Southern California CSU DNP Consortium

California State University, Fullerton
California State University, Long Beach
California State University, Los Angeles

USING BED AHEAD TO IMPROVE UTILIZATION IN A PROGRESSIVE CARE UNIT

A DOCTORAL PROJECT

Submitted in Partial Fulfillment of the Requirements

For the degree of

DOCTOR OF NURSING PRACTICE

By

Dino Luzuriaga

Doctoral Project Committee Approval:

Laura Sarff, DNP, RN, MBA, CPHQ, NEA-BC Team Leader
Rachel McClanahan, DNP, RN, NCSN, Team Member

May 2023

Author Note

Dino Luzuriaga - https://orcid.org/0000-0002-6163-8249
DOI 10.5281/zenodo.10548081

ABSTRACT

Emergency Department (ED) overcrowding is a serious problem that is exacerbated by ED boarding. ED boarding occurs when hospitals do not have enough inpatient beds for admitted patients. Bed assignments are one variable that impacts ED overcrowding, but the process of assigning beds is challenging and complex. Ultimately, ED overcrowding leads to increased patient mortality rates and poor patient care. This is especially critical when patients in the ED require Progressive Care Unit (PCU) care. The purpose of this project was to develop and implement an evidenced-based bed ahead process that ensured patients in the ED needing a PCU level of care were assigned a bed with minimal ED boarding time. The Patient Flow Managers (PFMs) collaborated with PCU charge registered nurses to identify patients that could be DUDed (Downgrade, Upgrade, Discharge) from the PCU. The theoretical framework used for this project was the Iowa Model with a quantitative pretest-posttest design. This project was conducted at a public tertiary hospital located in Los Angeles, California. The sample for this project included all adults (age 18-99+) who were admitted to the PCU from the ED. The bed request to bed occupy time, and PCU Length of Stay (LOS) were compared pre- and post-implementation. Data was gathered using Teletracking®, a bed management software program used to monitor for trends in the bed ahead process. The mean bed-request-to-bed-occupy-time was 582 minutes post-implementation. The mean was greater by 285 minutes compared to the pre-implementation data. Pre-implementation PCU LOS was 2.5 days, and post-implementation remained at 2.5 days. In evaluating and improving the project, staff shortage and increased bed closures in the PCU were noted to be contributing factors that increased the mean bed-request-to-bed-occupy-time. As a result of the project, there has been a change in practice and heightened awareness of how PFMs view bed demand and capacity. Increased communication between the PFMs and nurses in the PCU helped identify and move patients out of the PCU.

Keywords: Patient Flow, Patient Throughput, Bed Ahead, ED Overcrowding, and Bed Assignment.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

I want to thank my amazing family, especially my wife, whose unyielding support and dedication to our family have helped me get through this rigorous yet fulfilling program. I want to thank my daughter, Leila, who went with me to numerous coffee shops to keep me company with her tablet and books while I spent hours writing and revising my project. I want to thank my amazing team leader and team member who supported me throughout this project. I want to take a moment to reflect on where I was a few years ago before starting my DNP journey and how far I've grown, as an individual, and the knowledge I have garnered from this amazing program. I am so grateful for the people I've met in this program and the experiences we've shared together.

Background

According to the Centers for Medicare and Medicaid Services (CMS, 2021), hospitals are pressured to become more cost-effective and proficient with their services. Patient throughput is critical in moving hospital patients through their continuum of care. Patient flow refers to the movement of patients throughout the hospital based on their need for nursing care. Optimum patient flow decreases hospital congestion and delays in treatment and addresses Emergency Department (ED) overcrowding (Boiko et al., 2021). Poor patient flow can lead to poor-quality care, which can increase costs (Boiko et al., 2021). Hospitals with effective patient throughput improve their capacity to provide safe and effective care for their patients. Effective patient throughput also ensures that patients receive the right level of care.

Emergency department overcrowding and delays in throughput have contributed to an increased patient volume in emergency rooms (Boiko et al., 2021). ED overcrowding has been linked to increased mortality and patients leaving the ED without completing their care (Jarvis, 2016). Overcrowding occurs when there are too many patients in the ED and poor throughput into the inpatient units or not enough available inpatient hospital beds to care for the patients (Jarvis, 2016). This creates a bottleneck that compromises the quality of patient care (Chartier et al., 2016). When patients are admitted into the hospital but remain in the ED while waiting for an available bed, they are identified as boarders. The boarding of patients in the ED contributes to ED overcrowding, an ongoing problem that interferes with patient flow from the ED to the hospital (Bornemann-Shepherd et al., 2015). Patient boarding causes ED resources to be taxed and interferes with the flow of patients that need to be examined and treated promptly (Huang et al., 2018).

Emergency department boarding adds to an already strenuous workload for ED nurses responsible for monitoring these patients and evaluating new incoming patients. ED nurses must provide care for inpatients and ED patients until a bed becomes available for the boarded patient (Chartier et al., 2016). Furthermore, as the number of patients increases in the ED, so does the patient-to-provider ratio in the waiting room. This is further impacted if no beds are available, creating an unsafe environment for high-acuity patients and a precarious medical-legal challenge for healthcare providers (Chartier et al., 2016).

Patients entering the hospitals from the ED who will need to be admitted are assigned to a hospital bed consistent with their level of care. If an appropriate bed is not available for these ED patients, then they may need to remain in the ED for several hours (and sometimes days) before an appropriate bed is available. Beds may be unavailable for a variety of reasons. One reason may be that all appropriate beds are occupied. Another reason may be that the beds may be dirty and need to be cleaned by housekeeping. And finally, the movement of patients may not be efficient. There may be some patients who no longer need the high level of care provided in the intensive care unit (ICU) but are not moved because there are no beds available in units with a lower level of care, such as the progressive care unit (PCU) or a medical-surgical unit. In many hospitals, a person or group oversees bed availability and ensures that the "flow" of patients is maintained throughout the hospital. These individuals ensure that patients are in the right bed for the level of nursing care they need.

The process of managing bed flow is complex. Some organizations have instituted a process known as "bed-ahead." The bed-ahead concept means that inpatient units should anticipate an admission (demand) for incoming patients and have an available bed for the patient prior to the need for the bed (Melton et al., 2016). By establishing a perpetually available bed for

the next available patient, hospitals can place patients in beds quickly, thus reducing the length of stay (LOS) for patients waiting in the ED (DiGiacomo et al., 2020). Being proactive, hospital leadership could play an active role in utilizing available resources and improving overall patient flow for the organization (Melton et al., 2016).

As improvements in healthcare contribute to longer life expectancy, so does demand for efficient services with lowered costs (Prin & Wunsch, 2014). Hospitals are under pressure from the government to become more cost-effective (Chan et al., 2019). Hospitals allocate their beds based on the level of nursing care needed by a patient. Patients requiring the highest level of nursing care are assigned to ICU beds. According to Kaier et al. (2020), ICUs represent one of the highest clinical costs in healthcare today. The median daily cost for a patient in the ICU is $13,443, and the median LOS is approximately five days (Ohsfeldt et al., 2021).

To mitigate costs, patients should be placed in beds appropriate for their level of care. Patients can be placed within the PCU when they no longer need the level of care required within the ICU. PCUs are generally less expensive than ICUs because of the higher nurse-to-patient ratio (Chan et al., 2019). This difference in ratio leads to lower costs when a patient is in the PCU versus the ICU (Prin & Wunsch, 2014). Due to patient flow inefficiencies, patients needing PCU levels of care may be “upgraded” to ICU level care or remain in the ED as boarders. This contributes to higher hospital costs and inefficiencies related to inappropriate bed utilization.

Problem Statement

Patients are admitted to a level of care based on the intensity of nursing care required. Bed assignment is a challenging and complex process. Ensuring patients are in the appropriate bed based on the level of nursing care needed is the goal of hospital flow. If a bed is not available when needed, patients may be forced to stay in the ED, which may not be able to

provide them with the level of care they need. This is especially critical when patients require ICU or PCU care.

As the high demand for PCU beds becomes critical due to the high number of patients requiring these services, hospitals need to be better equipped to serve these patients. The problem this project addresses is ensuring that patients who need PCU-level care can be assigned to the appropriate bed quickly with as little ED boarding time as possible.

Purpose Statement

The purpose of this evidence-based project was the implementation of a bed ahead process that ensures patients needing PCU-level care are assigned a bed as quickly as possible with little ED boarding time.

Evidence-Based Practice Model

Theoretical frameworks can help researchers ask clinical questions to evaluate whether their findings could improve the quality of patient care through the systematic use of research evidence (Lynch et al., 2018). A theoretical framework also provides a guide for interpreting the findings of an evidence-based project (EBP). It is the foundation on which a project is designed, and the methods used to evaluate the effectiveness of the intervention. The Iowa Model Revised was used to guide this EBP DNP project (Appendix A). The permission to use the Iowa Model for the project can be found in Appendix B.

The Iowa Model was developed in the 1990s by a team of nurses from the University of Iowa Hospitals and Clinics and College of Nursing to guide clinicians in the evaluation and infusion of research into practice (Iowa Model Collaborative et al., 2017). The model was revised in 2015 to address the sustainability of EBP changes and was revised again in 2017. The Iowa Model Revised has clear and concise steps that provide a framework for nurses to design an

EBP change practice, from identifying the problem to sustaining and maintaining the practice changes (Iowa Model Collaborative et al., 2017). The Iowa Model Revised includes seven steps with three decision points. The present project will refer to the Iowa Model Revised as the Iowa Model.

The Iowa Model offers a step-by-step process for implementing an EBP project using a systematic approach. The first step of the Iowa Model is identifying a trigger, which leads to a practice problem that needs to be addressed. Identifying the trigger is a critical component in finding a solution. The identified trigger in this project was ED overcrowding, which contributed to delays in patient throughput. ED overcrowding results in boarding patients who are admitted to the hospital but not moved to inpatient units due to unavailability of beds.

The second step in the Iowa Model is stating the purpose or the question that needs to be answered. The project team acknowledges that a problem exists, which is delays in throughput for patient admissions into the hospital from the ED. Hospitals with effective patient throughput improve their capacity to provide safe and effective care for their patients. Once the problem is acknowledged, the project team engages in research to identify methods for addressing it (Iowa Model Collaborative et al., 2017).

The project team then determines the purpose of the project. The purpose of this EBP project was to implement a bed ahead process to ensure that patients waiting in the ED requiring PCU-level care can have a bed assigned to them as soon as possible. At this point, the team determines if the problem is a priority to the organization; this is the first decision point in the Iowa Model. Multiple discussions with hospital leadership, including the Associate Chief Medical Officer (ACMO), Chief Medical Officer (CMO), Chief Nursing Officer (CNO), and Chief Executive Officer (CEO), confirmed the urgency and priority of this project. Optimum

patient flow could decrease hospital congestion and decrease delays in treatment and overcrowding in the ED. The continuum of care is critical to maintain when moving patients through the hospital. Determining a problem as a priority is pivotal in ensuring buy-in from key stakeholders and leadership. Without buy-in, the problem will not receive allocated resources to address it (Iowa Model Collaborative et al., 2017). Once it was determined that the problem was a priority, the project team moved forward with implementing the project.

The third step in the model is the formation of a team. Creating a team is a critical step in the problem-solving process. Selecting a multidisciplinary team requires that each member has the specific skills to contribute to solving the problem. The collaboration between team members is critical as it ensures that individuals with expertise are on the team so the problem can be solved effectively and efficiently (Iowa Model Collaborative et al., 2017). The team collaborating and working on this project was comprised of PCU nurses, ED nurses, medical providers, patient flow managers (PFMs), and hospital leadership.

The fourth step in the Iowa Model is assembling, appraising, and synthesizing the body of evidence. The purpose of this step is to determine if there is sufficient evidence to support the proposed practice change, which is required to satisfy the next decision point in the Iowa model. A comprehensive literature review identified sufficient evidence to support the proposed change in practice.

The fifth step in the Iowa Model is designing and piloting the practice change. This is where the team decides to implement their project as a pilot to determine if their solution to the problem is effective. This project was piloted in the three PCUs in the project hospital. Piloting is done to avoid wide implementation of the intervention before knowing if the intervention was effective on a smaller scale. A bed ahead process was created to ensure patients needing PCU-

level care can be assigned a bed as quickly as possible with little ED boarding time. This process served to guide PFMs, nurses in the PCU and ED, and administration to ensure a step-by-step approach for moving patients from the ED to the PCU was effective.

