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An Interprofessional Collaboration to Increase Total Enteral Nutrition in Critically Ill Patients on Vasopressor Agents in CVICU

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An Interprofessional Collaboration to Increase Total Enteral Nutrition in Critically Ill Patients on Vasopressor Agents in CVICU

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Abstract

Background: Delayed enteral nutrition (EN) in critically ill patients increases the risk of complications and poor outcomes. The 2016 American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) and Society of Critical Care Medicine (S.C.C.M.) evidence-based guideline recommends initiating EN within 24-48 hours of Intensive Care Unit (ICU) admission once resuscitation and hemodynamically stability have been achieved. The evidence-based guideline notes that critically ill patients on low-dose vasopressors can be started on EN with close monitoring.

Purpose: This interprofessional project aims to increase the amount of EN delivered to all qualifying Cardiovascular Intensive Care Unit (CVICU) patients who are at risk for poor nutrition through the use of staff education, improved guideline compliance, dietary consultations, and chart audits.

Methods: A retrospective and prospective chart audit and pre-and-post nursing survey to determine overall nutritional intake via EN in CVICU patients with vasopressor agents. The CVICU nurses will complete a pre-test via redcaps, receive digital education (voiceover PowerPoint), and then a post-test via redcap's survey software. Retrospective institutional data (chart audit) will be collected to compare the total volume of EN received in the eligible population within 48 hours of vasopressor initiation at baseline (pre-education) compared to after-education intervention. The chart audit will also review the coordination of nutrition care between the critical care team, as evidenced by increasing nutrition consult orders within 24 hours of vasopressor initiation.

Results: There was a significant improvement in confidence level using the University of Kentucky Healthcare (UKHC) EN feeding guideline (p-value < .001). Most respondents

considered their EN knowledge average/above average in pre and post-test (86.8% and 92%). Although 86.8% of participants had considered their EN knowledge average/above average in the pretest, respondents reported a knowledge deficit (less than 25% correct) in the pretest about the timing of EN, differentiating between high-risk vasopressor dose when on multiple pressors, tube feed formula, signs and symptoms of feeding intolerance, and clinical evidence required to initiate EN. Only 22% (n=9) of patients in the pre-intervention chart review and 37.5% (n=15) of patients in the post-intervention chart review were started on EN within less than 48 hours of vasopressors being ordered. Therefore, initiating EN within 48 hours of vasopressors being ordered (p-value 0.125) or increasing the number of nutrition consult orders (p-value 0.325) and nutrition evaluation (p-value 0.381) was not statistically significant.

Conclusion: There is still a gap in initiating EN therapy within 48 hours of vasopressors. However, more education and a larger sample size can better understate guideline compliance. This study demonstrated the positive impact of a multifaceted educational approach on nursing knowledge and attitudes. Despite the established guideline, it highlighted some challenges and gaps associated with EN in the ICU.

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Dedications

"Be the kind of person you are today. She is the one with vision and strength to create your future"- Anonymous.

Five years ago, when I began my DNP journey, I heard this quote somewhere, and ever since then, it has been stuck with me as a reminder of whom I am meant to be and achieve in life. It has been a long journey, but I can proudly say that I have done it. I have achieved the dream that a younger, high school version of me once saw. Therefore, I dedicate this accomplishment to myself first for seeing a vision and staying dedicated to fulfilling my vision. However, this long journey would not have been fulfilled without the unconditional support and sacrifice of my husband, who took care of me and all my needs and valued the time given so I could prioritize my studies. I dedicate my accomplishment to my parents, who sacrificed their beautiful lifestyle in Nepal and moved across the world to provide better education and opportunities for my brother and me. It is the sacrifices that they made in their journey of living in an unknown country to get me where I am today. Achieving this degree would be my parents' dream come true more than mine. Lastly, to my brother who inspired me growing up to achieve a higher education to the best of my potential.

Table of Contents

List of Appendices

List of Tables

Background and Significance

Problem Statement

Early enteral nutrition (EN) within 24-48 hours is frequently recommended for hemodynamically stable patients in Intensive Care Unit (ICU) (Taylor et al., 2016). Critical illnesses are associated with a catabolic stress state which activates the body's systemic inflammatory response (Taylor et al., 2016). However, patients in the ICU often appear to have a different degree of inflammation resulting in reduced energy and protein intake, increased energy expenditure, and protein catabolism (Wischmeyer, 2020). Complications such as infectious morbidity, prolonged hospital stays, prolonged wound healing, loss of lean muscle mass, and multi-organ failure from increased pro-inflammatory cytokine production, gut barrier dysfunction, and cellular apoptosis are common (Wischmeyer, 2020). Approximately 40% of critically ill patients have malnutrition (O'Leary-Kelley & Bawel-Brinkley, 2017), and 70% of malnutrition occurs when staying in the hospital (Taylor et al., 2016). Gastrointestinal dysmotility in critically ill patients has been shown to occur between 30% to 70% of the time, leading to EN intolerance (Wischmeyer, 2020). A delay in patients receiving nutrition within 24-48 hours of beginning a vasopressor was observed throughout personal nursing practice, anecdotally resulting in a noticed practice gap.

Context, Scope, and Consequences of the Problem

Critically ill patients are often started on vasopressor agents during the shock state to correct vascular tone depression and improve organ perfusion pressure. During the shock state, our body's compensatory response is to shunt blood away from nonvital organs (e.g., gastrointestinal [GI tract]) (Wischmeyer, 2020). The shunting of the blood and the presence of vasopressor agents act on splanchnic circulation, raising concerns for mesenteric ischemia and

non-occlusive bowel necrosis (NOBN) (Taylor et al., 2016). Bowel necrosis carries a high rate of mortality of 46%–100% (Wischmeyer, 2020). However, the incidence of mesenteric ischemia in patients on EN and vasopressor therapy is only about 0.3% to 3.8% (Merchan et al., 2017). The magnitude of the effect on gut perfusion and NOBN seems to be dose related. Studies have shown that even 20% of EN can prevent bacterial transmission, metabolic deterioration, and gut ischemia, maintain intestinal function, and enhance immunity (Wischmeyer, 2020).

Evidence-Based Practice

Multiple studies have recommended early enteral feeding in critically ill patients; however, controversy still exists regarding the optimal time to deliver EN safely and effectively in patients receiving vasopressors. The American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) and Society of Critical Care Medicine (S.C.C.M.) suggest holding EN in hemodynamically unstable patients on "high-dose" catecholamine therapy until stable but, also advocates for the cautious use of EN in patients on "low dose" catecholamine therapy (Taylor et al., 2016). The specific definition of "low dose" catecholamine therapy is not defined in the ASPEN/SCCM guidelines. Nevertheless, there is multiple research that indicates initiating early EN versus no EN or late EN has led to decreased ICU mortality, hospital mortality, and lowered 28-day mortality (Merchan et al., 2017; Ohbe et al., 2020; Ohbe et al., 2018). There are many clinical practice guidelines (CPG) specific to trophic feedings and EN available to guide providers regarding the dosing of vasopressors. The University of Kentucky Healthcare (UKHC) “Feeding the hemodynamically unstable adult patient” (appendix B) guideline seeks to increase early EN administration in appropriate clinical scenarios and guides providers in high-risk situations where EN should be restricted to a reduced rate or withheld.

Purpose/Objectives

This project aims to increase total EN administration within 48 hours on hemodynamically stable patients requiring vasopressors in the Cardiovascular Intensive Care Unit (CVICU) at UKHC. It is an interprofessional project aimed at ensuring that the UKHC feeding guideline is being followed, leading to an increase in the total amount of EN. The objectives for this project include the following:

1) Develop a digital education based on current UKHC feeding guidelines.
2) Deliver an educational intervention to nurses (pre/post surveys) via Redcaps.
3) Engagement by registered dietitians: increased number of nutrition consults within 24 hours of vasopressor orders.
4) Conduct an audit (using an algorithm tool) to ensure guideline compliance and total EN increased among high-risk qualifying patients pre/post-intervention.

Improving patients' nutritional status will support patients' GI function, lower inflammation, support immune response, restore microbiome composition, and decrease insulin resistance (Wischmeyer, 2020). Hemodynamic stability makers include normal lactate less than 2.0 mmol/L, mean arterial pressure (MAP) greater than 65 mm HG, vasopressor requirement decreasing or stable, fluid requirement stabilizing, and no ongoing or active bleeding.

Theoretical Framework

Lewin's theory of planned change will guide the implementation of early EN initiatives to facilitate change in practice. Lewin's theory of change includes three stages: Unfreeze, change, and refreeze (Wojciechowski et al., 2016). The first step to Lewin's 3-step model of change is to challenge the status quo, demonstrating issues or problems (unfreeze). The second step is training, demonstrating the benefits of change or decreasing forces that negatively affect changes

(changing). The last step is to stabilize the new equilibrium in the system to become a habit (refreeze) (Wojciechowski et al., 2016).

This model will create awareness among nurses about the UKHC guidelines for feeding hemodynamically stable patients (unfreeze). Nurses can initiate conversations about tube feeds, and providers can be more attentive toward ordering nutrition consults within 24 hours of vasopressor orders so that registered dietitians can do their nutrition evaluation within 24 to 48 hours (change). Nurses and clinicians can help "refreeze" the change by ensuring the guideline are followed by every patient who meets the criteria.

