Improving Care and Outcomes for Patients Receiving Titratable Vasopressors Medications: A Quality Improvement Project

THE DNP SCHOLARLY PROJECT

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Table of Contents

Abstract

The Surviving Sepsis Campaign guidelines (Dellinger, 2013) recommend that vasopressors be used to stabilize hypotensive patients unresponsive to volume resuscitation. Vasopressors are an integral part of hemodynamic management for patients with sepsis and septic shock. These medications are managed by nurses who initiate and increase infusion rates until patients are hemodynamically stable, then "wean" medications once therapeutic targets can be maintained. Vasopressors save lives but can also cause lethal complications, particularly when underdosed or overdosed. Therefore, it is critical that titration order instructions are clear and accurate so that weaning delays, practice variability, and medication errors are mitigated. The Joint Commission has set evidence-based safety standards on the use of vasopressors. Clear administration orders and accurate documentation are centerpieces of these guidelines. In the critical care unit at a community hospital in Texas, review of vasopressor use data revealed that a high percentage of patients remained on vasopressors after therapeutic endpoints had been met. A root cause analysis was conducted to identify reasons for weaning delays. Based on results, a quality improvement project was developed aimed at improving consistency in vasopressor titration practices and appropriate discontinuation. Interventions included creation of a Joint Commission compliant smart phrase addition to current computerized order sets clarifying vasopressor administration instructions, and an educational refresh for nurses on vasopressors management best practices. A Likert-scale tool was used to survey nurses on their confidence in managing vasopressors. The project results indicated improved timely vasopressor weaning and a statistically significant improvement with a p value of 0.00 in nursing self-confidence with vasopressor management.

Keywords: Vasopressors titration, critical care nurse's self-efficacy, weaning vasopressors, electronic titration order sets, titration of norepinephrine, nurse's confidence, vasopressors titration, electronic instructions order sets.

Section I: Introduction of the Problem

Introduction

Vasopressor therapy is an integral component of hemodynamic management in sepsis and septic shock patients. Management of vasopressors is a key responsibility of critical care nurses as they are trained to administer these medications. The American Association of Critical Care Nurses [AACN], has been working with the Joint Commission to clarify medication management standards, which delineates required hospital policies for medication orders, including titrated medications.

Understanding and implementing order requirements can create confusion for the clinician and risk for the patient. Vasopressor therapy is recommended by the Surviving Sepsis Campaign guidelines when fluid resuscitation interventions fail to increase mean arterial pressure (MAP) to greater than or equal to 65 mmHg (Arellano & Hanneman., 2014). Due to the fact that the complications of vasopressor therapy are serious and potentially lethal, healthcare providers need to closely monitor patients, titrate medications within recommended ranges, and wean patients off vasopressors as soon as feasible (Arellano & Hanneman, 2014). Administering titratable continuous infusions requires multiple steps, which induces higher medication error rates that have greater severity. Some of these medication errors associated with titratable infusions have occurred due to a lack of clear titration instructions (Chen et al., 2019).

The Joint Commission has multiple standards related to medication management. One of these standards mandates that "medications orders are clear and accurate" (Joint Commission, 2019). The goal of this standard is to maintain consistent administration practices and decrease variation among nurses and other practitioners. Data suggests that reducing practice variation in the clinical setting improves outcomes (Chen et al., 2019). Medication titration orders have recently been scrutinized by the Joint Commission and many hospitals have received citations for having titration orders that lack complete instructions for initiation, adjustments, dose limits, and goal parameters (Davidson et al., 2021). Titration orders are defined as those in which the medication dose is either progressively increased or decreased in response to the patient's status (Joint Commission, 2019). Vasopressor titration is an essential skill that, if

not performed correctly, may put patients at further risk for adverse events. There is a narrow therapeutic index for vasopressors due to the adverse events that occur if vasopressors are underdosed (hypotension and hypoperfusion of end organs) or overdosed (cardiac arrhythmias and ischemic limbs; (Chen et al., 2019). During the resuscitation phase of patients in septic shock, vasopressors are titrated to achieve a target MAP of 65-70 mmHg. Once the patient is stabilized and hemodynamics are within the target range, vasopressors must be weaned or titrated off. The development and use of standardized order sets and computerized provider order entry (CPOE) has had a positive impact on order writing accuracy and decreasing practice variability. Standardized titration instructions are now included in most vasopressor order sets.

When performance inconsistencies in the management of vasopressor medications were identified at a Southeast Texas hospital's critical care unit (CCU), the critical care providers and leadership team members began meeting to discuss the causes. A root cause analysis was conducted and several issues were identified. Even though the unit's critical care nurses had been trained to manage vasopressors, it was the perception of many that CPOE instructions were unclear when used to guide titration and the initiation of weaning initiation. The lack of a hospital or unit-based protocol for titrating medications was also a reason for weaning delays. Some nurses expressed general lack of confidence in vasopressor management, while others were concerned that the initiation of weaning was outside of their scope of practice. This quality improvement (QI) project was developed to improve the clarity of CPOE vasopressor order instructions, improve titration performance by frontline staff in the timely weaning and discontinuation of vasopressors in hemodynamically stable patients, and to improve nursing confidence in the management of vasopressors.

Practice Setting

This project took place at a tertiary level health care system in Southeast Texas, within an adult critical care unit where patients with acute and chronic medical conditions are admitted. This unit annually admits approximately 420 patients with sepsis and septic shock. Norepinephrine, phenylephrine,

epinephrine, and vasopressin are the most commonly used vasopressors with patients in septic shock in this unit.

Target Population

The population of interest was frontline nurses working in the critical care unit who were caring for patients with sepsis and septic shock at the project site. The critical care nurses' experience ranged from 2-32 years. Nurses were ADN, BSN and MSN prepared and were evenly divided between day and night shift workers. Many of the 89 nurses who participated in this project held specialty certifications.

Need Assessment

The Surviving Sepsis Campaign (Dellinger, 2013) guidelines provide recommendations for initiating vasopressors, but there is no recommended method to discontinue vasopressors in patients resolving from septic shock. Several concerns associated with vasopressors were found at the project site. An increased duration of vasopressor use in the CCU was identified during multidisciplinary rounds. Patients were continued on vasopressors without titration during night shifts. In the shared governance meetings, nurses stated that they relied on providers' orders for weaning or discontinuing vasopressors and data analysis on vasopressor titration showed 69% of titration non-compliance rate. The most pressing question was 'why are nurses not decreasing the dose or rate of medication'? This led to another question 'when is the patient ready to be weaned off vasopressors'? A fishbone diagram developed from the root cause assessment described the identified key foci as patients, nursing, process, environment, culture, and communication (see Appendix A).

One patient safety concern related to the prolonged use of vasopressors was the requirement of a central line, which increases the risk of catheter associated infection (Centers for Disease control and Prevention, 2011). Use of vasopressors can also be a barrier to safe mobilization as patients on titratable vasopressors are hemodynamically unstable. Immobility due to prolonged bed rest and weakness can increase length of stay in the unit. Nursing staff were concerned about patients' instability related to vasopressors titration and were also unclear about their role, responsibilities, and scope of practice on titrating vasopressors. Some expressed a lack of confidence and insufficient clinical judgment skills to

decrease the dose and rate of vasopressors. Process needs included a lack of a relevant hospital policy/protocol or weaning guidance and there were no clear expectations from the CCU leadership for weaning vasopressors. Nighttime weaning rates were noted to be much lower than day shift rates.

Within the culture and environment of the unit, it was noted that new nurses learned from their preceptors, so when experienced nurses expressed concerns of whether the titration and discontinuation are within their scope of practice, this sentiment was often adopted by the preceptees. Documented order instructions were found to be inconsistent or inaccurate as the nurses depended on additional provider orders before initiating weaning; nurses perceived lack of guidance and specificity related to weaning and discontinuing vasopressors in the order sets pointed to the need for developing order instructions with clearer weaning language. Based on the needs assessment, the critical care and leadership team members identified multiple reasons why vasopressors were not appropriately discontinued in hemodynamically stable patients even after the target MAP of 65-70 mmHg was achieved.

SWOT Analysis

A strength, weakness, opportunity, and threat (SWOT) analysis method was used to assess and formulate strategies to implement the project (see Appendix B). This analysis is a strategic planning framework used in evaluation of an organization, a plan, a project, or a business activity. SWOT analysis has two dimensions: Internal and external. The internal dimension includes organizational factors, including strengths and weaknesses while the external dimension includes environmental factors, including opportunities and threats (Gürel & Tat, 2017). Identified strengths and opportunities are helpful in achieving organizational objectives and are promising for the organization. Weaknesses and threats are also identified and addressed as these are harmful to achieving the organizational objectives and are unfavorable for the organizations.

