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The Impact of an Enteral Feeding Protocol on Nutritional Support in Critically Ill, Mechanically Ventilated Patients

By

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Dedication

To my parents, for always supporting me and instilling in me the value of education.

To my husband, Anthony, for all of your love, patience, support,
and encouragement throughout this process.

And

To my son, Anthony Jr. - While the completion of this project has given me much pride,
nothing makes me prouder than being your Mommy.

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Abstract

Although proper nutrition has been found to be an essential factor in health maintenance and restoration in the critically ill patient, research has indicated that this population often falls victim to malnutrition while in the intensive care unit (ICU). Malnutrition has been associated with increased morbidity, mortality, and length of stay. Conversely, early initiation of nutritional support has been associated with reduced mortality and morbidity, decreased length of stay, lower rates of infection, and decreased time on mechanical ventilation. Enteral feeding protocols have been found to combat the risk of malnutrition in the critically ill, mechanically ventilated patient, with data suggesting that they may reduce time to feeding initiation, reduce interruptions, and reduce time to reaching goal feeding rates. The goal of this project was to develop an enteral feeding protocol for critically ill, mechanically ventilated patients in a local community hospital based on evidence collected and to measure the impact of this protocol on enteral feeding initiation, advancement to goal rate, and length of stay. While a reduction in time to enteral feeding initiation ($p = 0.158$) and decreased length of stay ($p = 0.861$) was found with the introduction of the protocol, the impact was not statistically significant. However, significant reduction in time to enteral feeding goal rate achievement was found ($p = 0.004$). Based on this data, in addition to research reviewed, it has been concluded that the use of enteral nutritional protocols should be standard in all ICUs in an attempt to improve outcomes and minimize complications among the critically ill, mechanically ventilated patient.

Keywords: enteral feeding protocol, enteral nutrition, mechanical ventilation, critically ill

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THE IMPACT OF AN ENTERAL FEEDING PROTOCOL

Chapter I: Problem

Introduction

Although proper nutrition has been found to be an essential factor in health maintenance and restoration in the critically ill patient, research has indicated that this population often falls victim to malnutrition (Doig, Heighes, Simpson, Sweetman, & Davies, 2009; Heighes, Doig, Sweetman, & Simpson, 2010; Rice, Swope, Bozeman, & Wheeler, 2005). Data has shown that, on average, this population often receives only half to three fourths of their daily caloric goal (Doig, Heighes, Simpson, Sweetman, & Davies, 2009; Heighes, Doig, Sweetman, & Simpson, 2010; Rice, Swope, Bozeman, & Wheeler, 2005). Additionally, while there is a plethora of research showing the benefits of starting enteral feedings within 24 to 48 hours with minimal interruptions thereafter, data shows that feedings are frequently withheld and interrupted for reasons that lack evidence (Ellis, 2015; Doig et al., 2009; Heighes et al., 2010; Kattelman et al., 2006; Khalid, Doshi, & DiGiovine, 2010; Lofgren, Mabesa, Hammarqvist, & Hardcastle, 2015; Rice, et al., 2005; Rubinsky & Clark, 2012; Sorosky & Leonov, 2012; Yin et al., 2015; Zacharias et al., 2011).

Malnutrition has been associated with increased morbidity, mortality, and length of stay. Conversely, early initiation of nutritional support has been associated with reduced mortality and morbidity, decreased length of stay, lower rates of infection, and decreased time on mechanical ventilation (Ellis, 2015; Doig et al., 2009; Heighes et al., 2010; Kattelman et al., 2006; Khalid et al., 2010; Lofgren et al., 2015; Rubinsky & Clark, 2012; Sorosky & Leonov, 2012; Yin et al., 2015; Zacharias et al., 2011). Enteral feeding protocols have been found to combat the risk of malnutrition in the critically ill who cannot receive oral feedings, such as those who are mechanically ventilated. Data has suggested that such protocols have the potential to effectively

reduce time to initiation of feedings, reduce interruptions, and reduce time to reaching goal feeding rates (Compton, Bojarski, Siegmund, & Van Der Giet, 2014; Ellis, 2015; Kattelman, et al., 2006; Meyer,et al., 2009; Heyland et al., 2009; Reeves et al., 2012; Zacharias et al., 2011). Moreover, while maximizing benefits of proper nutrition, enteral feeding protocols have also been found to be helpful in minimizing the possible risks of enteral feeding in the critically ill patient, such as aspiration (Heyland et al., 2009). The goal of this project was to develop an enteral feeding protocol for critically ill, mechanically ventilated patients in a local community hospital based on evidence found and measure the impact of this protocol on enteral feeding initiation, advancement to goal rate, and length of stay.

Background and Significance

In response to acute illness, stress hypermetabolism and hypercatabolism, a phenomenon where basal metabolic rate and protein catabolism increases, takes place, resulting in breakdown of lean body mass with the goal of increasing energy stores (Ellis, 2015; Rubinsky & Clark, 2012, Stewart, 2014; Yin et al., 2015). This process, when combined with malnutrition, can lead to depletion in glucose storage, muscle wasting, reduction in blood protein levels, impaired wound healing, metabolic derangements, electrolyte imbalance, increased susceptibility to infection, and organ dysfunction (Ellis, 2015; Rubinsky & Clark, 2012). Hypoperfusion of the gut is common during this phenomenon and can lead to gastrointestinal mucosal atrophy and ulcer formation, altered gastric and intestinal pH, and bacterial overgrowth that has the potential to spread systemically due to increased gut permeability (Khalid et al., 2010; Rubinsky & Clark, 2012; Soroksky & Leonov, 2012). Increased morbidity, mortality, and prolonged length of stay and time on mechanical ventilation can result from this systemic response to acute illness in the setting of suboptimal caloric intake (Ellis, 2015; Kattelman et al., 2006; Rubinsky & Clark,

2012; Sorosky & Leonov, 2012; Yin, et al., 2015; Zacharias et al., 2011). Early initiation of nutritional support is not only crucial in the prevention of malnutrition, allowing for the preservation of lean body mass and the reduction of oxidative stress and metabolic complications, but has also been shown to increase blood flow to the gastrointestinal tract, reducing the possibility of the gastrointestinal sequelae mentioned (Lofgren et al., 2015; Rubinsky & Clark, 2012; Soroksky & Leonov, 2012).

Since oral feedings are not possible in the orally intubated, critically ill patient, alternative means of nutrition through enteral or parenteral feedings is essential. According to the Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines and the European Society of Clinical Nutrition and Metabolism (ESPEN) guidelines, enteral nutrition is preferred over parenteral nutrition as the latter has been associated with increased risk of infection, electrolyte imbalance, and higher costs (McClave et al., 2016; Kreymann et al., 2006; Rubinsky & Clark, 2012; Yin et al., 2015). It is also their recommendation that enteral feedings begin within 24 to 48 hours in order to avoid complications of malnutrition (Kreymann et al., 2006; McClave et al, 2016; Soroksy & Leonov, 2012). Unfortunately, nutritional support in the critically ill patient is often delayed, with studies revealing that up to 60% of patients who stay in the intensive care unit for more than 3 days receive no nutritional support for 48 hours or longer and 40% of critically ill patients receive no nutritional support during their intensive care unit stay (Rice et al., 2005; Doig et al., 2009; Heighes et al., 2010).

Medical and nursing practices have been found to contribute to delays in feeding as well as hypocaloric, or inadequate, feedings (Marshall & West, 2006; Rice et al., 2005; Sorosky & Leonov, 2012). Research has shown that enteral feedings are often withheld until emergent

concerns are stabilized, though early initiation of feedings in the unstable patient has not been found to increase risk of complications (Rice et al, 2005; Yin et al., 2015). Studies have also found that medical staff often make underestimations of the nutritional needs of the patient, resulting in less than optimal feeding rates (Ellis, 2015). Poor documentation practices, such as failure to document delivery rates, times of interruptions, and reasons for those interruptions, may result in the patient receiving less nutritional support than medical staff are aware of (Rice et al., 2005).