PICOT Question and Search Methods

A literature review was conducted to determine the evidence supporting the implementation of EN guidelines set by the ASPEN/SCCM. The question guiding this project review is: In CVICU patients receiving treatment with a vasopressor agent who qualifies for EN, does a nursing-staff education program on early EN guidelines, compared to no education, result in an increased overall nutritional intake within 48 hours of vasopressor initiation.

The literature review was conducted using PubMed and CINAHL with the inclusion criteria of evidence-based articles published between 2012 to 2022 that are in full text and in English language. The key search terms included “ICU patients,” “enteral nutrition,” “vasopressors,” “nutrition guideline,” “registered dietitians,” “providers,” “nurses,” and “education.” Exclusion criteria were studies with children.

Review, Analyze, and Synthesize Evidence

The literature review was narrowed to 10 research articles. Six articles were conducted in the medical ICU, and four were in multiple ICUs. One study was a randomized control trial, two were quasi-experimental, one was a quality improvement, one was observational, and the

remaining were retrospective and prospective studies. All ten studies were based on education intervention, of which seven focused on nurses, two on a multidisciplinary team, and one on providers. Education to the nurses was about implementing fasting guidelines and nurse-led nutrition protocol. Education to the providers was about implementing the EN phone app, and education to the multidisciplinary team was about implementing nutrition enhancement protocol (NEP) and the use of mean arterial pressure/norepinephrine equivalent dose index (MAP/NEQI) as the measure for EN.

Summary of the Evidence, Including Strength of Evidence

Three studies found that implementing a fasting guideline in ICUs reduced the interruption time of EN and allowed for better EN/caloric delivery (Gonik et al., 2016; Jenkins et al., 2019; Segaran et al., 2016). Four studies focused on nurse-led nutrition protocol, initiating EN within 24-48 hours and increasing overall nutritional intake (Friesecke et al., 2014; Koontalay et al., 2020; Orinovsky & Raizman, 2018; Padar et al., 2017). Two studies focused on educating multidisciplinary teams found that NEP increased overall EN intake. In contrast, another study found that patients with MAP/NEQ index greater than 417 mmHG/kg/min could be started on EN with a low risk of feeding intolerance (McCartt et al., 2022; Wang et al., 2022). Lastly, one study that focused on using an EN phone application to assist providers in selecting a tube feed formula based on a patient's hemodynamics significantly reduced the EN initiation time (Mahmood et al., 2019). Overall, the strength of the studies was good. One study was level I, one was level II, and the remaining were level III evidence.

Identify Current State, Desired State, Gaps in Practice

Currently, EN is not being started within 48 hours despite the patient being hemodynamically stable on vasopressors. The desired state would be to increase EN guideline

compliance in patients who meet the inclusion criteria and start EN within the first 48 hours of vasopressor initiation. The current gap is related to a need for more knowledge about the UKHC feeding guideline among bedside nurses, therefore, lack of utilization of the guideline. This project aims to address the gap by first assessing the nurse's knowledge of UKHC EN guidelines at baseline via pre-survey, then utilizing the information discovered from the survey to create a digital education about the importance of EN and the UKHC guideline and re-evaluate their knowledge using post-survey. The goal is to increase total EN in stable patients with vasopressors.

Design

This research project is an interprofessional intervention designed to increase EN among patients identified as high risk for poor nutrition in the CVICU. This research study will use a pre-and-post-nursing survey and retrospective and prospective chart audit to determine overall nutritional intake via the enteral route in CVICU patients with vasopressor agents.

Setting

Agency Description

The project was implemented at UKHC in Lexington, Kentucky. The project will be conducted in the 42-bed CVICU. The patients in CVICU are managed by critical care medicine (CCM), cardiothoracic (CT) surgery, heart and lung transplant team, thoracic surgery team, respiratory therapist, and nurses. The average nursing staff is 27 nurses per shift.

Alignment of DNP Project to Agency's Mission/Goals/Strategic Plan

The UKHC mission is committed to academic healthcare, research, education, and clinical care. UKHC strives to provide the best patient care to the community by offering the most advanced patient care and information resources (UK Healthcare, 2022). This research

project aligns with the mission because the focus is on advancing patient care by educating nurses and implementing evidence based early EN guidelines in a clinical care setting to improve patient outcomes (increased overall nutritional intake).

Stakeholders

The key stakeholders were nurses, providers, registered dietitians (RD), clinical nurse specialists (CNS), managers, and patients. Nurses provide direct patient care, implement evidence-based guidelines, and participate in nursing surveys. Providers decide which patients meet the inclusion criteria for early EN and carry out the guideline. Registered dietitians are the main experts and can help execute the guideline by seeing the patients within 24 hours of nutrition consult orders. CVICU nurse manager and CNS help facilitate the distribution of pre-post surveys. Lastly, patients receive nutritional care based on the guidelines, directly affecting their ICU outcomes.

Site-specific Facilitators and Barriers to Implementation

Facilitators of the project implementation would be an alignment of UKHC mission with the project, CNS as a project mentor, manager, and RD support of the project. Barriers to implementation would be the reluctance of the nursing staff (taking their time away from the bedside to educate about UKHC guideline), staff turnover, providers' personal biases (risk of mesenteric ischemia), or interfering with daily nursing care priorities.

Sample

The target patient sample for institutional chart review will be CVICU patients on vasopressors. The inclusion criteria for sample patients include patients lactate less than 2.0 mmol/L, MAP greater than 65 mmHg, vasopressor requirement decreasing or stable, fluid requirement stabilizing, and no ongoing or active bleeding. Exclusion criteria are a

contraindication to receiving EN (e.g., ischemic bowel). Approximately 100 patients' institutional data will be collected.

Procedure

IRB Submission Process and Timeline of Project Phase

This study was approved by the University of Kentucky Instructional Review Board (Lexington, KY) as meeting the criteria for expedited status. Since this was a retrospective and prospective medical record review, individual informed consent was waived due to the study being minimal risk. The rights and welfare of subjects were protected using a password-protected computer and password-protected Microsoft Excel spreadsheet. Baseline data collection occurred after the IRB approval of the project from June to August 2022 for electronic chart review and pre-education survey data in September 2022 from nursing staff. The education intervention was completed in October 2022. Lastly, post-intervention data via electronic chart review was collected from December to March 1st, 2023. Post-education survey data was collected after the completion of the educational intervention in November 2022.

Evidence-Based Intervention

A digital education intervention was presented describing the importance of early EN, current healthcare gaps with EN on patients with vasopressors, and updated EN guideline recommendations. Nursing education was presented through a digital voiceover PowerPoint sent out to bedside nurses, and in-depth teaching was provided during the monthly CVICU education council meeting and non-working hours. The education intervention focused on increasing the administration of early EN in appropriate clinical scenarios, improving the coordination of nutrition care between critical care teams, guiding in high-risk situations where EN should be

restricted to a reduced rate or withheld, and increasing nutrition consult orders and recommendations within 24 hours of vasopressor initiation.

Measures and Instruments

The measures of this study are knowledge and competency skills. Post-education survey data measured the knowledge and skills were measured by institutional data showing an outcome of overall nutritional intake and nutrition consult orders. The variables used for institutional data collection included patient demographics, heart rate, MAP, vasopressor dosage, time from vasopressors initiation to EN, and total feeding received in 48 hours.

An instrument used for this project was a pre-and post-survey questionnaire from ASPEN/SCCM EN guideline and UKHC feeding guideline consisting of open and close-ended and Likert -scale questions. An instrument for institutional data was an algorithm tool created to look at guideline compliance on the target patient population as evidenced by pre/post institutional metrics and a nutrition consult order after the education intervention.

Data Collection Plan

Nursing pre- and post-education survey data and retrospective institutional data were collected. The inclusion criteria for nurse participants for pre-and post-education surveys were CVCIU bedside nurses. The pre-post education survey was collected via Redcaps survey software. Participants for the nursing survey were recruited by sending out an email with the study information, cover letter form, and survey links to bedside nurses of CVICU. Approximately 50 nurses were recruited for the pre-and post-nursing survey. Retrospective institutional data were collected through the University of Kentucky Center for Clinical and Translation Science (UK CCTS). Data collection compared the EN started less than 48 hours or more than 48 hours after vasopressor initiation at baseline (pre-education) compared to after

education; EN goal met or unmet per RDs recommendation, and an overall increased EN knowledge amongst nurses.

Data Analysis Plan

Statistical data were analyzed through SPSS software. Demographics such as age, gender, employment status, past medical history, smoking status, weight, average heart rate, MAP, lactate, hemoglobin, and hematocrit were analyzed using descriptive statistics. Crosstabulation was done to compare EN started in less than 48 hours, greater than 48 hours, nutrition goals, oral intakes, and diagnosis.