Once the team designed and piloted the practice change, they reached a third decision point to determine if the change is appropriate for adoption. This decision ensures efficiency of time since the intervention was implemented as a pilot. Once it is determined the pilot was successful, the intervention can be implemented on a larger scale. The outcome of this project will determine if it should be adopted for use in practice at the project facility. Scholarly evaluation of the pilot test data will help guide the team's decision to determine if a wider implementation is warranted (Iowa Model Collaborative et al., 2017).

The sixth step in the Iowa model is integrating and sustaining the practice change. Identifying and engaging key personnel is vital to the success of a project (Iowa Model Collaborative et al., 2017). Identifying champions, frontline staff, and Nurse Managers from the ED and PCU departments, including PFMs, is critical in sustaining the change process. Ensuring and monitoring that the bed ahead process is being followed is critical to the project’s success.

The seventh step in the Iowa Model is the dissemination of the results. Disseminating the results marks the successful completion of the project. Dissemination of results can help increase awareness and provide a roadmap for others to replicate the work as deemed appropriate. Findings from this project will be disseminated locally within the hospital to the leadership team and various nursing councils. The results will also be disseminated via poster presentations at regional and national scientific meetings.

In conclusion, the Iowa Model provided the framework for the evidence-based practice of a bed ahead process. A process was created, piloted, implemented, and disseminated in the

facility. Ultimately, implementing an EBP change promotes the delivery of safe, effective, and high-quality care.

Literature Review

A literature review was conducted using CINAHL and PubMed search engines. The following key terms were used to search for relevant publications: emergency department (emergency room or emergency services), patient flow (patient throughput or waiting times or wait time or crowding or overcrowding), bed ahead, pull model, and bed assignment. The literature searched was limited to peer-reviewed articles, published in the English language, between 2016 to 2022. The search yielded 163 articles. The articles were then examined for duplicates and relevance to the project, leaving 19 articles for the literature review. The search also included grey literature, including white papers from the Institute for Healthcare Improvement (IHI) on "Optimizing Patient Flow," books on improving patient flow, "The Patient Flow Advantage," and "Leadership for Smooth Patient Flow."

After reviewing the selected articles, the following themes were identified: negative impact of ED delays on patient outcomes, collaboration, and effective communication to improve patient flow, and changes in standard practice could improve patient flow. Implementing a bed ahead process will improve patient throughput in the ED and optimize patient flow.

Patient Flow

Patient flow refers to the movement of patients throughout the hospital based on their need for nursing care. Patient flow is the hospital's ability to anticipate and move patients efficiently through their continuum of care (Jensen et al., 2007). Optimum patient flow decreases hospital congestion and decreases delays in treatment and overcrowding (Boiko et al., 2021). Poor patient flow can lead to poor quality of care, which can increase costs (Boiko et al., 2021).

Hospitals with effective patient throughput improve their capacity to provide safe and effective care for their patients. Patient throughput is a process of moving patients efficiently throughout the hospital from an outpatient status to an inpatient bed (DeAnda, 2018). Effective patient throughput also ensures that patients receive the right level of care. Understanding hospital patient flow is more than just improving patient throughput in the ED. It also requires looking at the whole system of care (Rutherford et al., 2020). Ensuring patients are in the appropriate bed based on the level of nursing care needed is the goal hospitals seek to achieve to improve patient flow. Implementing a bed ahead process to improve utilization in a PCU will improve patient throughput and optimize patient flow.

Changes in Standard Practice to Improve Flow

The process of managing bed flow is complex. Studies identified using the Lean methodology in the ED to improve patient flow, address overcrowding, and reduce LOS (Elamir, 2018). The Lean methodology introduces a pull system to move patients from the ED to the PCU. The Lean methodology is derived from the Toyota Production System, which took inspiration from the work of W. Edwards Deming and Henry Ford's moving assembly line (Elamir, 2018). The principles of Lean involve minimizing delays, increasing worker empowerment, ongoing improvement, and eliminating waste (Elamir, 2018). For this project, utilizing the pull system would be to anticipate the need for a bed and implement a process to create a bed**.**

The use of the pull method to move patients along their continuum of care has been found to decrease LOS for patients waiting in the ED (Artenstein et al., 2017; Melton et al., 2016). In the pull method of service, inpatient units should anticipate an admission (demand) of an incoming patient and have an available bed for boarding the anticipated new admission. This

should be done before receiving notice of their next admission (Melton et al., 2016). Expediting the transfer of patients from the ED to other units in the hospital can contribute to delivering optimal patient care. Actively pulling patient admissions from the ED improves the balance between demand and capacity in patient flow (Artenstein et al., 2017). Facilitating the continuous movement of patients out of the ED was found to improve patient satisfaction and decrease patient LOS (DeAnda, 2018; Melton et al., 2016).

Bed Ahead Process

Implementing a bed ahead process that utilizes the pull method reduces the LOS for patients waiting in the ED and thus reduces overcrowding (Artenstein et al., 2017; DiGiacomo et al., 2020; Melton et al., 2016). DiGiacomo et al. (2020) describe a project where they implemented a bed ahead process to pre-assign trauma patients to the surgical intensive care unit (SICU). In this pre-post design, they analyzed the ICU LOS before and after implementation of a bed ahead process. They found statistically significant differences in the mean LOS for both ED and ICU. Melton et al. (2016) described a quality improvement project implementing the bed ahead process where the leadership team on the floor actively engaged in looking for the next available patient bed, before receiving a call from the ED that they were receiving a patient admission. The bed ahead processes improved hospital flow for the hospital; it also allowed leadership on the units to play an active role in the utilization of their beds.

The bed ahead process minimizes room assignment changes after beds are assigned by the patient flow coordinator (Melton et al., 2016). Patients moved from beds that they were initially placed in creates delays in treatment and inefficiencies; therefore, it is important that patients are in the correct bed on the correct unit to begin with. This promotes efficiency, while reducing overcrowding in the ED. Thus, the time spent onboarding a patient is minimized in the

ED using the bed ahead process. Removing the barriers to finding the next available bed from the decision-making process, for example a trauma patient that needs that next available bed in the ICU, will ensure that patients are appropriately placed in their continuum of care (DiGiacomo et al., 2020).

Stankiewicz et al. (2019) implemented a protocol to reduce the time to transfer patients from the ED to the SICU. In this pre- and post-design, they analyzed the transfer times before and after implementation of the protocol. They found a statistically significant difference in the mean LOS for ED patients requiring SICU beds. The protocol also showed that a collaborative effort between a multidisciplinary team of nurses and doctors could expedite the transfer of ED patients into the SICU.

Collins (2021) implemented a bed ahead process utilizing the pull method to minimize admission delay times and expedite the movement of medical-surgical patients from the ED. Instead of relying on the ED nurses to call for report for their patients, the accepting nurse calls the ED for report; and then arranges for transportation to fill the available bed. The process showed a reduction in the mean admission delay from 184 minutes to 112 minutes. The bed ahead process showed that by expediting the movement of patients from the ED to the appropriate units, there was a decrease in admission delays for patients. The decrease in admission delay also decreased negative patient outcomes (Collins, 2021). The bed ahead process will decrease the congestion in the ED, and it will also allow for increased capacity for patients entering the ED for emergency care.

Optimizing ED throughput ensures that patients in the ED receive continuity of care without delays. This then decreases the time patients spend waiting in the lobby and allows them

to receive treatment in the ED (Stankiewicz et al., 2019). The bed ahead process will improve admitted patient disposition from the ED and improve patient throughput (Melton et al., 2016).

The Negative Impact of ED Delays on Patient Outcomes

Inefficient patient flow can impact patient safety. If patients cannot be moved to their inpatient bed, they will need to remain in the ED until a bed is available, leading to ED overcrowding. When the ED is overcrowded, the quality of patient care is impacted and patient safety decreases (Jensen & Mayer, 2015). Research showed that ED overcrowding contributes to several negative adverse outcomes for patients (Boiko et al., 2021; Chartier et al., 2016; DiGiacomo et al., 2020; Khanna et al., 2017; Rasouli et al., 2019) including increased mortality rate (Boiko et al., 2021; Khanna et al., 2017; Leung et al., 2017; McBeth et al., 2017; Rasouli et al., 2019; Stankiewicz et al., 2019). Patient boarding in the ED was associated with a mortality rate of 2.5% for those waiting for less than 2 hours and increased to 4.5% for those waiting for 12 hours (Haq et al., 2018). Additionally, when the ED is overcrowded, patients are more likely to leave the ED without being seen by a healthcare provider, which results in a delay in service that compromises patient care (Artenstein et al., 2017; Haq et al., 2018; Rasouli et al., 2019; Stankiewicz et al., 2019). Patient satisfaction is also impacted by ED overcrowding which makes it necessary to address since these ratings have financial implications for hospitals (Boiko et al., 2021; Melton et al., 2016; Rasouli et al., 2019). According to Claret et al. (2016), when patients in the ED are admitted to a unit within a reasonable length of time (less than 2 hours), the hospital would have a cost savings of 4 million dollars per year. The same is true when patients leave without being seen, and the hospital forfeits potential revenues it could have had from those patients (Jensen & Mayer, 2015).

Taken together, evidence suggests that improving patient flow and patient throughput in the ED ultimately decreases the amount of time patients stay in the ED. Reducing overcrowding and decreasing wait times in the ED could significantly impact the care provided to patients resulting in a reduction in mortality rate and improved patient satisfaction.

Collaboration and Effective Communication Improve Patient Flow

Effective communication and collaboration among departments could improve the efficiency of patient flow (Gualandi et al., 2020; McBeth et al., 2017; Stankiewicz et al., 2019). Interprofessional relationships are vital in breaking down barriers relevant to performance-driven coordination and collaboration, this is especially true when it comes to patient flow management in the ED (Boiko et al., 2021; Khanna et al., 2017). Solutions for addressing ED overcrowding can emerge from various perspectives. Key stakeholders can provide valuable insights that may not be accounted for or discussed when there is no collaboration. The insight provided through collaboration could improve policies for better hospital bed management and result in delivering high-quality care for patients (Claret et al., 2016; Gualandi et al., 2020).

According to Boiko et al. (2021), patient flow is more than just simply dependent on the flow coordination through the ED but is dependent on the engagement of various key professionals. Boiko et al. (2021) describes a qualitative research project utilizing semi-structured interviews with ED staff, who were involved in patient care. The research determined that interactions among hospital staff play a critical role in performance-driven coordination and collaboration in improving hospital patient flow. Hospitals are interconnected and improvements in one department could affect outcomes for other departments (Rutherford et al., 2020). Engaging key departments such as the environmental services, and educating staff on the impact they have on patient flow can help to move patients along their continuum of care. Delays in how

we communicate and obtain laboratory results could potentially delay a patient from getting admitted to the hospital.

In conclusion, after a thorough review of the literature, the research indicated that creating a bed ahead process, utilizing the pull method along with working collaboratively with an interdisciplinary team while using effective communication will decrease ED boarding and overcrowding.

Methods

The purpose of this project was to make changes in the current process of bed assignments by developing and implementing an evidence-based bed ahead process. The process changed how the patient flow team worked together to place patients into beds from the ED to the PCU. The project utilized a quantitative pretest-posttest design that evaluated the effect of the change on ED LOS, ED boarding time, and LOS in the PCU. Prior to implementation of the practice change, education, and training of the PFMs on the bed ahead process was implemented.

Setting

This project was conducted at a large urban public tertiary hospital located in Los Angeles, California. The project hospital has one of the busiest EDs in the United States. The hospital receives approximately 170,000 ED patient visits per year and treats approximately 40% of trauma cases in the United States (Coffey et al., 2018). The hospital was part of a healthcare system that has four hospitals and 19 healthcare centers. The hospital offered acute inpatient, outpatient, emergency, urgent care, mental health, specialty care, and physical and occupational therapy. The hospital was a level one trauma center and has 600-beds that serve not only the residents of the county of Los Angeles, but also other neighboring counties. The hospital has a total of 30 PCU beds divided into three PCU locations, which include 4M (nine beds), 5F (nine beds), and 8B (12 beds). The project stakeholders included PCU nurses, ED nurses, medical providers, PFMs, and leadership from the hospital.

Sample

The sample for this project included all adult (age 18-99+) patients with admission orders to the PCU from the ED from one year prior to the implementation to three months post-implementation of this process. During this project, there was an average of 14 PCU patients per

week admitted to the PCU from the ED. The bed ahead process was implemented by the PFMs after they received education and training on the bed ahead process.