Strengths

Strengths included an excellent team of intensivists and nurse practitioners, the CCU educator and the pharmacist, all of whom were supportive in the development of the project. Critical care nurses and CCU management participated in project planning and implementation. The critical care committee,

unit shared governance council and hospital magnet committee as well as organizational stakeholders supported the team lead in various phases of project development. The nurses' desire to increase their knowledge of titration and weaning off vasoactive medications and use order sets with clear titration instructions were also strengths of the project. The project also emphasized patient centered quality care which is one of the organization's core values.

Weaknesses

The main weakness was the lack of a policy or written hospital protocol regarding discontinuation of vasoactive medications by nursing. Some nurses indicated that the electronic order set language was not clear and accurate. Even though the word *titrate* was included in the order language, nurses were not decreasing the rate and dose of the vasopressors when appropriate. Some nurses self-identified a lack of confidence about the weaning process and fear of recurring hemodynamic instability. Some were waiting for provider orders to decrease and wean vasopressors even though providers felt that expectation was communicated in current orders and the delays in the weaning of vasopressors even after the target goal was achieved were inappropriate.

Opportunities

Opportunities included interprofessional team collaboration among the CCU personnel, the information technology (IT) team, clinical pharmacists, the statistician, and the education department. Collaboration in technological advances in healthcare can integrate educational and clinical performance and can improve patient care quality and outcomes. Inter-collaborative attendance at critical care committee meetings ensured all team members had the opportunity to identify the weakness in current CCU operations and also enabled the creation of a nursing cardiac report tableau for reviewing the dose and rate of medications based on the hemodynamic status. The tableau is a platform in the electronic health record that facilitates simultaneous viewing of vasopressor infusion rates and MAP for easy determination of titration compliance ratio.

Threats

Identified threats were the lack of nurses' confidence to decrease the dose and rate of the

vasopressors due to patient safety concerns and the lack of proper documentation which led to communication failure between nursing staff and providers. There was also the possibility that titration performance and/or survey responses reviews could have a negative impact on individual nurses job performance evaluations security.

Inquiry Question

The inquiry question developed for the project was: For nurses caring for adult patients on vasopressors, does the addition of supplemental administration instructions to current orders, and an educational refresh on vasopressor management best practices, decrease failure to wean rates and improve titration documentation compared to current practice?

PICOT elements include:

Population - Critical care nurses caring for adult patients on vasopressors;

Intervention - 1) Development of computerized provider order entry smart phrase to enhance current vasopressor administration instructions, 2) Implementation of a workflow change to add supplemental vasopressor administration instructions to the current order set and 3) an educational refresh on vasopressor medication management best practices;

Comparison - to current practice;

Outcome - the expected outcomes are improvement in vasopressor medication order compliance and communication, decrease failure to wean rates; improve nursing documentation related to vasoactive medication infusions; and

Timeframe - Two months after the launch of smart phrase order build in electronic medical record and educational training.

Purpose/Aims

The purpose of this Doctor of Nursing Practice (DNP) QI project is to decrease inappropriate vasopressor weaning delays in hemodynamically stable patients who have clinical improvement of sepsis and septic shock. The aims include improving the accuracy and clarity of the electronic vasopressor order entry in compliance with the Joint Commission standards and increasing nursing confidence in

vasopressor management through nursing in-service.

Conceptual Framework: Knowledge to Action

The knowledge to action (KTA) conceptual framework was used to guide the project's development, implementation, and completion. This conceptual framework provides the benefit of translating research into practice by providing a systematic approach for knowledge translation and guiding the implementation of the desired change (Nilsen, 2015). Developed in 2000 by Graham and colleagues, the KTA framework has been used by healthcare professionals concerned with translating knowledge to deliver evidence-based interventions and improve organizational systems (Field et al., 2014). The KTA framework has two components: (1) knowledge creation and (2) the action cycle, with dynamic phases that may overlap each other (Field et al., 2014). Knowledge for the initial phase was gained by identifying the problem and determining the gap, reviewing evidence-based literature regarding best practices in managing vasopressor medication titration. (See Appendix C).

During the action phase, the evidence synthesis was presented in the critical care committee for approval of the project and a team was formed. With support of the stakeholders in the organization, intensivists and nurse practitioners in the CCU, the team leader created a project charter. During the development of the project, Institutional review board approval was obtained from the organization.

The DNP student collaborated with the pharmacists and the educator to assess barriers in implementing the project. A CPOE smart phrase and nursing cardiac report tableau was created in collaboration with the IT team. The second step was conducting nursing in-service for critical care nurses on management of vasopressors in patients with septic shock. The providers were informed of new smart phrase use in the order set as they are the facilitators to knowledge use. Data collection and analysis of nursing confidence with vasopressor management using pre and post education surveys and weekly run charts on smart phrase insertion was conducted to monitor knowledge use and evaluate outcome. To sustain knowledge use, the team lead completed all DNP requirements with the guidance of the university faculty and project site mentor.

Section II: Presentation of the Evidence

Search Strategy

Evidence to support the study was identified by searching electronic databases and reference lists for relevant studies and articles. The DNP student's university and organization library resources were utilized for the literature search. CINAHL, PubMed, MeSH, and Cochrane Library databases were used for locating articles. A Boolean search strategy was performed in PubMed using the keywords and phrases: vasopressors titration, critical care nurse's self-efficacy, weaning vasopressors, electronic titration order sets. The Cochrane Library database was utilized using advanced search options with headings; ICU and vasoactive medications, vasopressors, titration of norepinephrine, nurse's self-efficacy, and vasopressors titration and electronic instructions.

Original studies involving titration of vasopressors, QI, and nurses' self-efficacy were selected. Full texts of articles in the English language from 2010-to 2021 were searched to identify their research data and clinical guidelines. All randomized and non-randomized studies evaluating the complications associated with prolonged use of vasopressors in adult patients, benefits of early weaning of vasopressors, and patient outcomes were reviewed. Relevant articles on nurses' knowledge and competency in medication titrations in ICUs, nurses' self-efficacy in vasoactive medication weaning, and vasopressors discontinuation strategies were sought using Google Scholar. A total of 81 articles were retrieved with the term "vasopressors" and 26 articles were retrieved with the terms nurse's and vasoactive medications. A total of 21 full-text articles were selected for review and of those, 10 research studies were selected for the literature review. The Johns Hopkins nursing evidence-based practice research evidence appraisal ([JHNEBP], Dang et al., 2021) protocol supported this critical appraisal and synthesis of research evidence.

Review of Evidence

A survey of nurses' experiences applying the Joint Commission's medication management titration standards conducted by Davidson et al in 2021 was distributed electronically to members of the American Association of Critical-Care Nurses. 80% of nurses perceived titration standards to cause delays in patient care and 33% could not comply with titration orders. In 2017, the Joint Commission

placed restrictions on titration practice, decreasing nurses' autonomous decision-making. In response to the survey, critical care nurses reported their perception that these medication titration standards adversely impact patient care and contribute to moral distress. Most of the respondents wanted their scope of practice to include decisions regarding the titration dose, the rate and frequency of titration, and when to pause and restart medication infusion. In 2021, the Joint Commission revised the requirements to clarify the administration and documentation of titrated medications, with the minimum elements of a complete medication order.

A systematic review was conducted by Hunter et al. (2019) to investigate how intensive care nurses prepare, initiate, administer, titrate, and wean vasoactive medications. These reviewers found three studies that focused on titration and weaning of vasoactive medications. The study's participants identified special education and collegial support during titration episodes as essential to the development of decision-making and affective skills, while describing clinical experience and integrating technology as instrumental to developing psychomotor skills. Fadale et al. (2014) conducted a study to determine if simulation-based learning (SBL) experience increases nurses' self-efficacy and skill performance. The purpose of the QI project was to determine if an SBL experience designed for patients with sepsis improved nurses' self-efficacy and performance related to vasopressors titration skills for septic shock. The participants made statistically significant improvements in their general and vasopressors-related self-efficacy, suggesting that the SBL training may have contributed to improving and sustaining the general and situational self-efficacy of the participants. The total number of titrations improved significantly across the three-time points, suggesting that participants would be able to achieve hemodynamic stability more effectively for their patients.

Wu et al. (2016) investigated the prediction of vasopressors administration and weaning in the ICU. This work takes a crucial step toward actionable use of ICU data by modeling ICU interventions. The two questions in the study were (a) when will a patient require a vasopressor? and (b) whether a patient currently on a vasopressor is ready to be weaned from it? These researchers had several relevant findings. Clinicians reported being conservative about estimating when the patient is ready for weaning

and leaving patients on interventions longer than necessary because they are attending to other patients. One of the predictive tasks was weaning readiness which is defined as being able to stop administration completely within 2 hours and a successful wean as defined as not requiring vasopressors again within 4 hours. Predicting weaning success is harder than predicting intervention onset. There is a fundamental uncertainty about the right time to wean a patient, and the decision may depend on staffing considerations, clinical judgment, or lack of familial support for intervention removal.