Data has also found that enteral feedings are often held or discontinued unnecessarily due to what nursing staff may perceive as higher than acceptable gastric residual volumes (GRV). Clinical nutrition guidelines, such as the SCCM, ASPEN, and ESPEN guidelines, advise against the use of GRVs as part of routine care in monitoring patients receiving enteral nutrition (McClave et al., 2016; Sorosky & Leonov, 2012). However, if GRVs are being utilized in the intensive care unit setting, SCCM and ASPEN guidelines suggest that volumes up to 500 milliliters without signs of intolerance, such as vomiting, abdominal distention, or diarrhea, are acceptable and do not increase risk of aspiration (McClave et al., 2016; Sorosky & Leonov, 2012). Nevertheless, it is common practice for nurses and medical staff to hold feedings for GRVs below this recommendation, with GRV thresholds of less than 200 milliliters commonly being perceived as intolerance to feedings (Marshall & West, 2006; McClave et al., 2016; Sorosky & Leonov, 2012). Adding to malnutrition are frequent interruptions in feedings due to testing and procedures that are unavoidable in the case of the critically ill patient in order to obtain a complete diagnosis (Rice et al., 2005; Sorosky & Leonov, 2012).

There is an abundance of data showing the benefits of early and adequate nutrition in the critically ill patient. Literature has indicated that such benefits include decreased overall hospital

length of stay, decreased intensive care unit length of stay, improved immune response resulting in lower rates of infection, improved tissue healing, decreased time on mechanical ventilation, and reduced morbidity and mortality. Early enteral nutrition has been found to have the potential to decrease risk of death by as much as 30 to 35% (Ellis, 2015; Doig et al., 2009; Heighes et al., 2010; Kattelman et al., 2006; Khalid et al., 2010; Rubinsky & Clark, 2012; Sorosky & Leonov, 2012; Zacharias et al., 2011). Moreover, proper nutrition has the potential to cut hospital costs, with studies showing the cost of treating a patient with malnutrition being 20% higher than that of a patient without malnutrition (Stewart, 2014). Interventions, such as enteral feeding protocols and algorithms, have the potential to promote early introduction and advancement of enteral nutrition safely and consistently to help maximize its benefits in the critically ill, mechanically ventilated patient.

PICO Question

The goal of this project was to utilize the evidence collected to develop and introduce an enteral feeding protocol to a local North Bergen, New Jersey intensive care unit and collect data to answer the following PICO question: In critically ill, mechanically ventilated patients in the intensive care unit, does the use of a standard enteral feeding protocol compared to no standard protocol decrease time to enteral feeding initiation, time to reaching nutritional goal rate, and length of stay?

The various components of this PICO question are as follows:

Population (P): Critically ill, mechanically ventilated patients in the intensive care unit

Intervention (I): Standard enteral feeding protocol

Comparison (C): No standard protocol

Outcome (O): Decreased time to enteral feeding initiation, time to reaching nutritional goal rate, and length of stay

Chapter II: Evidence

Sources and Search Process

In order to obtain evidence for this project, a comprehensive search was conducted using the CINAHL, MEDLINE, Cochrane Library, EBSCOhost, and Google Scholar databases. The key words used were enteral nutrition, enteral feedings, guidelines, protocol, algorithm, critically ill, and mechanical ventilation. Studies that addressed the use enteral nutrition protocols in critically ill patients were selected. Studies greater than 10 years old were excluded. After review of 113 research articles found using combinations of these key words, 10 research articles were found to meet these criteria. Level of evidence of each article was then identified according to Melnyk and Fineholt-Overholt (2015) (see Appendix A), with details and limitations of each study being placed in an Evaluation Table of Studies (see Appendix B).

Literature Review

In a systematic review of studies investigating the impact of enteral feeding protocols in critically ill patients, Ventura & Waitzberg (2014) provided Level I evidence demonstrating the usefulness of this intervention in prompting early initiation of enteral nutrition and increasing caloric intake in this population. While reviewing 19 studies related to this topic, it was found that enteral nutrition protocols did have the capability of optimizing nutrition therapy (Ventura & Waitzberg, 2014). However, a significant improvement in overall patient outcomes could not be determined, with Ventura & Waitzberg (2014) characterizing clinical outcomes as modest.

In an observational cohort study performed by Meyer et al. (2009) measuring the effects of feeding protocols on mechanically ventilated patients admitted to a pediatric intensive care

unit in London, England, it was found that use of this intervention resulted in reduction in time taken to initiate enteral feedings and an increase in the daily energy provision delivered, providing Level IV evidence in support of the use of enteral feeding protocols. Among the 353 critically ill pediatric patients studied, with data being collected via chart reviews before and after implementation of enteral feeding protocols, time to nutrition support initiation was reduced from 15 hours to 4.5 hours and the percentage of this population receiving a daily energy provision of 50 to 70% of their estimated average requirement rose from 6% to 21% (Meyer et al., 2009). The data collected was found to be statistically significant, with p values < 0.001 for both measures (Meyer et al., 2009).

Compton, Bojarski, Siegmund, & Van Der Giet (2014) also provide Level IV evidence in support of the use of enteral feeding protocols as a method for reducing time to feeding initiation and shortening time to reaching feeding goal rates in the critically ill, mechanically ventilated patient. Data regarding prescription, implementation, and advancement from this cohort study involving 160 mechanically ventilated adult patients admitted to a medical intensive care unit in Berlin, Germany, was collected through the use of retrospective chart review before and after the implementation of an enteral feeding protocol (Compton et al., 2014). This research found that use of their enteral feeding protocol resulted in earlier initiation of enteral feedings ($p = 0.007$), with 54% of the population being started on enteral feedings on day one compared to 38% pre-intervention. It was also found that after implementation of the enteral feeding protocol, the amount of nutrition prescribed and delivered also was significantly higher ($p < 0.001$) and the time taken to reach enteral feeding goals was significantly reduced from 10 days to 6 days ($p < 0.001$) (Compton et al., 2014).

In another cohort study performed by Zacharias et al. (2011), an enteral feeding protocol is again shown to reduce time to initiation of enteral feedings, providing Level IV evidence in support of the use of enteral feeding protocols. In this study, a sample of 146 surgical intensive care unit patients pre-intervention and 141 patients post-intervention were used to collect data regarding enteral nutrition initiation times and adverse events, such as aspiration, with the use of the protocol (Zacharias et al., 2011). It was found that enteral feeding was started earlier after the implementation of the protocol, reducing time from 2 days to 1 day ($p < 0.001$) (Zacharias et al., 2011). Moreover, they found that there was not an increased risk of aspiration with implementation of this intervention, with 8% aspirating pre-intervention and 9.2% aspirating post-intervention ($p = 0.606$). The researchers, however, did not find a significant decrease in intensive care unit length of stay with the implementation of an enteral nutrition protocol.

Level IV evidence in favor of the use of enteral feeding protocols is also exhibited in a study performed by Bowman et al. (2005). In this observational cohort study performed researching the effects of an enteral feeding protocol incorporating an aspiration risk reduction algorithm, it was found that a higher percentage of patients reached goal rate after the intervention, increasing from 78% to 85% and reports of aspiration pneumonias decreased from 6.8 to 3.2 per 1000 patient days (Bowman et al., 2005). In the study, however, sample size was small with the pre-intervention group involving 18 medical intensive care unit patients, and the post-intervention group involving 13 (Bowman et al., 2005). Furthermore, value of significance was not established with the data collected (Bowman et al., 2005). Similarly, in a study conducted by C. Ellis (2015), use of an enteral feeding protocol was associated with earlier initiation of enteral feedings, with 83% of the post-intervention group receiving enteral feedings within 48 hours of admission, compared to 54% pre-intervention. The post-intervention group

was also found to receive higher caloric intake than pre-intervention patients, with 77% of the post intervention group receiving at least 60% of their prescribed enteral feeding goal, compared to 63% of the pre-intervention group (Ellis, 2015). Again, however, sample size was small, with 33 critically ill, mechanically ventilated patients in the pre-intervention group and 18 in the post-intervention group, and significance was not established with the data collected (Ellis, 2015).