Ethical Considerations

The project was submitted to the Institutional Review Board (IRB) for approval from the California State University, Fullerton (CSUF). During this project, participants were not required to identify themselves, as data was gathered in TeleTracking® (2023). TeleTracking® (2023) is a data software solution that the hospital uses to make data-informed decisions that optimized patient flow. The approval to conduct the project was obtained from the project facility. The letter of approval could be found in Appendix C.

SWOT Analysis

As background to support a bed ahead process, the project lead conducted a strength, weakness, opportunities, and threats (SWOT) analysis to identify challenges to optimize patient flow (Appendix D). Support of the executive leadership team was identified as a strength. Executive leadership believed the project was patient-focused and was supported by evidence from research. The executive leadership deemed the project critical in optimizing patient flow.

A potential weakness was identified as the reluctance of some PFM team members to participate in the new change process. This was a problem since the PFMs are critical members of the change process, and without them the project cannot be implemented. As a result, a lead PFM was created by facility leadership to assist in creating an environment for change. The lead PFM (also this project's lead) engaged in re-iterating the need for the practice change through one-to-one conversations, emails, and group discussions. After engaging in the ongoing discussions, all the PFMs were on board to work with improving patient throughput.

The opportunities for this practice change include the creation of a new lead PFM and new nursing leadership in the PFM office. Additional opportunities included the implementation and use of the current software system, TeleTracking® (2023) which provided real-time data on bed supply and demand. TeleTracking® (2023) is a data software solution that the hospital uses to make data-informed decisions to optimize patient flow. This software created the opportunity for hospital patient flow to be data-informed and data-driven.

A lack of data analysis skills of the PFM team was a threat to the project. Many team members performed these duties for many years and felt they had an intuitive sense of patient flow. However, in order to be evidence-based, the patient flow process, including bed ahead, needs to be data-driven and data-informed. The project lead ensured that the PFM team relied on data to guide their decisions moving forward. Improving the data analytical skills of the team would allow this process to be standardized and reproducible.

Overall, the strengths outweighed the weaknesses. The need to reduce the mortality rate and improve patient satisfaction of ED boarders was more than sufficient to implement a bed-ahead process to improve hospital patient flow. The bed ahead process would help to increase the efficiency of the ED throughput process. Patients would be able to receive the care they need by being properly placed into their beds in the PCU.

Implementation of the Evidence-Based Project

A bed ahead process guideline was established to guide the PFM team workflow in ensuring that patients in the ED needing PCU level care would be assigned a bed with little ED boarding time. This guideline was submitted for approval by the Inpatient Medical Leadership Committee and by the ICU Committee. The guideline was formally adopted prior to implementation. By implementing a bed ahead process, the team hypothesized that there would

be a reduction in the bed request to bed occupy time and a reduction in the ED boarding time. Furthermore, the team hypothesized that PCU LOS would decrease because a bed would be continuously available.

Data Collection

After IRB approval was obtained from CSUF, baseline data from September 30, 2021 to September 30, 2022, for all patients who presented to the ED and were admitted to PCU was obtained. TeleTracking® (2023) software was used to gather baseline data to monitor for trends, and seasonal variations as the bed ahead process was implemented. Data retrieved from TeleTracking® (2023) included patient-level data regarding origin unit, occupied unit, assigned location, ED bed request to bed assigned time, and ED bed request to bed occupied time. Additionally, data was collected for the date, time of bed request, and time the bed was occupied. No protected health information (PHI) was obtained (e.g., Patient name, medical record number, date of birth, diagnosis). The data was provided to the project leader in this de-identified manner by the TeleTracking® (2023) information technologist as an excel spreadsheet. The data was kept confidential and stored on the project leaders' password-protected computer.

Data Management and Analysis

To assess the impact of the "bed-ahead" process, and to identify any seasonal variations, 12 months of baseline data from TeleTracking® (2023) was obtained. This data included a weekly aggregate of all patients admitted to the PCU from the ED as follows:

1. The time interval of bed request to bed occupy in minutes subgrouped by week starting September 30, 2021. This data showed the impact of the bed ahead process. The bed request time was the time the physician wrote the order for admission. The bed occupy time was the time the patient arrived in the unit and occupied the bed.

2. The time interval of ED boarding was defined as the time the physician places an order to admit to the time the patient got admitted to the hospital in minutes subgrouped by week starting September 30, 2021.
3. The PCU LOS, defined as the number of midnights a patient occupies a PCU bed in days, subgrouped by week starting September 30, 2021.
4. Daily check of PCU bed availability. Every day at noon, the patient flow lead looked at TeleTracking® (2023) and identified whether a bed was available in PCU. This data was recorded on a spreadsheet as yes or no. The data was compiled into a P chart using QI Macros® (2021).

The baseline data was converted to control charts using QI Macros® (2021). The aggregate number of minutes per week were the data points. An XMR (Individuals) chart was used to display and analyze the data. An XMR chart was the appropriate chart to use for this data set because the variables were continuous and aggregated by week. This chart showed any changes in the data collected and showed a picture of changes in the data over time.

Twelve months of data subgrouped by week was obtained as a baseline. This allowed for sufficient data points to be gathered so accurate data analysis could occur. Control charts were used to analyze this data. Post-implementation, the data continued to be collected and data analysis included reviewing the data for common cause or special cause variations. Common cause variation was defined as the natural or expected variation in a process that affected the system's process and outcomes. Special cause variation was unexpected variation that resulted from unusual occurrences that were not part of the system.

The mean bed request to bed occupy time was 251.9 minutes pre-implementation. There would be an expected reduction in bed requests to bed occupy and ED boarding time because of

the establishment of a perpetually available bed for the next ED patient as the project progresses and as the bed ahead process was implemented. There would be an expected reduction in PCU LOS because of the already established bed ahead process that would have alerted the PFMs to constantly review if patients in the PCU still required PCU level of care.

Project Timeline

April 2022: Obtain letter of approval from site

May 2022: Defense proposal

June 2022 – August 2022: IRB approval

August 2022: Baseline data/Develop Bed Ahead process for PFMs

September 2022: Implement Bed Ahead process

September 2022 – December 2022: Data analysis, data collection, results, and discussion

Evaluation Plan

After approval of the process and implementation of this project, the project lead assessed and determined if the PFMs were following the established bed ahead process. The project lead continued to collect data and shared metrics weekly on the implementation and results of the project and reinforced the bed ahead process to the PFMs by consistently being available either by phone, email, or in person for questions, clarifications, and any concerns they may have had about the process during the day and at night. The project lead reviewed daily data (P chart) from TeleTracking® (2023) to ensure that the PFMs were keeping a PCU bed open and to identify any potential challenges that may need to be addressed. After obtaining baseline data from TeleTracking® (2023) to assess the impact of the bed-ahead process and to identify any seasonal variations, post-implementation data was analyzed from September 2022 to December 2022 to determine whether the bed ahead process showed a reduction in the bed request to bed occupy

time, ED boarding time, and PCU LOS. Data analysis included reviewing the control chart data for common cause or special cause variations. The health care rules were used to identify special cause variation (Provost & Murray, 2011). Utilizing the control chart rules, the project lead was able to determine if any changes were statistically significant. After a few months of implementation, the project lead evaluated the feasibility of the project, along with garnering feedback and suggestions from key stakeholders on their thoughts on how to better improve the bed ahead process. Once the process has demonstrated sustained success, the bed ahead process would become part of the new hire orientation process for all incoming PFMs and a standardized tool that new and seasoned PFMs could follow.

Results

The purpose of this project was to implement a bed-ahead process that ensured patients needing PCU-level care were expeditiously assigned a bed with minimal ED boarding time. Data was gathered using TeleTracking® (2023). TeleTracking® (2023) is the bed management software program used to optimize patient throughput and flow at the project hospital. The TeleTracking® (2023) information technologist provided the project lead with de-identified data on an excel spreadsheet. The de-identified data included the patient's origin unit and the assigned unit. The de-identified data was then filtered by the patient flow lead for patients who were admitted to the three PCU locations in the hospital. The locations included 4M, 5F, and 8B. The project specifically examined patients who were admitted from the ED and excluded all other patients admitted from other areas.

Pre-Implementation Data Results

Baseline data was gathered from September 30, 2021 to September 25, 2022 to assess for seasonal variations in the following project variables: bed request to bed occupy time and PCU LOS. There was a total of 2,074 patients admitted to the PCUs from the ED. There were 626 patients admitted to the 4M PCU location; this accounted for 30% of all admissions. The 5F PCU admitted 625 patients (30%) and 8B PCU admitted 646 patients, which accounted for 40% of all admissions (Appendix E). There were more admissions from 8B because this unit has three more patient beds than 4M and 5F.

To gain a better understanding of the current process, control charts were constructed using QI Macros® (2021) Data were collected on each admission and subgrouped by week. The subgroup size varied from 21 to 59 admissions per week with a mean of 40 patient admissions. An XbarS chart was used to display several types of data points, which included the bed request

to the bed assigned, the assigned ED bed to the bed occupy, the request for an ED bed to bed occupied, and PCU LOS. An XbarS control chart was used for this data set because the variables are continuous and the subgroup sizes were greater than one. The XbarS calculates the mean and standard deviation for the data within each subgroup (Provost & Murray, 2011). Furthermore, the large subgroup sizes gathered for this data would allow for detecting of special cause variations (Provost & Murray, 2011). Separate control charts were created for each variable in each PCU location. (Appendix F). Results for each unit are described below as well as the aggregate data.

Bed Request to Bed Occupy Time Aggregate

The PCU aggregate for ED bed request to bed occupy time from September 30, 2021 to January 27, 2022 showed a mean average of 537 minutes with an upper control limit (UCL) of 762 and a lower control limit (LCL) of 312 (Appendix G). The data shows a special cause variation, with data points above the upper control limits that occurred during the weeks of January 6 to January 20, 2022. These special cause variations were likely the result of a multitude of challenges ranging from a national staffing crisis due to the coronavirus disease (COVID-19) pandemic and bed unavailability due to hospital census. Anecdotally, the PFM noted that during this staffing crisis many nursing, healthcare providers, and ancillary services called off, which resulted in an insurmountable number of beds closed and created a decrease in the healthcare workforce attending to patients. As a response to the COVID-19 pandemic, there was a push to improve capacity-demand, increase hospital throughput, and reshape hospital demand to improve patient flow. On January 27, 2022, prior to implementation of this project, the data suggested a process change had occurred with > 8 points below the center line using health care rules (Provost & Murray, 2011). Investigation revealed more frequent rounding occurred in the PCU by the Critical Care Medical Director in an effort to improve throughput.

There were also more daily safety PCU huddles to improve patient flow. As a result of this change in process, new control limits were established resulting in a mean of 297 minutes with an UCL of 395 and an LCL of 197. There were additional special cause variations which resulted in three points above the upper control limit on June 9, June 30, and July 21 of 2022. These variations may have been due to lack of staff, closed beds and/or the COVID-19 pandemic. Because these special causes did not persist, the means, UCL and LCL were not adjusted. The goal in collecting data from September 2021 to September 2022 was to identify any seasonal variations in bed request to bed occupy time. No seasonal variations were identified. The process change and the establishment of new control limits in January established the baseline data for this project's implementation.

PCU LOS Aggregate

The PCU aggregate LOS from September 30, 2021, to January 27, 2022, showed a mean average of 2.6 days with an UCL of 3.4 and a LCU of 1.7. The data showed a special cause variation, which resulted in one point above the upper control limit on December 2, 2021, likely due to the same challenges presented in the bed request to bed occupy data (Appendix H). As described previously, the data demonstrated a persistent special cause variation with >8 points below the centerline, so the control limits were adjusted to a mean of 2.5 days with an UCL of 3.6 and a LCL of 1.2. These results became the project's baseline performance. Data were analyzed for each PCU location to determine if there were any variations between the PCU units. The results are reported below.

4M Bed Request to Bed Occupy Time

The average number of minutes from the request for a bed to the time the bed was occupied in 4M PCU showed a mean average of 292 minutes with an UCL of 481 and a LCL of

102 (Appendix I). Prior to the process changed that occurred on January 27, 2022, the mean average was 559 minutes with an UCL of 939 and a LCL of 150. The data showed a special cause variation, which resulted in one point above the upper control limit that occurred on July 21, 2022 due to the same challenges presented in the PCU aggregate data.