Leven's test for equality of variances was used for analyzing self-rated nursing confidence. Crosstabulation was done to compare the demographics of nurses taking pre-and post-nursing surveys and comparison of diagnosis. Pearson chi-square tests were used to analyze knowledge-based questions in the pre-and post-nursing survey and compare nominal measures such as gender, comorbidities, vasopressor agents, and smoking status. Lastly, an independent sample test was used for continuous measures such as heart rate, MAP, hemoglobin, hematocrit, weight (kg), and age.

Feasibility, Sustainability, Resources

A digital education, in-person CVICU education council meeting, and ample time for surveys and data collection/analysis allowed for the high feasibility of completion of this project. Upon completion, the digital education PowerPoint could be used by the CVICU staff education team to educate new oncoming nurses on the unit, thus increasing the sustainability of this project. Resources used for this study were statisticians provided by the UK College of Nursing (UK CON), a clinical mentor for supervision, and a primary investigator for executing electronic health record (EHR) reviews, analyzing data, and interpreting data. The consultation with a

statistician was free of charge. Data collecting and analyzing software were provided by UKHC free of charge.

Results

Nursing Survey

Demographics. A total of 50 (N=50) nurses completed the pre-education survey, and 53 (n=53) took the post-education survey. The same individuals (n=50) completed the pre- and post-education survey. Most nurses who completed the survey were female (73.6%). The bulk of participants were full-time nurses (75.5%) with a Bachelor of science in nursing (BSN) degree (83.0%). The spread of ICU experience ranged from 1-2 years (39.6%) and five years or greater (30.2%). Nursing survey demographics are outlined in Table 1.

Self-Rated Nursing Confidence. There was a significant improvement in the level of confidence in using the UKHC EN feeding guideline (p-value < .001, table 2) and an improvement in the confidence in being able to access the guideline via the UKHC Care web page (p-value < .001, table 2) after the educational intervention. There was no change in the confidence level when initiating a conversation with the provider about EN post-educational interventions (p-value 0.940). The participants' confidence level about the importance of EN also remained unchanged from pre-education to post-education; however, the overall knowledge of EN was increased (P-value < .001, table 2).

Self-Rated Nursing Knowledge. Most respondents considered their EN knowledge average/above average in pre and post-test (86.8% and 92%, table 5). The overall knowledge score was also significantly improved after the education from a mean of 3.57, SD of 1.25 to a mean of 6.66, SD of 2.02 (p-value < .001, table 3). Eighty-six percent of the participants agreed/strongly agreed that the PowerPoint Presentation helped them understand the importance

of early EN for patients who are considered high-risk (table 4). Some participants also voiced that they could follow the guidelines with their patients and inform the providers about the next step with EN following the guideline during audit rounds. In two open-response questions, 88% of the participants (n=44) were able to state the benefits of EN therapy in critically ill patients. Participants were also able to state multiple situations that would require withholding or delaying EN therapy.

Knowledge Deficits. Respondents reported a knowledge deficit (less than 25% correct) in relation to the timing of EN, high-risk vasopressor dose, tube feed formula, signs and symptoms of feeding intolerance, and clinical evidence required to initiate EN in the pretest (Table 3). Respondents acknowledge that registered dietitians were primarily responsible for determining the feeding regimen and giving their input within 24 hours of orders being placed; however, they believed they needed a better understanding of the kind of tube feeds they were administering to their patients. During audit rounds, some respondents verbalized that the comparison of tube feeds mentioned in the PowerPoint education was helpful for them in understanding why the dietitians chose the specific tube feed formulas.

Retrospective and Prospective Chart Review

The retrospective chart review was collected from June 2022 to august 2022. Eighty patients had vasopressors ordered, of which 41 patients met the inclusion criteria, and 39 patients were excluded. Similarly, in the prospective chart review collected from December 2022 to March 1st, 2023, 86 patients in CVICU had vasopressors order, of which 40 patients met the inclusion criteria and 45 were excluded. Patients were excluded due to lactate exceeding 2.0 mmol/L or high dosages of a vasopressor agent.

Demographics Comparison. There was no significant difference in patient characteristics, such as age, weight, and gender, in the retrospective and prospective chart review. The average mean age was in the mid-50s, with a mean weight (kg) of 80 kg (table 6). The gender was evenly distributed between 50- 55% male and 45- 48.8% female in pre- and post-chart reviews (table 6). The majority of the patients admitted to CVICU were in cardiothoracic service (19.8%) and cardiology service (13.6%) (table 7).

Diagnosis Comparison. In the pre-intervention chart review, 34.2% of patients were diagnosed with coronary artery bypass graft (CABG), and 26.6% were diagnosed with other heart diseases (ex: heart failure, endocarditis, myocarditis, atrial fibrillation etc.). However, in post- intervention chart review, only 7.5% of patients were diagnosed with CABG, and 35% were diagnosed with other heart diseases. More patients with respiratory problems (17.5%) and valvular heart disease (17.5%) were in the post-intervention group than in the pre-intervention group. The diagnosis comparisons can be found in table 8.

Co-morbidities Comparison. Nine co-morbidities were compared on all CVICU patients (smoking status, coronary artery disease [CAD], congestive heart failure [CHF], chronic kidney disease [CKD], acute kidney injury [AKI], hypertension [HTN], acute myocardial infarction [AMI], end-stage kidney disease [ESKD], and CABG). There was no significant difference in the co-morbidity comparison from pre- and post-intervention chart reviews. More than 55% of the patients had a medical history of CAD, CHF, or AKI, and almost everyone, 85-92%, had HTN in both groups. There were 55% of patients who had never smoked in the pre-intervention group, and 45% of patients were former smokers in the post-intervention group. The co-morbidities comparison can be found in table 9.

Hemodynamic Comparison. There was no significant difference in the hemodynamics from the pre- and post-intervention chart reviews. The average heart rate in both groups remained approximately 80 bpm, with an average MAP of the 70s-80s mmHG, lactate of 1.3-1.4 mmol/L, hematocrit of 30%, and hemoglobin of 9 to 10 g/dl. A significant difference in MAP with $p < .001$ was noted due to an outlier in the dataset; however, the overall mean and standard deviation of MAP remained unchanged from the pre- and post-intervention group (table 10).

Vasopressor Comparison. The majority of patients in the pre-intervention chart review were on epinephrine (44%) and norepinephrine (51.2%), whereas the majority of patients in the post-intervention chart review were on norepinephrine (55%) (table 11).

Enteral Nutrition, Nutrition Order, and Evaluation Comparison. Initiating EN within 48 hours of vasopressors being ordered (p-value 0.125) or increasing the number of nutrition consult orders (p-value 0.325) and nutrition evaluation (p-value 0.381) was not statistically significant. Only 22% (n=9) of patients in the pre-intervention chart review and 37.5% (n=15) of patients in the post-intervention chart review who were started on EN within less than 48 hours of vasopressors being ordered. Most patients who received EN in less than 48 hours did meet their nutritional goal (60% in the pre and 75% in the post-intervention group) recommended by RD. There was only a 10% increase in the number of nutrition consults and recommendations made by RD in the post-intervention chart review. Over 60% of the ICU patients were being followed and evaluated by RD daily at baseline (table 12).

Oral intake (PO) Comparison. Over 75% of patients in the pre-and post-intervention chart review had oral intake. In the pre-intervention chart review, 76% (n=22) of the patients had oral intake, of which 39% had open heart surgeries and, therefore, would have oral intake after the surgery (post-extubation). Similarly, 79.2% (n=19) of patients in the post-intervention chart

review had an oral intake, of which 32.5% had open heart surgery and were able to have oral intake (table 13). Approximately 96% of the patients who have had open heart surgeries could have oral intake, and more than 60% of the patients who did not have surgery but were medically managed had an oral intake (table 14), thus not requiring EN. However, the study did not look at the nutritional goals for patients who had oral intake; therefore, it cannot be concluded that patients who received oral intake met the nutrition goals per recommendations made by RD.

Discussions

The primary study objectives were to ensure that the UKHC feeding guideline was being followed, leading to an increase in the total amount of EN. Education of the UKHC feeding guideline to CVICU nurses via objectives one, two, and four resulted in a significant increase in the usage of EN guideline; however, objective three did not make any statistical difference. The two measures of this study were knowledge and competency skills. The post-education survey data measured knowledge, while competency skills were measured by institutional data showing an outcome of overall nutritional intake and an increase in nutrition consult orders.

Nurses Knowledge

Enteral nutrition in ICU patients is often delayed for reasons such as procedures, gastrointestinal dysfunction, lack of access, or lack of knowledge on the importance of early EN. Nurses play a vital role in coordinating with the multidisciplinary team to have patients receive EN if there are no complications. The ASPEN/SCCM guideline for providing and assessing nutrition support therapy in critically ill adult patients recommends EN initiation within 24-48 hours following admission to ICU once resuscitation and hemodynamic stability have been obtained. This guideline recommends that EN be withheld in patients requiring significant hemodynamic support. Consistent with the findings of Darawad et al. (2015) and Morphet et al.