In a large scale prospective, observational, cohort study performed by Heyland et al. (2010), involving 269 intensive care units in 28 countries and 5,497 critically ill, mechanically ventilated adult patients, data from sites without the presence of an enteral feeding protocol were compared to those with an enteral feeding protocol in place. It was found that in sites where enteral feeding protocols were utilized, enteral nutrition was initiated earlier, with an average time to initiation of 41.2 hours compared to 57.1 hours in sites without protocols ($p = 0.0003$). Moreover, motility agents were used more frequently in patients with high gastric residual volumes with 64.3% of patients receiving motility agents compared to 49% in sites without protocols ($p = 0.0028$) and overall nutritional adequacy was higher in those with protocols, on average reaching 61.2% of patients' caloric requirements compared to 51.7% ($p = 0.0003$) (Heyland et al., 2010). Though the large size of the sample is a strength, this study was limited by the lack of standardization in enteral feeding protocols used amongst the sites studied (Heyland et al., 2010). In another cohort study evaluating the impact of a critical care enteral feeding algorithm, Reeves et al. (2012) also found that this intervention resulted in a higher percentage of patients reaching at least 80% of the energy requirements, increasing from 20% to 60% ($p < 0.01$). This study also found that the algorithm enabled early initiation time, with feedings starting on average within 8 hours. However, time to enteral nutrition initiation prior to the algorithm was either not measured or not reported (Reeves et al., 2012).

Friesecke, Schwabe, Stecher, & Abel (2014) and Theodorakopoulou (2014) both provide additional Level IV evidence showing the usefulness of enteral feeding protocols in prompting early enteral feeding initiation in intensive care units. While studying 101 and 97 critically ill patients pre- and post-intervention respectively, Friesecke et al. (2014) found that the use of an enteral feeding protocol led to a 19 hour reduction in time to feeding initiation on average ($p < 0.001$), with 64% of patients starting feedings within 24 hours compared to 25% pre-intervention ($p < 0.0001$). While studying 83 critically ill, mechanically ventilated patients, Theodorakopoulou et al. (2014) found that enteral nutrition was started early in 77.1% of their patients using an enteral nutrition protocol. However, they did not offer a comparison to prior to this intervention and, furthermore, found that the protocol did not promote compliance, with only 28.1% of their population meeting caloric goals by day 7 (Theodorakopoulou et al., 2014). In this study, it was found that despite their enteral feeding protocol, though feedings were initiated early, they were often interrupted or discontinued for various reasons, such as procedures, gastrointestinal intolerance, and hemodynamic instability (Theodorakopoulou et al., 2014).

Summary

The evidence obtained from this comprehensive literature review suggests that an enteral feeding protocol has the potential to decrease time to initiation of enteral feedings and decrease time to reaching goal rates without increasing risk of complications, such as aspiration. The evidence collected supports the use of enteral feeding protocols to reduce risk of malnutrition and potentially improve outcomes in the critically ill, mechanically ventilated patient.

Chapter III: Methodology

Population of Interest

This evidence-based project focused on those critically ill, adult patients in the critical care unit (CCU) who were intubated and being mechanically ventilated.

Practice Setting and Resources

This evidence-based project took place in the CCU of a community hospital located in North Bergen, New Jersey. The CCU of this facility consists of ten monitored patient beds, with a nurse to patient ratio of one to two. All patients admitted to this department are over 18 years of age. The CCU staff consists of a nursing director, a nurse clinical coordinator, nurses, respiratory therapists, registered dieticians, physician intensivists, and medical residents.

Participants, Sampling, and Recruitment Strategies

Prior to initiation of the enteral feeding protocol, a chart review was performed to collect data involving all mechanically ventilated patients admitted into the CCU over the previous 3 months without contraindications to enteral nutrition. A total of 23 patients were found to meet criteria for inclusion in this study during this time frame. After implementation of this intervention, all mechanically ventilated patients admitted into the CCU without contraindications to enteral nutrition were selected for data collection for this study, with 17 patients found to meet criteria for inclusion during this time frame. Contraindications to enteral nutrition included intestinal obstruction or ileus, abdominal trauma, active gastrointestinal hemorrhage, bowel ischemia, and severe hemodynamic instability or circulatory shock. Mechanically ventilated patients who expired during admission or were discharged to hospice care were also excluded from this study.

Budget

Cost of this intervention could not be determined. While an enteral nutrition protocol may potentially result in early and more complete nutrition, resulting in increased costs for feedings and supplies, these costs may outweigh the benefits as the intervention has the potential to improve patient outcomes. There are no studies available estimating the potential cost expenditure or saving for such an intervention. Future evaluation will be necessary in order to obtain budget data.

Feasibility Assessment / Support and Sustainability

In the institution where this project took place there was previously no standard enteral feeding protocol in place resulting in inconsistency in care related to enteral nutrition therapy. Prior to the initiation of this study, registered dieticians working in the CCU of the location of interest had expressed their concern regarding practices related to enteral feeding, such as delays in ordering enteral feedings, order errors resulting in hypocaloric feeding rates, and frequent interruptions for various reasons, such as health care staff holding feedings for GRVs that were often under what is recommended by nutritional clinical guidelines. They had also expressed that though feedings were often appropriately withheld due to signs of intolerance, such as vomiting and diarrhea, there was often a delay in restarting feedings and that the use of prokinetic medications to help alleviate these symptoms was often overlooked.

While there was support by dietary staff for an enteral feeding protocol, there was potential for failure due to non-compliance. As mentioned previously, it is common practice to check GRVs though nutritional clinical guidelines have advised against this. At the selected practice setting, it had been found that nurses and physicians often held feedings due to GRVs below the clinical guideline recommendations, with staff reporting that they had held enteral

feedings for GRVs as low as 100 milliliters. A change in this standard could have been met with strong resistance, especially from nursing staff that had become accustomed to this practice. Fortunately, the change in practice was quickly accepted and did not interfere with the conducting of this study. Frequent education and supervision was performed to ensure compliance among the nursing and medical staff. This, in addition to continued support from the nursing, medical, and dietary staff throughout the process, resulted in high compliance with the intervention and creates a high potential for sustainability in the future.

Ethical and Legal Considerations

This project was approved by the Saint Peter's University and the medical center's Institutional Review Boards prior to data collection (see Appendix F and G).

Study Framework

For this project, the Iowa Model was used to introduce practice change (See Appendix D). This model calls for identification of clinical triggers, such as potential issues and opportunities in the practice environment, followed by formation of a multidisciplinary team if change is identified as a priority in the institution (The University of Iowa Hospitals and Clinics, 2015). This team conducts a review of literature and, if evidence supports it, practice change is implemented. If insufficient evidence is found during a literature search, the Iowa Model recommends that a study take place to determine the effect of the proposed practice change (The University of Iowa Hospitals and Clinics, 2015). The impact of the practice change is then analyzed and measured and results are disseminated throughout the organization (The University of Iowa Hospitals and Clinics, 2015). Adjustments in the practice change may be made if outcomes are less than optimal, at which time a reevaluation would take place (The University of Iowa Hospitals and Clinics, 2015).