In a systematic review of randomized controlled trials conducted by Hylands et al. (2017) comparing high MAP (75-85 mmHg) vs low (60-70 mmHg) blood pressure targets for vasopressor therapy administered to hypotensive critically ill patients. The results do not suggest that higher blood pressure targets in adults critically ill patients needing vasopressors modify mortality overall. The researchers found that higher blood pressure targets might acutely increase the risk for supraventricular arrhythmias and current evidence does not support a MAP target > 70 mmHg in critically ill hypotensive patients requiring vasopressor therapy.

An interesting prospective, randomized controlled trial was conducted by Merouani et al (2008) who applied fuzzy logic principles to modify intravenous norepinephrine infusion rates in septic patients to reduce the duration of the shock. Septic patients were randomly assigned to norepinephrine infusion either at the clinician's discretion (control group) or under a closed loop based on fuzzy logic (fuzzy group). The infusion rate changed automatically after the analysis of mean arterial pressure in the fuzzy group. The goal of the study was to reduce the duration of poorly controlled hemodynamic status by using a closed-loop controller based on fuzzy logic in septic patients. Weaning of norepinephrine was achieved in 18 of the 20 control patients and all 19 fuzzy group patients. The duration of shock was significantly shorter ($p < 0.001$) in the fuzzy group than in the control group. The total amount of norepinephrine infused was significantly lower in the fuzzy group than in the manual control group.

Duclos et al. (2019) performed a meta-analysis on investigations of the effects of the discontinuation sequence of norepinephrine and vasopressin on hypotension incidence in patients with septic shock. Although the order of vasopressor initiation in patients with septic shock is established,

limited information is available about vasopressor discontinuation. The results of the meta-analysis suggest that the risk of rebound hypotension increases in patients with septic shock in whom vasopressin is weaned before norepinephrine. This study highlights the need for data regarding weaning orders to prevent adverse effects.

Jeon et al. (2018) conducted a prospective randomized, double-blind, controlled trial on the incidence of hypotension, the discontinuation order of vasopressors in the management of septic shock. During the study period, vasopressors were only tapered when the MAP had been maintained > 65 mmHg with a constant infusion of norepinephrine and vasopressin for at least 2 hours. Vasopressors were titrated by the bedside nurse and treating physician based on the study protocol of maintaining a target MAP of 65 mmHg. There were no significant differences in the overall incidence of hypotension during the entire study period between the norepinephrine and vasopressin groups. The results suggest that tapering vasopressin before norepinephrine may lead to a lower incidence of hypotension in patients recovering from septic shock who are on concomitant vasopressin and norepinephrine.

Chen et al. (2019) evaluated whether adding detailed titration instructions to norepinephrine medication orders decreased time to goal MAP or systolic blood pressure in ICU patients. Although the result of the study showed that the addition of titration instructions may have limited nurses' ability to adjust infusions rapidly, there were no significant changes in the maximum amplitude of norepinephrine dose increases. Arellano and Hanneman (2014) provided a foundation for the development of a systemic vasopressor weaning approach to optimize tissue perfusion and improve patient outcomes. Vasopressor weaning is guided by patient response to drug titration and clinical nursing judgment. If the patient is receiving more than one medication it is important to determine which vasopressor should be weaned first and this decision might be made collaboratively with the treatment provider and team. Utilization of standardized dosing during the titration process will help to decrease erratic swings in MAP. These authors recommend close monitoring and aggressive titration to maximize both treatment and weaning of vasopressor therapy in patients with sepsis. Knowledge of vasopressor side effects, doses, and titration methods helps ensure rapid weaning off these medications.

Guinot et al. (2021) performed a scoping review of 143 published studies evaluating vasopressor sparing strategies by analyzing the results from randomized controlled trials conducted in patients with septic shock, with a focus on vasopressors doses and/or duration reduction. Despite the abundant literature on vasopressors' therapy, few studies have focused on vasopressors sparing strategies in patients with septic shock. Based on their results the researchers proposed an evidence-based vasopressor management strategy and implemented a weaning strategy that aimed to reduce vasopressor exposure and its side effects. The management of vasopressors can be divided into several phases, (a) an initial resuscitation phase to obtain the target blood pressure to restore tissue perfusion, (b) a stabilization phase, and (c) a weaning phase. When the blood pressure target is achieved, the cardiac and vascular properties are gradually restored, and the weaning of vasopressors can be initiated.

Levels of Evidence

The JHNEBP levels were utilized for the project. They are:

Level I: Experimental study, Randomized control trial (RCT), systematic review of RCTs with or without meta-analysis

Level II: Quasi-experimental study, systematic review of a combination of RCTs and quasi-experimental, or quasi-experimental studies only, with or without meta-analysis

Level III: Non-experimental study, qualitative study or systematic review, with or without meta-analysis

Level IV: Opinion of respected authorities and /or nationally recognized expert committees/consensus panels based on scientific consensus evidence, clinical practice guidelines and consensus panels

Level V: Experimental and non-research evidence, literature review, quality improvement and case reports (Dang et al., 2021; see Appendix D).

Critical Appraisal

The 10 selected articles were critically appraised by the DNP student based on the JHNEBP level of evidence, critical appraisal identified three Level I studies, two Level II studies, one Level III study,

three Level IV studies and one Level V study.

Evidence Synthesis

The three key ways in which evidence-based practice can enhance QI projects include (a) create awareness and interest, (b) build knowledge and commitment, and (c) prompt action and adoption. This project's patients were admitted to the CCU with septic shock requiring vasopressors which were continued in the unit for sustained use. The delay in weaning vasopressors was due to a lack of awareness of weaning parameters. After the targeted MAP is achieved, vasopressors are continued until providers order weaning instructions. This is because there were no standardized instructions for decreasing the medication dose and frequency in the medication order set. The unit shared governance meeting opened a platform for nurses to express their interest in understanding vasopressors weaning and discontinuation. A team was formed in the ICU for implementing a QI program for improving care and outcomes for patients receiving titratable vasopressor medications.

Literature review helped analyze the important studies that could be utilized to build knowledge. A CPOE order set using smart phrase was created in the electronic health record (EHR) for the providers using the Joint Commission recommendations. The educational program included the Joint Commission's requirements for titrating medications, specific instructions for weaning vasopressors in the EHR, and nurses' documentation of drug titration in the EHR. These data will be analyzed by the team lead and the educator for compliance rate. Efficient nursing education will enhance nursing competency and autonomy, knowledge and performance, decrease errors, and increase patient safety. Optimized patient management using hemodynamic guidelines may be associated with more vasopressor-free days and shorter ICU stays (Guinot et al., 2021). Creating a smart phrase usable medication order set in the EHR for the providers and nursing in-service enables the critical care team to adapt and adopt the project.

Themes

One of the primary themes identified from the evidence review was that vasopressor administration is a core critical care nursing skill and responsibility, however, prolonged unnecessary vasopressor use is associated with adverse patient outcomes. The Surviving Sepsis Campaign guidelines

emphasize early recognition and management of sepsis (Dellinger, 2013). Hypotension should be managed initially with intravenous crystalloid therapy to maintain a MAP greater than or equal to 65 mmHg. If fluid resuscitation fails to establish MAP greater than or equal to 65 mmHg, vasopressor therapy is indicated. The use of vasopressors for sepsis-induced hypotension is critical to maintaining adequate blood pressure and tissue perfusion after fluid resuscitation efforts have failed (Arellano and Hanneman,2014). Studies related to the use of vasopressors indicate Norepinephrine is the first drug to treat hypotension during septic shock (Delinger et al., 2012). When the patient is hemodynamically stable with a therapeutic MAP, vasopressor weaning should commence. Observational evidence suggests that patients exposed to higher vasopressor doses have a higher risk of adverse cardiovascular events (Hylands et al., 2017).

The second theme emphasized was clear and accurate electronic orders for titratable medications decreases practice variability and protects nursing scope of practice. There is no hospital protocol or unit policy for weaning vasopressors. This leads to prolonged weaning because nurses rely on providers' orders to decrease vasopressors dosage. Literature review shows that knowledge and performance skills can enhance nurses in the management of vasopressors in the CCU. TJC submitted an update effective January 2021 that provides clarity on the revised requirements related to medication titration orders, including administration and documentation of titrated medications (The Joint Commission, 2021). A complete medication order must include medication name, medication dose, medication route, and medication frequency. For medication titration orders, providers must also include the initial infusion rate, specific instructions on increasing or decreasing the medication dose, frequency of rate adjustment, maximum infusion rate, and the objective measure being used to guide titration, such as MAP for hemodynamic status (The Joint Commission, 2021).