(2016), in the pretest, nurses from the study acknowledged their role in assessing feeding tolerance and delivering EN, yet they reported a lack of knowledge in relation to the dosages of vasopressors and identifying what is considered low risk, medium risk, and high-risk dosage when on multiple vasopressors. Nurses were also unaware of the recommended feeding rate, which may prevent nurses from adequately assessing and managing their patients. However, education to the bedside nurses was statistically significant ($p < .001$, table 3) in improving their overall knowledge of EN. Nurses showed a significant improvement in knowledge-based questions ($p<.001$, table 3), and 88% of the respondents could list the benefit of early EN and when to withhold or delay EN therapy in an open response requestion.

During audit rounds, some respondents verbalized that they have a better understanding of the importance of EN, the signs and symptoms of feeding intolerance, and why certain tube feed formals are used. For example, respondents were able to differentiate “Peptamen intense VHP,” which is evenly distributed with protein, carbs, and fat and commonly used on critically ill patients, versus “impact peptide,” which is commonly recommended in long term patients to reduce the rates of infection, length of stay, and ventilator days in surgical and critically ill patients, and helps with wound healing verses “Peptamen 1.5” which is a calorically-dense GI formula, address nutritional needs in smaller volume, especially on heart failure patient with fluid overload. Overall, in-person education and communication with coworkers have been documented as the preferred source of EN information and improved protocol adherence (Morphet et al., 2016).

Competency Skills

The competency skills (increase in EN intake and increase in nutrition consult and evaluation by RD within 24 hours) measured by institutional data were not statistically

significantly different in post-education (p-value of 0.125, 0.352, and 0.381) (Table 12). There was an increase in initiating EN in less than 48 hours by 15%, which could be due to fewer patients being admitted for open heart surgery and more patients being admitted for medical management with other heart diseases, valvular heart disease, and respiratory problems during post-intervention chart review which occurred during the winter holiday month. However, a larger sample size of patients with EN and a more extended study duration is required to see a significant difference in compliance with nutrition guidelines. There was an increase in nutrition consult orders and recommendations made by RD by only 10%.

Two of the significant key findings were that most of the services admitting patients to ICU settings have ICU preset orders, which includes nutritional consult order regardless of patients being on vasopressors therapy. Therefore, more than half of the patients were already being followed and evaluated by RD daily, leading to no statistical difference in improvement. Thus, it cannot be concluded that there was an increase in nutrition consults orders after initiating vasopressor therapy. Another finding was that open heart surgery patients have brief ICU stays and often recover within the first 1–2 days after surgery; therefore, they are less likely to benefit from intense nutrition support. Generally, oral or EN intake is continued within less than 24 after surgery to reduce surgical stress, maintain physiological functional capacity, and facilitate postoperative functional recovery (Hill et al., 2018). Many patients who had open heart surgeries and were also on multiple vasopressors (epinephrine, norepinephrine, dopamine) were fast-tracked to extubation within 2–6 hours postoperatively; thus, there were a higher number of patients (more than 75%) with oral intakes, not requiring EN therapy.

Plans for Sustainability

Many patients in the ICU are on vasoactive agents for hemodynamic support. Nurses and providers must understand that nutritional therapy within 24 to 48 hours after admission to the ICU is essential to a patient's intensive care and better outcomes. Enteral nutrition, when started at an appropriate time, has reduced the incidence of unfavorable outcomes in critically ill patients as well as the risk of infectious complications and ICU length of stay (Wischmeyer, 2020). The educational content made of this project can be incorporated as a required component of the ICU orientation process. For the new graduate nurses and regular staff, the educational content and the UKHC feeding guideline can be converted into web-based training, where annual competency is required from all ICU nurses and providers. This helps increase awareness amongst nurses and providers and improve compliance with the guideline.

Future Implications for Practice

Future Research

Future research should consider adding a "Nutrition Risk in Critically ill" (NUTRIC) score, a risk assessment tool specifically for ICU patients that identifies patients likely to have a mortality benefit from aggressive nutrition therapy. A NUTRIC score of five or greater would indicate that patients are most likely to benefit from aggressive nutrition therapy. The score would allow the researcher to investigate if high-risk patients in ICU were started on EN therapy on time.

This study did not look at the tolerability of EN with certain vasopressors and their dosages nor compared the differences in diagnosis that required vasopressors such as surgeries, shock (septic, cardiogenic, or distributive shock), and cardiac procedures. The future implication for practice is to look at the tolerability of EN with specific diagnoses and different types of

vasopressor agents, as each agent has different effects on mesenteric vasculatures, thus leading to different tolerability. Future research should also consider adding diabetes mellitus as one of the comorbidities because vasopressors such as norepinephrine can cause a wide swing in blood glucose levels, changing the course of nutrition therapy that patients can receive.

Lastly, future research should exclude patients with open heart surgeries and only consider patients in ICU for medical management. As mentioned earlier, patients with open heart surgery are typically fast-tracked to extubation within 2-6 hours postoperatively and have oral intake. To gain a broader understanding of compliance with the EN guideline, only medically managed patients should be included as inclusion criteria. Furthermore, patients from the medical ICU, trauma ICU, and neurovascular ICU should also be considered for a bigger sample size and to compare the compliance of UKHC feeding guideline from different services.

Future Policy

A best practice advisory (BPA) is a clinical decision support (CDS) tool built into the EHR that alerts healthcare providers to promote quality care, reduce inefficiency, and advance communication through web-based delivery of information (Fry, 2021). A BPA or red flag can be added to the UKHC EPIC (EHR) system that will alert providers if the patient has not had any nutritional intake in the past 24 hours or has had an "NPO" order for more than 24 hours. This will allow providers to assess and reassess patients' nutritional status daily.

Cost Implications

The cost of disease-associated malnutrition in the United States has been estimated as more than $147 billion per year, with $15.5 billion attributed directly to treatment costs (Sulo et al., 2017). According to National Health and Nutrition Examination Survey and the National Health Interview Survey, an estimated direct medical cost of disease-associated malnutrition in

Kentucky is $46 per capita cost, and the overall burden of direct medical expenditures related to malnutrition by diseases (such as stroke, COPD, CHF, colon cancer, breast cancer, dementia, musculoskeletal and depression) is approximately $205.4 million annually, of which malnutrition burden due to dementia is the highest in Kentucky, $113.8 million annually (Goates et al., 2016).

Data from the 2018 healthcare cost and utilization project (HCUP) found that 55% of patients with a coded diagnosis of malnutrition (CDM) were 65 years and older, had longer lengths of stay, incurred higher costs, and were readmitted within 30 days as compared to patients without CDM (Guenter et al., 2021). Research has found that a nutrition-focused quality improvement program using a web-based budget impact model has led to a reduction in 30-day hospital readmissions and length of stay with a total cost saving of more than $4.8 million and the net savings of more than $3800 per patient treated for malnutrition (Sulo et al., 2017). Future research can also be done to understand the cost-effectiveness of similar nutrition-focused quality improvement programs targeting malnourished hospitalized patients in other healthcare networks. Proper inpatient nutrition care, which may frequently be delayed, is clinically and economically significant. Mobilizing healthcare stakeholders to implement effective, team-based care processes that monitor and improve the nutrition care of hospitalized patients can decrease patient morbidity, mortality, and cost nationally.

Limitations

There were several notable limitations in this study. Most noteworthy is the retrospective chart review design and the risk of selection bias and inaccuracies from missing information or data not double-checked for accuracy. The study only looked at EN as a source of nutrition. In contrast, some patients may have received additional caloric intake via parenteral routes such as

parenteral nutrition, propofol, and dextrose-containing IV fluids. Also, most patients admitted were surgical candidates requiring coronary artery bypass graft and, post-operatively, were transitioned to oral intake; thus, meeting the nutrition goal per RD recommendation was not studied on oral intakes. This study did not compare the sample by patients admitting diagnosis. More patient data and a longer duration of research are warranted to conclude which specific diagnosis had higher chances of patients being placed on vasopressor and thus also needing EN. The results of this study should not be generalized to all ICU patients as this study was specific to patients only admitted to the cardiovascular ICU. Multiple ICU patients are needed to maximize generalizability and have a broader understanding of guideline compliance.

Survey fatigue was also a likely barrier to survey participation. The nurses that were asked to self-report their level of EN knowledge may have over or under-reported their level of knowledge and confidence, which can affect the results. The "select all that applies" questions were not a good choice for knowledge-based questions as one may choose all the correct options but miss one to get the full answer wrong, thus skewing the correct overall results. The study's strength was diverse nursing years of experience, with a diverse range of clinical education.

Summary and Conclusion

Increased compliance with the UKHC feeding guideline through staff education can increase nutrition delivery and improve patient outcomes. There is still an existing gap in initiating EN therapy within 48 hours of vasopressors; however, more education and a larger sample size can better understate guideline compliance. This study demonstrated the positive impact of a multifaceted educational approach on nursing knowledge and attitudes. Despite the established guideline, it highlighted some challenges and gaps associated with EN in the ICU. Despite nurses indicating that their knowledge of EN is “average” or “above average,”

knowledge deficit is prevalent in some areas of the decision-making process about EN. Our goal is to cause no harm to our patients who are already sick; therefore, meeting the guideline recommendation to prevent harm should be considered in each patient through evidence-based strategies. Continuing to educate nurses and providers and implementing evidence-based policy changes (BPA alerts) can help augment evidence-based practice. Future research should focus on applying the guideline to the vulnerable population, such as malnourished individuals with low NUTRIC scores, and trending the outcomes.