The multidisciplinary team in this study included a lead investigator, a registered dietician, CCU nursing director, and staff nurses. The lead investigator, an adult nurse practitioner hospitalist, was responsible for developing the protocol, educating staff on how to follow the protocol as well as its importance, and collecting all data related to outcomes. The registered dietician served as an advisor to the lead investigator, providing guidance on changes that should be made in the protocol, and was responsible for making the lead investigator aware of any issues she observed related to compliance with the protocol so that they could be addressed in a timely manner. She was also responsible for determining the caloric needs for each patient admitted to the CCU, recommending type of feeding and nutritional goal rates based on her expertise and training. The CCU staff nurses were responsible for carrying out the protocol and voicing any concerns should there have been any. The lead investigator will be responsible for dissemination of data hospital-wide.

Formulation and Implementation of an Enteral Feeding Protocol

Based on the comprehensive literature review performed, it was evident that the current practice of the facility where this project took place was not consistent with what appeared to be best practice, with no enteral feeding protocol in place prior to this project. In accordance with the Iowa Model, a multidisciplinary team of nurses, registered dieticians, nursing director, and a nurse practitioner were assembled to oversee this practice change implementation in the CCU. Education of the staff nurses took place prior to implementation of the enteral feeding protocol to help ensure compliance. No modifications in the protocol have been deemed necessary thus far as no specific issues or concerns have been raised.

The proposed enteral feeding protocol for this evidence-based project is based on the recommendations of the Society of Critical Care Medicine (SCCM) and American Society for

Parenteral and Enteral Nutrition (ASPEN) outlined in their 2016 Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient (McClave et al., 2016). The SCCM and ASPEN guidelines were formulated after a review of 480 randomized controlled trials related to the topic of enteral and parenteral feedings and recommendations are based on this comprehensive review of evidence (McClave et al., 2016). The enteral feeding protocol utilized components of the protocols used in the studies evaluated for this project's literature review, making adjustments to ensure compliance with the SCCM and ASPEN guidelines.

Data Collection and Analysis

After Institutional Review Board approval of this evidence-based project from both the medical center and Saint Peter's University, a retrospective chart review of critically ill, mechanically ventilated patients covering a three month time frame was performed and data pertaining to time of intubation, time of enteral feeding initiation, time goal enteral feeding rate was achieved, and length of hospital stay was collected. After implementation of the proposed enteral feeding protocol, similar data was collected over a three month period via a prospective chart review. Time to enteral feeding initiation, time to goal enteral feeding rate, and hospital length of stay were measured pre- and post-intervention to determine the impact of the enteral feeding protocol. Average times of pre- and post-intervention measures were calculated and an independent t-test was performed to statistically determine whether mean differences calculated from each group are significantly different. Pearson's r coefficient was calculated to determine whether there was correlation between length of stay and time of enteral feeding initiation and time to goal enteral feeding rate achievement. Finally, effect size using Cohen's d analysis was

also calculated to further explain the magnitude of change between the pre-intervention and post-intervention groups in relation to these variables.

Plan for Dissemination of Outcomes

Upon completion of this evidence-based project, data will be disseminated to hospital staff in the form of hand-outs and a PowerPoint presentation.

Chapter IV: Results

A total of 40 subjects were included in data collection for this evidence-based project, with 23 subjects in the pre-intervention group and 17 in the post-intervention group. The pre-intervention group consisted of 10 females (43.5%) and 13 males (56.5%), while the post-intervention group consisted for 7 females (41.2%) and 10 males (58.8%), with mean ages of 70.04 years (SD = 16.552) and 70.24 years (SD = 18.683) pre- and post-intervention respectively (See Table 1). Chi square analysis found no difference between groups based on gender (χ^2 = 0.021, df = 1; p = 0.884) or age (χ^2 = -0.34, df = 38, p = 0.973). Data regarding race and diagnosis in each group were also collected (see Table 2 and Table 3) and compared, showing no statistical difference between the pre- and post-intervention groups based on these variables (race: χ^2 = 2.289, df = 4; p = 0.683; diagnosis: χ^2 = 4.54, df = 5; p = 0.475).

In the pre-intervention group, time taken to reach nutritional goal rate ranged from 34.48 hours to 189.2 hours, with a mean time of 78.07 hours (SD = 41.85) (See Figure 1). In the post-intervention group, time taken to reach nutritional goal rate ranged from 15.02 hours to 87.55 hours, with a mean time of 47.9 hours (SD = 15.8) (See Figure 2). With the introduction of the enteral nutrition protocol, the time to goal rate dropped significantly by 30.15 hours (t = 3.162; df = 29.81, p = 0.004). Furthermore, Cohen's d = 1.01, describing a large effect size.

In the pre-intervention group, time to initiation of enteral nutrition ranged from 12.35 hours to 114.22 hours, with a mean time of 43.9 hours (SD = 27.7) (See Figure 1). In the post-intervention group, time to initiation of enteral nutrition ranged from 10.17 hours to 80.3 hours, with a mean time of 32.7 hours (SD = 18.96) (See Figure 2). While there was an 11.2 hour drop in time to initiation of enteral nutrition post-intervention, t-test analysis did not find a statistically significant decrease in this variable (t = 1.441; df = 38, p = 0.158). Moreover, while there was a 6.7 hour decrease in average length of stay after the initiation of the enteral nutrition protocol, the drop was not found to statistically significant (t = 0.176; df = 38, p = 0.861). In regards to effect size, for time to enteral feeding initiation, Cohen's d = 0.46, describing a moderate effect size, while for length of stay, Cohen's d = 0.06, describing a small effect size when comparing pre-intervention and post-intervention groups.

Calculation of Pearson's r coefficient was also performed to determine whether there was any correlation between length of stay and time to initiation of enteral nutrition or time taken to reach nutritional goal rate. Though there was a positive relationship between length of stay and time to initiation of enteral nutrition, it was weak and not statistically significant (r = 0.127, p = 0.436). A positive relationship was found between length of stay and time taken to reach nutritional goal rate, but it also weak and not statistically significant (r = 0.289, p = 0.071).

Chapter V: Discussion

Overall, the introduction of the enteral nutrition protocol resulted in a drop in time to initiation of enteral nutrition, time taken to reach nutritional goal rate, and length of stay. However, statistical significance was found related to only one of the variables: time taken to reach nutritional goal rate. Moreover, while there was a positive relationship between length of stay and time to initiation of enteral nutrition and time taken to reach nutritional goal rate, the

relationships were neither strong nor significant. While review of literature has reported significant impact of enteral nutrition protocols on all of these variables mentioned, a definitive conclusion could not be reached in regards to its impact on time to initiation of enteral nutrition and length of stay based on data collected for this project. The relationship between the initiation of enteral nutrition, time taken to reaching nutritional goal rate, and length of stay could also not be definitively determined based on data collected for this project.

Limitations

A major limitation in this evidence based project was its small population size. Due to a period of low census during the data collection period and the short time frame, the number of subjects studied was greatly restricted. Had there been more subjects in each group, statistical significance may have been found in all outcome variables measured in this project; however, further research will be required.

Implications for Practice and Future Research

An abundance of research has found that the critically ill, mechanically ventilated patient is at increased risk of malnutrition, a condition associated with poor patient outcomes (Ellis, 2015; Doig et al., 2009; Heighes et al., 2010; Kattelman et al., 2006; Khalid et al., 2010; Lofgren et al., 2015; Rubinsky & Clark, 2012; Sorosky & Leonov, 2012; Yin et al., 2015; Zacharias et al., 2011). Research has further established the benefits of starting enteral feedings within 24 to 48 hours in this population, such as reduced mortality and morbidity, decreased length of stay, lower rates of infection, and decreased time on mechanical ventilation (Ellis, 2015; Doig et al., 2009; Heighes et al., 2010; Kattelman et al., 2006; Khalid et al., 2010; Lofgren et al., 2015; Rubinsky & Clark, 2012; Sorosky & Leonov, 2012; Yin et al., 2015; Zacharias et al., 2011).

