State of the Science: Enteral Nutrition Protocols

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Abstract

Managing nutrition in critically ill patients is an important intervention to promote healing. Adequate nutrition decreases rates of infections and pressure ulcers, improves prognosis for recovery, and decreases mortality. The purpose of this literature review is to determine the current state of the science in regards to evidence-based protocols for the administration and management of enteral nutrition (EN-tube feeding) in critically ill patients. Is the use of a nursing-driven protocol for enteral feeding in critically ill patients effective in improving patient outcomes compared with not utilizing a protocol? Ten studies with enteral nutrition protocols for adult, critically ill patients were included for review. Study characteristics and themes are identified. Early initiation of EN and adequate titration to goal are important for achieving the maximum nutritional advantage. The highest benefit is also derived from identifying and delivering an individualized caloric and/or protein goal. Interprofessional collaboration remains paramount, and an EN protocol increases standardization of practice. A nurse-driven protocol may yield higher compliance and greater effectiveness than a protocol that is not nurse-driven. Lastly, gaps in knowledge, future research opportunities, and applications to nursing administration, research, education, and practice are discussed.

Nutrition and malnutrition both have significant impacts on critically ill patients. Critical illness itself has physiologic impacts that affect nutritional status. Therefore, managing nutrition in critically ill patients is an important intervention to promote healing.

Physiologic Effect of Illness

The body's stress response to illness increases the basal metabolic rate as well as the catabolism of protein and lipids (Colaço & Nascimento, 2014; Ellis, 2015; Friesecke, Schwabe, Stecher, & Abel, 2014). Furthermore, hospitalized patients usually have decreased caloric intake. The resulting negative energy balance causes loss of body mass, increased risk for infection, metabolic derangements, organ dysfunction, and increased morbidity and mortality.

Malnutrition and Undernutrition

Some patients may have baseline malnutrition, while others' condition deteriorates during hospitalization (Damratowski & Goetz, 2016; Gerrish, Laker, Taylor, Kennedy, & McDonnell, 2016). Kuslapuu, Jõgela, Starkopf, and Blaser (2015) estimate that patients develop nearly a 6,000 kilocalorie deficit within the first week of admission to the intensive care unit (ICU). This may be due to the limited nutrition management education imparted to medical providers and nurses (Soguel, Revelly, Schaller, Longchamp, & Berger, 2012). Alternatively, caloric needs may simply be underestimated during hospitalization (Ellis, 2015).

Malnutrition and undernutrition have detrimental effects on the body's ability to recover from critical illness. Both have been shown to decrease immune response and wound healing thereby increasing the rate of infection and pressure ulcers, time on mechanical ventilation, hospital length of stay, as well as morbidity and mortality (Colaço & Nascimento, 2014; Damratowski & Goetz, 2016; Gerrish et al., 2016). Non-use of the gut, in particular, fosters intestinal permeability of bacteria and enhances the risk for sepsis (Friesecke et al., 2014; Jarden & Sutton, 2014). The in-hospital mortality rate of sepsis is approximately 10 percent, which is greater than that of an ST-segment elevation myocardial infarction, more commonly known as a heart attack (Singer et al., 2016). As an important aside, all of these effects increase hospital costs. Guerra et al. (2014) found that undernutrition increases hospitalization costs by 19 to 29 percent.

Benefits of Nutrition

Nutritional care has previously been considered merely a supportive function rather than therapeutic (Jarden & Sutton, 2014). However, the benefits of nutrition are numerous. Adequate nutrition allows for the reduction of the effects of physiologic stress and cellular injury, as well as decreased rate of infections and pressure ulcers due to improved immunity and increased tissue healing (Colaço & Nascimento, 2014; Ellis, 2015; Friesecke et al., 2014; Jarden & Sutton, 2014; Taylor, Brody, Denmark, Southard, & Byham-Gray, 2014). Overall, these equate to improved prognosis for recovery, higher quality of life, and decreased mortality. Protein specifically promotes injury repair and energy maintenance (Colaço & Nascimento, 2014). Enteral nutrition decreases the inflammatory response and maintains intestinal function, integrity, and motility (Friesecke et al., 2014; Jarden & Sutton, 2014).

Purpose

Multiple evidence-based guidelines exist for nutritional management in critically ill patients, such as those published by the American Society for Parenteral and Enteral Nutrition (ASPEN), the European Society for Parenteral and Enteral Nutrition (ESPEN), the Canadian Critical Care Clinical Practice Guidelines Committee, and the Society of Critical Care Medicine (SCCM) (Colaço & Nascimento, 2014; Damratowski & Goetz, 2016; Ellis, 2015; Kelly, 2014; Taylor et al., 2014). However, actual practice does not always align with the recommended guidelines (Compton et al., 2014; Damratowski & Goetz, 2016; Ellis, 2015; Friesecke et al., 2014; Jarden & Sutton, 2014; Kelly, 2014).