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List if Appendices

Appendix A

Cover Letter

An Interprofessional Collaboration to Increase Total Enteral Nutrition in Critically Ill Patients on Vasopressor Agents in CVICU

To CVICU Nursing Staff Members:
I am contacting you from the University of Kentucky College of Nursing, on behalf of Priyanka Shah. Researchers at the University of Kentucky are inviting you to take part in a research study to improve interprofessional collaboration to increase total enteral nutrition in critically ill patients on vasopressor agents. The purpose of this survey is for the researcher to gain a better understanding of your attitudes and knowledge of current evidence-based practice recommendations and assess your familiarity with the current UKHC "Feeding the Hemodynamically Unstable Patients" guideline. The information obtained from the pre survey will be used to develop an educational intervention that will be offered to all nurses during a monthly staff meeting scheduled in November 2022. A follow up post survey will be sent via email to staff that completed pre survey and attended the educational intervention. The post survey will assess whether the educational intervention influenced attitudes and/or improved knowledge.

Although you may not get personal benefit from taking part in this research study, your responses may help us understand more about early EN in a specific group of patients identified as high risk for poor nutrition in the CVICU. Some volunteers experience satisfaction from knowing they have contributed to research that may possibly benefit others in the future.

There is no known risk to participating in this study. Participation is voluntary and at no cost to you except for the time taken to complete the survey. You will not be penalized in any way for skipping or discontinuing the survey. The pre survey will take about 10 to 15 minutes to complete. The post survey is nearly identical to pre survey and therefore, will require 10-15 minutes to complete. The educational intervention will be presented via PowerPoint during a scheduled staff meeting and will require 15 minutes of time to complete

If you do not want to be in the study, there are no other choices except not to take part in the study. At the conclusion of pre and post survey, you will be redirected to a secondary REDCap link. There you can enter your name and email address for a chance to win a prize. Two (2) participants will be randomly selected to receive one (1) $100 dollar visa gift card as a gesture of appreciation for taking part in the study. The approximate likelihood of being drawn is 1 in 50. **To be eligible for the prize, participants must enter their name and UK email into the secondary link for <u>BOTH</u> surveys and verify attendance during the educational intervention by inputting their name in the chat option via Zoom.**

We hope to receive completed pre and post survey questionnaires from about 50 people, so your answers are important to us. Of course, you have a choice about whether or not to complete the

survey/questionnaire, but if you do participate, you are free to skip any questions or discontinue at any time. You will not be penalized in any way for skipping or discontinuing the survey.

There is minimal risk that there may be a breach of confidentiality. However, your response to the pre and post survey is anonymous which means no names, IP addresses, email addresses, or any other identifiable information will be collected from survey responses. We will not know which responses are yours if you choose to participate. Furthermore, if you choose to opt in for prize drawing, your identifiable information will not be linked to your previous survey responses.

Please be aware, while we make every effort to safeguard your data once received on our servers via REDCap, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still en route to us.

If you have questions about the study, please feel free to ask; my contact information is given below.

Thank you in advance for your assistance with this important project. To ensure your responses/opinions will be included, submit the pre and post surveys within two weeks of receiving this links. By clicking the link below, you are agreeing to participate in the research study.

Sincerely,

Priyanka Shah
College of Nursing, University of Kentucky
PHONE: 859-539-3582
E-MAIL: psh229@uky.edu

Faculty Advisors:
Dr. Sheila Melander, sheila.melander@uky.edu
Dr. Candice Falls, cdharv0@uky.edu

If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.

Appendix B

UKHC Enteral Nutrition Guideline

Table 1

Nutrition Risk Category	Vasopressor Dose	Nutrition Recommendations	Monitoring Parameters
Low risk	Norepinephrine ≤ 0.1 mcg/kg/min Epinephrine ≤ 0.05 mcg/kg/min Dopamine 2.5 – 5 mcg/kg/min Phenylephrine ≤ 0.1 mcg/kg/min Vasopressin ≤ 0.03 units/min	Peptamen VHP at 20 ml/hr advance by 10 ml/hr q 4 to goal rate of 50 ml/hr	Patients should be assessed by the RN q 4 hr for ability to titrate EN **Do Not Initiate or Advance TF if:** **Vitals/Labs:** Increasing lactate, MAP <65 (on or off vasopressors, per provider discretion), increasing vasopressor requirements, adding vasopressor agents, O2 sats <90% (or per provider discretion), or showing signs/symptoms of feeding intolerance (below) **Signs/Symptoms of Feeding Intolerance:** abdominal pain, severe abdominal distension, high gastric output (500 ml over 4 hr), nausea, vomiting, ileus, mesenteric ischemia, or other positive abdominal x-ray finding *If patient is already at goal TF rate, or is being titrated to goal rate, and clinically declines, TF order will be modified based on MD discretion *Use extra caution when initiating TF on patients recovering from mesenteric ischemia
Moderate risk	Norepinephrine 0.1 - 0.29 mcg/kg/min Epinephrine 0.05 - 0.09 mcg/kg/min Dopamine 5 – 7.9 mcg/kg/min Phenylephrine 0.1 – 1.8 mcg/kg/min Vasopressin 0.04 units/min	Peptamen VHP at 20ml/hr. Monitor for ability to transition full feeds q 4 hr	
High risk	Norepinephrine ≥ 0.3 mcg/kg/min Epinephrine ≥ 0.1 mcg/kg/min Dopamine ≥ 8 mcg/kg/min Phenylephrine ≥ 2 mcg/kg/min Vasopressin > 0.04 units/min	Hold or stop TF, monitor status for ability to start EN q 4 hr	
Nutrition Risk Category: The listed doses of agents per category, regardless of the number of agents being used, corresponds to the recommended feeding schedule. If a patient is on multiple agents of varying strengths, defer to the highest dosed vasopressor for the nutrition intervention **Nutrition Recommendations:** Can be used until the Registered Dietitian has completed their assessment and provided recommendations			

HealthCare. **UKHC Guidelines for Feeding the Hemodynamically Unstable Adult Patient**

Summary and Background
The gastrointestinal tract plays an important role in regulating inflammatory and immune response, in addition to the absorption of nutrients. In critical illness, patients can experience a massive pro-inflammatory response from the gut leading to tissue damage, impaired immunity against infection, and increased risk of bacterial translocation into the bloodstream. 30-50% of ICU patients are malnourished on admission, predisposing them to these complications. Early initiation of enteral nutrition (EN) can be greatly beneficial in supporting proper GI function. Providing just 20% of a patient's total nutritional goals enterally can lower inflammation, support immune response, restore microbiome composition, and decrease insulin resistance.

The 2016 ASPEN/SCCM guidelines state that EN can be initiated within the first 24-48 hours following ICU admission, once resuscitation and hemodynamic stability have been achieved. However, ASPEN does not define parameters for resuscitation or hemodynamic stability. ASPEN also notes that critically ill patients on low dose, stable vasopressors can be started on EN with close monitoring. However, they do not give dose parameters for a low dose vasopressor. Additionally, ASPEN recommends EN should be withheld from patients on high dose vasopressors, but they do not give dose parameters for a high dose vasopressor.

The effect of vasopressors on gut perfusion and the risk of non-occlusive bowel ischemia seems to be dose-related. Thus, recommendations for a safe dose range of vasopressor selection for initiation of enteral nutrition would be of utility. Specific to UKHC, there is great heterogeneity between critical care teams in regards to how they provide EN to patients on vasopressors. There is an opportunity to improve the nutrition status of our ICU patients by initiating and advancing feeds in a timely and safe manner.

These guidelines seek to increase the administration of early EN in appropriate clinical scenarios, improve the concordance of nutrition care between critical care teams, as well as provide guidance in high-risk situations where EN should be restricted to a reduced rate or withheld.

Prior to initiation of EN, assess the patient for resuscitation and hemodynamic stability markers:
- -Lactate normalized (≤ 2.0 mmol/L) or correcting rapidly
- -Mean arterial pressure (MAP) maintained >65 mm Hg (with or without vasopressors, or per provider discretion)
- -Vasopressor requirements decreasing or stable (e.g.: Norepi @ 0.2mcg/kg/min with other stable parameters listed here)
- -Fluid requirements stabilizing (patient is not actively requiring fluid boluses for blood pressure maintenance)
- -No ongoing or active bleeding

-Once resuscitation and hemodynamic stability have been achieved, the primary team will initiate tube feedings based on the guidelines below (Table 1)
-The RD will be responsible for completing a Nutrition Evaluation Note with tube feeding recommendations within 24 hours of the placement of the Nutrition Consult order

Appendix C

Pre-Education Nursing Survey

1. How do you identify yourself?
    a. Male
    b. Female

2. What is your employment status?
    a. Full time
    b. WEPP (weekends only)
    c. PRNs
    d. Travel Nurse

3. How many years of ICU experience do you have?
    a. < 1 year
    b. 1- 2 years
    c. 3-4 years
    d. ³ 5 years

4. What is your highest level of education?
    a. Associate Degree in Nursing (ADN)
    b. Bachelor of Science in Nursing (BSN)
    c. Master of Science in Nursing (MSN)
    d. Doctorate in Nursing (DNP or PHD)

5. How would you rate your level of knowledge of enteral nutrition?
    1= Poor
    2= Below average
    3= Average
    4= Above average
    5= Excellent.