Interventions to promote early and complete nutrition are vital to improving outcomes in these patients.

Other than significantly improving time taken to reach nutritional goal rates, the data from this project did not reflect a significant impact on outcomes. It is suspected that this is largely the result of the small population size, a major limitation in this study. The reduction in times for all outcome variables measured is promising, but further collection of data until a sufficient population size is reached is necessary in order to make a definitive conclusion based on this research. Nevertheless, previous data has suggested that enteral protocols have the potential to effectively reduce time to initiation of feedings, reduce interruptions, and reduce time to reaching goal feeding rates (Compton, Bojarski, Siegmund, & Van Der Giet, 2014; Ellis, 2015; Kattelman, et al., 2006; Meyer,et al., 2009; Heyland et al., 2009; Reeves et al., 2012; Zacharias et al., 2011). Based on this information, it has been concluded that the use of enteral nutrition protocols should be standard in all intensive care units in an attempt to improve outcomes and minimize complications among the critically ill, mechanically ventilated patient.

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Table 1

Sample Demographic: Age

Age (Years)	Pre-Intervention n (%)	Post-Intervention n (%)
< 30	0 (0)	1 (5.9)
30-39	2 (8.7)	1 (5.9)
40-49	0 (0)	0 (0)
50-59	3 (13)	1 (5.9)
60-69	4 (17.4)	4 (23.5)
70-79	7 (30.4)	3 (17.6)
80-89	6 (26.2)	5 (29.4)
>90	1 (4.3)	2 (11.8)

Table 2

Sample Demographic: Race

	Hispanic	White	African American	Middle Eastern	Asian
Pre-Intervention n (%)	12 (52.3)	7 (30.4)	2 (8.7)	1 (4.3)	1 (4.3)
Post-Intervention n (%)	9 (52.9)	7 (41.2)	1 (5.9)	0 (0)	0 (0)

Table 3

Sample Demographic: Diagnosis

	Cardiac	Sepsis	Renal	Pulmonary	Neuro	Overdose
Pre-Intervention n (%)	7 (30.4)	10 (43.6)	1 (4.3)	4 (17.4)	1 (4.3)	0 (0)
Post-Intervention n (%)	5 (29.4)	6 (35.3)	0 (0)	4 (23.5)	0 (0)	2 (11.8)

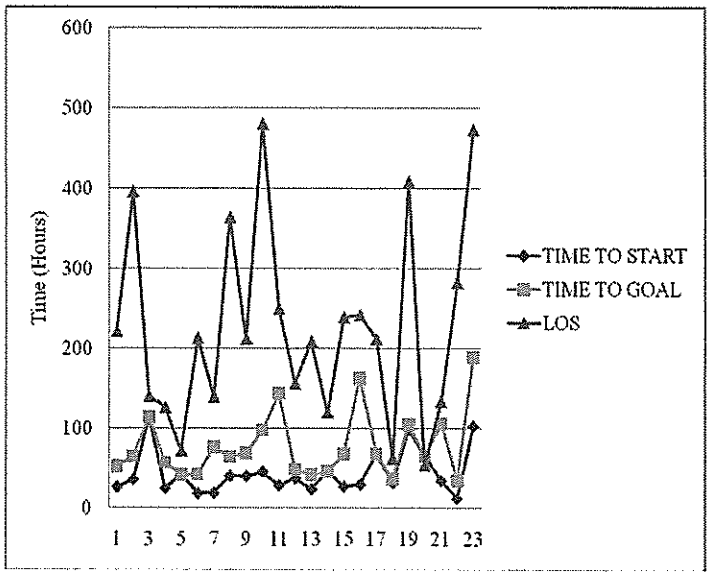


Figure 1: Pre-intervention outcomes.

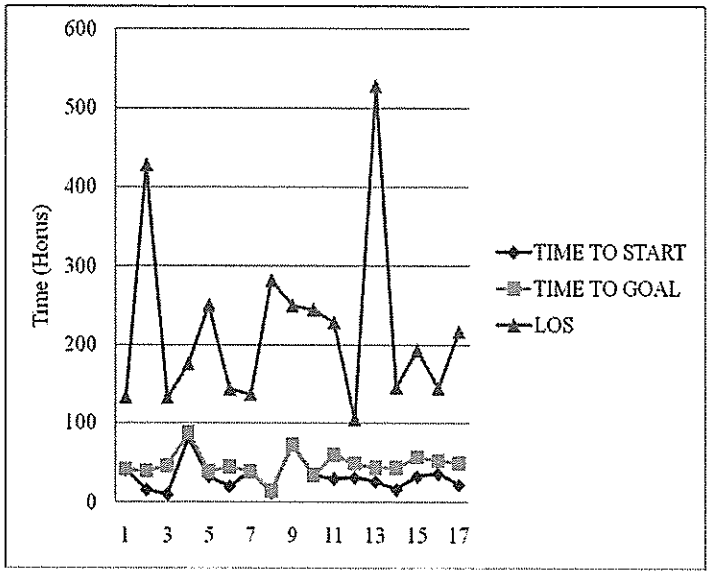


Figure 2: Post-intervention outcomes.

Appendix A

Level of Evidence according to Melnyk & Fineout-Overholt (2015)

Level I - Systematic review & meta-analysis of randomized controlled trials; clinical guidelines based on systematic reviews or meta-analyses
Level II - One or more randomized controlled trials
Level III - Controlled trial (no randomization)
Level IV - Case-control or cohort study
Level V - Systematic review of descriptive & qualitative studies
Level VI - Single descriptive or qualitative study
Level VII - Expert opinion

Appendix B

Evaluation Table of Studies

Author, Year and Title	Theory Base	Design & Method	Number, Attrition	Independent & Dependent Variables	Measurement Scales	Data Analysis	Findings Limitations	Levels of Evidence Hierarchy and Rating
Meyer, R., Harrison, S., Sargent, S., Ramnarayan, P, Habibi, P., & Labadarios, D. (2009). The impact of enteral feeding protocols on nutritional support in critically ill children. *Journal of Human Nutrition and Dietetics, 22*, 428-436.	None	Prospective cohort study	353, no attrition	Independent: gender, age, diagnostic category (neurology, respiratory, surgery, sepsis, or other) Dependent: Time to nutritional support initiation, proportion of patients reaching 50-70% of estimated average requirement by day 3	None	Statistical analysis using SPSS 14 performed to assess outcome measures, using the Kruskal-Wallis (analysis of variance) test	Estimated average requirement (EAR) of nutrition may have been inaccurate in many of the patients as <50% of patients could be weighed on admission. In these patients, EAR calculation was based on age.	Level IV
Compton, F., Bojarksi, C., Siegmund, B., & Van De Giet, M. (2014). Use	None	Retrospective cohort study	73 pre-intervention, 87 post-intervention ; no attrition	Independent: age, gender, diagnostic categories (sepsis, pulmonary disease, cardiac	None	Statistical analysis using SPSS 19. Results of continuous	Small sample size. The two groups compared differed in	Level IV

of a nutrition support protocol to increase enteral nutrition delivery in critically ill patients. *American Journal of Critical Care, 23*(5), 396-403.				arrest, neurological disease), mechanical ventilation, vasopressor therapy, height, weight, body mass index (BMI) Dependent: timing to enteral nutrition initiation, time of goal rate achievement, ICU length of stay		variables expressed as mean (standard deviation) and median and were compared using the nonparametric Mann Whitney *U* test. For categorical variables, the absolute numbers and percentages were calculated and differences were assessed for significance with the χ^2 test.	severity of illness, with post-intervention group more critical than pre-intervention group.	
Reeves, A., White, H., Sosnowski, K., Leveritt, M., Desbrow, B., & Jones, M. (2012).	None	Prospective cohort study	104, no attrition	Independent: weight, height, clinical parameters Dependent: time to enteral	None	95% confidence intervals were used for statistical comparison.	Small sample size.	Level IV

