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Increasing Adherence to Protocolized Diuresis for De-resuscitation of ICU Patients by Increasing Nursing Knowledge and Confidence

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Increasing Adherence to Protocolized Diuresis for De-resuscitation of ICU Patients by
Increasing Nursing Knowledge and Confidence

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Nursing
Practice at the University of Kentucky

By

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Lexington, KY

2022

Abstract

Background: Fluid overload in patients requiring intensive care leads to increased costs for hospitals and patients, increased length of intensive care unit (ICU) and total hospital stay, ventilator days, acute kidney injuries, and mortality rates. Multiple studies have indicated that aggressive de-resuscitation with diuretics can decrease length of stay, ventilator days, organ injury, and mortality rates. A nurse-driven diuresis protocol utilizing intravenous (IV) push furosemide was introduced to the University of Kentucky Medicine ICU, but patients are still commonly still over-resuscitated with no plan to diurese until organ damage has occurred. By educating bedside nurses, improving their knowledge and confidence regarding the diuresis protocol adherence to the protocol may be increased.

Purpose: The purpose of this DNP project was to examine the impact a web-based educational intervention has on bedside ICU nurses' perceived knowledge, confidence, adherence, and attitudes on using protocolized diuresis. In addition, barriers towards using a protocolized diuresis will be identified.

Methods: This study used a one-group pre- and post-intervention survey design. Participants completed a 15-question survey prior to and after watching a web-based educational intervention. Unpaired t-tests and Spearman's Correlation Coefficient via SPSS software were used to analyze the data and interpret its significance to clinical practice.

Results: There were no statistically significant changes in total knowledge over time, with a p value of 0.245. Nurses were significantly more comfortable in using the MICU Diuresis protocol in the post-intervention survey ($p = 0.010$). Additionally, nurses more strongly agreed that excessive fluid resuscitation increased length of ICU and total hospital stay, ventilator days, acute kidney injuries, and mortality rates ($p = 0.017$) in the post-intervention results. There were

no statistically significant changes in barriers identified by nursing staff to utilizing the MICU Diuresis Protocol.

Conclusion: Results of this study indicated that MICU bedside nursing staff, while familiar with the signs of over-resuscitation, were uncomfortable using the nurse-driven Diuresis Protocol for a variety of reasons. While there was no statistical significance in the study, notably there was clinical significance, as nurses felt much more comfortable using the diuresis protocol. The study also showed that utilization of a web-based training intervention can be effective at significantly improving knowledge, comfort, and attitudes towards and determining barriers of using the MICU Diuresis Protocol. Future research should focus on assessing the knowledge, confidence, and attitudes of other MICU healthcare providers to understand the barriers surrounding multidisciplinary use of the Diuresis Protocol.

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I would also like to acknowledge Ron Simpson, Adam Gould, Jenny Renaud, Seth Curtis, and Ben Hughes for providing me access to the ListServ accounts for the UK Medicine ICU as well as the UK Good Samaritan ICU bedside nurses, and for allowing me to complete my DNP project on their units. Finally, I would like to acknowledge the staff at both the UK Medicine ICU as well as the UK Good Samaritan ICU for participating in my DNP project. None of this would be possible without all of you.

Dedication

This DNP project is dedicated to my husband, JJ, my son Grayson, my stepson Austin, my in-laws Joe and Ann Haupert, and my parents Michael and Diana McDonald. JJ, you have been my rock over the last 10 years of my nursing education. I know that putting up with my hectic schedule throughout my initial night shift scheduling, classes, and clinicals has been ridiculously difficult, but I can't imagine having gone through this with anyone else. Austin, thank you so much for being such an understanding person. I began this journey when you were in middle school, and I'm so proud of the young man you've become. Joe and Ann, thank you so very much for all your support and assistance through the program, and thank you so much for watching Grayson during all my clinical shifts and classes. Mom and Dad, thank you for instilling in me the work ethic and dedication needed to get through such an arduous journey. While nursing school wasn't my original career goal, you all have been the most supportive parents anyone could ask for. And finally, Grayson. I love you so very, very much, and probably would not have pursued my advanced practice degree if you hadn't come along when you did. You make me want to be a better person and mother.

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Table of Contents

Abstract.....	2
Acknowledgements.....	4
Dedication.....	5
Background and Significance.....	9
Problem Statement.....	9
Context, Scope, and Consequences of the Problem.....	10
Current Evidence-Based Interventions/Strategies Targeting the Problem	12
Purpose and Objectives.....	14
Theoretical/Conceptual Framework.....	15
Review of Literature.....	16
PICOT Question and Search Methods.....	16
Summary and Strength of the Evidence.....	17
Current State, Desired State, and Gaps in Practice.....	18
How the Proposed Solution to the Problem Addresses the Gaps.....	18
Project Design and Methods.....	19
Design.....	19
Setting	19
Agency Description and Project Congruence	20
Stakeholders	20
Facilitators and Barriers	21
Sample Selection.. ..	22
Research Procedure	23

Consent & IRB Approval	23
Evidence-Based Intervention	23
Measures and Instruments	24
Data Collection.....	25
Data Analysis	26
Results	26
Survey Results	27
Discussion	28
Implications for Future Nursing Practice	30
Limitations.....	32
Conclusion	33
References	35

List of Tables

Table 1. Descriptive Summary of Participant Characteristics: Independent Samples..... 42

Table 2. Descriptive Summary of Participant Characteristics: Paired Samples 42

Table 3: Were you able to watch the educational module titled, "Diuresis Protocol Educational Module?"..... 43

Table 4. Changes in Perceived Knowledge and Attitudes Towards Protocol Use: Independent Samples43

Table 5: Changes in Perceived Knowledge and Attitudes Towards Protocol Use: Paired Samples...44

Table 6. Changes in Perceived Barriers Towards Protocol Use: Independent Samples 44

List of Appendices

Appendix A. Cover Letter for Informed Consent 45

Appendix B. Letter of Approval from University of Kentucky Nursing Research Council.....47

Appendix C. University of Kentucky IRB Approval Letter 49

Appendix D. Qualtrics Pre-Intervention Survey Questionnaire.....50

Appendix E. Qualtrics Post-Intervention Survey Questionnaire..... 54

Appendix F. MICU Diuresis Protocol59

Appendix G. MICU Diuresis Protocol Educational Intervention.....60

Appendix H. Iowa Model of Evidence-Based Practice69

Background and Significance

Problem Statement

Patients are admitted to the intensive care unit (ICU) for a plethora of reasons: septic shock, respiratory failure, kidney and liver injuries, trauma, hypovolemic shock, hemorrhagic shock, etc. While the reasons for ICU admissions differ, one thing they have in common is that they are routinely and aggressively fluid resuscitated to improve hemodynamics and organ perfusion as well as potentially decrease mortality rates, (Bissell, Laine, Thompson- Bastin, Flannery, Kelly, Riser, Neyra, Potter, & Morris, 2020). Unfortunately, this fluid resuscitation may be to excess, leading to damage to multiple organ systems, (Bissell, et al, 2020). Recent research has indicated that intermittent scheduled intravenous (IV) push diuresis is as effective in reducing ventilator days, ICU and hospital length of stay, as well as mortality rates, as renal replacement therapy (RRT) or continuous diuretic infusions, (Sakr, Rubatto Birri, & Kotfis, 2017). By reducing hospital and ICU length of stay and ventilator days, hospitals and patients will experience significantly reduced costs, (Evans, Kobewka, Thavorn, D'Egidio, Rosenberg, & Kyeremanteng, 2018).

The University of Kentucky Medicine ICU pharmacists, providers, in conjunction with nursing representation developed an evidence-based nurse-driven protocol to battle the effects of over-resuscitation, but there appeared to be a gap between provider/pharmacist application of the diuresis protocol and nursing education and knowledge. When the protocol was initially trialed (April 1, 2018 – April 1, 2019), bedside nursing staff received substantial education surrounding it's use. However, since that point in time, there has been significant staff turnover, leading to unfamiliarity with the MICU Diuresis Protocol from a bedside nursing point of view.

The principal investigator (PI) of this DNP project is employed in the UK Medicine ICU and has been informed by providers and pharmacists that the Diuresis Protocol is not being utilized as well as it should be. Interviews with bedside nursing staff indicated that nurses were not confident on utilization of the protocol, nor were they aware of the importance of de-resuscitation in ICU patients. This paper will discuss the impact on an evidence-based educational intervention on bedside nurses' perceived confidence, knowledge, and attitudes regarding the use of a unit specific nurse and pharmacist driven diuresis protocol in a medicine intensive care unit (MICU) at a large academic medical center. Additionally, barriers to its use will also be discussed.

Context, Scope, and Consequences of the Problem

Aggressive fluid resuscitation and fluid overload results in increased ventilator days, end organ damage, length of stay in the ICU and whole hospital stay, and mortality rates, (Sakr, et al, 2017). Excessive fluid balance from medication and maintenance fluids in addition to resuscitation fluids may also lead to hyperchloremia and acute kidney injuries, leading to increased incidence of acidosis and mortality, (Magee, Bastin, Laine, Bissell, Howington, Moran, McCleary, Owen, Kane, Higdon, Pierce, Morris, & Flannery, 2018). Patients with a 10% increase in body weight are more likely to develop acute kidney injuries (AKI), acute respiratory failure, sepsis and need for mechanical ventilation, (Claire-Del Granado & Mehta, 2016).