4M PCU LOS

The mean average for 4M PCU LOS was 2.4 days with an UCL of 4.5 and a LCL of 0.3. Prior to the process changed that occurred on January 27, 2022, the mean average was 2.7 with an UCL of 5 and a LCL of 0.4 (Appendix J). No special cause variation was noted, which suggests that the expected variation was in control.

5F Bed Request to Bed Occupy Time

The average number of minutes from the request for a bed to the time the bed was occupied in 5F PCU showed a mean average of 304 minutes with an UCL of 485 and a LCL of 122. (Appendix K). Prior to the process changed that occurred on January 27, 2022, the mean average was 533 minutes with an UCL of 870 and a LCL of 171. The data showed a special cause variation, which resulted in two points above the upper control limit that occurred on June 30, 2022, and September 8, 2022 due to the same challenges presented in the PCU aggregate data.

5F PCU LOS

The mean average for 5F PCU LOS was 2.5 days with an UCL of 4.6 and a LCL of 0.4. (Appendix L). Prior to the process changed that occurred on January 27, 2022, the mean average was 2.6 days with an UCL of 3.9 and a LCL of 1.4. The data showed a special cause variation, which resulted in one point above the upper control limit that occurred on July 21, 2022 due to the same challenges presented in the PCU aggregate data.

8B Bed Request to Bed Occupy Time

The average number of minutes from the request for a bed to the time it was occupied for 8B PCU showed a mean average of 295 minutes with an UCL of 442 and a LCL of 147 (Appendix M). Prior to the process changed that occurred on January 27, 2022, the mean average was 522 minutes with an UCL of 860 and a LCL of 157. The data showed a special cause variation, which resulted in two points above the upper control limit that occurred on June 30, 2022 and July 21, 2022 due to the same challenges presented in the PCU aggregate data.

8B PCU LOS

The mean average for 8B PCU LOS was 2.5 days with an UCL of 4.1 and a LCL of 0.8. (Appendix N). Prior to the process changed that occurred on January 27, 2022, the mean average was 2.5 days with an UCL of 2.5 and a LCL of 0.4. No special cause variation was noted, which suggests that the expected variation was in control.

Bed Ahead Process for Patient Flow Managers

The bed ahead process was to ensure patients needing PCU level care are assigned a bed as quickly as possible with little to no ED boarding time. The patient flow lead introduced the bed ahead process to the PFMs (Appendix O). The patient flow lead met with each of the PFMs and answered any questions and concerns they had about the process. The implementation of a bed ahead process was created to minimize ED boarding time. The bed-ahead process guided the PFMs through collaboration with the charge nurses in the PCU and support from the Critical Care Medical Director of the ICU to identify patients that could be downgraded, upgraded, or discharged (DUD) to improve bed utilization in the PCU; thereby, decreasing boarding time of patients needing a PCU bed in the ED.

The PFMs followed the bed ahead process where they rounded in all the PCUs twice a day at 10:15 in the morning and 22:15 at night. In their rounding, the PFMs were in direct communication with the primary care team of the patients via telephone and they were also in communication with the PCU charge nurses who informed them of patients in their unit who no longer needed PCU monitoring and could be downgraded or discharged. In addition, the PFMs kept a log of patients that the charge nurses in the PCU informed them that could be DUDed on Microsoft Teams. Data was entered into the log on Microsoft Teams by the assigned PFM on duty. The PFM on duty was responsible for entering the information on the log for his or her shift. Only the PFM identified in the bed ahead process was able to input the information in the Microsoft Teams log. This is critically important because the validity of the data collected is critical and cannot be understated. The data collected by the PFMs was constantly reviewed by the lead PFM for accuracy and completeness. This log allowed the PFMs to monitor and track phone calls they've made to the patient's medical provider and to keep track of how many patients were DUDed every shift. The log also was used as a reporting tool to hospital leadership of any patients were DUDed on a weekly basis as well as challenges, if any, the PFMs face with the patient's provider. Furthermore, the patient flow lead was able to keep track of PCU bed availability by monitoring the TeleTracking® (2023) every day at noon.

Post Implementation Data Results

The bed ahead process was implemented on September 26, 2022. During the twelve weeks of data collection, data was added to the existing XbarS chart, which included bed request to bed occupy times and PCU LOS, which were two of the three measures to assess the impact of the bed ahead process. The other measure used to determine the bed ahead process was a daily check of the PCU bed availability.

PCU Aggregate

This project was implemented on September 26, 2022. Beginning October 24, 2022, the data reflected a persistent special cause variation of >8 points above the centerline suggesting another process change had occurred. As a result of this process change, the control limits were revised to reflect a new mean of 582 minutes with an UCL of 812 and a LCL of 353 (Appendix P). The mean was greater by 285 minutes compared to the pre-implementation data. This special cause variation may have been due to RN staffing shortages in the ICU which contributed to an increase in beds closed.

PCU LOS

The mean PCU aggregate LOS remained the same (Appendix Q). No special cause variation noted, which suggests that the process was stable.

Daily Check of PCU Bed Availability

Every day at noon, the patient flow lead looked at TeleTracking® (2023) and identified whether a bed was available in the PCU. The data was recorded on a excel spread sheet as yes or no. During the twelve weeks of data collection, the patient flow lead identified 55 out of 84 days, which was 65%, with a bed or beds available in the PCU (Appendix R).

Discussion

This project established and implemented a bed ahead process that guided the PFM team in ensuring patients in the ED needing a PCU level of care were assigned a bed with little ED boarding time. This project was guided by the Iowa Model which offered a step-by-step process in implementing this EBP using a systematic approach. The Iowa Model offered a systematic way to identify the problem to sustaining and maintaining the project.

The bed ahead process was expected to reduce the bed request to bed occupy time for patients in the ED waiting for a PCU bed as well as decrease the LOS for patients staying in the PCU. The literature suggested that the bed ahead process would improve admitted patients' disposition from the ED and improve patient throughput (Melton et al., 2016). Unfortunately, that did not happen. During the period of implementation, the PFM lead noted RN staffing shortages in the facility, which contributed to an increase in beds being closed, since there were no RNs to cover those beds; and the demand for beds were consistently high especially in the ED. DiGiacomo et al. (2020), argued that implementing a bed ahead process may not be possible when the ED is at capacity and full of inpatient boarders however it could act as a preemptive triage tool in ensuring patients get a bed sooner rather than later. Furthermore, establishing a comprehensive and executively supported project can improve ED throughput and decrease overcrowding (Melton et al., 2016).

Hospitals across the country were experiencing a national shortage of nurses, leading to the closure of many hospital beds (Goudie et al., 2022). The staffing shortage was unexpected because it caught everyone by surprise since during the COVID pandemic there were more RNs to open beds. Many believed, including the PFM lead, that the COVID pandemic was behind us and that staffing would not have been an issue. Studies reported many of these RNs either retired

or moved to other hospitals to work for different organizations (Kovner, 2022). This project did not include collecting data on staffing, as that would have been beyond the scope of this project. The data suggested that the practice of MD rounding had a positive effect on reducing ED boarding time and LOS. The MD rounding process functioned as a means to reassess patients and determine whether they were in the right location for nursing care. Data on MD rounding was also not collected as part of this project.

As a result of the implementation of the bed ahead process, the PFM lead anecdotally noted a change in practice that focused on how the PFMs look for beds in the hospital and a heightened awareness in how nursing and medical leadership view bed demand and bed capacity. The data showed that 65% of the time there was a bed available in the PCU. The practice of ensuring bed availability has become the expectation from leadership. PFMs need to look for an available bed for patients boarding in the ED by identifying patients in the PCU that no longer meet the criteria to remain on the unit. Anecdotally, the PFM lead noted that leadership perceptions toward PFMs changed and there was a push to view them as conduits for decreasing ED boarding time. The PFMs were required to identify patients that could be DUDed from the PCU but also lend themselves as a resource or a liaison to the nurses working the PCU. A positive outcome of the project was the rapport that was established between the PFMs and PCU nurses. Anecdotally, the PFM lead noted that prior to the project, there was minimal communication between departments; however, the project forced communication channels which caused individual to physically speak with one another. This increase in communication may have helped to identify patients who no longer needed to be in the PCU and allowed for the PFMs to communicate this information to the medical team. Furthermore, the interprofessional relationships established between the PCU nurses and the PFMs were critical in that they

allowed for performance-driven coordination and collaboration, which was critical to the care of patients in their units. The collaboration efforts between the nurses and hospital bed management may have improved the delivery of high-quality care to patients (Claret et al., 2016; Gualandi et al., 2020). This was demonstrated by the high number of DUDed patients (Appendix T, Table 6). Needed orders from medical providers to DUD patients anecdotally occurred more readily, suggesting improvements in communication amongst the team members.

Although the bed ahead process did not reduce the LOS of patients boarding in the ED waiting for a PCU bed, it did spark a widespread discussion between hospital leadership on the importance of investing in and improving patient flow. The hospital enrolled the PFMs in an IHI virtual course "Hospital Flow Professional Development Program" in October 2022. The course helped the PFMs identify strategies to make meaningful and sustainable hospital flow changes. Furthermore, the course discussed the importance of evidence-based practices and to be data-driven and data-informed. This was critical because many of the PFMs were reluctant to change their practices and many were performing their duties based on past practices and relied on their intuitive sense of patient flow. Many PFMs now have a greater sense of the importance of being data-informed and use the data to make decisions. Data on the project was shared with the PFMs and was discussed to help answer questions. Looking at data and understanding the literature related to ED boarding times created a sense of urgency for the PFMs as they were able to understand that as patients wait time increase in the ED, patients had a greater chance of mortality. The PFMs are looking more at patient dashboards on TeleTracking® (2023) to be more data-informed. Moreover, a Patient Flow Leadership Committee was established to improve patient throughput throughout the hospital and identify ways to optimize the movement of patients through their continuum of care.

Project Strengths and Limitations

The implementation of the bed ahead process was comprehensive and well-structured, with a multidisciplinary team that involved physicians and nurses at all levels. Physician and nursing leadership supported the evidence-based project wholeheartedly and deemed it a priority and critical in moving patients into their continuum of care. The data demonstrated a bed available in the PCU 65% of the time. However, there were many limitations to this project.

Although the data showed a bed available 65% of the time, data was only collected once a day. It may have been helpful to collect data more frequently or on different times of the day. Additionally having a bed available 65% of the time means that 35% of the time there was no bed available. The lack of bed availability affected the boarding times and the PCU length of stay. Additionally, there may have been demand for more than one bed. This project did not measure bed demand.

The data also showed that MD rounding had an effect on the boarding times and PCU LOS. A limitation in this study is that MD rounding was not further analyzed to determine whether this practice would have proved sustainable and maintained consistently lower times. Another limitation for this study was the fact that this was only one facility, limiting the generalizability of the study. The bed ahead process was an evidence-based practice which should have resulted in a perpetually available bed, however, as previously mentioned, a bed was available only 65% of the time.

Although there has been a change in practice and a heightened awareness on how the PFMs look at bed demand and bed capacity, there were some concerns about the sustainability of the project. One that's more obvious is the amount of time taken away from the PFMs to assign beds for patients when they're rounding in the PCUs and following the bed ahead process. When

the PFMs round in the PCUs, they are not in their workstation looking at TeleTracking® (2023) to view their demand and capacity for their hospital. This may have contributed to increased patients waiting in the ED for a bed assignment.

The hospital provided IPAD devices for the PFMs to have so that when they were out of their workstation, they could still view the hospital's demands. However, not all PFMs utilized the IPAD. This goes back to the SWOT analysis in that the PFMs still relied on their intuitive sense to perform their duties. Furthermore, although the bed ahead process took approximately a few minutes to complete, anecdotally, it took up to 45 minutes to an hour for some PFMs to complete due to pre-existing mobility issues. The bed ahead process may need to be adapted to ensure that PFMs are still rounding in the PCUs and communicating with the medical teams, but at the same token, have the option to call the PCU units when they are not able to round because of increasing demands of patients that need bed assignments.

Finally, a confounder in this project was staffing shortages. As alluded to earlier, hospitals across the country were experiencing a national shortage of nurses, leading to the closure of many hospital beds (Goudie et al., 2022). The staffing shortages during this study resulted in bed closures. A closed bed is not an available bed. From early October to late December of 2022, an average of 35-45 (35% - 45%) ICU beds were closed. This lack of ICU beds may have contributed to a lack of PCU beds.