Utility/Feasibility

The purpose of this QI project was to create an electronic order entry set smart phrase with clarified titration instructions, provide a critical care nurse education refresh regarding vasopressors titration improve consistency in vasopressors administration practices, decrease titration variation among

nurses and other practitioners, and to ensure that nurses understood and practiced within their legal scope when managing vasopressor medications.

Section III: Methodological Framework

Restate Inquiry Question

To restate the inquiry question: For nurses caring for adult patients on vasopressors, does enhancement of titration instructions in current vasopressor administration orders, and an educational refresh on vasopressor management, improve order communication, decrease weaning delays, and improve nursing confidence in vasopressor management, compared to current practice?

Project Design

This was a QI project, implemented to improve care and outcomes for patients receiving titratable vasopressors medications in a CCU.

Institutional Review Board Process

The DNP student submitted the project proposal plan to the Institutional Review Board (IRB) who determined that the project does not meet the definition of Human Subject Research per 45 CFR 46 and did not require prior IRB review. The project met criteria for the QI project and received IRB approval (See Appendix E).

Interprofessional Collaboration

The project team included the DNP student as team lead, CCU educator, intensivists and nurse practitioners, pharmacist, CCU Director, IT team, magnet committee members, education department, and shared governance members. The team lead proposed the project to the critical care committee, after approval a team was formed with the CCU educator and Medical Director. After pharmacy and critical care leadership approval on smart phrase language, the IT team helped facilitate smart phrase availability for the EHR. IT also helped with development of the electronic nursing cardiac report platform created to display an overview of cardiac medication documentation, of dose titration and corresponding MAP. The education refresh was conducted by the CCU nurse educator and the team lead. The nurse confidence survey was administered and analyzed by the team lead pre and post education. The questionnaire was

developed by the organization's education department research lead and project coordinator. Nurse practitioners and intensivists were in-serviced about the smart phrase availability, reason for use and how to incorporate it into the existing CPOE vasopressor orders. The educator helped to organize the in-service power points, coordinated meetings with IT team and data analysts, collaborated with the team leader and inter professional department meetings and assisted in maintaining the project charter.

The leader collaborated with multidisciplinary teams and management for the approval of the project in the unit. The team lead attended critical care committee meetings for approval of the project, and collaborated with the IT/ EPIC team for creating a tableau. Monthly teams meeting with the IT professionals were conducted to convey the idea and create a screen in EHR. The Magnet committee and the CCU management actively participated in the completion of the project. The education department and IT department extended their service and cooperation in the implementation of the project. Mindfulness and decision-making skills of the team lead are important for the success of the team to implement the project.

Implementation Framework

To understand the current vasopressor weaning process and identify opportunities for improving weaning practice and nursing confidence with management of these medications, the model for improvement Plan Do Study Act (PDSA) cycle provided the methodological framework for this QI project (Agency for Healthcare Research and Quality, 2013). The MFI was developed by the Institute for Healthcare Improvement in 1996. The MFI uses the PDSA rapid cycle process to test the effects of small changes, make them, and ultimately spread the effective changes through the practice or organization. The MFI PDSA cycles assist current practices in making a shift to thinking about their processes and systems and how they can be modified to produce better outcomes.

The project’s planning components were varied and included collecting baseline weaning data for compliance rate analysis, meeting with stakeholders and forming a team, inter professional collaboration to develop Joint Commission recommended CPOE smart phrase. Smart phrases are documentation shortcuts that allow EMR users to type a few characters that automatically expand to a longer phrase or

paragraph. Also known as “dot” phrases. The users type a period followed by a short user generated phrase. Smart phrases can be created by individual users, shared with or discovered by other users, or made more widely available by making them department-level or hospital-wide. The Smart phrase created for this project was **.***Levo* (See Appendix F).

The do elements included running the test on a small scale, administering pre nursing survey, providing nursing education, repeating the survey, sharing Smart phrase, and educating providers on workflow change, and launching Smart phrase implementation and tracking smart phrase utilization using weekly run chart. The study component required analysis of survey results, analysis of Smart phrase utilization, and analysis of weaning data. The act component focused on outcomes. If outcomes improved, a discussion would follow on adopting the new process and maintaining sustainability, while if there was no improvement, the plan would be adapted, and the cycle repeated. This would provide the opportunity for ongoing process improvement and periodic reassessment of the interventions or if needed, abandoning the plan in favor of a different process.

Data Analysis Plan

An a priori power analysis was conducted using G*Power 3.1.9 to determine the minimum sample size required to find statistical significance using a paired t-test. With a desired level of power set at .80, an alpha (α) level at .05, and a small to moderate effect size of .50 (*d*), a minimum of 64 incidences of Smart phrase insertion were required to ensure adequate power (Cohen, 1988; see Appendix G). The University’s Center for Research & Data Analytics (CRDA) for statistical and/or methodological support was consulted for data analysis of the nursing self-confidence survey scores. Nurse confidence survey scores were analyzed using the Statistical Package for the Social Sciences (SPSS) software. A five-question Likert-scale survey was used to measure before and after the educational refresh survey. A paired sample *t*-test to compare pre-post survey responses and a weekly run chart analysis was utilized to describe the project data.

In collaboration with the institution’s statistical data analyst support, a weekly run chart for Smart phrase use was maintained for analysis. No patient information was included in the data collection. The

pharmacist provided information on the number of patients who were on vasopressors. Chart review was conducted to identify the time vasopressors were ordered using the Smart phrase '.levo'. Vasopressors ordered in the emergency department (ED) were not included in the project data report; only order sets used by critical care providers were included in the weekly run chart. Compliance with vasopressor weaning rates during the pre- and post-implementation phase was measured using data from the nursing cardiac report tableau.

Data Evaluation Plan

The team lead monitored the EMR to confirm statistically useful data. The collected data maintained confidentiality by including only de-identifying information. The vasopressor compliance data was collected pre-and post-educational in-service and launch of Smart phrase use. There were no barriers to data collection. The CCU educator and DNP student collected and entered data in an Excel spreadsheet. The data was stored on a computer in the institution's research folder, under a unique file name and was username and password protected. Only the project lead had access to the survey data and the participants' information remains unidentified. Data was extracted from the EHR to analyze medication titration documentation. Vasopressor weaning compliance rate was measured using parametric paired sample *t*-tests (pre- post-intervention).

Proposed Budget, Timeline and Resources Plan

Since this was a unit-based QI project, the proposed budget was minimal. The DNP student and educator created a PowerPoint presentation for the nurses, options were given to attend in person or via Teams meeting. The CCU providers were informed in person on how to use the newly created Smart phrase. Multi-disciplinary collaboration was conducted through Webex and Teams meetings. The timeline for this project was 18 months, the project was held twice due to COVID 19 surge. The DNP student completed all tasks with the guidance of the DNP faculty lead and clinical mentor.

Metrics Grid

Measurement is a critical part of testing and implementing changes as measures tell a team whether the changes they are making actually lead to improvement (Health Quality Ontario, 2013).

Determining if improvement really happens and if it is lasting requires observing patterns over time. In a QI project, once a care process or outcome issue is identified, goals and benchmarks must be established when implementing the change process (Moran et al, 2020). Measurement in QI allows the team to demonstrate current performances, set goals for future performances, and monitor the effects of changes as they are made (Health Quality Ontario, 2013).

The care process includes many individuals who may have different confidence in their skills. The critical care nurse's competencies include management of complex pharmacologic interventions. The nurse's confidence and autonomy in managing vasoactive medications involves systematic data guided activities to monitor, evaluate and improve quality and safety outcomes. An unit based educational in-service was provided as part of the project. The sessions were conducted by the team lead and the educator using PowerPoint presentation software. The participants had the option to attend in person or through web meetings. The demographics, pre and post education survey and data extraction from the EHR were used for data collection.

The outcome was assessed relative to the purpose of this project which was to evaluate the effectiveness of education in the improvement of the nurse's confidence and performance in the vasoactive medication management, thus improving the patient outcomes and decreasing the length of CCU stay. The approaches to measure processes and outcomes were quantitative data analysis of MAP monitoring and medication titration documentation in the EHR.