Retrospective cohort studies have indicated that fluid overload greater than 10% “was associated with a 58% increased odds of major adverse kidney events,” (Woodward, Lambert, Ortiz-Soriano, Li, Ruiz-Conejo, Bissell, Kelly, Adams, Yessayan, Morris, & Neyra, 2019). Additionally, odds of patients developing a major adverse kidney event increased by 2.7% for every 1 day from ICU admission, with hospital mortality increasing 82% (Woodward, et al,

2019). The Fluids and Catheters Treatment Trial (FACTT) determined that patients with acute lung injury had a significantly shorter length of stay in the ICU and less time on mechanical ventilation if fluid intake was limited and if they were kept “dry” by diuresis, (Wiedemann, 2008).

In patients with septic shock, patients with higher cumulative fluid balance “at day 3 but not in the first 24 hours after ICU admission was independently associated with an increase in the hazard of death,” (Sakr, et al, 2017). A study from the University of Kentucky Medicine ICU in 2020 indicated that patients that received aggressive diuresis following over-resuscitation had an over-all decrease in in-hospital mortality (5.5% vs 16.1% in the control group), (Bissell, et al, 2020). Additionally, it was found that these patients had 2 fewer ICU days opposed to patients that were not routinely diuresed, (Bissell, et al, 2020). Other retrospective analysis studies appear to back up this data. In a large retrospective analysis from 2013, covering over 600 United States hospitals, it was found that increased length of stay (LOS) and hospital costs were independently associated with fluid overload, with LOS approximately 3 days longer, and hospital costs over \$12,000 more for fluid overloaded patients, (Magee & Zbrozek, 2013).

Multiple studies have indicated that a positive fluid balance by day 3 is an independent risk factor to 30-day mortality where-as de-resuscitation to a negative fluid balance is associated with lower mortality, (Silversides, Fitzgerald, Manickavasagam, Lapinsky, Nisenbaum, Hemmings, Nutt, Trinder, Pogson, Fan, Ferguson, McAuley, & Marshall, 2018 & Sirvet, Ferri, Baro, Murcis, & Lorenzo, 2015)). In addition to being a risk factor in determining 30-day and 60-day mortality, fluid overload leads to numerous complications, including pulmonary edema, cardiac failure, tissue breakdown, impaired bowel function, and delayed wound healing, (Claure-

Granado & Mehta, 2016). Patients experiencing these complications lead to increasing hospital costs, which subsequently leads to higher costs for patients and insurance companies.

According to the Society of Critical Care Medicine, over 5 million patients are admitted to intensive care units in the United States annually for numerous reasons: airway support and management, stabilization of acute or life-threatening medical problems, maximization of comfort for dying patients, overdose/poisoning, septic shock, respiratory failure, kidney and liver injuries, trauma, hypovolemic shock, hemorrhagic shock, etc., (SCCM, 2022). In the early 2000's, intensive care costs increased approximately 92%, from roughly \$57 billion, to nearly \$110 billion, (SCCM, 2022). By reducing length of ICU stay by 4 or more days, hospitals could save almost \$900,000 annually, “which represents 0.3% of total in-patient hospital costs and 1.2% of ICU costs,” (Evans, et al 2018). In a retrospective study performed in 2014 reviewing over 500 United States hospitals, it was discovered that patients suffering from fluid overload total hospitalization costs were \$15,344 higher per visit than non-fluid overloaded patients, and that ICU costs for over-resuscitated patients was \$5,234 higher than those not fluid overloaded, (Child, Cao, Sieberlich, Brown, Greenberg, Swanson, Sewall, & Robinson, 2014). Data collected from the state of Kentucky indicated that out of the 25 most common admissions in 2021, 9 were diagnoses that were commonly over-resuscitated or fluid-overloaded (i.e. sepsis/septic shock, pulmonary edema, heart failure, renal failure, gastrointestinal hemorrhage). Those admissions counted for 93,307 admissions in 2021, with average charges per patient ranging from \$26, 715.51 per visit to \$63,989.57, (Kentucky Cabinet for Health and Family Services, 2022).

Current Evidence-Based Interventions/Strategies Targeting the Problem

Currently there is an overall lack of standardization to identify patients experiencing fluid-overload, so there is no specific recommendation relating to the optimal transition time

between fluid resuscitation and fluid removal, (Bissell, et al, 2020). Current fluid status assessment includes physical examination (i.e. pulmonary rales, lower extremity edema, and jugular venous distention (JVD)), pulmonary catheter wedge pressure (PCWP), chest radiography, natriuretic peptides, bioimpedance vector analysis, and thoracic ultrasound, (Claire-Del Granado & Mehta, 2016). While all of these assessments are helpful in adequately assessing volume status, they are fairly inaccurate when used independently, (Claire-Del Granado & Mehta, 2016).

Delays in initiation of fluid removal may be related to concerns of serum creatinine rises and acute kidney injuries. Diuresis may also be delayed because clinical signs of hypervolemia (i.e., pulmonary edema, hypertension, cardiac failure, impaired bowel function, etc) are delayed in relation to true onset of organ damage. Current protocols guiding diuresis in the ICU population are outdated and do not use current evidence-based practices, such as relying on central venous pressures or pulmonary artery occlusion pressures, (Bissell, et al, 2020).

As there is a significant issue with standardized de-resuscitation of fluid overloaded ICU patients, in 2020, critical care pharmacists, in conjunction with nephrology and pulmonary service line providers, as well as bedside nursing staff at the University of Kentucky developed a diuresis protocol for de-resuscitation in ICU patients to reduce patient mortality, length of hospital stay, and ventilator days. This study indicated that patients that received protocolized diuresis experienced an additional ventilator free day, and a considerable difference in 72-hours post-shock fluid balance, (Bissell, et al, 2020).

Several weeks prior to the initial trial of the Diuresis Protocol, nurses received significant education during shift change. Nursing staff also received one-on-one education with the providers and pharmacists when the protocol was ordered. Following the initial implementation

of the Diuresis Protocol, nursing staff were surveyed, and results indicated that nursing staff was fairly comfortable utilizing the protocol. However, the COVID-19 pandemic led to substantial bedside staff turnover. In an interview with Medicine ICU manager Ron Simpson (2022), the PI was informed that because of this turnover, approximately 30% of the nursing staff currently are travel nurses, and many permanent employees have less than 2 years ICU nursing experience.

The lack of experience within the nursing staff has led to a critical knowledge gap regarding protocols that are not frequently used. Other issues that may contribute to discomfort and misutilization of the MICU Diuresis Protocol are a lack of continued education regarding the protocol, as well as implementation of a new electronic medical record (EMR). Currently, within UKHC's Medicine ICU there is no required nursing education that specifically relates to evidence-based knowledge and the UK developed Diuresis Protocol. Lack of education has led to ineffective utilization and misutilization of the Diuresis Protocol, potentially leading to increased length of stay and increased mortality in Medicine ICU patients.

Purpose and Objectives

The purpose of this quality improvement DNP project was to examine the effect of a web-based training module regarding the UK Diuresis Protocol on medicine ICU nurses' perceived knowledge of the diuresis protocol while increasing confidence and compliance. This practice inquiry also examined potential barriers for utilizing the nurse-driven diuresis protocol, as well as attitudes of nursing staff. This was accomplished by assessing knowledge before and after viewing the web-based educational module via a 15-questions pre- and post-intervention survey created utilizing Qualtrics.

The objective of this project was to conduct a knowledge improvement program about protocolized diuresis and its importance in reducing patient morbidity and mortality while

increasing ICU nurses' knowledge and self-confidence in the University of Kentucky's Medicine ICU. The specific aims of this project were as follows:

1. Assess the knowledge and confidence levels of ICU nurses when using the diuresis protocol to identify gaps in knowledge and improve nurse knowledge and confidence by utilizing both pre- and post-surveys.
2. Identify barriers MICU nurses discover when using the diuresis protocol and identify methods to overcome these barriers.
3. Educate approximately 150 Medicine ICU nurses at the University of Kentucky Medical Center on the diuresis protocol between March 2022 and April 2022.

Theoretical/Conceptual Framework

Evidence-based practice is critical for registered nurses to provide the highest quality, lowest cost patient care. (Melnyk & Fineout-Overholt, 2019). The Iowa Model allows clinicians to identify clinically relevant practice questions that can aid in the improvement of bedside practice and healthcare. This model also encourages administrators and nurses to create “a culture of inquiry, clinician ownership, and a system supporting evidence-based care delivery,” (Melnyk, et al, 2019). As evidence-based practice enhances healthcare, aids in the reduction of healthcare costs, improves patient outcomes, and empowers clinicians (Melnyk, et al, 2019), The Iowa Model was the clear choice for this practice inquiry.

This conceptual framework is composed of several steps. The first is to identify a problem or knowledge-focused trigger that would benefit from an evidence-based practice change. In the second step of the Iowa Model, the PI determines if the problem identified is a priority for a specific unit, department, or organization, (Brown, 2014). Problems with higher costs, higher volume, or higher risk are seen as higher priority. In this project, over-resuscitation

in ICU patients has been shown to increase length of ICU and total hospital stay, hospital costs, and incidence of hospital associated pressure injuries (HAPIs), acute kidney injuries, lung injury, pulmonary edema, impaired bowel function, and end organ dysfunction.