Recommendations

After completing the project several recommendations can be made. Further analysis of the MD rounding process should be done to determine whether that process should supplement what the PFMs are doing. A review of bed availability should be done to determine whether a “bed ahead” at 10AM and 10PM should continue or whether the times should be adjusted based

on bed demand. Staff also attended the IHI patient flow course. That course recommended that patient flow is not solely the responsibility of the PFMs but a system problem in that the responsibility of moving patients into their continuum of care should be addressed as a whole. The course recommended the use of a system mapping to explore current flow issues to optimize operational capacity. The course was concurrent with this project and that the course should be reviewed, and recommendations should be identified. Finally, the patient flow leadership team should review these findings and this data should be available continuously so trends and special causes can be identified early and addressed.

Conclusion

Bed assignment is a challenging and complex process. The bed ahead process was intended to minimize the ED boarding time of patients needing a PCU bed. Implementing the bed ahead process did not reduce ED bed requests to bed occupy time as intended (Appendix S). The data suggested that frequent MD rounding in the PCUs significantly impacted the reduction of ED bed requests to bed occupy time rather than the implementation of the bed ahead process. The data was shared with the hospital leadership in the Patient Flow Leadership Committee meeting to discuss and find a solution for establishing a consistent rounding process. The bed ahead process has received positive feedback from hospital leadership and the nurses in the PCU in that it has allowed for meaningful collaboration and trust between the PFMs and the nurses on the unit. There was a sense of urgency in having PCU bed availability in that the PFMs ensured that patients in the PCU were appropriately placed in the PCU because they needed to be there. Data will continue to be shared in the Patient Flow Leadership Committee to find ways to optimize hospital flow. The bed ahead process will become part of the new hire orientation process for all incoming PFMs and seasoned PFMs at the project hospital.

References

Artenstein, A. W., Rathlev, N. K., Neal, D., Townsend, V., Vemula, M., Goldlust, S., Schmidt, J., & Visintainer, P. (2017). Decreasing emergency department walkout rate and boarding hours by improving inpatient length of stay. *Western Journal of Emergency Medicine*, *18*(6), 982–992. https://doi.org/10.5811/westjem.2017.7.34663

Boiko, O., Edwards, M., Zschaler, S., Miles, S., & Rafferty, A. M. (2021). Interprofessional barriers in patient flow management: An interview study of the views of emergency department staff involved in patient admissions. *Journal of Interprofessional Care*, *35*(3), 334–342. https://doi.org/10.1080/13561820.2020.1760223

Bornemann-Shepherd, M., Le-Lazar, J., Makic, M. B. F., DeVine, D., McDevitt, K., & Paul, M. (2015). Caring for inpatient boarders in the emergency department: Improving safety and patient and staff satisfaction. *Journal of Emergency Nursing*, *41*(1), 23–29. https://doi.org/10.1016/j.jen.2014.04.012

Centers for Medicare and Medicaid Services. (2021, August 6). *Hospital readmissions reduction program.* https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program

Chan, C. W., Green, L. V., Lekwijit, S., Lu, L., & Escobar, G. (2019). Assessing the impact of service level when customer needs are uncertain: An empirical investigation of hospital step-down units. *Management Science*, *65*(2), 751–775. https://doi.org/10.1287/mnsc.2017.2974

Chartier, L. B., Simoes, L., Kuipers, M., & McGovern, B. (2016). Improving emergency department flow through optimized bed utilization. *BMJ Quality Improvement Reports*, *5*(1), 1–5. https://doi.org/10.1136/bmjquality.u206156.w2532

Claret, P. G., Boudemaghe, T., Bobbia, X., Stowell, A., Miard, É., Sebbane, M., Landais, P., & De La Coussaye, J.-E. (2016). Consequences for overcrowding in the emergency room of a change in bed management policy on available in-hospital beds. *Australian Health Review*, *40*(4), 466–472. https://doi.org/10.1071/AH15088

Coffey, C., Carter, V., Wei, E., Hutcheon, D., Gruen, J. P., Anonas-Ternate, A., Sandoval, R., Marquez, A., Sarff, L., & Spellberg, B. (2018). No more “Code Black”: Intervention to improve inpatient flow at a large public hospital. *American Journal of Medicine*, *131*(4), 371–376. https://doi.org/10.1016/j.amjmed.2017.10.05

Collins, J. (2021). Improving emergency department throughput: Using a pull method of patient flow. *SOAR@USA*. https://doi.org/10.46409/sr.CSAP4806

DeAnda, R. (2018). Stop the bottleneck: Improving patient throughput in the emergency department. *Journal of Emergency Nursing*, *44*(6), 582–588. https://doi.org/10.1016/j.jen.2018.05.002

DiGiacomo, J. C., Angus, L., Wallace, R., Cardozo-Stolberg, S., Gerber, N., Munnangi, S., Sookraj, K., & Skarka, K. (2020). The impact of an ICU "Bed Ahead" policy on ED length of stay and patient outcomes. *Annals of Surgery*, *271*(2), 303–310. https://doi.org/10.1097/SLA.0000000000002832

Elamir, H. (2018). Improving patient flow through applying lean concepts to emergency department. *Leadership in Health Services*, *31*(3), 293–309. https://doi.org/10.1108/LHS-02-2018-0014

Goudie, C., Markoff, B., Tressel, C., & Weidner, R. (2022, September 21). Nurse shortage could reach more than 1M be end of year. *ABC 7: Chicago*. https://abc7chicago.com/nurse-shortage-2022-nursing-jobs-job/12248442/

Gualandi, R., Masella, C., Viglione, D., & Tartaglini, D. (2020). Challenges and potential improvements in hospital patient flow: the contribution of frontline, top and middle management professionals. *Journal of Health Organization and Management, 34*(8), 829–848. https://doi.org/10.1108/JHOM-11-2019-0316

Haq, N., Stewart-Corral, R., Hamrock, E., Perin, J., & Khaliq, W. (2018). Emergency department throughput: An intervention. *Internal and Emergency Medicine, 13*(6), 923–931. https://doi.org/10.1007/s11739-018-1786-1

Huang, Q., Thind, A., Dreyer, J. F., & Zaric, G. S. (2018). The impact of delays to admission from the emergency department on inpatient outcomes. *BMC Emergency Medicine, 10*(1), 16. https://doi.org/10.1186/1471-227X-10-16

Iowa Model Collaborative, Buckwalter, K. C., Cullen, L., Hanrahan, K., Kleiber, C., McCarthy, A. M., Rakel, B., Steelman, V., Tripp-Reimer, T., Tucker, S., & Authored on behalf of the Iowa Model Collaborative (2017). Iowa Model of Evidence-Based Practice: Revisions and Validation. *Worldviews on Evidence-Based Nursing*, *14*(3), 175–182. https://doi.org/10.1111/wvn.12223

Jarvis, P. R. (2016). Improving emergency department patient flow. *Clinical and Experimental Emergency Medicine*, *3*(2), 63–68. https://doi.org/10.15441/ceem.16.127

Jensen, K., & Mayer, T. (2015). *The patient flow advantage: How hardwiring hospital-wide flow drives competitive performance*. Fire Starter Publishing.

Jensen, K., Mayer, T. A., Welch, S. J., & Haraden, C. (2007). *Leadership for smooth patient flow: Improved outcomes, improved service, and improved bottom line*. Health Administration Press.

Kaier, K., Heister, T., Wolff, J., & Wolkewitz, M. (2020). Mechanical ventilation and the daily cost of ICU care. *BMC Health Services Research 20*(267), 1-5. https://doi.org/10.1186/s12913-020-05133-5

Kovner, C. (2022). COVID-19 and the supply and demand for registered nurses. *International Nursing Review*, *69*(2), 118–120. https://doi.org/10.1111/inr.12759

Leung, A. K., Whatley, S. D., Gao, D., & Duic, M. (2017). Impact of process improvements on measures of emergency department efficiency. *Journal of the Canadian Association of Emergency Physicians, 19*(2), 96–105. https://doi.org/10.1017/cem.2016.382

Lynch, E. A., Mudge, A., Knowles, S., Kitson, A. L., Hunter, S. C., & Harvey, G. (2018). "There is nothing so practical as a good theory": A pragmatic guide for selecting theoretical approaches for implementation projects. *BMC Health Services Research*, *18*(1), 857. 1-11. https://doi.org/10.1186/s12913-018-3671-z

McBeth, C. L. (2017). Interprofessional huddle: one children's hospital's approach to improving patient flow. *Pediatric Nursing, 43*(2), 71–95.

Melton, J. D., Blind, F., Hall, A. B., Leckie, M., & Novotny, A. (2016). Impact of a hospitalwide quality improvement initiative on emergency department throughput and crowding measures. *Joint Commission Journal on Quality and Patient Safety*, 42(12), 533–542. https://doi.org/10.1016/S1553-7250(16)30104-0

Ohsfeldt, R. L., Choong, C. K., Mc Collam, P. L., Abedtash, H., Kelton, K. A., & Burge, R. (2021). Inpatient Hospital Costs for COVID-19 Patients in the United States. *Advances in Therapy*, *38*(11), 5557–5595. https://doi.org/10.1007/s12325-021-01887-4

Prin, M. & Wunsch, H. (2014). The role of stepdown beds in hospital care. *American Journal of Respiratory and Critical Care Medicine*, *190*(11), 1210–1216. https://doi.org/10.1164/rccm.201406-1117PP

Provost, L. P., & Murray, S. K. (2011). *The health care data guide. Learning from data for improvement*. Jossey-Bass.

QI Macros® (2021). *QI Macros for Excel* (Version 2021.01). https://www.qimacros.com/

Rasouli, H. R., Esfahani, A. A., Nobakht, M., Eskandari, M., Mahmoodi, S., Goodarzi, H., & Farajzadeh, M. A. (2019). Outcomes of crowding in emergency departments; A systematic review. *Archives of Academic Emergency Medicine*, *7*(1), 1–10. https://doi.org/10.22037/aaem.v7i1.332

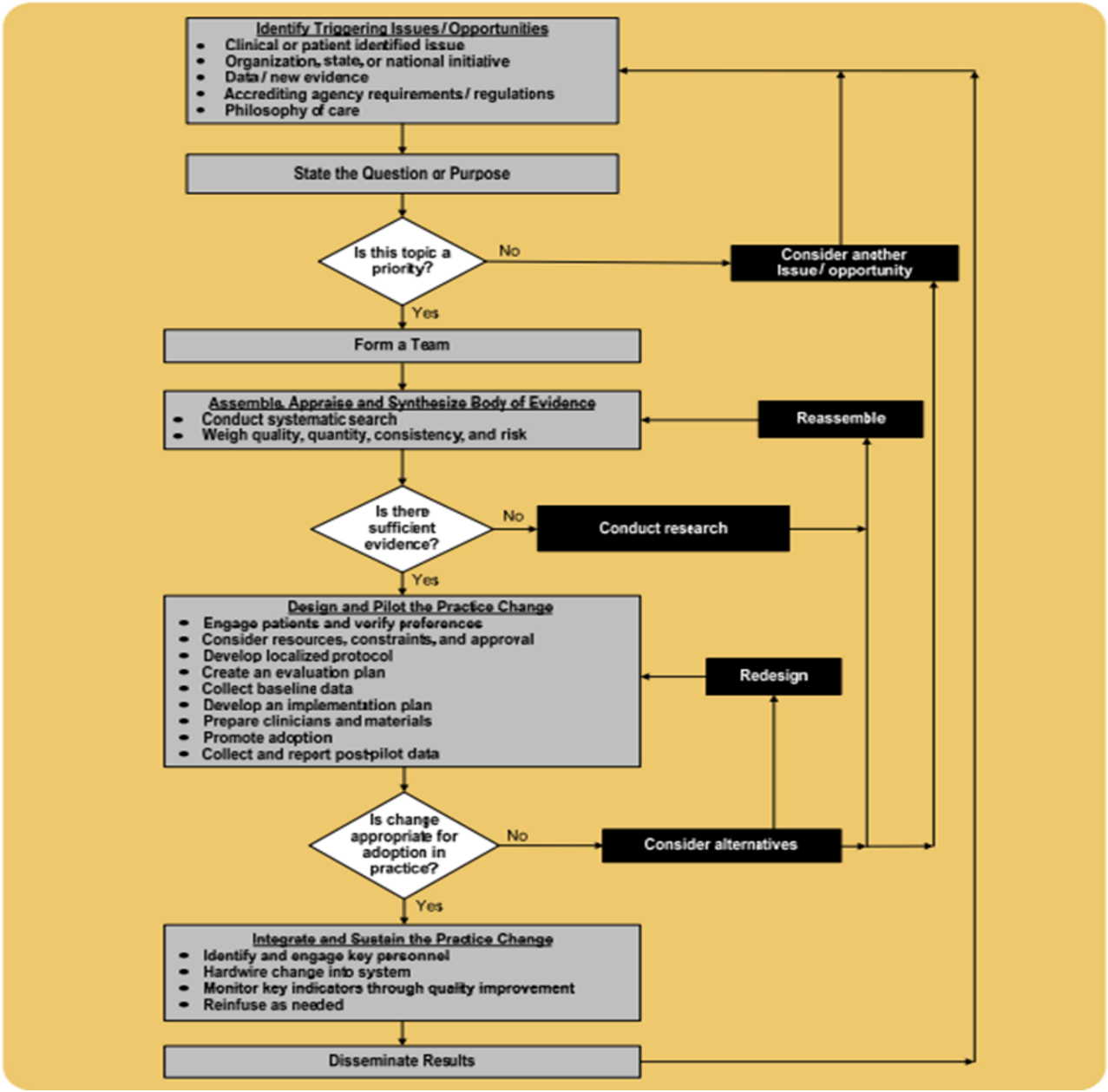
Rutherford, P.A., Anderson, A., Kotagal, U. R., Luther, K., Provost, L.P., Ryckman, F. C., Taylor, J. (2020). *Achieving hospital-wide patient flow (2nd ed)*. Institute for Healthcare Improvement White Paper. http://www.ihi.org/resources/Pages/IHIWhitePapers/Achieving-Hospital-wide-Patient-Flow.aspx