Multidisciplinary evaluation of a critical care enteral feeding algorithm. *Nutrition & Dietetics, 69,* 242-249.				nutrition initiation, time goal rate feeding achieved, percentage of estimated requirements achieved.				
Zacharias, N., Blank, R., Bittner, E.A., Joyce, S, Kondili, D., Fisher, D., Eikermann, M., Velmahos, G. C., & Schmidt, U. (2011). Introduction of guidelines to facilitate enteral nutrition in a surgical intensive care unit is associated with earlier enteral feeding. *European Journal of Emergency and Trauma Surgery, 37,*	None	Prospective cohort study	146 pre-intervention, 141 post-intervention ; no attrition	Independent: age, gender, APACHE II score, diagnostic category (general surgery, trauma, thoracic, vascular, burn, orthopedic) Dependent: aspiration, time to enteral nutrition initiation, length of stay	None	Statistical analysis performed using SPSS version 12.0.01. Ordinal variables expressed as medians, while continuous variables expressed as mean ± standard deviation. Characteristics pre and post intervention were compared using unpaired t-test for normally	No limitations identified.	Level IV

605-608.						distributed variables. Mann-Whitney *U* test used for non-normally distributed variables. χ^2 test used to compare absolute numbers and proportions.		
Ellis, C. S. (2015). Improving nutrition in mechanically ventilated patients. *Journal of Neuroscience Nursing, 47*(5), 263-270.	Iowa Model of Evidence -Based Practice to Promote Quality Care	Prospective cohort study	33 pre-intervention, 18 post-intervention ; no attrition	Independent: age, gender, mechanical ventilation Dependent: time to enteral feeding initiation, time to reaching 60% of prescribed goal	None	Percentage of patients who reached 60% of prescribed goal rate and mean time to enteral feeding initiation were compared pre- and post-intervention.	Small sample size. Level of significance could not be determined.	Level IV
Heyland, D. K., Cahill, N. E., Dhaliwal, R., Sun, X., Day, A. G., & McClave, S. A. (2010). Impact of enteral feeding	None	Prospective cohort study	1,081 no protocol, 4,416 with protocol; no attrition	Independent: age, gender, admission category (medical vs. surgical), APACHE II score, presence of ARDS, height, weight, baseline	None	Characteristic s were compared with Fisher's exact test and Rao-Scott adjusted χ^2 method for	Because data was collected from 269 sites, there was lack of standardization in the enteral nutrition	Level IV

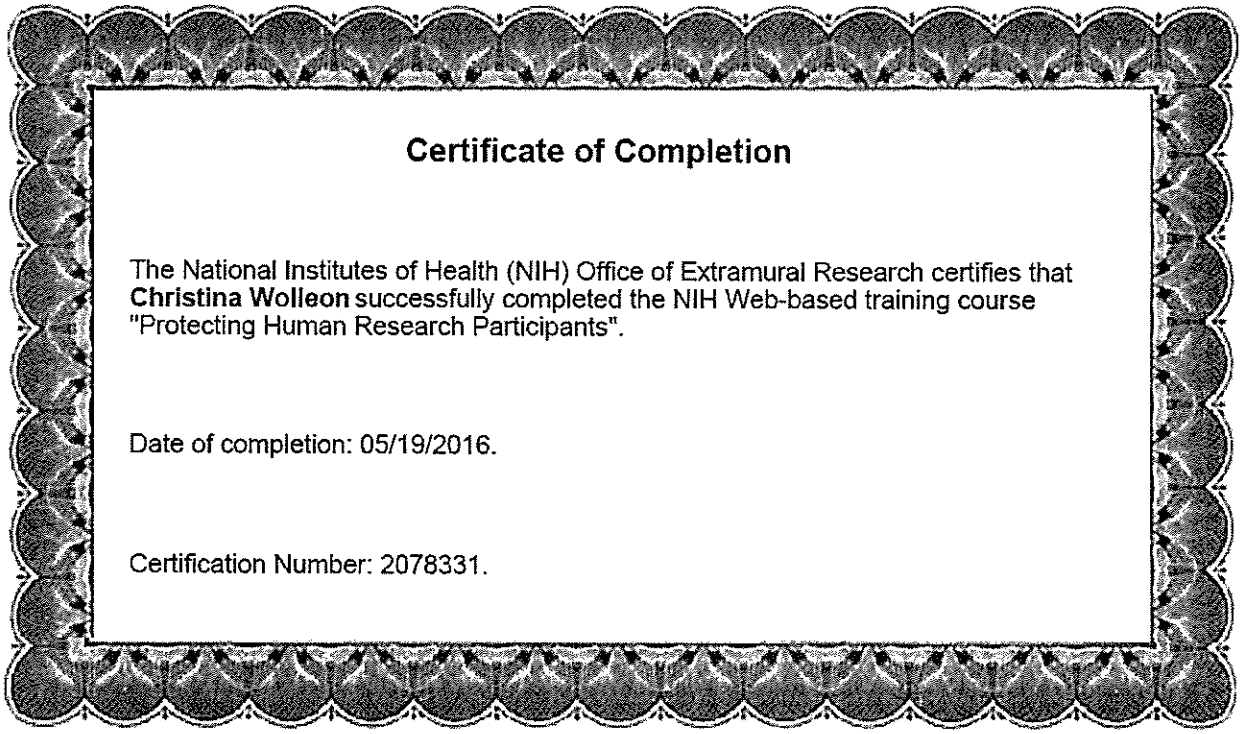
protocols on enteral nutrition delivery: results of a multicenter observation study. *Journal of Parenteral and Enteral Nutrition, 34*(6), 675-684.				nutrition assessment Dependent: time to enteral nutrition initiation, use of motility agents, nutritional adequacy		categorical variables and Wilcoxon-Mann-Whitney test for continuous variables. Continuous variables were also compared between groups by a linear mixed effect model that included random intercepts to account of dependence due to ICU and year within ICU.	protocol use.	
Bowman, A., Greiner, J. E., Doerschug, K. C., Little, S. B., Bombei, C. L., & Comried, L. M. (2005). Implementation of an evidence-based feeding protocol and	Iowa Model of Evidence -Based Practice to Promote Quality Care	Retrospective cohort study	18 pre-intervention, 13 post-intervention ; no attrition	Independent: history of aspiration, vasopressor therapy, use of analgesics/sedatives, glycemic control, electrolyte imbalance, neuromuscular	None	Percentage of patients who reached goal rate and of those who developed aspiration pneumonia was calculated pre- and post-	Small sample size. Level of significance could not be determined.	Level IV

aspiration risk reduction algorithm. *Critical Care Nursing, 28*(4), 324-333.				blockage, supine positioning Dependent: time to reaching goal rate, reported aspiration		intervention.		
Ventura, A. M. C. & Waitzberg, D. L. (2014). Enteral nutrition protocols for critically ill patients: are they necessary? *Nutrition in Clinical Practice, 30*(3), 351-362.	None	Systematic review	19 studies	Independent: None identified Dependent: number of days of enteral nutrition (EN), time to initiation of nutrition therapy, median of delivered energy, time until goal rate achieved, intolerance to EN.	None	None, Narrative review was conducted due to heterogeneous characteristics of the studies included.	Because of narrative nature of analysis, no definitive data could be calculated to make a definite conclusion.	Level I
Friesecke, S., Schwabe, A., Stecher, S. S., & Abel, P. (2014). Improvement of enteral nutrition in intensive care unit patients by a nurse-driven feeding protocol. *Nursing in*	None	Prospective cohort study	101 pre-intervention 97 post-intervention ; no attrition	Independent: age, gender, mechanical ventilation, admission diagnosis (respiratory, cardiovascular, sepsis, gastroenterology, other)	None	Groups were compared using Student's *t*-test for the time to start of enteral feeding and daily calories. Pearson's χ^2 tests used for the frequency	Standardized quantities of nutrition were used rather than using individual calculations of the calorie goal as recommended by clinical guidelines.	Level IV