Additionally, the Iowa Model aids clinicians in recognizing problematic current practices and determining if new evidence-based practices are effective by utilizing feedback loops which focus on analysis, evaluation, and modification, (Melnik & Fineout-Overholt, 2019) and allows clinicians to determine if the issue is relevant to a specific patient population or an entire organization. The clinical problem, or “trigger,” identified was lack of understanding and confidence when using the diuresis protocol by bedside nursing staff. As the University of Kentucky utilizes evidence-based practice to guide care, the Iowa Model was determined to be the best framework to plan this project around.

Review of Literature

PICOT Question and Search Methods

This practice inquiry determined that there were several facets to be researched for it to be effective. As such, the following question was posed: in ICU patients that have received resuscitative measures and are subsequently profoundly fluid overloaded does utilization of nurse-driven protocolized diuresis reduce ventilator days, ICU length of stay, total hospital days, morbidity, and mortality by increasing nursing understanding, level of knowledge, and confidence?

An integrative literature review was conducted utilizing the University of Kentucky Medical databases Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, and Google Scholar. This literature review was performed to assess existing diuresis protocols and how to best implement evidence-based practice. Only articles

written in English within the last 5 years were included. Keywords utilized in the search were *fluid overload, volume overload, fluid resuscitation, diuresis, protocolized diuresis, diuresis protocol, renal replacement therapy, intensive care units, mechanical ventilation, mortality, nurses' perceptions, education, and evidence-based practice implementation*. Inclusion criteria were studies that were randomized controlled trials, systematic reviews or meta-analysis of randomized controlled trials, and retrospective analysis. Studies of pediatric populations were not included, nor were studies that did not occur within the intensive care population. A total of 45 peer-reviewed journals were identified; only 25 fit the search criteria.

Summary and Strength of the Evidence

Currently there is an overall lack of standardization to identify patients experiencing fluid-overload, so there is no specific recommendation relating to the optimal transition time between fluid resuscitation and fluid removal, (Bissell, et al, 2020). Current protocols guiding diuresis in the ICU population are outdated and do not use current evidence-based practice. Many facilities focus on central venous pressures or pulmonary artery occlusion pressures to measure the level of over-resuscitation, rather than utilizing physical examination of the patient, (Bissell, et al, 2020). Several studies indicated that while previous protocols guiding fluid removal in critically ill patients with conditions such as acute decompensated heart failure, and acute kidney injury (AKI) can be found, there is not a general diuresis protocol for ICU patients. Other studies indicated that there were several disadvantages to continued fluid resuscitation in ICU patients after the initial 24-48 hours. Positive fluid balance leads to significant damage to pulmonary and renal function, mortality, morbidity, ventilator days, and length of stay. Numerous other studies indicated that lack of standardization in identifying fluid-overloaded

patients also exists, and that clinical signs of organ damage caused by fluid overload are delayed, which may lead to ineffective utilization of diuresis.

Current State, Desired State, and Gaps in Practice

The critical care pharmacists, nephrology and pulmonary/critical care providers, and bedside nursing staff in the Medicine ICU at the University of Kentucky have developed a diuresis protocol utilizing IV push furosemide in incrementally increasing doses to be used until the fluid goal is met. While nursing staff was given extensive education initially regarding the protocol, high nursing turnover, high employment rates of ICU travel nurses, and implementation of a new EMR, interviews with MICU staff has led this PI to believe there is a considerable lack of confidence and significant confusion from bedside nursing staff when the Diuresis Protocol is ordered. The goal of this project is to assess understanding and desire of bedside nurses to learn about the diuresis protocol, provide specific education on the protocol, and increase nursing understanding and compliance of the protocol. By providing this education, the primary investigator hopes that the Diuresis Protocol will be more appropriately utilized, allowing for shorter length of ICU and hospital stay and decreased mortality rates, ventilator days, and hospital costs.

How the Proposed Solution to the Problem Addresses the Gaps

Implementation of new evidence-based practice is critical in providing the highest quality, safest and most efficient patient care. Registered nurses are at the forefront of patient care. Because of this, healthcare institutions must focus on educating nurses to incorporate new practice changes. Assessing barriers in knowledge and confidence, nursing attitudes and misconceptions, patient expectations, and organizational constraints will allow for increased compliance and adherence to the diuresis protocol. Additionally, assessing the aforementioned

factors will be helpful in determining knowledge deficits, systems problems, and ineffective processes occurring at the bedside.

Project Design and Methods

Design

The purpose of this quality improvement project was to assess the knowledge of UK's MICU bedside nurses about the MICU Diuresis Protocol while increasing confidence and compliance. The primary investigator utilized a quasi-experimental one-group pretest-posttest questionnaire designed for bedside MICU nursing staff with web-based educational module. This DNP project assessed nursing beliefs, attitudes, and understanding about the diuresis protocol before and after watching the educational module.

The primary investigator, acting as a change champion, utilized the practice of educational outreach to teach bedside nurses about the diuresis protocol introduced to the Medicine ICU at the University of Kentucky in 2019. Following a more comprehensive review of the literature regarding protocolized diuresis established by the Medicine ICU pharmacy team, the web-based educational module provided information regarding current evidence-based practices to support the use of the diuresis protocol, inclusion and exclusion criteria using the protocol, an outline and schematic of the diuresis protocol, order sets for the protocol, and considerations when using the protocol.

Setting

The setting of this study was the University of Kentucky, a 945-bed Level 1 trauma center and academic medical center located in central Kentucky. This facility treats medical and surgical patients from all over Kentucky, as well as patients from surrounding states such as Tennessee, Ohio, and West Virginia. It is the only extracorporeal membrane oxygenation

(ECMO) certified facility in the state and is also one of 2 transplant facilities in Kentucky. This DNP project was completed in the Medicine ICU, which is comprised of a 44-bed unit at UK Albert B Chandler Hospital on the 9th and 10th floors, and a 15 bed ICU on the 4th floor at UK Good Samaritan Hospital. Of the 59 beds, 32 of those beds are on MICU teaching teams comprised of residents and fellows. The remaining 27 beds are managed by advanced practice providers.

Agency Description and Project Congruence

The University of Kentucky espouses DIRECT values (diversity innovation, respect, compassion, and teamwork) to continuously pursue the next generation of cures, treatments, protocols, and policies, and provide the highest quality care to every patient, every time. As of the 2019 annual report, the University of Kentucky hospital employed over 9,300 full-time employees. Additionally, 41,589 patients were discharged in 2019, an average of 114 patients discharged daily (UKhealthcare.uky.edu, 2022).

UK HealthCare has a strategic plan going towards 2025 with a goal of building on advanced subspecialty care and collaborating with providers across Kentucky in order to remain committed to creating a healthier Kentucky. This will be accomplished by (1) building the culture of UK, (2) investing in the people of UK and Kentucky, (3) providing better value to health care, (4) strategically advance care, & (5) create a healthier Kentucky, (ukhealthcare.uky.edu, 2022).

Stakeholders

For this project several stakeholders will be involved. First, the DNP project committee will consist of Dr. Sheila Melander, the chair, Dr. Candice Falls, College of Nursing faculty, and & Dr. Brittany Bissell Turpin, the clinical mentor. Additionally, at the Medicine ICU, Dr.

Melissa Thompson-Bastin, a second pharmacist, Ronald Simpson, MICU manager, Adam Gould, Jenny Renaud, and Andrew Booth, MICU assistant managers have agreed to support the project implementation. Ben Hughes, director of the Medicine Service Line, and Seth Curtis, the manager of the UK Good Samaritan ICU were also supportive of the project. Finally, the most important stakeholders for the implementation of this DNP project are UK bedside nurses and MICU patients.

Facilitators and Barriers

There were several facilitators for completing this project in the Medicine ICU at the University of Kentucky, specifically, the support of the project committee, MICU administrative team, and bedside nursing staff. Additional facilitators included support of information technology for data access, and statistical reports, and the availability of the approximately 150 nursing staff that were offered the questionnaire. The survey questionnaires and educational module were available on-line, which aided in ensuring that all nursing staff were able to participate if they chose to.

Several barriers to implementation of the project existed. The protocol is not ordered by providers frequently enough for nurses to gain and maintain confidence in its usage. Resident physicians on the MICU teaching teams have not received education on the protocol, and many have not heard of it. Links to the survey questionnaires and the web-based educational modules were sent through unit specific ListServes, without read receipts. Length of time allotted for the educational intervention was 4 weeks, which may decrease knowledge retainment. Additionally, COVID-19 has wreaked havoc on staffing in the MICU, leading to many travel nurses staffing the unit. These travel nurses are not stakeholders for this project, and do not participate in many

unit-driven projects. Many of the nursing staff do not check their emails regularly and may not have seen the links.

To overcome these barriers, the primary investigator worked nursing staff and managerial staff to develop a timeline and schedule conducive for study implementation and evaluation. Additionally, the primary investigator worked with managerial staff to plan for educational materials to be given during staff meetings. The primary investigator also educated nursing staff on unit to clarify any misunderstandings and confusion about the Diuresis Protocol.

Sample Selection

As this study was to determine bedside nurses' level of knowledge, perceived confidence, and perceived barriers in implementing the diuresis protocol at the University of Kentucky Medicine ICU, only nurses employed in that unit were surveyed. While the Diuresis Protocol is MICU specific, the nurses employed within UK Good Samaritan ICU routinely get pulled to the Medicine ICU and have a 4-week orientation period within the MICU where they may be exposed to the Diuresis Protocol. Because of this, the PI deemed it appropriate to include them in the study. The study sample was deliberate purposive sampling, and as such may limit generalizability compared to other sampling techniques, (Burns, Duffett, Kho, Mead, Adhikari, Sinuff, & Cook, 2008). An invitation email was sent to MICU ListServ. The email included a cover letter that described the project objectives, voluntary participation, and survey response deadlines. Additionally, the link to the pre-intervention survey. A convenience sample of the roughly 150 staff nurses from the 9th and 10th floor Medicine ICUs at the University of Kentucky and UK Good Samaritan ICU were targeted for this study. Inclusion criteria for this study included:

1. Participants were registered nurses.

2. Participants were employed within the Medicine ICU at UK Albert B Chandler Medical Center and UK Good Samaritan.
3. Participants must have completed their orientation period.
4. Participants were full-time, weekend staff, per diem, and travel nurses.