6. I feel confident using “Feeding the Hemodynamically Unstable Adult ICU Patient” guideline on every patient on vasopressors in the CVICU as recommend by UKHC.
    1= Not confident at all
    2= Below average level of confidence
    3= Average level of confidence
    4= Above average level of confidence
    5= Highest level of confidence

7. I can find UKHC “Feeding the Hemodynamically Unstable Adult ICU Patient” guideline on the care web?
    1= Strongly Disagree
    2= Disagree

3= Neutral/Undecided
4= Agree
5= Strongly Agree

8. I feel confident initiating enteral nutrition conversations with the providers.
    1= Strongly Disagree
    2= Disagree
    3= Neutral/Undecided
    4= Agree
    5= Strongly Agree

9. Enteral nutrition is started within 48 hours of initiating vasopressors on critically ill patients in CVICU.
    1= Never
    2= Rarely
    3= Sometimes
    4= Very Often
    5= Always

10. According to UKHC guidelines, what is the recommended tube feed formula that can be started on qualifying patients with vasopressors?
    a. Isosource 1.5
    b. Peptamen VHP
    c. Peptamen 1.5
    d. Impact Peptide 1.5

11. What is the recommended tube feed rate that can be started on patients with vasopressors?
    a. 10 ml/hour
    b. 20 ml/hour
    c. 30 ml/hour
    d. 40 ml/hour

12. What is considered low risk vasopressor dose to initiate tube feeds?
    a. Norepinephrine $\leq$ or equal to 0.1 mcg/kg/min
    b. Norepinephrine at 0.1 – 0.29 mcg/kg/min
    c. Vasopressin at 0.04 Units/min
    d. Epinephrine 0.05-0.09 mcg/kg/min

13. What is considered high-risk vasopressor dose where tube feed should be held or stopped?
    a. Norepinephrine 0.1-0.29 mcg/kg/min
    b. Dopamine 5- 7.9 mcg/kg/min
    c. Vasopressin 0.04 units/min
    d. Phenylephrine $\geq$ 2 mcg/kg/min

14. How often should the RN assess patients for the ability to titrate EN?
    a. Every 2 hours
    b. Every 4 hours
    c. Every 8 hours
    d. Every shift

15. Conversations with providers about enteral nutrition can be started when which of the following criteria are met? SELECT ALL THAT APPLY
    a. MAP > 65mmHG
    b. Lactate < 2.0 mmol/L
    c. Vasopressor requirement decreasing or stable.
    d. Fluid requirement stabilizing
    e. No ongoing or active bleeding

16. What are the signs and symptoms of feeding intolerance? SELECT ALL THAT APPLY
    a. Abdominal pain
    b. Abdominal distension
    c. Nausea and vomiting
    d. Increased bowel sounds
    e. Ileus
    f. Increased flatus
    g. Positive abdominal x-ray findings

17. Registered dietitians are responsible for completing a nutrition evaluation note with tube feed formula and rate recommendations within what hour of the nutrition consult order?
    a. 24 hours
    b. 36 hours
    c. 48 hours
    d. 72 hours
    e. Any time after 72 hours

18. If the patient is on multiple vasopressor agents of varying strengths, I would defer to the highest dosed vasopressor for the nutrition intervention.
    1= Strongly Disagree
    2= Disagree
    3= Neutral/Undecided
    4= Agree
    5= Strongly Agree

19. Clinical evidence of contractility (bowel sounds, flatus) is required prior to initiating EN in critically ill adult patients.
    1= Strongly Disagree
    2= Disagree
    3= Neutral/Undecided
    4= Agree
    5= Strongly Agree

20. OPEN RESPONSE QUESTION: What is the benefit of early EN in critically ill adult patients?

21. OPEN RESPNSE QUESTION: In what situations would you consider withholding or delaying EN therapy?

Post Education Nursing survey

1. How do you identify yourself?
    a. Male
    b. Female

2. What is your employment status?
    a. Full time
    b. WEPP (weekends only)
    c. PRNs
    d. Travel Nurse

3. How many years of ICU experience do you have?
    a. < 1 year
    b. 1- 2 years
    c. 3-4 years
    d. ³ 5 years

4. What is your highest level of education?
    a. Associate Degree in Nursing (ADN)
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    1= Not confident at all
    2= Below average level of confidence
    3= Average level of confidence
    4= Above average level of confidence
    5= Highest level of confidence

7. I can find UKHC "Feeding the Hemodynamically Unstable Adult ICU Patient" guideline on the care web?
    1= Strongly Disagree
    2= Disagree
    3= Neutral/Undecided
    4= Agree
    5= Strongly Agree

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    a. 10 ml/hour
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    b. Norepinephrine at 0.1 – 0.29 mcg/kg/min
    c. Vasopressin at 0.04 Units/min
    d. Epinephrine 0.05-0.09 mcg/kg/min

13. What is considered high-risk vasopressor dose where tube feed should be held or stopped?
    a. Norepinephrine 0.1-0.29 mcg/kg/min

b. Dopamine 5- 7.9 mcg/kg/min
c. Vasopressin 0.04 units/min
d. Phenylephrine ≥ 2 mcg/kg/min

14. How often should the RN assess patients for the ability to titrate EN?
    a. Every 2 hours
    b. Every 4 hours
    c. Every 8 hours
    d. Every shift

15. Conversations with providers about enteral nutrition can be started when which of the following criteria are met? SELECT ALL THAT APPLY
    a. MAP > 65mmHG
    b. Lactate < 2.0 mmol/L
    c. Vasopressor requirement decreasing or stable.
    d. Fluid requirement stabilizing
    e. No ongoing or active bleeding

16. What are the signs and symptoms of feeding intolerance? SELECT ALL THAT APPLY
    a. Abdominal pain
    b. Abdominal distension
    c. Nausea and vomiting
    d. Increased bowel sounds
    e. Ileus
    f. Increased flatus
    g. Positive abdominal x-ray findings

17. Registered dietitians are responsible for completing a nutrition evaluation note with tube feed formula and rate recommendations within what hour of the nutrition consult order?
    a. 24 hours
    b. 36 hours
    c. 48 hours
    d. 72 hours
    e. Any time after 72 hours

18. If the patient is on multiple vasopressor agents of varying strengths, I would defer to the highest dosed vasopressor for the nutrition intervention.
    1= Strongly Disagree
    2= Disagree
    3= Neutral/Undecided
    4= Agree
    5= Strongly Agree

19. Clinical evidence of contractility (bowel sounds, flatus) is required prior to initiating EN in critically ill adult patients.
    1= Strongly Disagree

2= Disagree
3= Neutral/Undecided
4= Agree
5= Strongly Agree

20. OPEN RESPONSE QUESTION: What is the benefit of early EN in critically ill adult patients?

21. OPEN RESPNSE QUESTION: In what situations would you consider withholding or delaying EN therapy?

22. The PowerPoint Presentation helped me understand the importance of early EN on patient who are considered high risk.
    1= Strongly Disagree
    2= Disagree
    3= Neutral/Undecided
    4= Agree
    5= Strongly Agree

Appendix D

Institutional Data Collection Measures

Study Measures

Measures	Descriptions	Level of Measurement	Data Source
Age	Patient's age	Nominal	Medical Record
Sex	Sex of the patient	Ordinal	Medical Record
Diagnosis	Admitting diagnosis	Ordinal	Medical Record
Co-morbidities	Past medical history	Ordinal	Medical Record
Weight	Weight of patients in pounds	Nominal	Medical Record
Heart Rate	Patient heart rate	Nominal	Medical Record
MAP	Patients mean arterial pressure	Nominal	Medical Record
Lactate	Patient lactate level	Nominal	Medical Record
Vasopressor Agent	Types of vasopressors ordered	Ordinal	Medical Record
Vasopressor Dose	Rate of vasopressor agent	Nominal	Medical Record
Vasopressor Initiation time	Starting time of vasopressor agent	Nominal	Medical Record
Enteral nutrition order	Enteral nutrition order in place	Ordinal	Medical Record
Enteral nutrition initiation date/time	Time that EN was started	Nominal	Medical Record
Nutrition consult order	Time of nutrition consult order	Ordinal	Medical Record
Nutrition Evaluation recommendation	Nutrition recommendation within 24 hours of orders being placed	Ordinal	Medical Record
Total Feedings within 48 hours	Total amount received in 48 hours in ml.	Nominal	Medical Record

List of Tables

Table 1. Survey Demographics	
	***n* (%)**
Gender	
Male	14 (26.4%)
Female	39 (73.6%)
Employment Status	
Full Time	40 (75.5%)
WEPP (weekends only)	1 (1.9%)
PRNs	5 (9.4%)
Travel Nurse	7 (13.2)
ICU Experience	
Less than 1 year	6 (11.3%)
1-2 Years	21 (39.6%)
3-4 years	10 (18.9%)
5 Years and greater	16 (30.2%)
Highest Level of Education	
Associate Degree in Nursing (ADN)	5 (9.4%)
Bachelor of Science in Nursing (BSN)	44 (83.0%)
Master of Science in Nursing (MSN)	2 (3.8%)
Doctorate in Nursing (DNP/PhD)	2 (3.8%)