Critical Care, 19(4), 204-210.				Dependent: time to enteral feeding initiation, number of patients meeting nutritional goal in first 5 days of ICU admission		of protocol-conform enteral nutrition.		
Theodorakopoulou, M., Dimopoulou, I., Karambi, S., Strilakou, A., Diamantakis, A., Orfanos, S., & Armaganidis, A. (2014). Early enteral feeding in the septic critically ill patient: evaluation of our feeding protocol. *Critical Care, 18*, 423.	None	Prospective cohort study	83 mechanically ventilated patients; no attrition	Independent: APACHE II score, SOFA score, weight, BMP, nutritional status upon admission. Dependent: Time to enteral nutrition initiation, achievement of caloric goals	None	Averages of time taken to enteral nutrition initiation were calculated on day 0, 3, and 7. Percentages of patients achieving caloric goals were measured on day 0, 3, and 7.	Comparison to pre-intervention was not performed. Significance not determined.	Level IV

Appendix C

NIH Certificate



Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Christina Wolleon** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 05/19/2016.

Certification Number: 2078331.

Appendix D

Authorization to Use and/or Reproduce the Iowa Model

Permission to Use and/or Reproduce The Iowa Model (2015)

Kimberly Jordan - University of Iowa Hospitals and Clinics **<noreply@qemailserver.com>** **Sun, Mar 20, 2016 at 3:02 PM**

Reply-To: Kimberly Jordan - University of Iowa Hospitals and Clinics <kimberly-jordan@uiowa.edu>

To: cwolleon@mail.saintpeters.edu

You have permission, as requested today, to review/use *The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care (The Iowa Model Collaborative.(In review). The Iowa Model Revised: Development and Validation.)* Click the link below to open the model.

Copyright of *The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care* will be retained by The University of Iowa Hospitals and Clinics.

Permission is not granted for placing the Iowa Model on the internet.

The Iowa Model - 2015

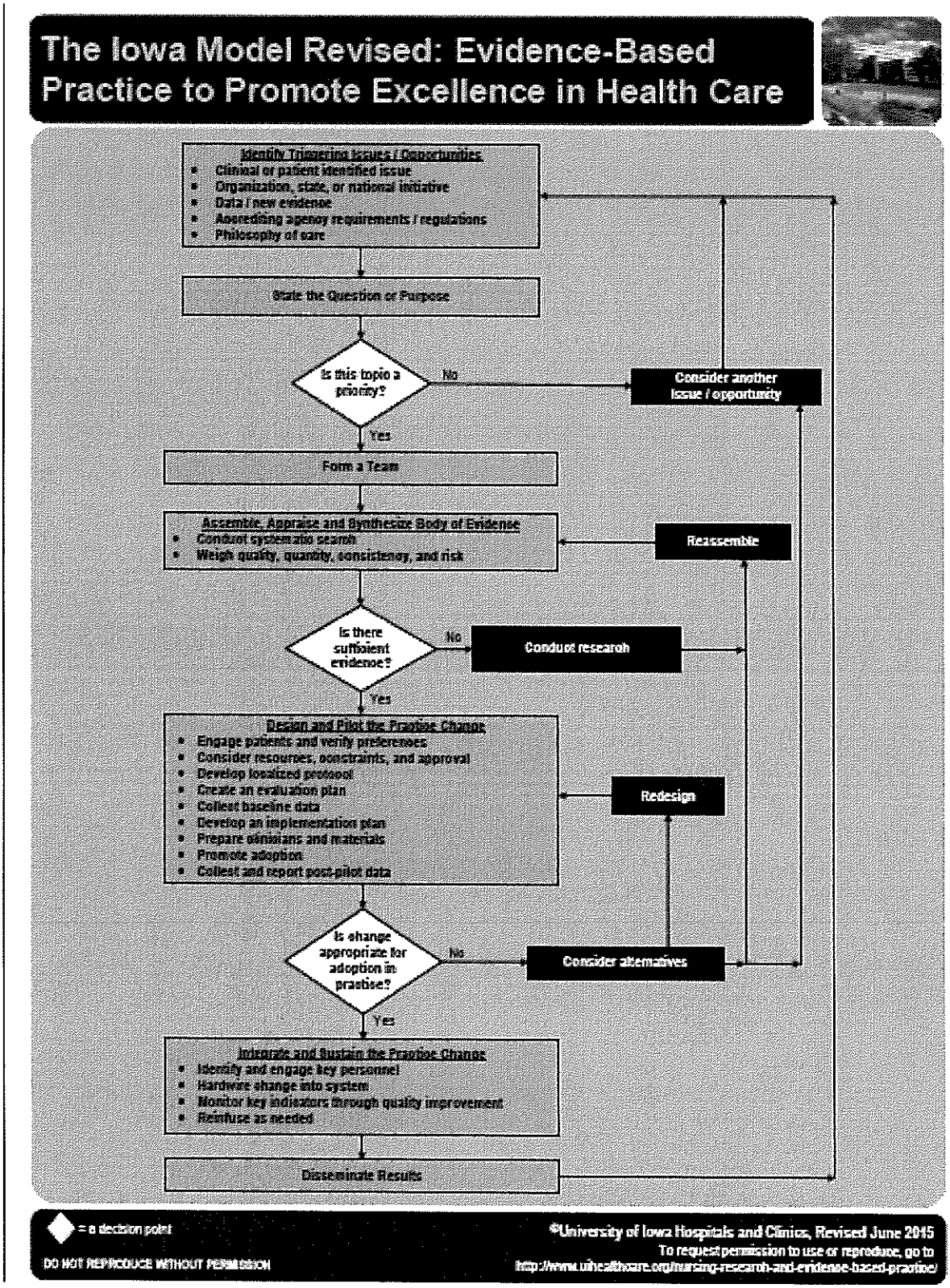
In written material, please add the following statement:

- ***Used/Reprinted with permission from the University of Iowa Hospitals and Clinics. Copyright 2015. For permission to use or reproduce the model, please contact the University of Iowa Hospitals and Clinics at** (319)384-9098.*

If you have questions, please contact Kimberly Jordan at 319-384-9098 or kimberly-jordan@uiowa.edu.

Appendix E

The Iowa Model (2015)



Appendix F

Saint Peter's UNIVERSITY

Institutional Review Board

To: Christina Wolleon
DNP Program
School of Nursing
Saint Peter's University

From: Dr. Peter P. Cvek, chair
SPU Institutional Review Board

Date: July 6, 2016

Project Title: The Impact of an Enteral Nutrition Protocol on Nutritional Support in the Critically Ill, Mechanically Ventilated Patient.

Protocol Approval Date: August 1, 2016 – January 30, 2017

In accordance with DHHS Regulations for Protection of Human Subjects (45 CFR 46.110), the human subjects application for this Evidence-based project underwent **Expedited** review and was determined to be an Evidence-based project intended to improve the performance of institutional practice in relationship to an established standard.

The investigator agrees to conduct this Evidence-based project in accordance with the Belmont Report, all the SPU Institutional Review Board guidelines, as well as all applicable HIPAA rules and regulations.

Important: SPU IRB acknowledges site IRB approval: Hackensack UMC Palisades Medical Center, June 3, 2016.

Re-review of this project is required if:

You wish to continue the project beyond January 30, 2017.
There are any changes in the protocol.
There are any reports of injury or unanticipated problems involving risks to human subjects.

Note: any injuries or adverse events must be reported to the IRB within three days of the event.

The IRB wishes you the best of luck in the successful completion of your project. Should you have any further comments and/or questions, please do not hesitate to contact me at your earliest convenience.