Exclusion criteria includes:

1. Non-RNs were not allowed to participate. This includes licensed practical nurses (LPNs), nursing care technicians, advanced practice registered nurses (APRNs), physician assistants, physicians, and pharmacists.
2. Nursing students could not participate.
3. Pool staff, and nursing staff pulled from other units could not participate

Research Procedure

Consent & IRB Approval

UK Healthcare's Nursing Research Council approved the PI's DNP project prior to contacting participants, (refer to Appendix B for NRC approval letter). Additionally, approval was obtained the University of Kentucky Institutional Review Board (IRB) prior to implementation of the DNP project (#70484) and data collection, (refer to Appendix C for the project's IRB approval letter).

Evidence-Based Intervention

This intervention was based on the Iowa Model Revised. The Iowa Model allows clinicians to identify clinically relevant practice questions that can aid in the improvement of practice and healthcare (Melnyk & Fineout-Overholt, 2019). Following several interviews with bedside nursing staff, the PI identified the clinical problem as a lack of comfort and understanding of, as well as adherence to the diuresis protocol by bedside nursing staff. Three

main components comprised the intervention: (1) a pre-education survey to gain baseline data about nurses' perceived confidence, level of knowledge, and perceived barriers to utilization of the diuresis protocol; (2) a 15-minute web-based training module, & (3) a post-education module questionnaire provided through Qualtrics.

Initially, this web-based module was created as a 17 slide Microsoft PowerPoint presentation on the primary investigator's password-encrypted laptop. Following approval from the PI's advisor, the presentation was then recorded as a web-based training module on YouTube on March 17, 2022, and titled, "Diuresis Protocol Education Module." Educational content of the web-based education module included information about over-resuscitation in the ICU and its complications, how to identify over-resuscitated patients, the benefits of de-resuscitation, how to properly use the diuresis protocol, and common concerns nurses may have. Content for the web-based training module was created through the comprehensive literature review.

Measurements and Instruments

Pre- and post-intervention surveys were developed by the primary investigator based upon educational content found in the web-based training module, as well as from provider and pharmacist input. Surveys were approved by the PI's DNP advisor and sent out through the manager provided ListServ. The initial email sent to the target population contained an IRB approved cover letter (see Appendix A) that addressed the purpose, methodology, risks/benefits, survey process, and investigator contact information for the PI. By clicking on the survey link, participants consented to participate in the study.

Both pre- and post-intervention surveys were 15 questions, with the first question requiring the creating of an anonymous identifier, which allowed for deidentified survey results. In addition to the IRB approved cover letter, the initial email to participants included a link to the

pre-survey created in Qualtrics and a link to the web-based training module. The pre-survey assessment assessed MICU nurses' baseline knowledge, attitudes, and perceived knowledge in the MICU Diuresis Protocol. Additionally, questions focusing on barriers when using the Diuresis Protocol were covered. Knowledge was assessed utilizing true/false, multiple choice, and select all that apply questions. Perceived attitudes and barrier questions were assessed using 5-point Likert Scale questions. Questions 2-4 were demographic questions assessing education level, years of nursing experience, and location of employment of participants. The pre-survey was open for 2.5 weeks (from March 15 to April 1, 2022) prior to the link expiring, which allowed nurses the same amount of time to view the educational module. 3 weeks after the initial email was sent, a second email was sent via the same ListServ containing the post-intervention survey. The Post-intervention survey covered the same topics as the pre-survey, utilizing the same questions. An additional question asked if participants were able to view the web-based education module. The post survey was open for 2.5 weeks (from April 9th to April 25, 2022) prior to expiring.

Data Collection

Data were collected anonymously for both the pre- and post-web-based surveys via Qualtrics. Qualtrics is available through the University of Kentucky and is a secure web-based survey creator. As the primary investigator is employed in the Medicine ICU at UK, she knew the participants of the survey, and felt that anonymous responses would be in the best interest of the project. The survey developing software available on Qualtrics allowed the primary investigator to develop demographic, Likert scale, true/false, & select all that apply questions related to the DNP project aims of determining the perceived knowledge, perceived barriers, and attitudes towards utilization of the Diuresis Protocol.

Data Analysis

Data analysis occurred following completion of the pre- and post-test surveys. Data collected via Qualtrics were downloaded to the password-encrypted hard drives of the PI and statistician. Utilizing the assistance of Dr. Amanda Thaxton-Wiggins collected data were analyzed using SPSS version 28 and used an alpha level of $p < 0.05$. A 95% confidence level was used throughout the analysis. Frequency distributions summarized demographic characteristics of survey participants. Unpaired and paired sample t-test were utilized to evaluate knowledge, attitude, and belief of perceived barriers from pre- to post-survey. Spearman's Correlation Coefficient was used to test for an association between years of nursing experience, level of education (ADN vs BSN vs MSN/DNP), and location of employment and all outcomes at baseline. Knowledge and confidence data were assessed by using descriptive statistics (mean and standard deviation). By using paired and unpaired t-tests, the PI compared the mean correct answers regarding the four knowledge questions from both surveys. While the focus of the results is on the unpaired results, data from the paired results can also be found in Tables 2 and 6.

Results

A convenience sample of bedside nurses working in the Medicine ICU at UK Albert B Chandler Medical Center MICU and UK Good Samaritan MICU. Of the sample size of approximately 150 bedside nurses invited to the study, 51 nurses participated in the pre-intervention survey, and 35 participated in the post-intervention survey. Most participants were Bachelor of Science in Nursing (BSN) educated nurses (74.5% pre-intervention, 77.1% post-intervention) with at least 5 years of nursing experience (49% pre-intervention, 65.9% post-

intervention, see Table 1). 33 (94.3%) participants in the post-intervention survey were able to watch the web-based training education module (see Table 3).

While the nurses in both surveys were likely the same participants, the PI was only able to match the anonymous identifiers of 11 participants. Additionally, it cannot be assumed that the 24 other nurses that participated in the post-intervention survey were the same that participated in the pre-intervention survey. Table 1 details the demographic data of all pre-intervention and post-intervention participants. Table 2 depicts demographic data from the 11 paired samples. Tables 4 and 5 depict the knowledge and attitude assessments of the independent and paired samples respectively. Table 6 indicates the changes in perceived barriers towards using the Diuresis Protocol from pre-intervention to post-intervention.

Survey Results

Unpaired t-tests that compared pre- and post-intervention results were utilized. Knowledge and confidence questions were analyzed for the number of correct answers. The pre-intervention survey ($n = 51$) total knowledge & confidence score had a mean (SD) of 3.55 (0.86). In comparison, the total post-intervention score had a mean (SD) of 3.77 (0.88). According to the data, there were no statistically significant changes in knowledge items over time, with a p value of 0.245. Two of the four knowledge questions showed a statistically significant difference when comparing unpaired pre-intervention and post-intervention results (Table 4). Nurses were significantly more comfortable in using the MICU Diuresis protocol in the post-intervention survey ($p = 0.010$). Additionally, nurses more strongly agreed that excessive fluid resuscitation increased length of ICU and total hospital stay, ventilator days, acute kidney injuries, and mortality rates ($p = 0.017$) in the post-intervention results. In the paired analysis there were no statistically significant differences between pre-intervention and post-intervention results. The

magnitude of changes was similar in comparison to the unpaired samples, so this is likely a function of the much smaller sample size.

There were no statistically significant changes in barriers identified by nursing staff to utilizing the MICU Diuresis Protocol from the select all that apply question from the pre-intervention compared to the post-intervention (see Table 6). While there were no significant changes in barriers identified, the data points are crucial in identifying potential areas for future education. Lack of nursing education regarding the MICU Diuresis Protocol was the largest factor in why nurses were uncomfortable utilizing the protocol appropriately both in the pre-intervention survey (13.7%) and the post-intervention survey (14.7%). That being said, those results could be considered quite reasonable as many bedside nurses in the MICU are newer hires, and were not working bedside at the time of initial protocol roll out. Only 5.9% (n=3) of nurses in the pre-intervention survey and 8.8% (n=3) of nurses in the post-intervention survey believed hemodynamic instability was a barrier in appropriately de-resuscitating MICU patients. One participant (2%) in the pre-intervention survey believed that poor kidney function in the MICU patient population was a hindrance in using the Diuresis Protocol, while no participants in the post-intervention survey felt the same.

Discussion

The purpose of this quality improvement project was to gain understanding of bedside nurses' knowledge of the MICU Diuresis Protocol as well as perceived attitudes and barriers towards using the MICU Diuresis Protocol before and after viewing a web-based educational module by examining the efficacy of educational outreach and change champions. Specifically, does increasing nursing understanding, level of knowledge and confidence lead to increased utilization of nurse-driven protocolized diuresis? Evidence-based practice is the foundation upon

which nursing education is built, it “enhances healthcare quality, improves patient outcomes, reduces costs, and empowers clinicians,” (Melnyk, et al, 2019). By utilizing an effective web-based educational module to educate bedside MICU nurses, compliance to the MICU Diuresis Protocol can be achieved.