Table 2. Self- Rated Nursing Level of Confidence			
	Pre-education (*n* = 53) *Mean* (SD)	**Post-education (*n* =50) *Mean* (SD)**	***P-Values***
Level of knowledge on enteral nutrition	3.25 (0.68)	3.30 (0.61)	.67
Level of Confidence using the UKHC Guideline	2.66 (.854)	3.46 (.813)	<.001
Able to locate the UKHC guideline on Careweb	3.08 (1.158)	4.04 (.880)	<.001
Confident initiating EN conversation with provider	4.20 (.800)	4.18 (.834)	.940

Table 3. Knowledge Based Questions			
	Pre-Education % Correct	**Post- Education % Correct**	**P-values**
Enteral nutrition is started within 48 hours of initiating vasopressors on critically ill patients in CVICU.	1.9%	8.0%	.20
According to UKHC guidelines, what is the recommended tube feed formula that can be started on qualifying patients with vasopressors?	20.8%	80.0%	<.001
What is the recommended tube feed rate that can be started on patients with vasopressors?	30.2%	84.0%	<.001
What is considered low risk vasopressor dose to initiate tube feeds?	34.0%	78.0%	<.001
What is considered high-risk vasopressor dose where tube feed should be held or stopped?	13.2%	58.0%	<.001
What is considered high-risk vasopressor dose where tube feed should be held or stopped?	52.8%	92.0%	<.001
Conversations with providers about enteral nutrition can be started when which of the following criteria are met? SELECT ALL THAT APPLY	43.4%	72.0%	.005
What are the signs and symptoms of feeding intolerance? SELECT ALL THAT APPLY	1.9%	2.0%	1.000
Registered dietitians are responsible for completing a nutrition evaluation note with tube feed formula and rate recommendations within what hour of the nutrition consult order?	84.9%	92.0%	.360
If the patient is on multiple vasopressor agents of varying strengths, I would defer to the highest dosed vasopressor for the nutrition intervention.	64.2%	82.0%	.049

Clinical evidence of contractility (bowel sounds, flatus) is required prior to initiating EN in critically ill adult patients.	9.4%	18.0%	.256
Total Knowledge Score (1-11)	M= 3.57, SD= 1.25	M= 6.66, SD=2.02	<.001

Table 4. Importance of early EN for patients who are considered high risk.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1= Strongly Disagree	1	2.0	2.0	2.0
	3= Neutral/Undecided	6	12.0	12.0	14.0
	4= Agree	13	26.0	26.0	40.0
	5= Strongly Agree	30	60.0	60.0	100.0
	Total	50	100.0	100.0	

Table 5. Rate your level of knowledge of enteral nutrition?

	Pre-Education n (%)	**Post- Education n (%)**
Poor	0 (%)	0 (0%)
Below Average	3 (5.7%)	2 (4%)
Average	38 (71.7%)	33 (66%)
Above Average	8 (15.1%)	13 (26%)
Excellent	4 (7.5%)	2 (4%)

Table 6. Demographics Comparison			
	Pre-Intervention Chart Data ***(n=41)*** **Mean (SD) or n (%)**	**Post- Intervention Chart Data** ***(n=40)*** **Mean (SD) or n (%)**	**P-Values**
Age	56.6 (14.1)	59.7 (13.2)	0.31
Weight (Kg)	88.6 (27.8)	83.2 (26.6)	.372
Sex			
Male	21 (51.2%)	22 (55%)	0.73
Female	20 (48.8%)	18 (45%)	0.73

Table 7. Service Comparison		
Service	**Frequency**	**Percent**
	41	50.6
CA1	11	13.6 %
CVT	16	19.8 %
Heart Failure	4	4.9 %
Lung Transplant	4	4.9 %
TSS	5	6.2 %
Total	81	100.0

Table 8. Diagnosis Comparison		
Diagnosis	**Pre-Intervention Chart Data** ***n=41*** **n (%)**	**Post Intervention Chart Data** ***n=40*** **n (%)**
Coronary Artery Bypass Graft (CABG)	14 (34.2%)	3 (7.5%)
Valvular Heart Disease	1 (2.4%)	7 (17.5%)
Other Heart Diseases	11 (26.6%)	14 (35%)
Respiratory Problems	6 (14.5%)	7 (17.5)
Lung Transplant	1 (2.4%)	1 (2.5%)
Shock	3 (7.3%)	2 (5%)
Others	5 (12%)	6 (15%)

Table 9. Co-morbidities Comparison			
Co-Morbidities	**Pre-Intervention Chart Data *(n=41)* n (%)**	**Post-Intervention Chart Data *(n=40)* n (%)**	**P-Values**
CAD	27 (66%)	22 (55%)	0.318
CHF	28 (68.3%)	23 (57.5%)	0.315
CKD	16 (39%)	14 (35%)	0.708
AKI	25 (61%)	23 (57.5%)	0.750
HTN	35 (85.4%)	37 (92.5%)	0.482
AMI	4 (9.8%)	0 (0%)	0.116
ESKD	9 (22%)	3 (7.5%)	0.067
CABG	11 (27%)	6 (15%)	0.191
SMOKING			
• Never	22 (55%)	17 (42.5%)	0.381
• Former	12 (30%)	18 (45%)	0.381
• Current	6 (15%)	5 (12.5%)	0.381

Table 10. Hemodynamics Comparison			
Hemodynamics	**Pre- Intervention Chart Data *(n=41)* Mean (SD)**	**Post-Intervention Chart Data *(n=40)* Mean (SD)**	**P-Value**
Average Heart Rate (bpm)	80 (18)	83 (19.1)	0.604
Average Mean Arterial Pressure (mmHG)	86 (14)	71 (13.5)	< .001
Average Lactate (mmol/L)	1.3 (0.49)	1.4 (0.32)	0.302
Average Hematocrit (%)	30.4 (6.1)	31.5 (5.9)	0.412
Average Hemoglobin (g/dl)	9.8 (2)	10.3 (2.1)	0.268

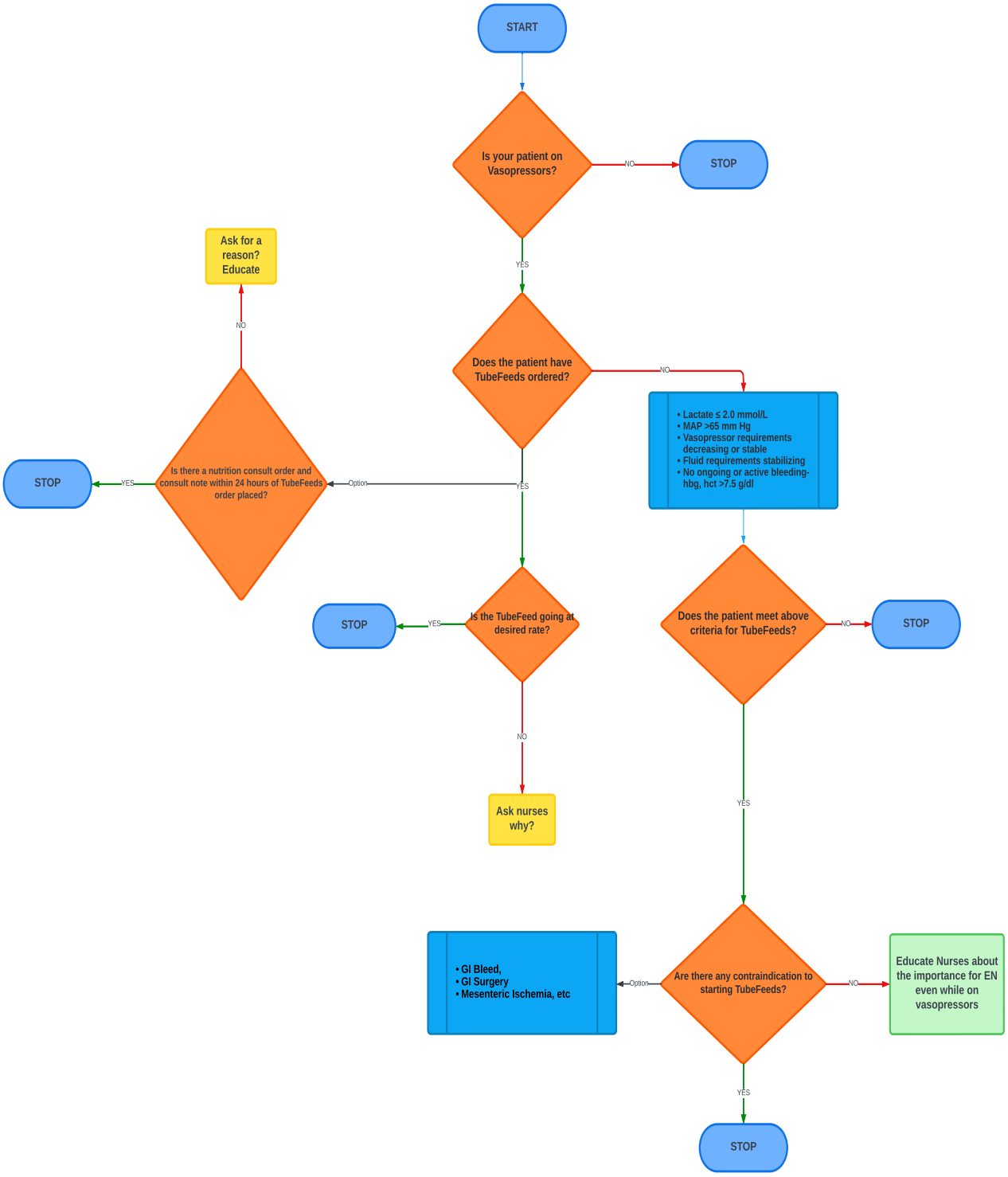
Table 11. Vasopressor Agent Comparison			
Vasopressor Agent	**Pre-Intervention Chart Data** ***(n=41)*** **n (%)**	**Post-Intervention Chart Data** ***(n=40)*** **n (%)**	**P-Values**
Epinephrine	18 (44%)	10 (25%)	.032
Norepinephrine	21 (51.2%)	22 (55%)	.032
Dopamine	0 (0%)	3 (7.5%)	.032
Vasopressin	0 (0%)	4 10%)	.032
Phenylephrine	2 (4.9%)	1 (2.5)	.032