Stankiewicz, S., Larsen, C., Sullivan, F., Zullo, C., Pugh, S. C., & Kopp, M. (2019). Evaluation of a practice improvement protocol for patient transfer from the emergency department to the surgical intensive care unit after a level I trauma activation. *Journal of Emergency Nursing*, *45*(2), 144–148. https://doi.org/10.1016/j.jen.2018.10.006

TeleTracking (2023). *Throughput*. https://www.teletracking.com/solutions/patient-throughput-solutions/

Appendix A

The Iowa Model Revised, adapted from the Iowa Model (2017)



Note. Copyright 2015 by the University of Iowa Hospitals and Clinics. Permission to use model is found in Appendix B.

APPENDIX B

Permission letter to use IOWA Model Revised for project

From: Kimberly Jordan - University of Iowa Hospitals and Clinics survey-bounce@survey.uiowa.edu

Sent: Friday, February 25, 2022 9:45 PM (UTC-08:00) Pacific Time (US & Canada)
To: Luzuriaga, Dino dluzuria@gmail.com

Subject: Permission to Use the Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care

You have permission, as requested today, to review and/or reproduce *The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care.* Click the link below to open.

The Iowa Model Revised (2015)

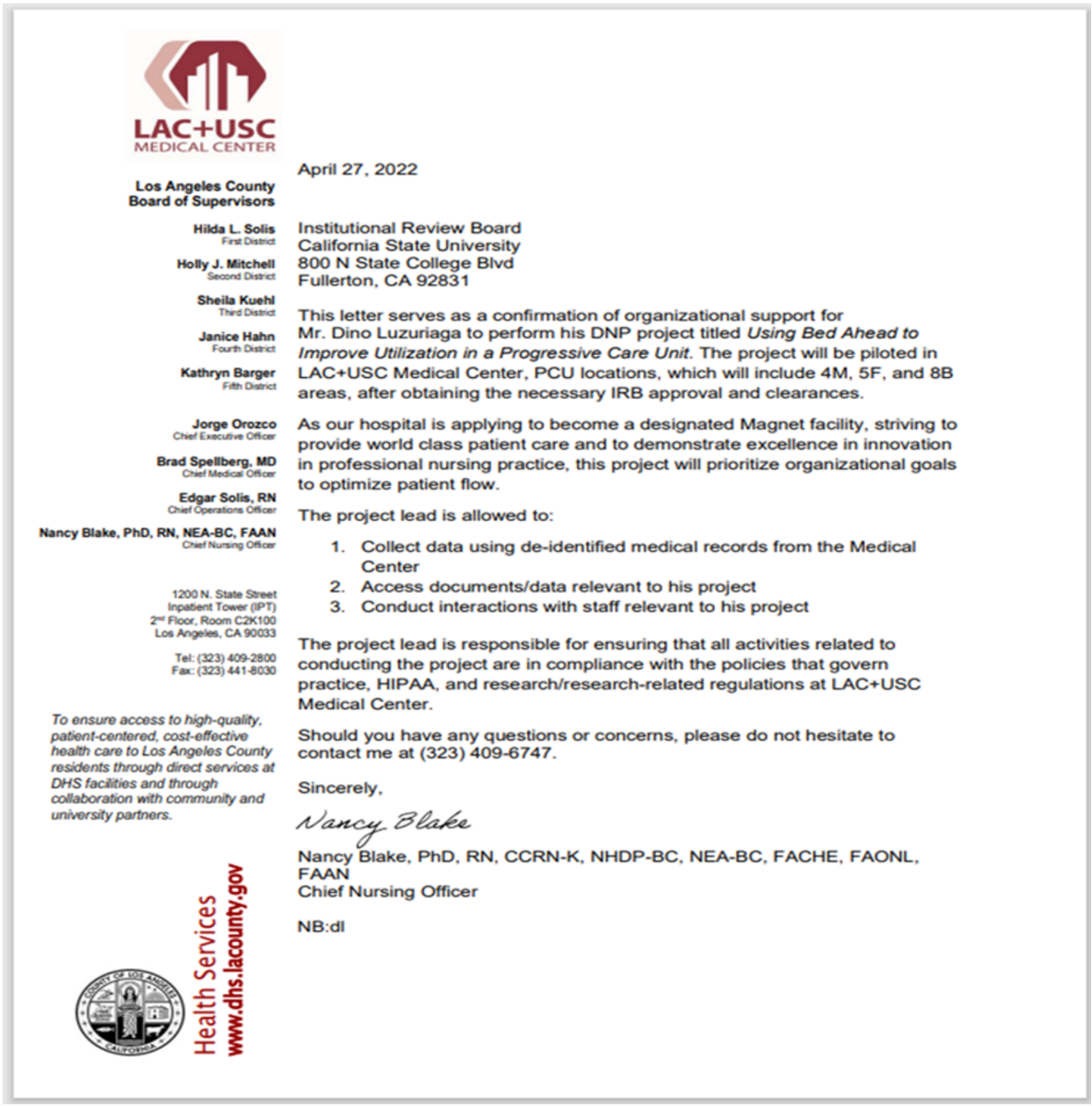
Copyright is retained by University of Iowa Hospitals and Clinics. **Permission is not granted for placing on the internet.**

Reference: Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 14(3), 175-182. doi:10.1111/wvn.12223*
In written material, please add the following statement:
Used/reprinted with permission from the University of Iowa Hospitals and Clinics, copyright 2015. For permission to use or reproduce, please contact the University of Iowa Hospitals and Clinics at 319-384-9098.

Please contact UIHCNursingResearchandEBP@uiowa.edu or 319-384-9098 with questions.

Appendix C

Letter of Approval from Facility



LAC+USC MEDICAL CENTER

1200 N. State Street
Inpatient Tower (IPT)
2nd Floor, Room C2K100
Los Angeles, CA 90033

Tel: (323) 409-2800
Fax: (323) 441-8030

To ensure access to high-quality, patient-centered, cost-effective health care to Los Angeles County residents through direct services at DHS facilities and through collaboration with community and university partners.

Health Services
www.dhs.lacounty.gov

April 27, 2022

Institutional Review Board
California State University
800 N State College Blvd
Fullerton, CA 92831

This letter serves as a confirmation of organizational support for Mr. Dino Luzuriaga to perform his DNP project titled *Using Bed Ahead to Improve Utilization in a Progressive Care Unit*. The project will be piloted in LAC+USC Medical Center, PCU locations, which will include 4M, 5F, and 8B areas, after obtaining the necessary IRB approval and clearances.

As our hospital is applying to become a designated Magnet facility, striving to provide world class patient care and to demonstrate excellence in innovation in professional nursing practice, this project will prioritize organizational goals to optimize patient flow.

The project lead is allowed to:

1. Collect data using de-identified medical records from the Medical Center
2. Access documents/data relevant to his project
3. Conduct interactions with staff relevant to his project

The project lead is responsible for ensuring that all activities related to conducting the project are in compliance with the policies that govern practice, HIPAA, and research/research-related regulations at LAC+USC Medical Center.

Should you have any questions or concerns, please do not hesitate to contact me at (323) 409-6747.

Sincerely,

Nancy Blake

Nancy Blake, PhD, RN, CCRN-K, NHDP-BC, NEA-BC, FACHE, FAONL, FAAN
Chief Nursing Officer

NB:dl

Appendix D

SWOT Analysis

	Beneficial	Harmful
Internal	Strengths Executive Leadership support	Weaknesses PFM reluctance to participate in change.
External	Opportunities 1. Creation of a lead PFM 2. New leadership in PFM 3. TeleTracking® provided real time data solutions	Threats 1. PFM not data-informed and not data-driven 2. PFM relied on their intuitive sense to perform their duties

Notes: PFM = Patient Flow Manager

Appendix E

PCU Admissions

Variable	4M	5F	8B	PCU Aggregate
Number of PCU Admissions (Percent)	626 (30%)	625 (30%)	823 (40%)	2074 (100%)

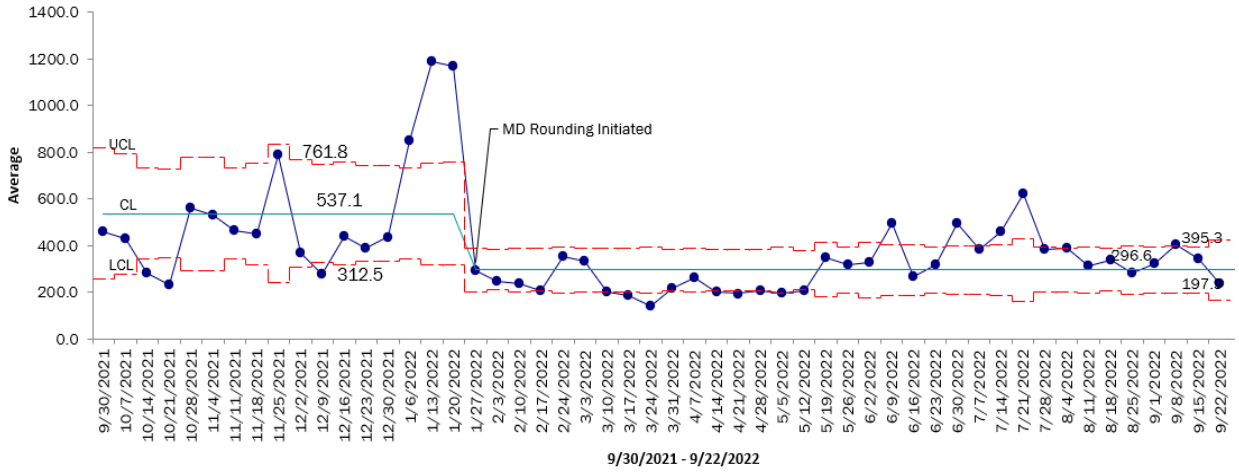
Appendix F

PCU Control Charts

Variable	4M	5F	8B	PCU Aggregate
Bed Request to Bed Occupy (UCL, LCL)	292 (481, 102)	304 (485, 122)	295 (442, 147)	297 (395, 198)
Average Admissions per week (UCL, LCL)	12 (22, 2)	12 (22, 2)	16 (28, 4)	40 (59, 21)
Average LOS	2.4	2.5	2.5	2.5