The results for this quality improvement project showed that bedside nurses were significantly more comfortable using the Diuresis Protocol following viewing the web-based education module. Additional results revealed that the educational module had a statistically significant effect on increasing nursing knowledge regarding the damage over-resuscitation can cause on ICU patients. There was no significant change in total knowledge over time, but in the post-intervention survey, nurses were considerably more comfortable using the Diuresis Protocol. Nurses also more strongly agreed that over-resuscitation increases ICU patient mortality, ICU and whole hospital length of stay, hospital costs, ventilator days, and end organ dysfunction following viewing of the educational module. While the results were not profoundly statistically significant, this is likely a function of sample size. These results appear consistent with current literature which indicates that web-based nursing education is effective in improving nursing knowledge and practice, (Liaw, Wong, Lim, Ang, Mujumdar, Ho, Mordiffi, & Ang, 2016). Recent research also indicates that web-based training also has the benefit of being a practical and accessible way for nursing staff to further their knowledge, (Tuma & Aljazeera, 2021).

Results of this study indicated that there is still a significant gap in knowledge regarding implementation and use of the MICU Diuresis Protocol. Knowledge surrounding diuresis and de-resuscitation appears considerably improved. While there was no statistically significant change in perceived barriers, there is some evidence that frequent education can reduce the barriers

nurses believe exist when incorporating the Diuresis Protocol in the Medicine ICU. Nurses in both the pre- and post-intervention surveys believed that lack of education regarding the MICU Diuresis protocol was a major reason that the protocol was not used appropriately. Additionally, a large portion of study participants believed that MICU patients were not hemodynamically stable enough to adequately diurese. Others believe that MICU patients' kidney function are too poor for the high-dose diuretics used in the protocol. Further questioning of bedside staff is needed to explore what other barriers may exist that impede use of the MICU Diuresis Protocol.

The PI of this study will share the results with UK Healthcare MICU management as well as healthcare providers and MICU staff. Because of the small sample size, these results cannot be generalized, so the PI will discuss the need for annual Diuresis Protocol education for all MICU staff during annual competencies, as well as education for new hires to the unit. This study is easily sustainable, as further questioning of bedside staff through web-based surveys that explore additional barriers and knowledge gaps can be performed.

Implications for Future Nursing Practice

Recent literature and this study suggest that utilization of a web-based training educational intervention can be beneficial in increasing knowledge and confidence in using the MICU Diuresis Protocol. The findings from this study imply that there is need for further education geared towards MICU staff regarding fluid overload, over-resuscitation, and the importance of de-resuscitation in Medicine ICU patients. This study also implied that long term, frequent education is needed to sustain knowledge and to enhance confidence and compliance with the Diuresis Protocol. Recognition of fluid overload is also vital, so additional educational content could be added to the existing MICU Diuresis Protocol module for further knowledge retention.

At the time the MICU Diuresis Protocol was initially implemented, MICU bedside nursing staff received substantial education, including one-on-one education with MICU providers and pharmacists when the protocol was ordered. Additionally, MICU staff received education several weeks prior to protocol roll-out, and were surveyed approximately 2 months following implementation. Secondary to massive staff turn-over, employment of travel nurses, and inexperience of staff, many MICU bedside nurses are unfamiliar and uncomfortable when implementing the MICU Diuresis Protocol. Currently there is no required standardized education for bedside nurses or providers. Future educational efforts for new hires should include educational material about how to effectively use the Diuresis Protocol. Moreover, an annual review on the protocol containing any changes made should be required with annual competencies. Additionally, in-person education sessions may foster more nurse engagement, and allow time for questioning, leading to increased knowledge retention. Reassessment can be completed within 3-6 months to assess for knowledge retention as well.

Additional forms of education regarding the protocol could also be implemented. Besides in-person and web-based training, education could also be tailored to audio learners, and additional flyers with frequently asked questions about the protocol could be distributed. Nurses should also be given longer time for learning retention and project participation, with re-evaluation of knowledge retention at 6-months and 12-months post intervention. Should this project be re-implemented, the PI would include questions ascertaining whether nurses were comfortable activating diuretic orders, where to locate activatable orders, how to determine whether the patient has met their goal per 8-hour shift, where to locate electrolyte levels on the EMR and how to decide whether additional doses should be given. Additionally, education on how to locate the pharmacist on service should the bedside nurse have questions on the protocol.

As physicians and advanced practice providers (APPs) are not educated on proper use of the diuresis protocol, future research should include assessing what additional knowledge gaps and perceived barriers exist from a provider's point of view when attempting to order the Diuresis Protocol. Do providers know where to locate the diuresis protocol in EPIC, or how to order it appropriately? Following interviews with Critical Care/Nephrology Fellow physicians, the PI determined that MICU residents are very unfamiliar with the Diuresis Protocol. This is due to Internal Medicine resident rotation schedule. Most spend one month a year in the MICU during their residency, and the majority are unaware the protocol exists. Education specifically aimed at providers, residents in particular, may lead to increased implementation of the MICU Diuresis Protocol.

Further research could be done to assess use within the protocol. Is the protocol being used correctly? Are providers ordering the protocol, only to have the on-coming treatment team discontinue it, regardless of whether the patient is responding appropriately? Are deviations to the protocol occurring, and do these issues require educational interventions when deviating from the Diuresis Protocol?

Limitations

There were several limitations with this quality improvement study. Generalization of the data collected is limited by the small sample size (n = 51 in pre-intervention survey; n = 35 in post-intervention). This study was conducted at a large academic medical center but was specifically focused on one intensive care unit. Including bedside nurses employed in all ICUs at the University of Kentucky would have likely increased sample size. Adding UKHC MICU physicians and APPs to future studies would be beneficial to assess what additional knowledge gaps and perceived barriers exist to proper utilization of the Diuresis Protocol. Survey fatigue

may be a reason for limited response. During the time this project was implemented, numerous other surveys were sent to the MICU listserv, including other Doctor of Nursing Practice project surveys. The Covid-19 pandemic has also led to significant burnout of nursing staff, which may also be a factor in the lack of response received.

Another important limitation is that this study lacked a control group that did not participate in the web-based training but responded to the pre- and post-intervention surveys. It is also possible that study participants stated they viewed the educational module without watching it. The results assume that participants viewed the educational module in totality. Time constraints for this quality improvement project may have lowered response rates. This study was carried out over a total of 8 weeks from March to April 2022, so long-term effects of a web-based education module cannot be determined at this time.

Initially, the PI of this study had intended for the educational intervention to be conducted in person on-site in the MICU. The COVID-19 pandemic ensured that the PI was unable to have any educational seminars on the floor, as visitors were restricted during the study period, but it appears that utilization of a web-based educational module on its own would have been more effective given more time.

Conclusion

Aggressive fluid over-resuscitation remains an issue for most patients admitted to the Intensive Care Unit worldwide. This over-resuscitation routinely leads to end organ damage, more days on the ventilator, delayed wound healing and increase in Hospital Associated Pressure Injuries, increased mortality rates, and increased hospital costs. This project examined how a web-based educational intervention could increase bedside nursing knowledge, confidence,

perceived empowerment, and compliance to a diuresis protocol developed by UKHC's Medicine ICU pharmacy team.

Current research shows that IV push diuresis is as effective as RRT or continuous drip diuretics in reducing fluid overload and improving patient outcomes. Results of this study indicated that bedside nursing, while familiar with the signs of over-resuscitation, were uncomfortable using the nurse-driven Diuresis Protocol for a variety of reasons. The study also showed that utilization of a web-based training intervention can be effective at significantly improving knowledge and comfort on this, and potentially other topics.

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Table 1. Descriptive summary of participant characteristics: Independent Samples

	Pre-education (n=51) n (%)	Post-education (n=35) n (%)	<i>p</i>
Years of nursing experience			.17
0-1 year	7 (13.7%)	4 (11.4%)	
2-4 years	19 (37.3%)	8 (22.9%)	
5+ years	25 (49%)	23 (65.9%)	
Education			.59
ADN	5 (9.8%)	4 (11.4%)	
BSN	38 (74.5%)	27 (77.1%)	
MSN/DNP	8 (15.7%)	4 (11.4%)	
ICU location			.34
UK Albert B Chandler MICU	45 (88.2%)	33 (94.3%)	
UK Good Samaritan ICU	6 (11.8%)	2 (5.7%)	

$p < .05$ is significantly different between time points

Table 2. Demographic summary of participant characteristics: Paired samples ($n = 11$)

	n (%)
Years of nursing experience	
0-1 years	1 (9.1%)
2-4 years	5 (45.5%)
5 + years	5 (45.5%)
Level of Education	
ADN	1 (9.1%)
BSN	10 (90.0%)
MSN/DNP	0 (0%)
Location	
UK Albert B Chandler MICU	11 (100%)
UK Good Samaritan ICU	0 (0%)

Table 3: Were you able to watch the educational module titled, "Diuresis Protocol Educational Module?"