Balance in QI is necessary. QI initiatives can generate new knowledge and identify needs for program development. Practice improvements guided by QI models use data-based methods to improve clinical or healthcare system processes and outcomes. The QI projects make an important data driven contribution to practice (Moran et al, 2020). If there is a gap in care or outcome issue (consequences), since QI is an ongoing improvement approach, the outcomes continue to be monitored. The program evaluation may include data-driven improvements, as the improvement and the standardization of process and outcome continues and set new benchmarks for continued improvements (Moran et al, 2020).

The team lead attended CITI training required for the planning and implementation of the project.

Nursing demographic variables, pre, and post-educational self-confidence survey responses on a five-point Likert scale exploring nurses' self-reflection of vasopressors titration skills were collected. The Nursing self-confidence survey questionnaire was developed by the institution's education department. Two content experts (ICU nurse educator and nursing professional development leader) reviewed the modified self-confidence survey scale. The tool was intended to measure critical care nurses' confidence in managing vasopressors when caring for patients with sepsis and septic shock. Data was collected and recorded by the team lead. Paired sample t-tests were used to compare survey responses for the same participants before and after education.

Section IV: Findings/ Results

Characteristics of Sample

Eighty-nine frontline critical nurses were the focus of this study. They were equally divided between day and night shift workers, but fairly diverse in terms of years in nursing, and ethnicity. The group was predominantly female, with a Bachelor's in Nursing as the highest degree earned (See Appendix H). Operational definition terms were created for use in data analysis, to define the terms: age in years, highest level of education- BSN, MSN, DNP, shift worked- nights vs days, years of critical care experience, specialty certifications, Smart phrase - CPOE shortcut for adding standardized supplemental order information to existing vasopressor order set in electronic health record, failure to wean - percentage of patients on vasopressors after target MAP is achieved, and nursing self-confidence - pre post education survey (See Appendix I).

Outcomes

Based on a power analysis, it was determined that a minimum of 64 CPOE smart phrase insertions would be needed to ensure the study had adequate power, and a total of 160 smart phrases

were used during the study timeframe. A run chart was used to track smart phrase utilization (See Appendix J). Smart phrase additions rose steadily until week 4, then took a sharp decline. The reasons for this are unclear and could have been related to anything from fewer patients needing vasopressors to provider compliance issues. However, use of CPOE rebounded again in the final weeks of the study. The largest improvement in survey responses was seen on questions 4 and 5 with mean effect sizes of 1.579 and 1.516 respectively (as shown in Appendix K). The outcome analysis revealed that there was a statistically significant improvement in nursing confidence post education, with a *p* value of 0.00 and a large mean effect size of 2.230587 (See Appendices L & M). The weaning compliance increased during the night shift compared to pre and pre-implementation phase (Appendix N). The vasopressor compliance rate increased after the project launch compared to 6 months baseline compliance in 2021.

Discussions/Conclusions

Clear, unambiguous orders helped decrease end-user confusion and practice variability. Following the implementation of a CPOE order set using Smart phrase and nursing in-service, there was improvement in weaning of vasopressors in the CCU with the biggest improvement in weaning from vasopressors occurring during night shift. The newly created Smart phrase followed the Joint Commission requirements for titratable medication order instructions. During project implementation, there was a regulatory survey in the organization, and the surveyors recommended expanding use of the Smart phrase to all vasopressor orders and the team decided to proceed with the recommendations for other vasopressors used in the unit. The organization improved compliance with Joint Commission regulatory requirements for titratable medications order instructions. Providers quickly adopted Smart phrase use. One of the primary reasons for successful project implementation was felt to be inter professional collaboration. The improved standardized order set language empowers the nurses to safely decrease and discontinue vasopressors without verbal orders from the providers.

Limitations

Baseline data collection was done during high COVID-19 census when most of the patients had prolonged high acuity and may differ from the current patient acuity mix. Organizational and unit

stakeholders were also confused regarding DNP project execution which had different steps and requirements compared to organizational QI projects. Finally, the study was conducted in a small CCU in a single community hospital for a short time frame.

Section V: Recommendations and Implications for Practice

Recommendations

This project adds to the evidence that clear and accurate medication order sets can decrease vasopressor titration delays in the CCU, decrease patients' length of stay in the unit, improve nursing documentation of changes in dose/rate of the medications and continuity of care. Collaboration to share these outcomes with ED staff who care for ICU patients when no critical care beds are available was recommended. The ED nurse educator at the project site will collaborate with the CCU management on adopting this project in their unit.

Implications for Practice

An increase sense of professionalism and autonomy occurs when nurses are better able to respond to patient needs through vasopressor titration as this is a component of art of bedside critical care nursing (Davidson et al., 2021) "I appreciate the effort to put the titration of vasoactive medications back into the hands of the critical care RN so she/he can respond to the changing patient's needs. This is the art of critical care nursing and belongs at the bedside." (Davidson et al., 2021).

Interdisciplinary collaboration was a major contributor to project success. The IT team assisted in creating a vasopressor titration compliance dashboard that filters patients admitted to ICU with septic shock requiring vasopressors such as norepinephrine, epinephrine, phenylephrine, and vasopressin.

Through ongoing education and dissemination of outcomes to all team members, the project lead will present the results to the critical care council and shared governance meetings. A "ripple effect" of organizational QI has resulted from this small project. The critical care nurses have been empowered in management of vasoactive medications within the scope of nursing practice. A nursing cardiac report tableau was created in EHR so providers have direct access to documentation. This will show the patient's systolic and diastolic blood pressure, MAP, and vasopressors dose /rate in one platform in EHR.

AACN Essentials

This QI project addresses the following American Association of Colleges of Nursing (2021) Essentials:

Domain1: Knowledge for nursing practice - the team lead demonstrated the application of nursing science to practice, synthesizing knowledge from nursing and other disciplines to inform education and practice, synthesizing current and emerging evidence to influence practice.

Domain 2: Patient centered care - The team lead promoted caring relationships to effect positive outcomes, demonstrated advanced communication skills and techniques using a variety of modalities. Develop evidence- based interventions to improve outcomes and safety and practice in system level change to improve care coordination across settings.

Domain 5: Quality and Safety -The QI project used national safety resources to lead team- based change initiatives. Advance quality improvement practices through dissemination of outcomes. Role modeling and lead well-being and resiliency for self and team.

Domain 6: Interprofessional Partnership - evaluate effectiveness of interprofessional communication tools and techniques to support and improve the efficacy of team-based interactions. Communicate nursing's unique disciplinary knowledge to strengthen interprofessional partnerships. Direct interprofessional activities and initiatives.

Domain 8: Information and Healthcare Technologies - the DNP student utilized information technology to support and improve patient care and provide leadership within healthcare systems. Propose a plan to influence the selection and implementation of new information and communication technologies. Generate information and knowledge from health information technology databases. Appraise the role of information and communication technologies in engaging the patient and supporting the nurse-patient relationship.

Risks / Benefits / Ethical Considerations

The project lead followed Health Insurance Portability Accountability Act (HIPAA) compliance and the institution's patient privacy standards throughout the project. The medical record numbers were

the only identifiable data, and these were stored in the institution's password protected computer with access only to team lead. This project benefited the CCU providers and patients. No financial obligations required of participants in the study, no human experiments were involved, and there was no harm to participants in the project. With accurate guidelines in the orderset and weaning parameters, collaboration was effective. Nurses verbalized increased autonomy and confidence in the management of vasopressors within scope of practice.

Self-reflection

The DNP student was the first nurse practitioner in this CCU to lead a QI project with the potential to empower nursing confidence and improve patient outcomes. Since improving timely vasopressor titration had not previously been attempted in the CCU, this led to a fulfilling career success and enabled this DNP student to accurately identify desired goals and motives which can drive future actions. As the team lead, the QI project helped identify opportunities for professional improvement and helped elevate her practice in the workplace. Nursing practice is evolving and the nurse's ability to keep pace with current practice is an inevitable part of professional growth. The support by the critical care team enhanced the DNP student's perseverance to achieve the goal through dedication and hard work.

The DNP student developed improved cognitive flexibility in managing changes within complex environments. The essential elements for critical care nurses and nurse practitioners are clinical judgment, critical thinking, and reasoning, integration of current evidence, and clinical expertise with individual and family preferences (AACN, 2021). The DNP student expanded professional growth from bedside nurse practitioner to conducting a unit-based quality improvement project, collaborated with multidisciplinary team members, attended meetings, and presented the project plan in various committees. The team lead was able to work with excellence, improve communication in a professional manner with the stakeholders, and learned to balance personal and professional life while pursuing career goals.