Appendix G

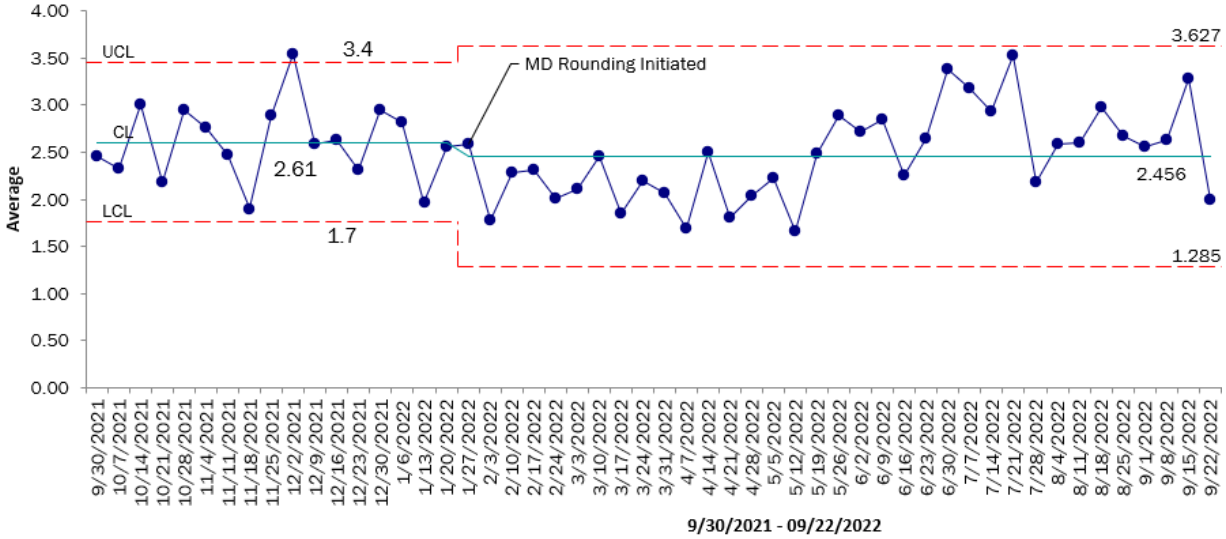
Pre-Implementation PCU ED Bed Request to Bed Occupy Aggregate