Multiple studies have been conducted to develop and test the effects of a protocol for nutritional care in critically ill patients (Compton, Bojarski, Siegmund, & van der Giet, 2014; Damratowski & Goetz, 2016; Ellis, 2015; Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Kuslapuu, Jõgela, Starkopf, & Blaser, 2015; Reeves et al., 2012; Taylor et al., 2014). What is known is that adequate nutrition is important to the physiologic response to critical illness and, conversely, that malnutrition is detrimental to healing and recovery. What is not known is whether the implementation of a protocol that guides enteral nutrition support is effective in improving the outcomes of critically ill patients. Furthermore, it is

unknown whether a nurse-driven protocol is more or less effective than a protocol not managed by nurses.

The purpose of this literature review is to determine the current state of the science in regards to evidence-based protocols for the administration and management of enteral nutrition in critically ill patients. Specifically, is the use of a nursing-driven protocol for enteral feeding in critically ill patients effective in improving patient outcomes compared with not utilizing a protocol?

Framework

The framework guiding this review is Patricia Benner's Clinical Wisdom for Critical Care Nursing. Parts of Benner's focus are clinical judgment and knowledge. She identified 31 competencies of nursing practice and seven domains of influence. Later, Benner identified nine domains specific to critical care nursing. Specifically, one of these domains is "diagnosing and managing life-sustaining physiologic functions in unstable patients" (Masters, 2013, p. 54). The use of a protocol for enteral feeding aligns with this concept. The critical care domains were further used to develop six aspects of clinical judgment and skilled behavior, such as reasoning-in-transition (practical, ongoing, clinical reasoning), skilled know-how (skill and intelligence), response-based practice (adaptation of interventions to changing needs), and agency (one's ability to influence a situation), among others.

Methods

Studies were identified by searching the Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus database. All searches were limited to articles published since 2011. The initial search for "nursing protocols," limited to peer-reviewed research in English, yielded 182 results. A couple of studies were identified, but this search was not appropriately specific to enteral nutrition. A search for "enteral nutrition" yielded too many results for review (n = 3,122), while "enteral nutrition AND nursing protocol" produced only 12. "Enteral nutrition AND nursing" yielded 368 results; the additional parameters of peer-reviewed research published in English limited the results to 96.

Studies with enteral nutrition protocols for adult, critically ill patients were included. Studies without a protocol and those pertaining to pediatric or disease-specific populations were excluded. Studies were also excluded if the study

population was medical-surgical or in the community, even if a nutritional protocol was presented.

Eight studies were identified through the CINAHL Plus database searches. Additional review of those articles' reference lists produced two more studies meeting the inclusion criteria. Unfortunately, only two of the ten studies presented a protocol clearly described as nurse-driven (Frisecke et al., 2014; Kuslapuu et al., 2015).

Furthermore, one of these nurse-driven protocols was developed out of the current study and not actually tested in the current study (Kuslapuu et al., 2015). A follow-up study was going to be conducted on the benefit of the protocol. The authors did not respond to a request for the status and results of the second study. The effect on this literature review is very limited data from that particular publication.

Results

Study Characteristics

Research method. One of the studies was qualitative (Damratowski & Goetz, 2016). One study was mixed methods (Reeves et al., 2012). The remaining eight were quantitative (Compton et al., 2014; Ellis, 2015; Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Kuslapuu et al., 2015; Taylor et al., 2014).

Framework. Seven of the studies did not indicate a theoretical framework (Compton et al., 2014; Damratowski & Goetz, 2016; Frisecke et al., 2014; Heyland et al., 2013; Kuslapuu et al., 2015; Reeves et al., 2012; Taylor et al., 2014). Each of the remaining three identified a different framework that guided the research. Ellis (2015) utilized the Iowa Model of Evidence-Based Practice to Promote Quality. Jarden and Sutton (2014) followed the Plan-Do-Study-Act (PDSA) quality improvement model. Lastly, Kelly's (2014) research was guided by Larrabee's Model for Change of Evidence-Based Practice.

Research design. Two studies conducted prospective, randomized control trials (Heyland et al., 2013; Reeves et al., 2012). The qualitative portion of the mixed methods study was conducted with structured interviews (Reeves et al., 2012). One study was a prospective observational design (Kuslapuu et al., 2015). The remaining

seven studies, including the qualitative one, utilized a pre- and post-implementation design (Compton et al., 2014; Damratowski & Goetz, 2016; Ellis, 2015; Frisecke et al., 2014; Jarden & Sutton, 2014; Kelly, 2014; Taylor et al., 2014).