Dissemination and Sustainability

After the implementation and outcome analysis, the team lead will no longer manage the project. To achieve sustainable change, QI initiatives must become the new way of working rather than something

added on to routine clinical care (Silver et al., 2016). Sustainability plans include review of cardiac tableau during daily rounds, ongoing compliance monitoring and outcomes evaluation, visual monitoring board for quarterly data review with interdisciplinary team and identify modifications to order sets education and training based on outcomes metrics, include in-service in onboarding and annual competency and create visual alert alarm in monitor with biomedical technology support. The project results will be used for the DNP student's final project presentation. The abstract submission at the organization's critical care symposium and poster presentation at the organization, and the DNP project manuscript and any publication in a national critical care journal will be posted in the DNP student's university's e-repository.

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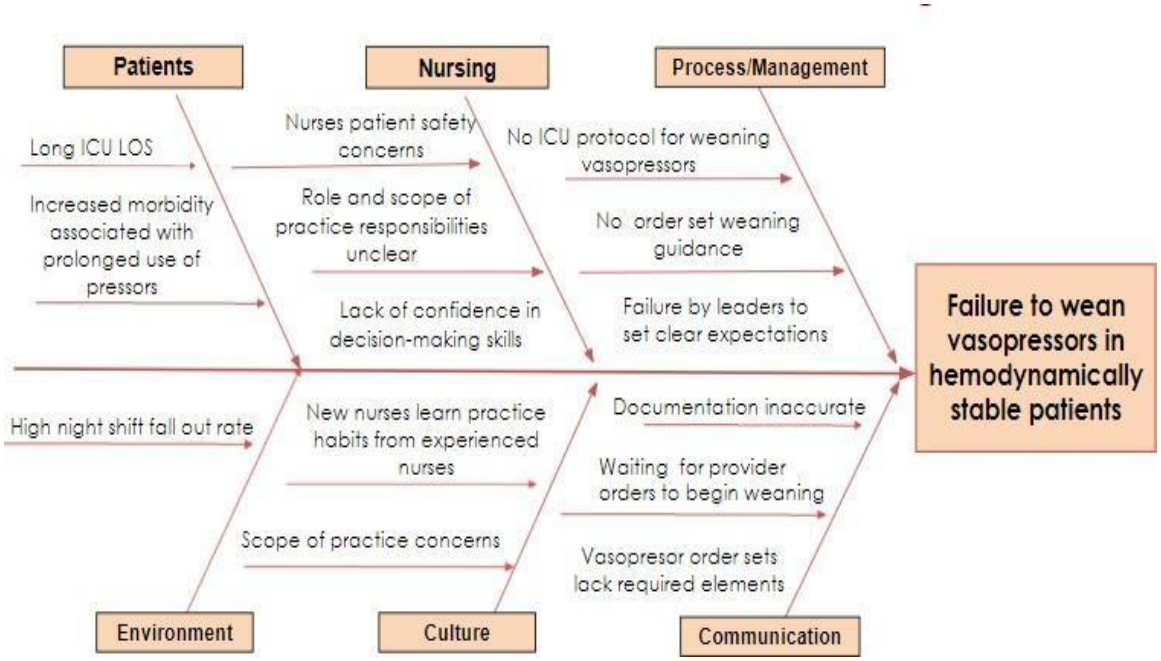
Appendix A

Fishbone Diagram



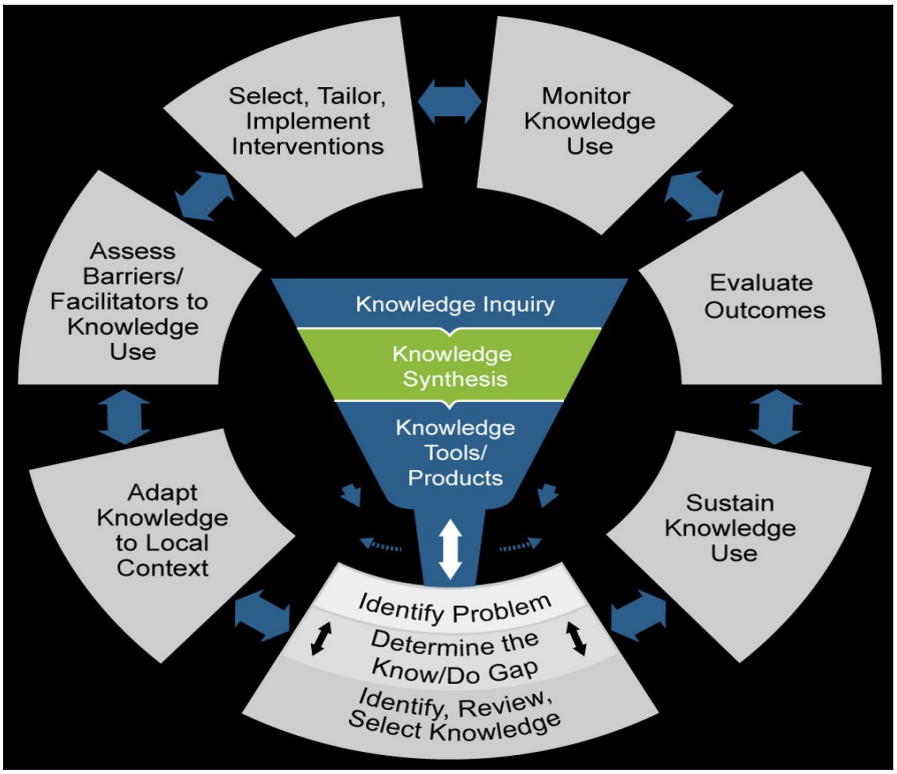
Appendix B

SWOT Analysis

Strengths	Weakness
• Supportive ICU team • Strong shared governance/Magnet committee • Organizational leadership support • Align with institutional core values of patient centered quality care	• No hospital policy or protocol • Nurses wait unnecessarily for provider orders • Lack of best practice role models; critical thinking • Lack of clarity in orderset language
Opportunities	**Threats**
• Interest shown by nursing staff to improve knowledge of vasopressors management • CC Team open to quality improvement project	• Fear of nurses to decrease the rate or dose of medications • Patient safety concerns • Lack of adherence to regulatory documentation guidelines • Failure to communicate/collaboration

Appendix C

Knowledge to Action Conceptual Framework



Note. Image adapted from *The Knowledge-to-Action Framework* by L. Crockett. (https://medium.com/knowledgenudge/kt-101-the-knowledge-to-action-framework- 7fbe399723e8).

Appendix D

John Hopkins Evidence Hierarchy

Note. Image adapted from *John Hopkins Nursing Evidence-Based Practice Models*, by Johns Hopkins Medicine, Center for Evidence-Based Practice. (https://www.hopkinsmedicine.org /evidence-based-practice/ijhn_2017_ebp.html). Copyright 2017.

Appendix E

IRB Approval Letter

April 8, 2022

TO: Preeni Shenoy, MSN, APRN, AGACNP-BC

SUBJECT: HMAI Determination of Not Human Subject Research: Improving Care and Outcomes for Patients Receiving Titratable Vasopressor Medications: A Quality Improvement Project

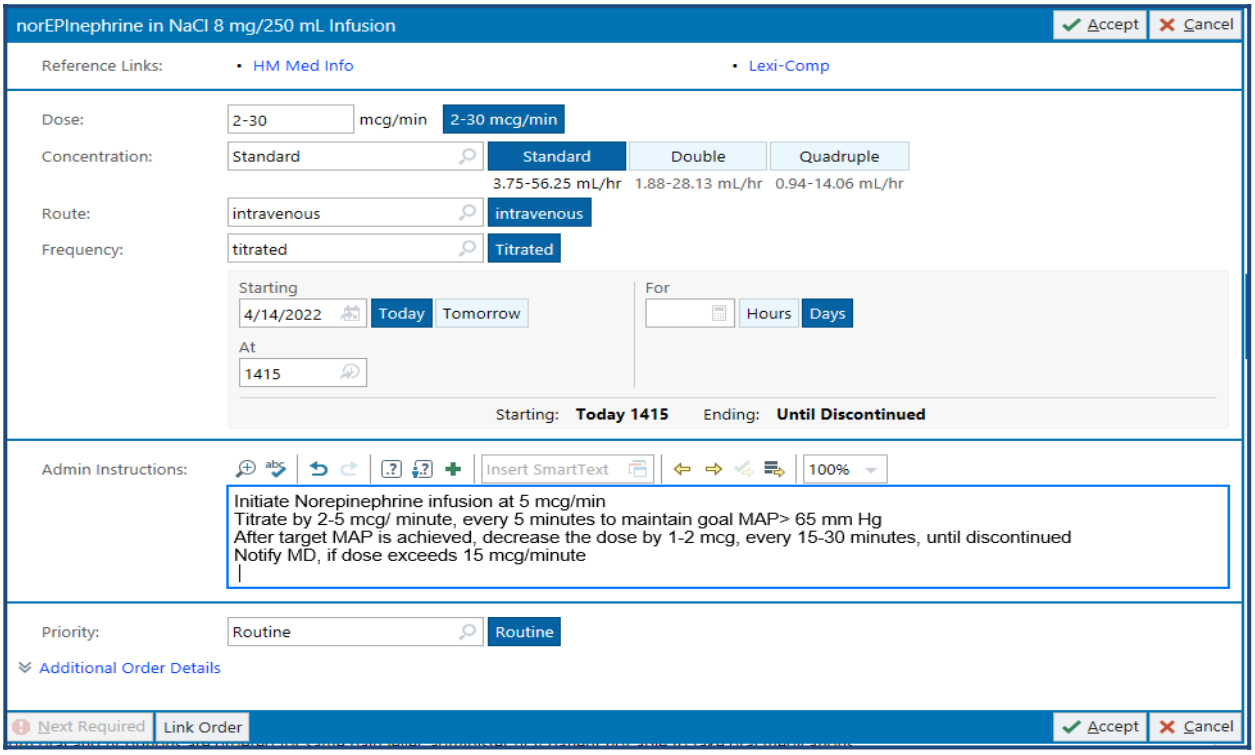
Based on the information and protocol provided, the HMRI IRB has determined that the project referenced above does not meet the definition of Human Subject Research per 45 CFR 46 and does not require prior IRB review and approval at Houston Methodist.

