phase of care.	The ED Nurse Manager will manage the critically ill patient during the ED phase of care and collaboration with the ICU Nurse Manager and Operations Administration for patient throughput from the ED phase of care to the ICU phase of care.	We will meet weekly for a summary of patient throughput. Will meet more frequently as critical issues arise. Meetings will be in-person or virtual via Zoom.
Intensive Care Unit (ICU) Nurse Manager	The ICU Nurse Manager is an expert in the clinical care of the ICU patient. They will manage the care of the patient during the ICU phase of care.	Management of keeping the open bed available during the project timeline, and collaborate with Operations Administration when overflowing to an alternate location when there is no bed in the physical ICU.	We will meet weekly for a summary of patient throughput. Will meet more frequently as critical issues arise. Meetings will be in-person or virtual via Zoom.
Operations Administrator (OA) Manager	Expert in the management of patient throughput and will manage the patient's transitions from each phase of care.	Collaborate with the ED and ICU Nurse Managers for bed management and patient throughput.	We will meet weekly for a summary of patient throughput. Will meet more frequently as critical issues arise. Meetings will be in-person or virtual via Zoom.

Operations Administrator (OA) Director	Professional expert in managing patient throughput, and will provide oversight to the patient transitions through each phase of care.	The OA Director will provide supervision and professional guidance with patient throughput and bed management.	We will meet bi-weekly to review and summarize the progression of the project. Meetings will be in-person or virtual via Zoom.
Emergency Department (ED) Medical Director	The medical expert in ED care and will guide provider involvement with patient care in the ED.	The ED Medical Director will provide oversight and professional guidance with patient throughput during the ED phase of care.	We will meet bi-weekly to review and summarize the progression of the project. Meetings will be in-person or virtual via Zoom.
Intensive Care Unit (ICU) Medical Director	The medical expert in the ICU and will guide provider involvement with critical care management of the patient in the ICU phase of care.	The ICU Medical Director will provide oversight and professional guidance with patient throughput during the ICU phase of care.	We will meet bi-weekly to review and summarize the progression of the project. Meetings will be in-person or virtual via Zoom.

Appendix F

A Bed Ahead Protocol Process Map