Table 12. Enteral Nutrition and Nutrition Consult/Evaluation			
	Pre-Intervention Chart Data ***(n=41)*** **n (%)**	**Post-Intervention Chart Data** ***(n=40)*** **n (%)**	**P-Values**
EN < 48 hours	9 (22%)	15 (37.5%)	0.125
EN > 48 hours	6 (17.6%)	3 (11.5%)	0.719
Nutrition Goal Met	9 (60%)	15 (75%)	0.467
Nutrition consult ordered within 24 hours	28 (68.3%)	31 (77.5%)	0.352
Nutrition evaluation notes within 24 hours	26 (63.4%)	29 (72.5%)	0.381

Table 13. Oral Intake and Open-Heart Surgery Comparison			
	Pre-Intervention Chart Data ***n=41***	**Post Intervention Chart Data** ***n=40***	**P-Value**
PO Intake	22 (76%)	19 (79.2%)	0.775
Open Heart Surgery	16 (39%)	13 (32.5%)	0.540

Table 14. Comparison of Oral Intake with Open Heart Surgery and Other Diagnosis			
PO Intake	**Open Heart Surgery**	**No Surgeries, Other Diagnosis**	**P-Value**
Pre-Data	12 (92.3%)	10 (62.5%)	0.062
Post Data	12 (100%)	7 (58.3)	0.012
Total	24 (96%)	17 (60.7%)	0.002

Algorithm Tool



Literature Review

Article	Setting	Study	Participants	Intervention	Collection	Finding	Level
Friesecke et al. (2014)	13 bed medical ICU	Retrospective and prospective	97 patients	To examine whether early EN(EN) of critically ill patients could be improved by a nurse-driven implementation of an existing feeding protocol.	6-months period	Following intervention, enteral feeding started significantly earlier, within 24 h in 64% versus 25% and for each of the first 5 days, the proportion of patients meeting their nutritional goal was significantly higher.	III
Gonik et al. (2016)	ICU Academic Medical Center	Randomized blinded control trail	24 Patients	Shorter fasts allow for better nutrition delivery and patient outcomes without increasing the risk.	30 days	Shortening preoperative fasts in intubated ICU patients allowed for better caloric delivery in the preoperative period.	I
Jenkins et al. (2019)	3 ICU (General, Cardiac, Neuroscience) within University Hospital Southampton	Retrospective study	74 patients	Implementation of fasting guideline on EN delivery, compliance with the local fasting guideline, and staff knowledge of the guidelines and barrier to their implementation.	14 days	- Significant improvements in the amount of EN delivered and reduced duration of feed breaks. - Increase in compliance with the fasting guidelines through increased staff education. - Improved planning of timing of procedures, further increasing nutrition delivery.	III
Koontalay et al. (2020)	Intensive Care Unit	Quasi-experimental pretest-posttest design	44 patients	Clinical practice guideline on enteral nutrition care vs standard nursing care	4 months	-The intervention group who received the CNPG had significantly shorter starting time of EN and a reduced duration of mechanical ventilator than those in the control group.	II

Mahmood et al. (2019)	Medical ICU in academic medical center	Quasi-experimental with retrospective chart review.	Internal medicine resident provider	Use of an iPod EN application to assist providers in choosing EN formulas for patients during their ICU rotation to improved initiation of EN within 24 hours of admission.	1 month	- Use of the EN application reduced the percent of patients with delayed initiation of EN from 61.2% prior to 37.5%. - The mean time to initiate EN also improved 44.5 vs 31.9 hours.	III
McCartt et al. (2022)	Trauma and Surgical ICU	Prospective Study	-256 patients prior to protocol (PP) group. -232 patients with enhancement protocol (EP) group.	Implementation of an evidence-based, multidisciplinary nutrition enhancement protocol (EP) to improve delivery of EN in critically ill trauma and surgical patients.	4 years	- The average percentage of nutrition delivered (based on 24-h kilocalorie requirements) improved after the implementation of the EP (75.3% PP vs 85.5% EP) - The percentage of patients receiving >80% of nutrition goal also improved (52.7% PP vs 65.2% EP). - Implementation of an EP significantly increased delivery of EN by 10.2% and achieved compliance with A.S.P.E.N/ SCCM guidelines.	III
Orinovsky and Raizman (2018)	Intensive Care Unit	Retrospective study	Control group: 65 patients Interventional group: 52 patients	Implementation of a nurse-led evidence-based feeding protocol.	2 years, 12 months before (control group) and 12 months after (interventional group)	- Enteral feeding was started significantly earlier (52.3 hours vs. 70.3 hours). - 90% of patients in the intervention group achieved their caloric target within 96 hours after admission. - Assigning the responsibility for implementation of a feeding protocol to the	III

						ICU nursing staff increased the number of patients who met the established caloric goals and ensured appropriate delivery of enteral feedings.	
Padar et al. (2017)	10 bed mixed medical - surgical intensive care unit	Observational and retrospective before and after study	-231 patients in pre-intervention -249 patients in post-intervention	Implementation of nurse-driven feeding protocol	2 years, 1 year pre-intervention and 1-year post-intervention	- Implementation of the feeding protocol resulted in a higher cumulative amount of nutrition enterally and a lower cumulative amount of nutrition parenterally. - Patients in the intervention group had a lower 90-d and 120-d mortality. - The protocol improves the delivery of enteral nutrition in ICU patients without concomitant increases in gastrointestinal symptoms or intra-abdominal hypertension.	III
Segaran et al. (2016)	General/ Trauma intensive care unit	QI project	11 patients	Implementation of ICU-specific fasting guidelines on the frequency of EN interruptions and nutrition delivery.	4 weeks	- Implementation of the fasting guideline resulted in statistical and clinical improvements in reducing fasting for airways procedures. - The calorie deficit also statistically and clinically decreased as a result of the guideline.	III
Wang et al. (2022)	50 bed central intensive care unit teaching hospital	Prospective cohort study	66 patients	Implementation of mean arterial pressure/noradrenaline equivalent dose (MAP/NEQ) index to distinguishing	Less than 28 days	-The MAP/NEQ index showed good predictive ability 6 hours before EN initiation. - The MAP/NEQ index ≥417 mmHg/mg/kg/min was suggested to start enteral nutrition with low	III

				whether a patient is suitable for initiation of EN to avoid feeding intolerance in patients with shock.		risk for feeding intolerance.	

Synthesis of Literature

Variable of Interest (Education Intervention)	**Friesecke et al. (2014)**	**Gonik et al. (2016)**	**Jenkins et al. (2019)**	**Koontalay et al. (2020)**	**Mahmood et al. (2019)**	**McCartt et al. (2022)**	**Orinovsky and Raizman (2018)**	**Padar et al. (2017)**	**Segaran et al. (2016)**	**Wang et al. (2022)**
	Level of Evidence: III	Level of Evidence: I	Level of Evidence: III	Level of Evidence: II	Level of Evidence: III	Level of Evidence: III	Level of Evidence: III	Level of Evidence: III	Level of Evidence: III	Level of Evidence: III
Implementation of fasting guideline		N, A ⬆	N, A ⬆						N, A NE	
Nurse-led Nutrition Protocol	N, A ⬆			N, A ⬆			N, A ⬆	N, A ⬆		
Nutrition enhancement protocol (EP)						MDT, A ⬆				MDT, B, NE
Phone EN app					P, B, NE					

LEGENDS:

- Target Audience: N= Nurse, MDT= Multidisciplinary Team, P= Provider
- A= statistically significant, B= statistically significant not reported, NE= Nutrition intake not evaluated
- Increased caloric / overall nutrition intake = ⬆