Please understand that should your protocol change in any way your new protocol will need to be resubmitted for review and a new IRB determination made before any data collection can begin.

If you have any questions, do not hesitate to contact me. Best of luck on a successful quality improvement project!

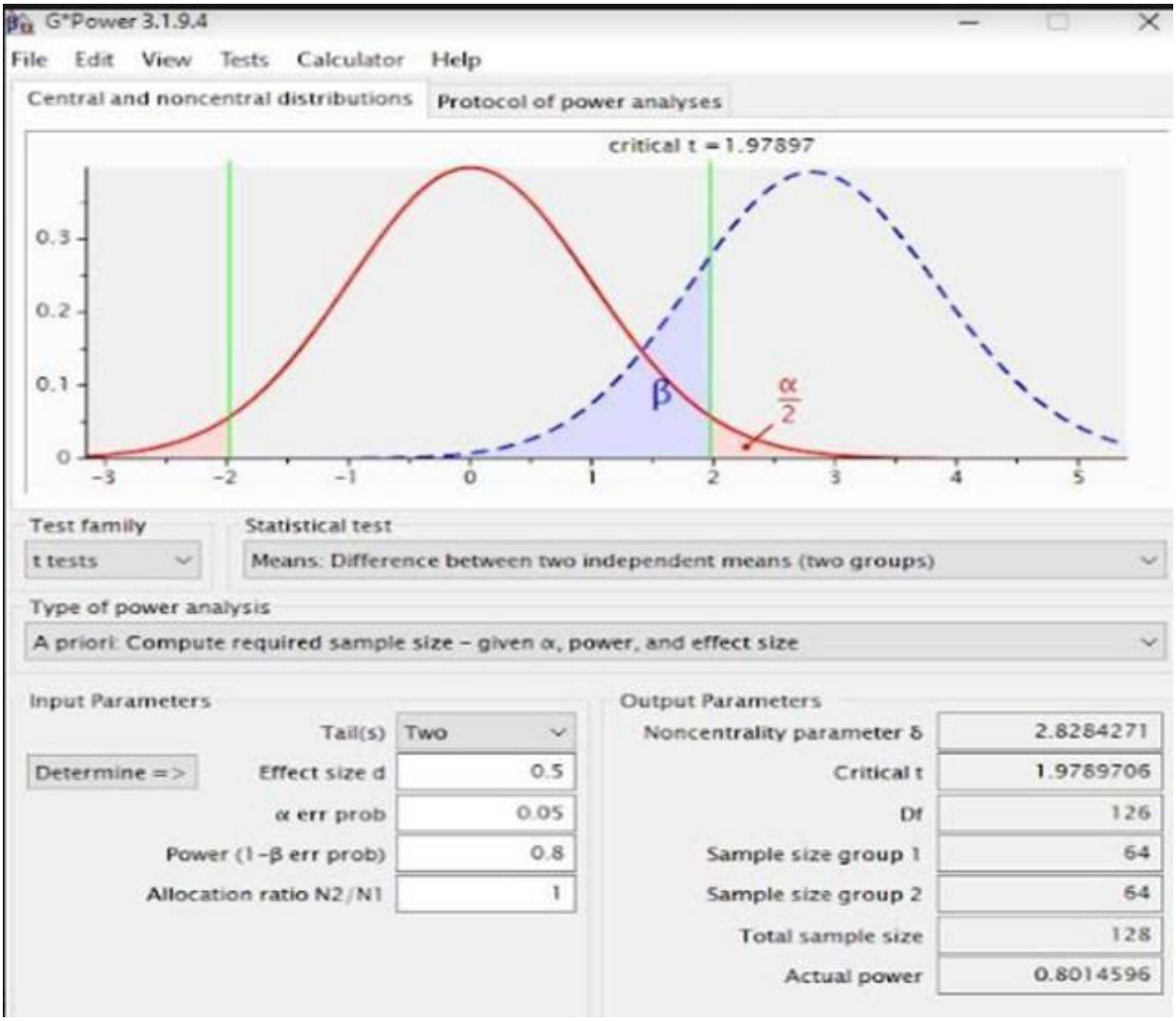
Appendix F

New Smartphrase Created Using Dot Phrase



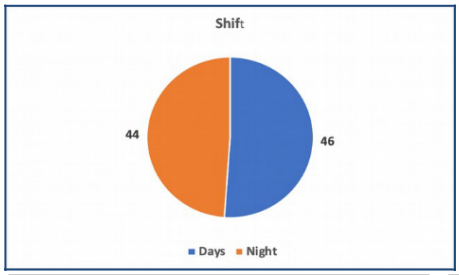
Appendix G

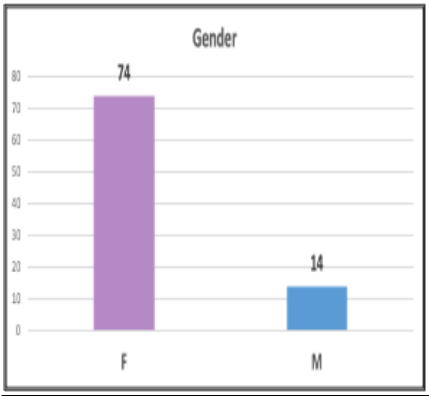
G Power Analysis

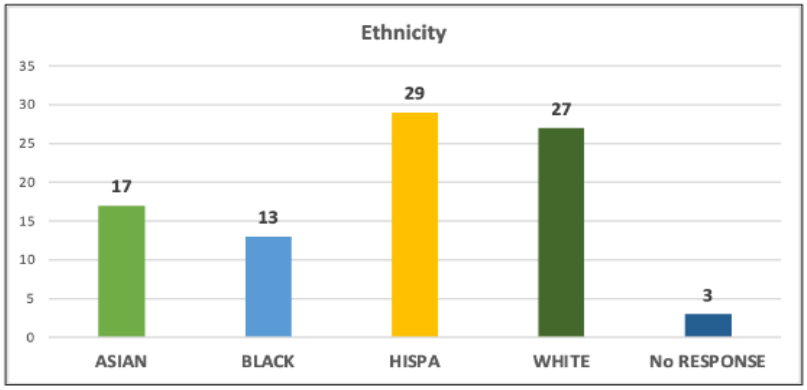


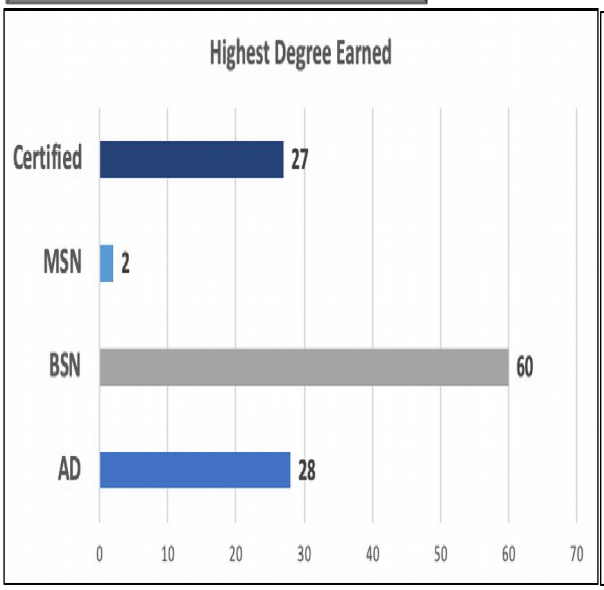
Appendix H

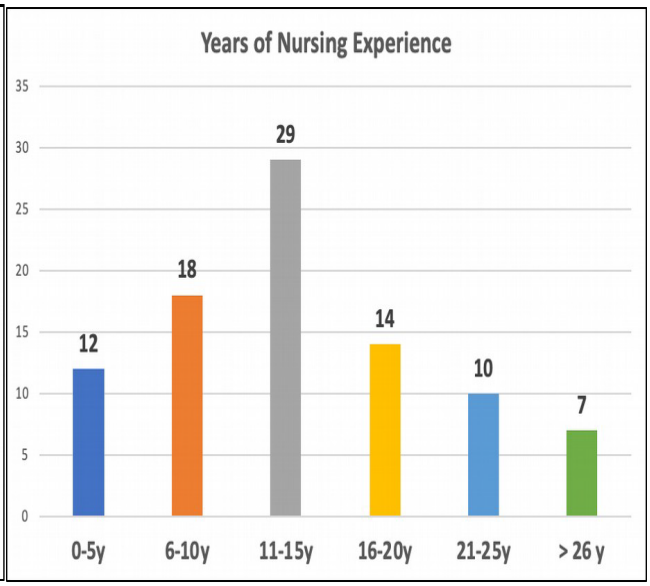
Nurse Demographics











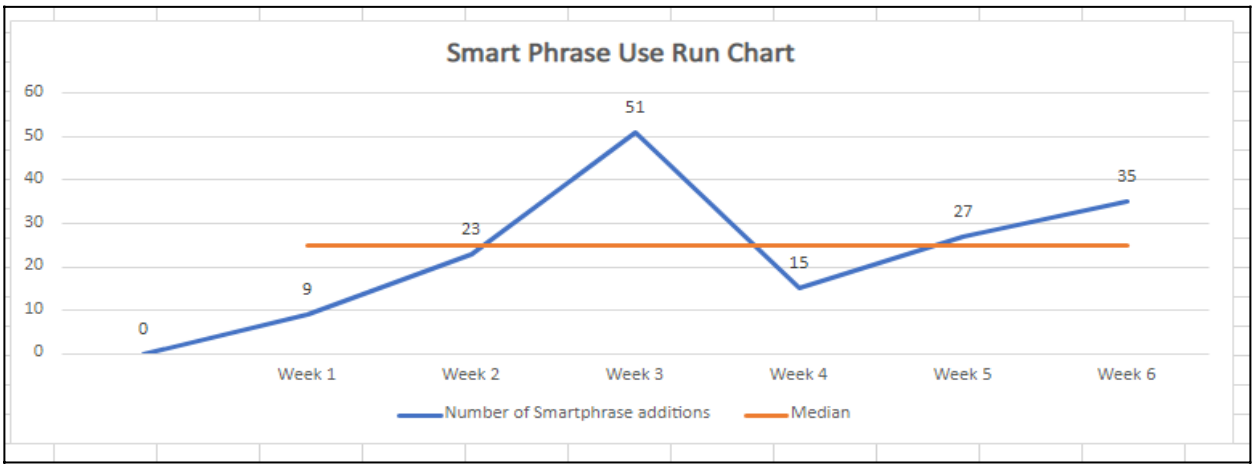
Appendix I

Demographics Operational Definitions

Term	Operational Definition
Age	Age in years
Highest level of education	BSN = 1 MSN = 2 DNP = 3
Shift	Primary shift worked: 1 = night shift 2 = day shift
CC experience	Number of years experience working in CC unit
Specialty Certifications	None = 1 Critical Care Registered Nurse (CCRN) = 2
Ethnicity	White = 1 Black = 2 Hispanic = 3 Asian = 3 Other = 4
Gender	Male = 1 Female = 2
Smart phrase	CPOE shortcut for entering standardized order instructions