Were you able to watch the educational module titled, "Diuresis Protocol Educational Module?"	Yes n (%)	No n (%)
n = 35	33 (94.3)	2 (5.7%)

Table 4. Changes in Perceived Knowledge and Attitudes Towards Protocol Use: Independent Samples

	Pre-education (n=51) Mean (SD)	Post-education (n=35) Mean (SD)	<i>p</i>
Knowledge (0-5)	3.55 (0.856)	3.77 (0.877)	0.245
Do you believe diuresis is as effective as hemodialysis in reducing volume in patients with volume overload?	3.22 (0.901)	3.29 (1.045)	0.741
Do you feel that Medicine ICU patients are routinely fluid overloaded?	4.27 (0.750)	4.09 (0.781)	0.263
Do you believe that over resuscitation of MICU patients results in increased length of ICU and total hospital stay, ventilator days, acute kidney injuries, and mortality rates?	3.82 (0.953)	4.26 (0.561)	0.010
How comfortable do you feel using the nurse-driven diuresis protocol?	3.02 (1.288)	3.63 (1.031)	0.017

$p < .05$ is significantly different between time points

Table 5: Changes in Perceived Knowledge and Attitudes Towards Protocol Use: Paired Samples

	Pre-education Mean (SD)	Post-education Mean (SD)	<i>p</i>
Knowledge (0-5)			
Does over resuscitation of MICU patients results in increased length of ICU and total hospital stay, ventilator days, acute kidney injuries, and mortality rates?	3.91 (0.831)	4.27 (0.467)	0.167
How comfortable do you feel using the nurse-driven diuresis protocol?	3.45 (1.293)	3.73 (1.009)	0.432

p<.05 is significantly different between time points

Table 6. Changes in Perceived Barriers Towards Protocol Use: Independent Samples

What do you feel are perceived barriers to using the nurse driven Diuresis Protocol?	Pre-intervention n (%)	Post-intervention n (%)
Lack of nursing education on Diuresis Protocol	7 (13.7%)	5 (14.7%)
Patients are not hemodynamically stable enough to diurese	3 (5.9%)	3 (8.8%)
Poor kidney function in patient population	1 (2.0%)	0 (0%)
All of the above	36 (70.6%)	25 (73.5%)
Other, not mentioned reasons	4 (7.8%)	1 (2.9%)

Appendix A. Cover Letter for Informed Consent

**Increasing adherence to protocolized diuresis for de-resuscitation of ICU patients by increasing nursing knowledge and confidence Survey
Cover Letter**

IRB Approval
2/15/2022 IRB #
70484
Exempt

Please consider completing the survey below:

Dear UK Medicine ICU Nursing Staff,

I am writing you on behalf of the University of Kentucky College of Nursing Doctor of Nursing Practice to request participation in a survey and education program as a requirement for graduation. The research proposal is entitled, "Increasing adherence to protocolized diuresis for de-resuscitation of ICU patients by increasing nursing knowledge and confidence," and seeks to investigate the impact an educational module has on nurses' confidence and knowledge regarding a protocol and how that confidence effects adherence to said protocol.

While there is no personal benefit or compensation from taking part in this research study, all responses will aid in the understanding of the effects of education on increasing adherence to the Medicine ICU Diuresis Protocol.

I hope to receive completed surveys from approximately 100 of you, meaning your answers are vital to me. Regardless, participation in this research study is entirely optional, and if you do choose to participate, you are free to skip any questions or discontinue the survey at any time.

The survey will take between 5 and 10 minutes to complete, and there are now known risks to participating in this research study.

All survey responses are anonymous, so no names or other demographic data will appear or be used on research documents; nor will they be used in presentations or publications.

Additionally, the research team will not know who any information came from, or who even participated in the study.

Please be aware though, that while I am making every effort to ensure the safety of your data once received on the server via REDCap, given the nature of online surveys, or with anything involving the internet, I cannot guarantee the confidentiality of the data while en route to me.

If you have questions regarding the survey or the research study, please feel free to ask. My contact information is provided below. If you have complaints, suggestions, or questions about your rights as a research volunteer, please contact the staff in the University of Kentucky Office of Research Integrity at (859) 257-9428, or toll-free at 1(866) 400-9428.

Thank you in advance for your assistance with this important project. If you choose to participate, please complete the survey within 14 days of receipt.

Sincerely,

Jenna Hauptert, BSN, RN, University of Kentucky College of Nursing

Phone: (859) 608-8543

Email: jenna.hauptert@uky.edu

Appendix B. Letter of Approval from University of Kentucky Nursing Research Council



January 12, 2021

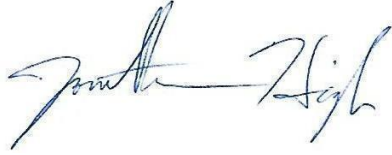
Dear Jenna R. Hauptert,

Your proposal entitled, “Increasing Adherence to Protocolized Diuresis for De-resuscitation of ICU Patients by Increasing Nursing Knowledge and Confidence” was reviewed during our January 12th meeting of the Nursing Research Council at the University of Kentucky Medical Center, and we are happy to report that your proposal has been approved. If you have not yet obtained approval for your research through the University of Kentucky Institutional Review Board (IRB), you must complete this process as well.

The Nursing Research Council reviews all proposals to conduct scientific inquiry that involve UK nursing staff in an effort to assess for a number of indicators: to determine the feasibility of conducting the proposed research, to establish the level of support from nursing management or administration to conduct the research, to determine the applicability to nursing, to facilitate IRB review ensuring proper protections are present, and to assess the completeness of the proposal. If your proposal is amended in any way such that the methods or procedures are modified significantly, your proposal must be re-submitted for review by this Council. ***You are required to provide your IRB approval date, study status and completion date to this council for compliance with Magnet verification requirements.***

Please contact me if you need further assistance, have questions, or wish to discuss anything.

Sincerely,



Jonathan High RN, BSN, CCRN, RN-BC

Dirk A. Church, RN, BSN, CCRN

Chair, Nursing Research Council

Co-Chair, Nursing Research Council

Office of the Executive Vice President for Health Affairs

University of Kentucky • 317 Wethington Building • 900 South Limestone • Lexington, Kentucky 40536-0200
Phone: (859) 323-5126 • Fax: (859) 323-1918 • www.ukhealthcare.uky.edu

Appendix C. University of Kentucky IRB Approval Letter



University of
Kentucky

Office of Research Integrity
IRB, RDRC

EXEMPTION CERTIFICATION

IRB Number: 70484

TO: Jenna Hauptert, BSN, DNP

Student College of Nursing

PI phone #: (859) 608-8543

PI email: jenna.hauptert@uky.edu

FROM: Chairperson/Vice Chairperson

Medical Institutional Review Board

(IRB) SUBJECT: Approval for

Exemption Certification

DATE: 2/15/2022

On 2/15/2022, it was determined that your project entitled "*Increasing adherence to protocolized diuresis for de-resuscitation of ICU patients by increasing nursing knowledge and confidence*" meets federal criteria to qualify as an exempt study.

Because the study has been certified as exempt, you will not be required to complete continuation or final review reports. However, it is your responsibility to notify the IRB prior to making any changes to the study. Please note that changes made to an exempt protocol may disqualify it from exempt status and may require an expedited or full review.

The Office of Research Integrity will hold your exemption application for six years. Before the end of the sixth year, you will be notified that your file will be closed and the application destroyed. If your project is still ongoing, you will need to contact the Office of Research Integrity upon receipt of that letter and follow the instructions for completing a new exemption application. It is, therefore, important that you keep your address current with the Office of Research Integrity.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "[PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research](#)" available in the online Office of Research Integrity's [IRB Survival Handbook](#). Additional information regarding IRB review, federal regulations, and institutional policies may be found through [ORI's web site](#). If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at 859-257-9428.

seeblue.

405 Kinkead Hall | Lexington, KY 40506-0057 | P: 859-257-9428 | F: 859-257-8995 | www.research.uky.edu/ori/

An Equal Opportunity University

Appendix D. Qualtrics Pre-Intervention Survey Questionnaire

Jenna Hauptert DNP Project Survey

Q1 As an anonymous identifier, please provide your street number and birth day.

Q2 How would you classify your experience as a registered nurse?

- 0-1 Years (1)
- 2-4 years (2)
- 5+ years (3)

Q3 What is your level of nursing education?

- ADN (1)
- BSN (2)
- MSN/DNP (3)

Q4 Do you work in the Medicine ICU at Albert B Chandler UK Hospital, or in the Medicine ICU at UK Good Samaritan Hospital?

- UK Good Samaritan (1)
- Albert B Chandler MICU (2)

Q5 Have you received education on the Diuresis Protocol in the past?

- Definitely not (1)
- Probably not (2)
- Might or might not (3)
- Probably yes (4)
- Definitely yes (5)

Q6 Do you feel that Medicine ICU patients are routinely fluid overloaded?

- Definitely not (1)
- Probably not (2)
- Neutral (3)
- Probably yes (4)
- Definitely yes (5)

Q7 What barriers do you feel hinder use of the Diuresis Protocol developed by UK MICU pharmacists? Select all that apply.

- Lack of nursing education on Diuresis Protocol (1)
 - Lack of provider understanding (2)
 - Patients are not hemodynamically stable enough to aggressively diurese (3)
 - Poor kidney function in patient population (4)
 - All of the above (5)
 - None of the above (6)
 - Other: Please elaborate in blank box below (7)
-

Q8 Do you believe that over resuscitation of MICU patients results in increased length of ICU and total hospital stay, ventilator days, acute kidney injuries, and mortality rates?

- Definitely not (1)
- Probably not (2)
- Might or might not (3)
- Probably yes (4)
- Definitely yes (5)

Q9 How comfortable do you feel using the nurse-driven diuresis protocol?