Notes: ucl = upper control limit; lcl = lower control limit

Appendix H

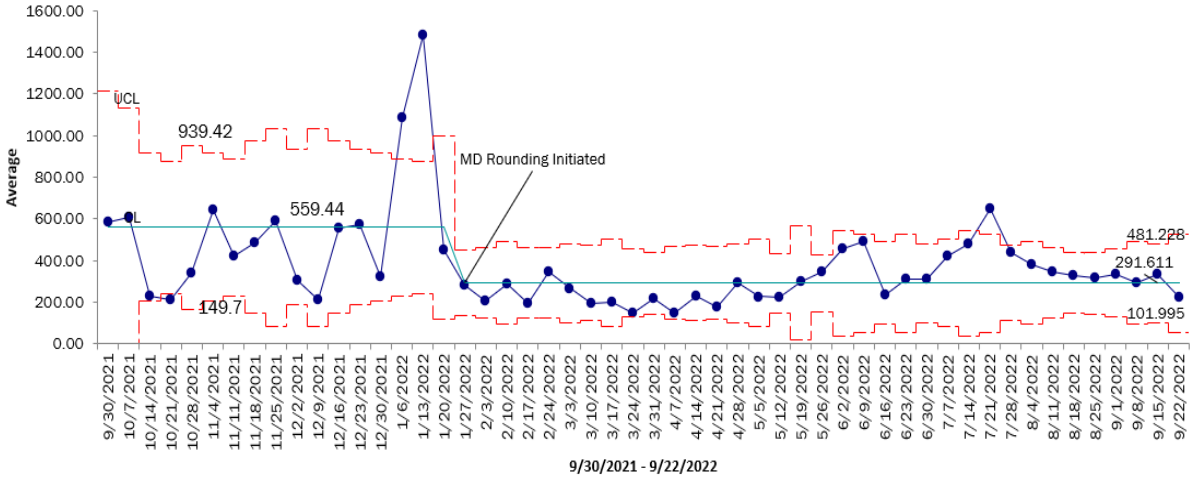
Pre-Implementation PCU LOS Aggregate



Notes: ucl = upper control limit; lcl = lower control limit

Appendix I

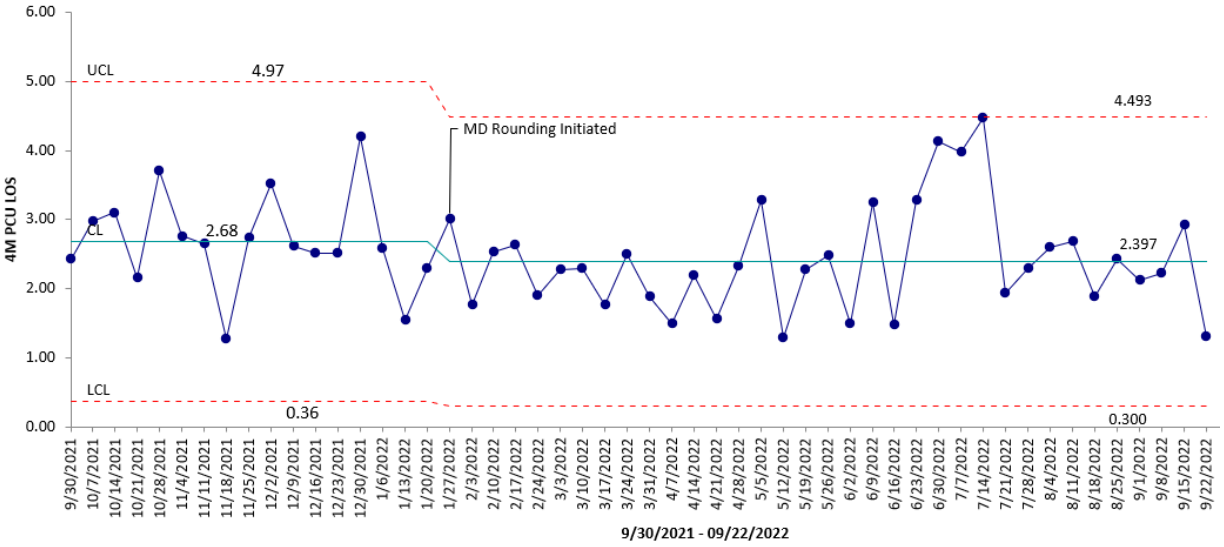
4M ED Bed Request to Bed Occupy



Notes: ucl = upper control limit; lcl = lower control limit

Appendix J

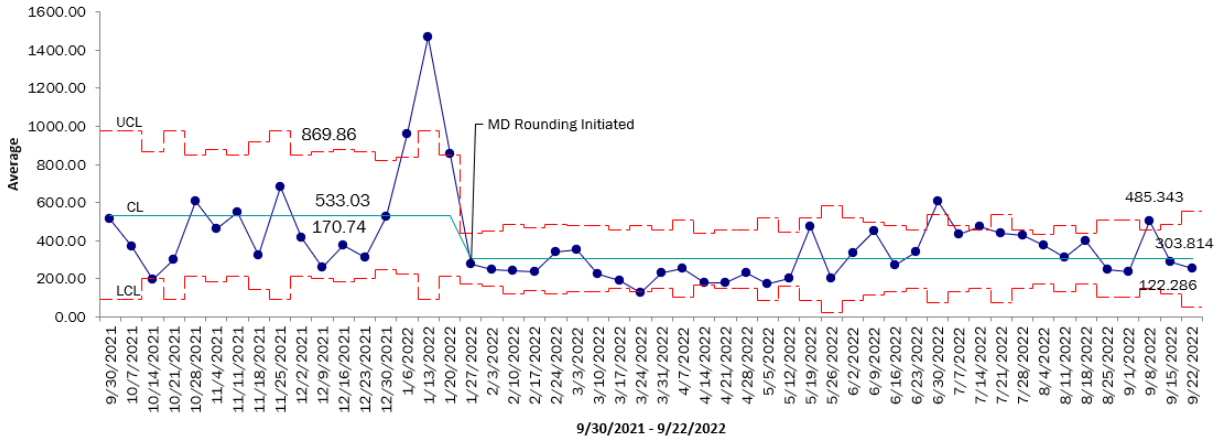
4M PCU LOS



Notes: ucl = upper control limit; lcl = lower control limit

Appendix K

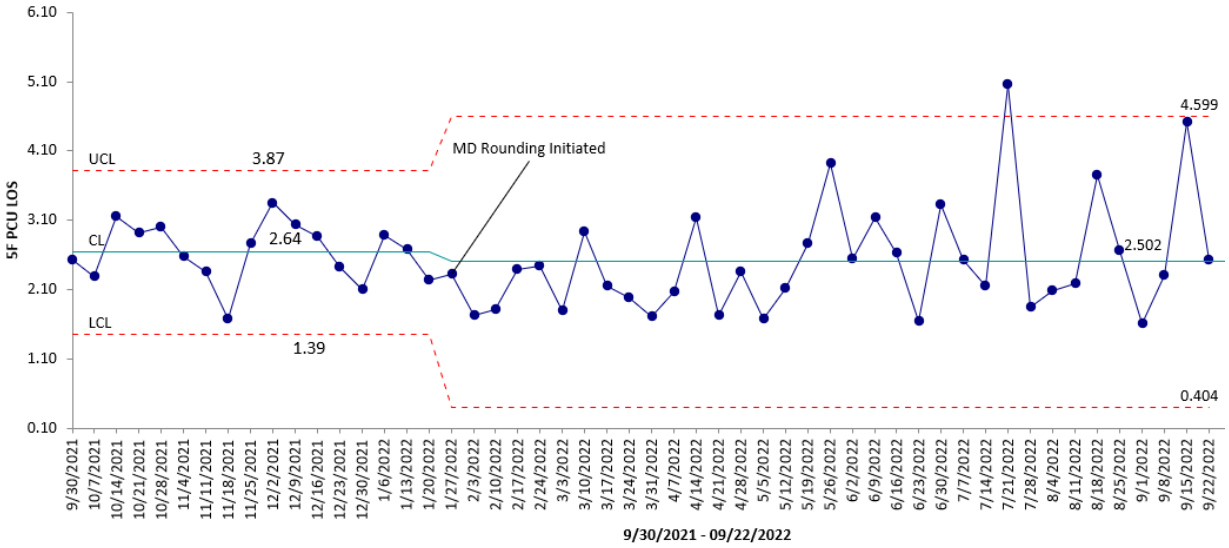
5F ED Bed Request to Bed Occupy



Notes: ucl = upper control limit; lcl = lower control limit

Appendix L

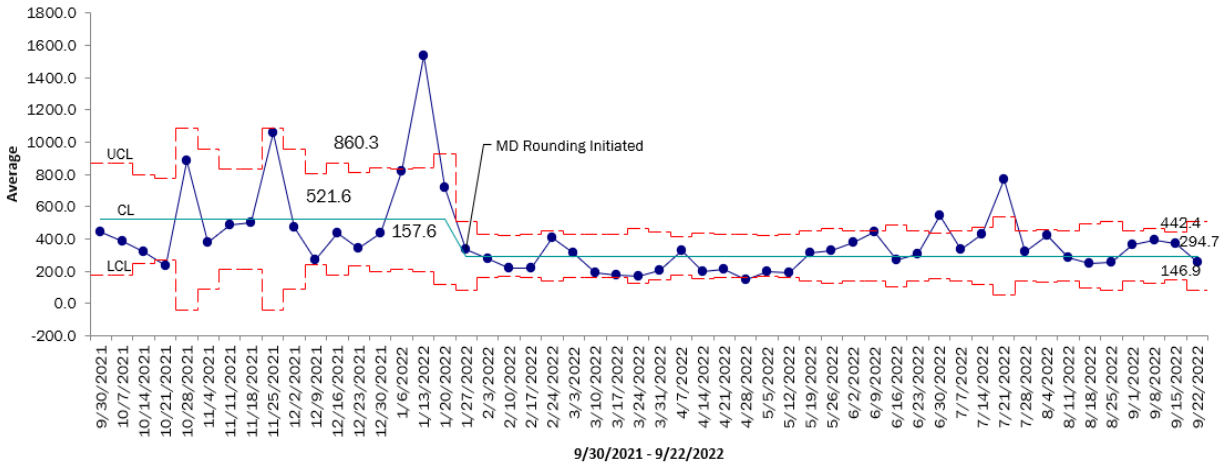
5F PCU LOS



Notes: ucl = upper control limit; lcl = lower control limit

Appendix M

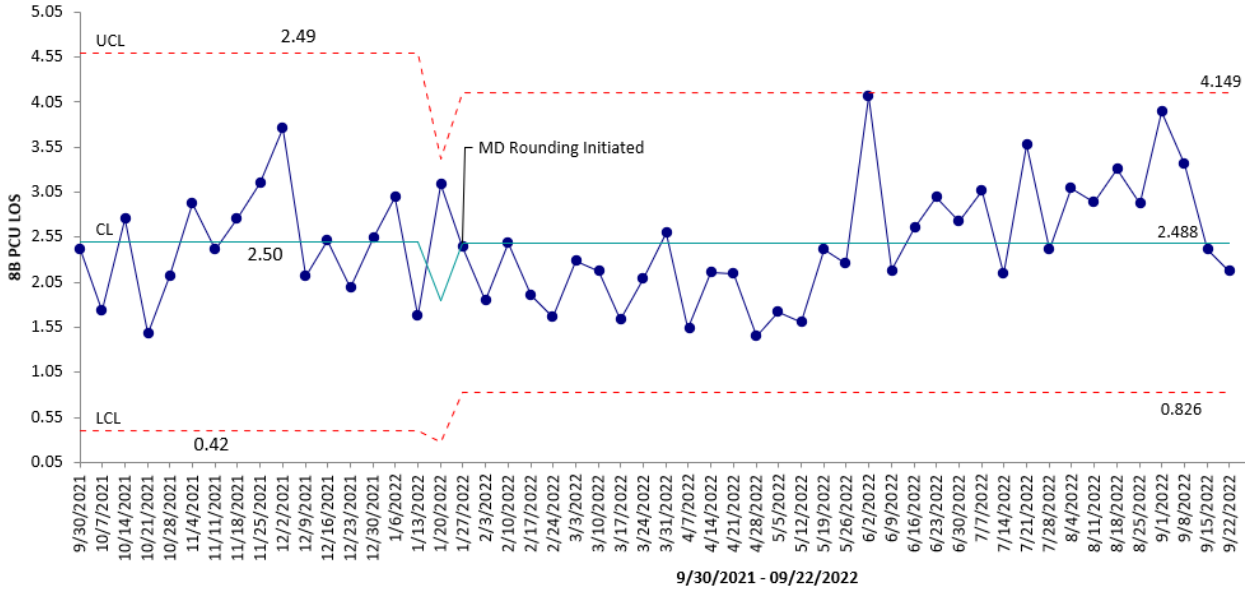
8B ED Bed Request to Bed Occupy



Notes: ucl = upper control limit; lcl = lower control limit

Appendix N

8B PCU LOS



Notes: ucl = upper control limit; lcl = lower control limit

Appendix O

Bed Ahead Process for Patient Flow Managers

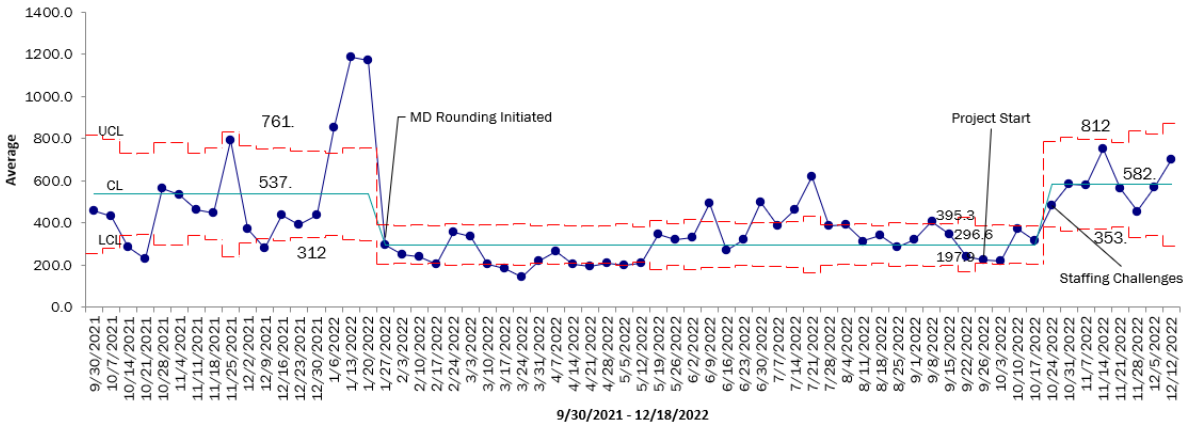
Process	Staff
Team:	Patient Flow Managers Team Lead
True North:	To ensure patients are placed appropriately in the right place and right care as soon as possible.
Purpose:	Implement a bed-ahead process that ensures patients needing PCU-level care are expeditiously assigned a bed with minimal emergency department boarding time.
Bed Ahead:	The intention of bed-ahead is for inpatient units to be able to anticipate the admission of incoming patients and have a bed available before needed.
Why:	By establishing an always-available PCU bed, we can: 1. Reduce patient LOS in DEM 2. Decrease mortality 3. Increase patient safety 4. Increase patient satisfaction 5. Decrease patients LWBS
Focus:	By being proactive and engaged in the patient flow process, the PFMs could play an active role in utilizing available resources and improving the overall patient flow for the organization.

NUMBER	WHAT	WHO
1.	Round in all PCUs (4M, 5F, and 8B) every 12 hours (2X a day) at 10:15 and 22:15	Patient Flow Managers
2.	Identify downgrades, upgrades, and discharges (DUD) in the PCU unit	PCU Charge RN
3.	Round and inform identified DUDs	Patient Flow Managers + PCU Charge RN
4.	Follow up with primary teams regarding identified downgrades (Call number posted on patient's door)	Patient Flow Managers
5.	If there is no response from the primary team (greater than 20 minutes), the PFM will contact the critical care medical director (CCMD) during the DAY, and the Teams Attending on service during the NOC	Patient Flow Managers
6.	CCMD will contact primary team regarding identified downgrade(s) - **DAY**	CCMD - **DAY**
7.	*Attending on service will contact primary teams regarding identified downgrade(s) – **NOC**. For Internal Medicine Teams, please go to AMION for NIGHT Nocturnist (may vary daily for NOC)	*Attending on service - **NOC**
8.	If there is no response from the primary team, the CCMD/Attending on service will place an order for downgrade. The primary attending/service chief and CMO will also be notified.	CCMD/*Attending on Service
9.	Record and track PCU bed availability every day at noon on an excel spreadsheet	Team Lead

*This may be subject to change

Appendix P

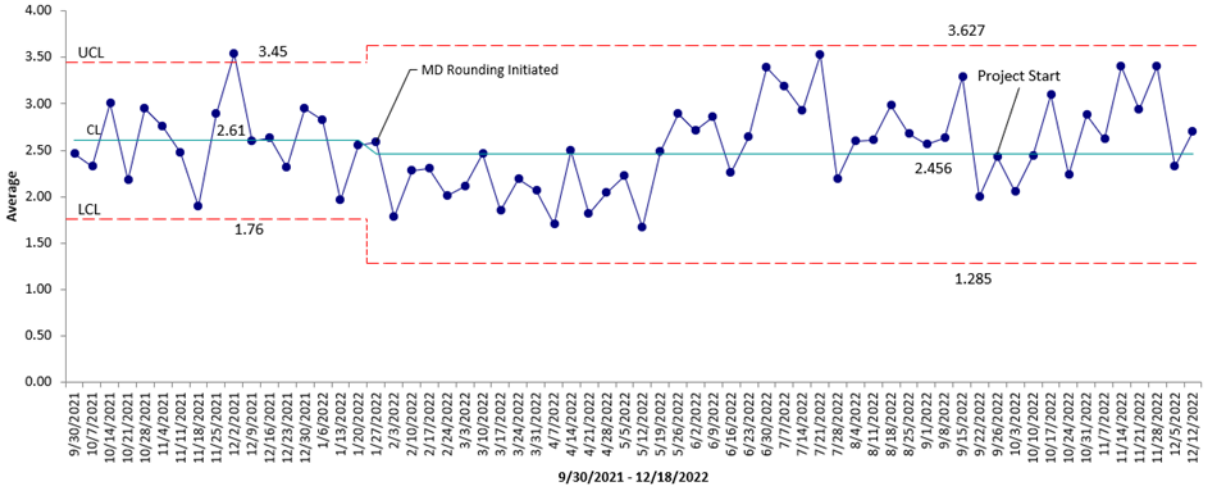
Bed Ahead Implementation PCU Aggregate ED Bed Request to Bed Occupy



Notes: ucl = upper control limit; lcl = lower control limit

Appendix Q

Bed Ahead Implementation PCU LOS Aggregate



Notes: ucl = upper control limit; lcl = lower control limit

Appendix R

Daily Check of PCU Bed Availability

Date	Time	PCU BED Available	Beds Available			
Location				4M	5F	8B
9/26/2022	Noon	Yes	2	1	1	
9/27/2022	Noon	Yes	3		1	2
9/28/2022	Noon	Yes	2		1	
9/29/2022	Noon	Yes	4	1	2	1
9/30/2022	Noon	Yes	1			1
10/1/2022	Noon	Yes	8	1	2	5
10/2/2022	Noon	Yes	1	1		
10/3/2022	Noon	No	0			
10/4/2022	Noon	Yes	3		2	1
10/5/2022	Noon	Yes	2		1	1
10/6/2022	Noon	Yes	1		1	
10/7/2022	Noon	Yes	1		1	
10/8/2022	Noon	Yes	1		1	
10/9/2022	Noon	No	0			
10/10/2022	Noon	Yes	1	1		
10/11/2022	Noon	No	1			1
10/12/2022	Noon	Yes	2	1		1
10/13/2022	Noon	No	0			
10/14/2022	Noon	Yes	2		1	1
10/15/2022	Noon	Yes	1	1		
10/16/2022	Noon	No	0			
10/17/2022	Noon	Yes	1			1
10/18/2022	Noon	Yes	2	1		1
10/19/2022	Noon	Yes	1		1	
10/20/2022	Noon	Yes	1			1
10/21/2022	Noon	Yes	1	1		
10/22/2022	Noon	Yes	6	2	1	3
10/23/2022	Noon	Yes	4	1	1	2
10/24/2022	Noon	Yes	1	1		
10/25/2022	Noon	Yes	1	1		
10/26/2022	Noon	Yes	3		3	
10/27/2022	Noon	Yes	1			1
10/28/2022	Noon	No	0			
10/29/2022	Noon	No	0			
10/30/2022	Noon	No	0			
10/31/2022	Noon	Yes	1		1	

11/1/2022	Noon	No	0			
11/2/2022	Noon	Yes	7	4	1	2
11/3/2022	Noon	No	0			
11/4/2022	Noon	Yes	1	1		
11/5/2022	Noon	Yes	1	1		
11/6/2022	Noon	No	0			
11/7/2022	Noon	Yes	1		1	
11/8/2022	Noon	Yes	1			
11/9/2022	Noon	No	0			
11/10/2022	Noon	No	0			
11/11/2022	Noon	Yes	1	1		
11/12/2022	Noon	No	0			
11/13/2022	Noon	No	0			
11/14/2022	Noon	No	0			
11/15/2022	Noon	No	0			
11/16/2022	Noon	No	0			
11/17/2022	Noon	Yes	1	1		
11/18/2022	Noon	No	0			
11/19/2022	Noon	Yes	1			1
11/20/2022	Noon	No	0			
11/21/2022	Noon	No	0			
11/22/2022	Noon	Yes	1			1
11/23/2022	Noon	Yes	1			1
11/24/2022	Noon	Yes	1			1
11/25/2022	Noon	Yes	1			1
11/26/2022	Noon	No	0			
11/27/2022	Noon	No	0			
11/28/2022	Noon	No	0			
11/29/2022	Noon	No	1		1	
11/30/2022	Noon	No	0			
12/1/2022	Noon	Yes	1	1		
12/2/2022	Noon	Yes	1	1		
12/3/2022	Noon	Yes	1			1
12/4/2022	Noon	No	0			
12/5/2022	Noon	Yes	1		1	
12/6/2022	Noon	No	0			
12/7/2022	Noon	Yes	2	1		1
12/8/2022	Noon	Yes	1			1
12/9/2022	Noon	Yes	1		1	
12/10/2022	Noon	Yes	2	1	1	
12/11/2022	Noon	Yes	1	1		
12/12/2022	Noon	Yes	1			1
12/13/2022	Noon	No	0			

12/14/2022	Noon	No	0	
12/15/2022	Noon	Yes	1	
12/16/2022	Noon	Yes	1	1
12/17/2022	Noon	No	0	
12/18/2022	Noon	Yes	1	1

Appendix S

Number of DUDed Patients

PCU locations	D/G	U/G	D/C
4M	48	2	15
5F	35	2	21
8B	52	6	13
Total	135	10	49