Failure to wean rate	Percentage of patients who remain on pressors despite achieving therapeutic endpoints
Nursing self-confidence	Nursing self-confidence as reported on self-confidence survey
Provider	Intensivist and nurse practitioners
ICU LOS	Time from ICU admission until discharge to a lower level of care

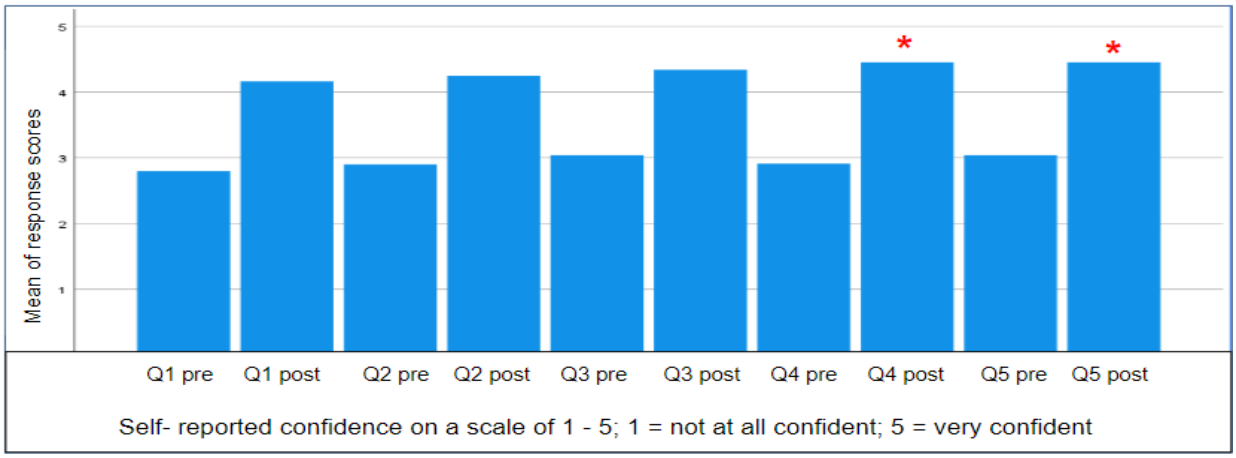
Appendix J

SmartPhase Use Run Chart



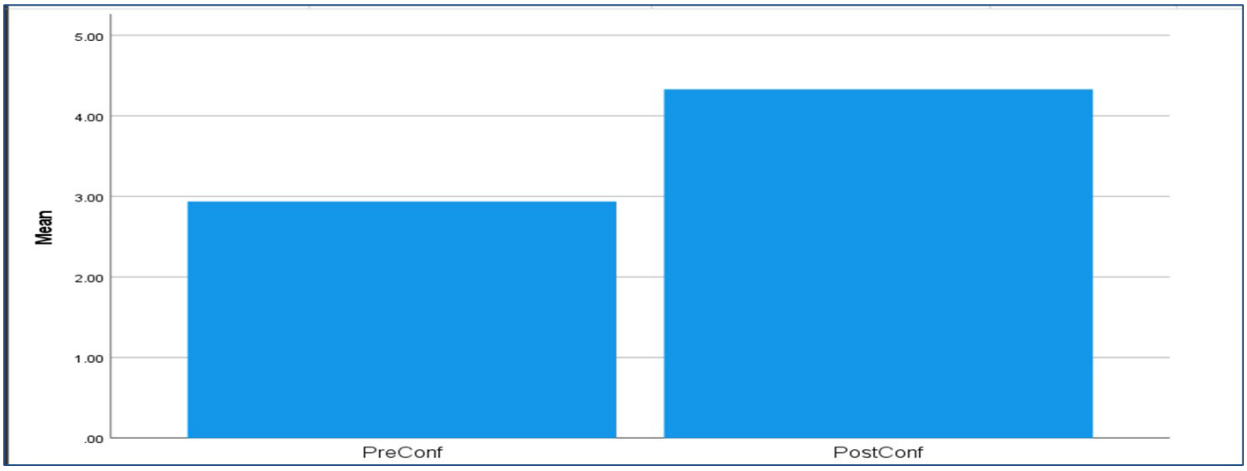
Appendix K

Nursing Confidence Individual Questionnaire Mean Scores



Appendix L

Mean of Pre-Post Self Confidence Survey Scores



Note: Outcome analysis revealed there was a large mean effect size of 2.230587 for all questions

Appendix M

Nursing Survey Size Effect

	Paired Differences					t	Df	Significance	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
				Lower	Upper				
PostConf PreConf	1.39250	0.58370	0.06526	1.26260	1.52240	21.338	79	**0.000**	**0.000**

Note: This paired sample *t* test revealed that there was a statistically significant improvement in nursing confidence post education, with a *p* value of 0.00 and a large mean effect size of 2.230587

Appendix N

Day and Night Shift Weaning Compliance Ratio