Sincerely,

Peter P. Cvek, Ph.D.
Chair, Institutional Review Board
Saint Peter's University
pcvek@saintpeters.edu

Appendix G

Palisades Medical Center
Hackensack University Health Network

June 3, 2016

Christina Wolleon, RN, APN
Clinical Support Services
HackensackUMC Palisades
7600 River Road
North Bergen, NJ 07047

Dear Christina,

Thank you for submitting your research study of the Capstone Proposal "The Impact of an Enteral Feeding Protocol on Nutritional Support in Critically Ill, Mechanically Ventilated Patients".

On behalf of the Institutional Review Board, I wish to inform you that your proposal was accepted and is approved to have HackensackUMC Palisades as a study site. During the next scheduled meeting, you will be invited to present the topic and any information obtained thus far. If the study is ongoing, you will be required to renew with the IRB on an annual basis.

Congratulations and best luck in the pursuit of your Doctor of Nursing Practice degree.

Sincerely,

Matthew Shatz, MD

Matthew Shatz, MD
Chairman/IRB Committee

Cc: M. Gruner
J. Mozeika

(memo.irblcw1)

Appendix H

Proposed Enteral Feeding Protocol

CRITICAL CARE UNIT (CCU) ENTERAL NUTRITION PROTOCOL

Initiation of Feeding

1. Mechanically ventilated patients should receive an orogastric tube (OGT) or nasogastric tube (NGT). The correct position of the tube should be confirmed by auscultation and chest radiograph.
2. Enteral nutrition (EN) should be initiated within 48 hours of admission to ICU, unless the patient is not hemodynamically stable, adequately resuscitated, or the gastrointestinal (GI) tract is believed to be non-functioning or compromised. Patients with recent abdominal surgeries require surgical clearance prior to initiating EN.
3. Patients receiving EN should be placed in the semi-recumbent position with the head of bed (HOB) 30-45°, unless otherwise indicated.
4. It is preferred that patients receive continuous enteral feeding. EN should start at 20 ml/hr, increasing by 10 mL every 4 hours as tolerated, reaching the goal rate as determined by the Registered Dietitian (RD) within 72 hours of feeding initiation.

Estimated Needs and Formula Selection

1. Standard polymeric formula may be initiated by Registered Nurse (RN) until patient is assessed by a RD and recommendations are made.
2. Energy and protein needs will be estimated by a RD and formula will be selected by RD based on severity and type of illness and past medical history.

Tolerance

1. EN tolerance should be monitored by multiple markers (pain and/or abdominal distention, physical exam, and passage of flatus and stool).
    a. Gastric residual volumes (GRV)
        i. GRV initially should be checked every 4 hours. If after 48 hours, GRV have been consistently < 200 mL, increase frequency of GRV monitoring to every 8 hours.
            1. If GRV < 200 mL, return residual amount and increase by 10 ml/hr until goal rate is reached.
            2. If GRV 200-500 mL and patient shows no signs of intolerance, return residual amount and increase by 10 ml/hr until goal rate is reached. *Consider:* adding prokinetic agent (i.e. metoclopramide 5-20 mg QID, erythromycin 125-250 mg QID)
            3. If GRV > 500 mL, clinically examine for signs of intolerance (i.e. abdominal distention, fullness, discomfort, or presence of emesis).

Return 200 mL, discard the remainder, and hold feeding for 2 hours. Recheck residual after 2 hours. If GRV remains > 200 mL, continue to hold feeding. *Consider:* KUB to rule out ileus/obstruction, adding prokinetic agent, small bowel feeding, minimizing use of narcotics, changing formula, decreasing goal rate, or total parenteral nutrition (TPN).

b. Emesis, abdominal distention
    i. Check HOB/patient position. *Consider:* holding feeding for 2 hours, KUB to rule out ileus/obstruction, prokinetic agent, anti-emetic, small bowel feeding, changing formula, decreasing goal rate, or TPN.
c. Diarrhea: > 500 mL every 8 hours or > 3 stools per day for at least 2 consecutive days
    i. Warrants further evaluation for etiology (i.e. enteral medications, *Clostridium difficile*, or other infectious etiologies.
    ii. Persistent diarrhea (where *C. difficile* has been excluded) may benefit from the use of a soluble fiber-containing enteral formula or the addition of soluble fiber or prebiotic fiber.
    iii. If it is determine that the patient exhibits GI absorption difficulty, the use of a peptide based or elemental formula may be justified.
d. Constipation: difficulty passing or no bowel movement > 3 days.
    i. Check for signs of dehydration.
    ii. Increase amount of free water.
    iii. Minimize use of narcotics, if possible.
    iv. Ensure adequate bowel regimen ordered.
    v. Rectal examination with disimpaction.
    vi. *Consider:* KUB to rule out obstruction.

***Inappropriate cessation of EN should be avoided. Holding EN for GRV < 500 mL in absence of other signs of intolerance should be avoided. The time period that enteral nutrition is held prior to, during, and immediately following the time of diagnostic tests or procedures should be minimized to prevent inadequate delivery of nutrients. In cases of prolonged or frequent interruptions in enteral nutrition, discuss with RD increasing feeding goal rate to ensure adequate volume delivery to meet total calorie and protein goals.**

***Enteral feedings should infuse for the total volume indicated by the RD and should *not* be stopped based on hour of day (i.e. start at 1600 and end at completion of total volume, not start at 1600 and end at 1200 the following day). RN must take into account interruptions in feedings and extend time feeding takes place in order to ensure that the entire volume recommended is delivered.**

CCU ENTERAL NUTRITION PROTOCOL

(For patients unable to receive oral nutrition)

Decrease Risk of Aspiration & Ventilator Associated Pneumonia (VAP)

- Keep HOB elevated at 30-45°.
- Mouth care twice daily with chlorhexidine wash.
- Minimize transport out of CCU for diagnostic testing.
- Reduce level of sedation/analgesia when possible.
- Consider small bowel feeding for patients at high risk of aspiration.

Hemodynamic Stabilization
Circulatory shock treated?

No → Hold enteral nutrition (EN), continue resuscitation.

↓ Yes

Contraindications for enteral nutrition (i.e. non-functioning GI tract, acute GI bleed, ileus/obstruction, planned surgery or endoscopy, post-operative patient (at discretion of surgeon)?

Yes → If patient is high nutrition risk or severely malnourished, consider initiating parenteral nutrition (PN) as soon as possible. If low nutrition risk, withhold PN for first 7 days following CCU admission if EN is not feasible.

↓ No

Place OGT or NGT and start EN within 48 hours of admission to CCU. Start continuous EN at 20 ml/hr. Advance as tolerated by 10 mL Q4H to goal rate. Check gastric residual volume (GRV) Q4H. If after 48 hours, GRV are consistently < 200, decrease frequency of GRV check to Q8H.

GRV < 200 mL (with no signs of intolerance)

- Return residual amount.
- Continue increasing infusion rate by 10 ml/hr Q4H to goal rate.

GRV 200-500 mL (with no signs of intolerance)

- Return residual amount.
- Continue increasing infusion rate by 10 ml/hr Q4H to goal rate.
- Consider: adding prokinetic agent (i.e. metoclopramide 5-20 mg QID, erythromycin 125-250 mg QID).

GRV > 500 mL

- Return 200 mL, discard the remainder.
- Hold feeding for 2 hours.
- If GRV remains > 200 mL:
  - Continue to hold feeding
  - Check HOB/patient position
  - Consider: KUB to rule out obstruction, prokinetic agent, small bowel feeding, minimizing use of narcotics if possible, changing formula, decreasing goal rate, TPN.

Emesis and/or abdominal distention

- Check HOB/patient position
- Consider: KUB to rule out obstruction, prokinetic agent, anti-emetic, changing formula, decreasing goal rate, TPN.