- Extremely uncomfortable (1)
- Somewhat uncomfortable (2)
- Neither comfortable nor uncomfortable (3)
- Somewhat comfortable (4)
- Extremely comfortable (5)

Q10 True or False: In addition to being a risk factor in determining 30-day mortality, fluid overload leads to numerous complications, including pulmonary edema, cardiac failure, tissue breakdown, impaired bowel function, and delayed wound healing.

- True (1)
- False (2)

Q11 How do know if your patient is fluid overloaded? Select all that apply.

- Increased ventilator settings (1)
- Increased serum creatinine and incidence of acute kidney injuries (2)
- impaired bowel function (3)
- delayed wound healing (4)
- All of the above (5)
- None of the above (6)

Q12 Do you believe central venous pressures (CVP) and pulmonary artery pressures (PAWP) accurately provide information about a patient's fluid status?

- Yes both CVP and PAWP provide accurate information regarding patient fluid status. (1)
- CVP only (2)
- PAWP only (3)
- Neither accurately provide information regarding patient fluid status. (4)

Q13 Do you believe that IV push diuresis is as effective in patients as a furosemide or bumetidine drip?

- Yes (1)
- No (2)

Q14 Do you believe diuresis is as effective as hemodialysis in reducing volume in patients with volume overload?

- Definitely not (1)
- Probably not (2)
- Neutral (3)
- Probably yes (4)
- Definitely yes (5)

Q15 Do you believe that diuresis adversely affects patient electrolyte status?

- Yes (1)
 - No (2)
-

DNP Post-Intervention Survey

Start of Block: Default Question Block

Q1 As an anonymous identifier, please provide the street number and birth day you provided in the pre-survey.

Q2 Were you able to watch the educational module titled, "Diuresis Protocol Educational Module?"

- Yes (1)
- No (2)

Q2 How would you classify your experience as a registered nurse?

- 0-1 Years (1)
- 2-4 years (2)
- 5+ years (3)

Q3 What is your level of nursing education?

- ADN (1)
- BSN (2)
- MSN/DNP (3)

Q4 Do you work in the Medicine ICU at Albert B Chandler UK Hospital, or in the Medicine ICU at UK Good Samaritan Hospital?

- UK Good Samaritan (1)
 - Albert B Chandler MICU (2)
-

Q6 After watching the educational module, do you feel that Medicine ICU patients are routinely fluid overloaded?

- Definitely not (1)
 - Probably not (2)
 - Neutral (3)
 - Probably yes (4)
 - Definitely yes (5)
-

Q7 What barriers hinder the use of the Diuresis Protocol developed by UK MICU pharmacists? Select all that apply.

- Lack of nursing education on Diuresis Protocol (1)
 - Lack of provider understanding (2)
 - Patients are not hemodynamically stable enough to aggressively diurese (3)
 - Poor kidney function in patient population (4)
 - All of the above (5)
 - None of the above (6)
 - Other: Please elaborate in blank box below (7)
-

Q8 Does over resuscitation of MICU patients results in increased length of ICU and total hospital stay, ventilator days, acute kidney injuries, and mortality rates?

- Definitely not (1)
 - Probably not (2)
 - Might or might not (3)
 - Probably yes (4)
 - Definitely yes (5)
-

Q9 How comfortable do you feel using the nurse-driven diuresis protocol?

- Extremely uncomfortable (1)
 - Somewhat uncomfortable (2)
 - Neither comfortable nor uncomfortable (3)
 - Somewhat comfortable (4)
 - Extremely comfortable (5)
-

Q10 True or False: In addition to being a risk factor in determining 30-day mortality, fluid overload leads to numerous complications, including pulmonary edema, cardiac failure, tissue breakdown, impaired bowel function, and delayed wound healing.

- True (1)
 - False (2)
-

Q11 How do you know if your patient is fluid overloaded? Select all that apply.

- Increased ventilator settings (1)
 - Increased serum creatinine and incidence of acute kidney injuries (2)
 - Impaired bowel function (3)
 - Delayed wound healing (4)
 - All of the above (5)
 - None of the above (6)
-

Q12 Do you believe central venous pressures (CVP) and pulmonary artery pressures (PAWP) accurately provide information about a patient's fluid status?

- Yes both CVP and PAWP provide accurate information regarding patient fluid status. (1)
 - CVP only (2)
 - PAWP only (3)
 - Neither accurately provide information regarding patient fluid status. (4)
-

Q13 Do you believe that IV push diuresis is as effective in patients as a furosemide or bumetidine drip?

- Yes (1)
 - No (2)
-

Q14 Do you believe diuresis is as effective as hemodialysis in reducing volume in patients with volume overload?

- Definitely not (1)
- Probably not (2)

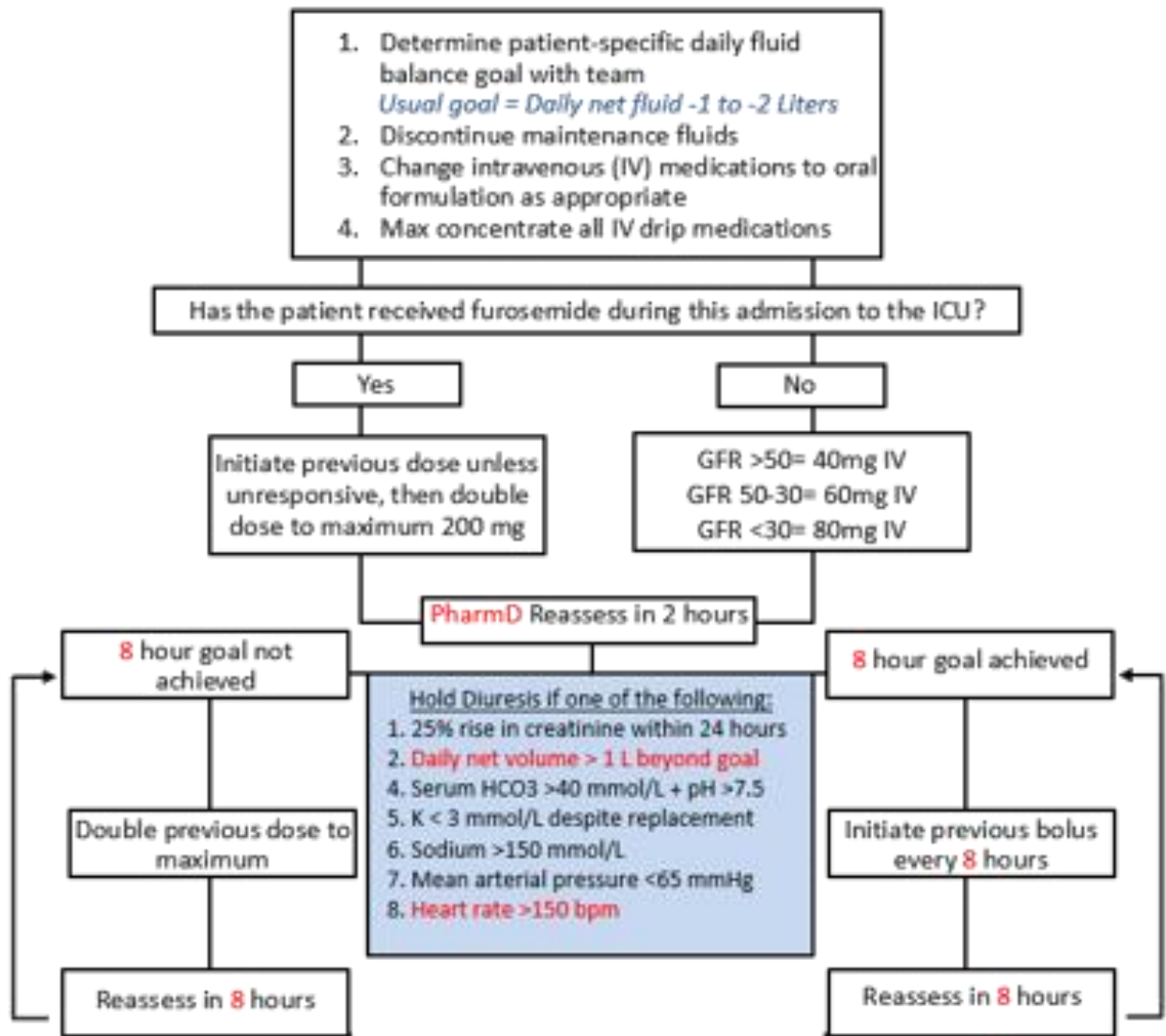
- Neutral (3)
 - Probably yes (4)
 - Definitely yes (5)
-

Q15 Do you believe that diuresis adversely affects patient electrolyte status?

- Yes (1)
- No (2)

End of Block: Default Question Block

Appendix F. MICU Diuresis Protocol



Goal shift fluid balance = Goal daily fluid balance/3

Increasing Adherence to Protocolized Diuresis for De-resuscitation of ICU Patients by Increasing Nursing Knowledge and Confidence

Jenna R. Hauptert, BSN, RN



Learning Objectives

1. Determine why critically ill patients are over resuscitated
2. Understand complications of over resuscitation and fluid overload in critically ill patients
3. Describe the signs and symptoms of over resuscitation in Medicine ICU patients
4. Identify benefits of de-resuscitation
5. Understand the Nurse-Driven Diuresis Protocol and how to integrate it into practice
6. Determine which patients qualify for the Nurse-Driven Diuresis protocol vs. single dose/IV drip diuresis vs. renal replacement therapy



Over Resuscitation in the ICU

- Patients are routinely and aggressively fluid resuscitated to improve hemodynamics and organ perfusion; (Bissell, Laine, Thompson Bastin, Flannery, Kelly, Riser, Neyra, Potter, & Morris, 2020).
- Adequate fluid resuscitation can dramatically decrease mortality rates for ICU patients
- Lack of standardization to identify fluid-overloaded patients
- No specific recommendation for transition from fluid resuscitation and fluid removal



Complications of Over Resuscitation

- Positive fluid balance on day 3 is an independent risk factor to 30-day mortality (Silversides, Fitzgerald, Manickavasagam, Lapinsky, Nisenbaum, Hemmings, Nutt, Trinder, Pogson, Fan, Ferguson, McAuley, & Marshall, 2018).
- Decreased renal function
- Acute lung injury requiring prolonged mechanical ventilation
- Acute Respiratory Distress Syndrome
- Pulmonary edema
- Acute heart failure & diastolic dysfunction
- Impaired bowel function
- Tissue breakdown and delayed wound healing



Identifying Over Resuscitation in the ICU

- Clinical exam and hemodynamic status together more accurate than fluid balance.
- Vital signs are not reliable end points of resuscitation alone
- CVP and PAP do not accurately provide information about fluid status as independent markers
- Lactate, base deficit, ProBNP, renal function panels, and electrolyte levels can be indicative of fluid overload



Benefits of De-Resuscitation

- Decreased ventilator days
- Decreased LOS in ICU/total hospital stay
- Reduced mortality rates
- De-resuscitation with IV push diuresis is as effective in most patients as continuous furosemide or bumetidine drips or hemodialysis.

MICU Diuresis Protocol

- Developed by MICU Critical Care Pharmacists Brittany Bissell, Melanie Lane, Melissa Thompson Bastin, & Alex Flannery
- Nurse and Pharmacist driven
- Goal: “To improve fluid balance post-shock in order to improve clinical outcomes with a simplified protocol that utilizes commonly evaluated bedside parameters,” (Bissell, 2020)



Inclusion Criteria

envision
engage
empower

- Non-pregnant
- Net positive fluid balance or signs of fluid overload on physical exam or CXR
- No vasopressor or bolus administration within 12 hours
- Receiving either mechanical ventilation or non-invasive ventilation

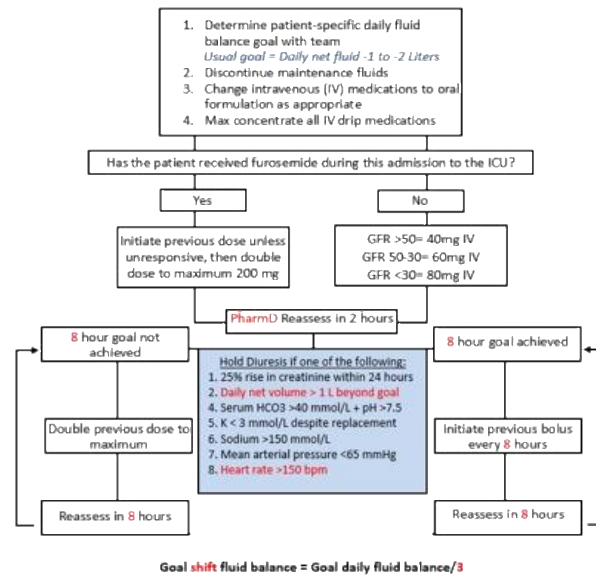


Exclusion Criteria

- Chronic restrictive, obstructive, neuromuscular, chest wall, or pulmonary vascular disease Neuromuscular disease
- Comfort Care/Hospice
- Anuric for at least 12 hours
- Nephrology consult for acute renal failure
- DKA/HHS
- Rhabdomyolysis
- Hepatorenal syndrome



MICU Diuresis Protocol



RESOURCES/REFERENCES/AVAILABILITIES:

MICU Diuresis Protocol

- Pharmacist determines daily fluid balance goal with team during morning rounds;
 - Typical goal is 1-2 liters net negative
- Maintenance fluids are discontinued
- IV drips and medications are either max concentrated or converted to oral formulation as appropriate
- If the patient was unresponsive to diuresis during their current ICU admission, initial dose is doubled
- If not administered furosemide during current stay, the ICU pharmacists dose based on GFR



RESOURCES/REFERENCES/AVAILABILITIES:

MICU Diuresis Protocol

- Goal typically net negative 1-2 liters over 24 hour period
 - Goal shift balance – daily goal/3
- Draw CMP 1 hour prior to initiation of Diuresis protocol
- Goal fluid balance is determined by pharmacy and team
- RN responsible for documenting urine output every two hours
- Must let pharmacy and team know no response or inappropriate response to diuresis
- Draw BMP every 8 hours
- Monitor for side effects (i.e. hemodynamic instability, tachycardia, ectopy)



Hold Diuresis IF:

- 25% rise in creatinine within 24 hours
- Daily net volume > 1L over goal
- Serum bicarbonate . 40 mmol/L & pH >7.5
- K < 3 mmol/L after replacement
- Sodium > 150 mmol/L
- MAP < 65 mmHg
- HR > 150 BPM sustained



Common Concerns

- What do I do if the provider does not order the Diuresis Protocol correctly?
- A: If on a MICU teaching team, first clarify with the resident and fellow if the team truly wants to utilize the Diuresis Protocol. Direct them to the protocol algorithm, and contact the MICU pharmacist for the proper dosing of furosemide. The residents have not received education about the protocol, and frequently need guidance through no fault of their own.
- A: If on MICU team 3, 4, or 5 the Advanced Practice Provider teams, clarify orders with the APPs and the MICU pharmacist on the team.



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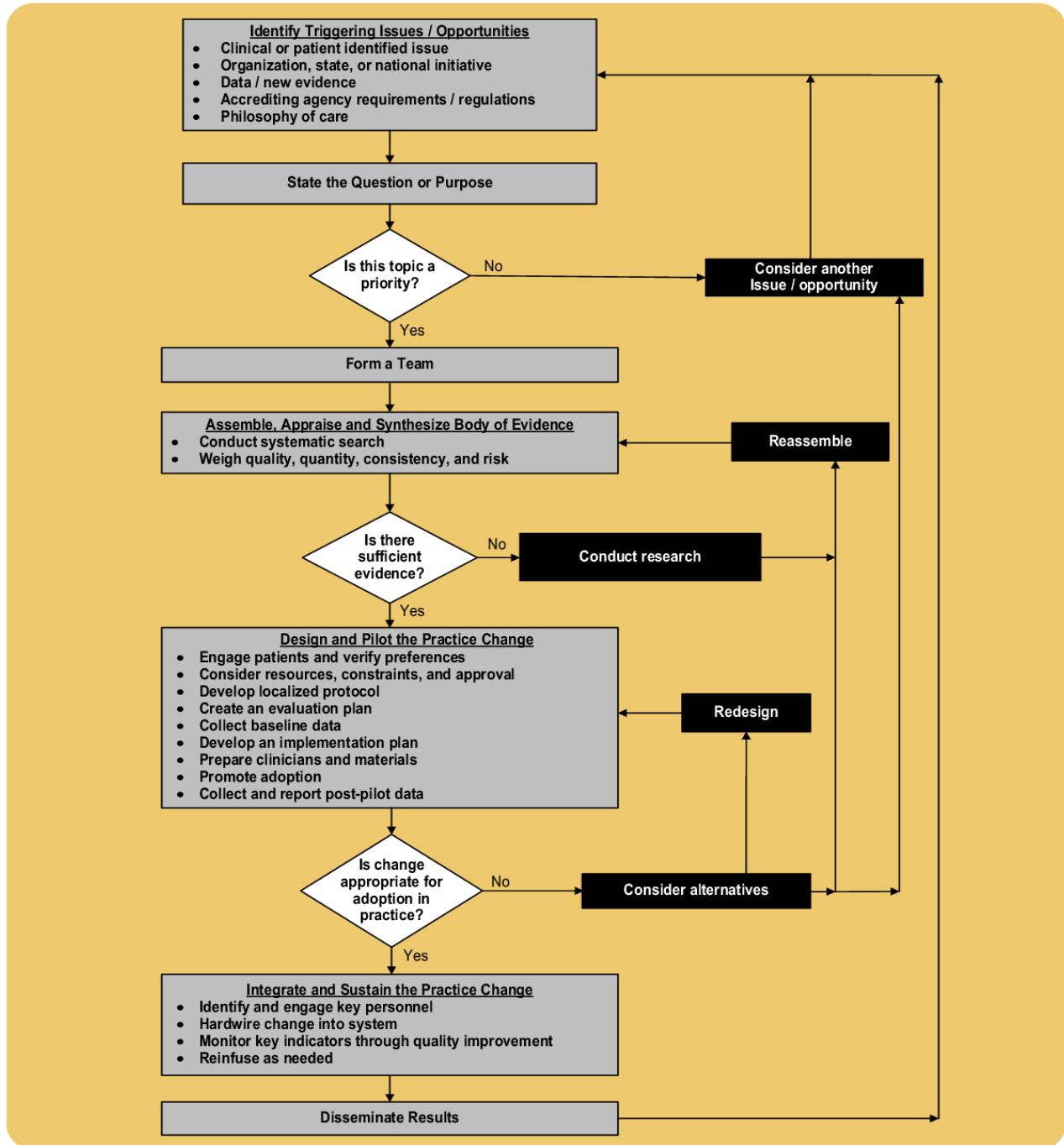


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The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care



◆ = a decision point

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