Sample. Per the inclusion criteria, all of the quantitative studies examined critically ill patients admitted to the ICU (Compton et al., 2014; Ellis, 2015; Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Kuslapuu et al., 2015; Reeves et al., 2012; Taylor et al., 2014). A few studies focused specifically on mechanically ventilated patients (Compton et al., 2014; Ellis, 2015; Heyland et al., 2013; Taylor et al., 2014). The qualitative study sample was comprised of ICU nurses (Damratowski & Goetz, 2016).

Themes

Time to initiation. All but one of the studies addressed the topic of "early" initiation of enteral nutrition (EN) for maximum benefit (Compton et al., 2014; Ellis, 2015; Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Kuslapuu et al., 2015; Reeves et al., 2012; Taylor et al., 2014). However, as several authors discussed, the recommended timeframe for initiation varied between the studies, generally ranging from within 24 to 48 hours (Ellis, 2015; Frisecke et al., 2014; Heyland et al., 2013; Taylor et al., 2014). Ellis (2015) even cited literature that identified within 48 to 72 hours as an acceptable timeframe for initiation. Others identified early initiation as within 24 hours (Frisecke et al., 2014; Jarden & Sutton, 2014; Kelly, 2014; Taylor et al., 2014). Notably, the event that starts the time also varies, from ICU admission, last oral intake, and time of intubation (Compton et al., 2014; Ellis, 2015; Frisecke et al., 2014; Heyland et al., 2013; Kelly, 2014).

Three studies demonstrated decreased time to initiation of EN with the implementation of the EN protocol. One study demonstrated a decrease in start time from day one after intubation to day zero, the day of intubation (Compton et al., 2014). This is the only study that counted days instead of hours. Ellis (2015) found that 83 percent of patients received EN within 48 hours of intubation, an increase from pre-implementation. Friesecke et al. (2014) also observed an increase to 64 percent in the number of patients receiving EN within 24 hours of admission, with an average of within 28 hours of admission.

Three other studies observed no significant change in the time to initiation

of EN with the implementation of an EN protocol (Jarden & Sutton, 2014; Kelly, 2014; Taylor et al., 2014). No studies demonstrated an increase in time to initiation of EN.

In the new, untested protocol, Kuslapuu et al. (2015) directed EN to begin within six hours of ICU admission. Only one other study demonstrated consistent initiation in less than 12 hours (Reeves et al., 2012). Kelly (2014) observed an average time to initiation of approximately 12 hours.

Caloric goal and delivery. Almost all of the studies discussed the intent to deliver a caloric and/or protein goal from EN (Compton et al., 2014; Damratowski & Goetz, 2016; Ellis, 2015; Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Reeves et al., 2012; Taylor et al., 2014). Again, however, there was variation between the studies in terms of what percentage of the goal is appropriate. For example, Damratowski and Goetz (2016) identified that patients will experience nutritional compromise if they receive less than 65 percent of their required daily calories. Conversely, Ellis (2015) asserted that delivery of more than 70 percent of the recommended calories via EN may produce an increased rate of complications, therefore the intake goal was 60 percent. Most other studies aimed for patients to receive equal to or greater than 80 percent of their caloric goal with EN (Damratowski & Goetz, 2016; Heyland et al., 2013; Kelly, 2014; Reeves et al., 2012; Taylor et al., 2014).

As far as the effect of the EN protocol on delivery of the caloric goal, 78 percent of patients reached the 60 percent goal in the study by Ellis (2015), which was an improvement from pre-implementation. Sixty percent of the patients in the study by Reeves et al. (2012) achieved 82 percent of their calorie and protein goals; this was an improvement with the protocol. In the study by Heyland et al. (2013), patients received 47 percent and 44 percent of their target protein and calories, respectively. Although this seems low compared to the goal of 80 percent, these figures demonstrated an improvement with implementation of the protocol. Taylor et al. (2014) implemented a revised version of the protocol by Heyland et al. (2013) and improved the calorie and protein delivery to 89 percent.

Three studies had not identified a target but reported the number of patients who reached their EN goal. Seventy-four percent of patients in the study

by Compton et al. (2014) reached their goal, and, notably, this was unchanged from prior to implementation to the EN protocol. Patients in another study received about 60 percent of the prescribed EN (Frisecke et al., 2014). Eighty percent of the patients in the study by Jarden and Sutton (2014) reached their target rate. Importantly, this was measured by the target rate rather than the caloric or protein content.

Lastly, few studies addressed how the nutritional goal was identified. Several studies identified that the target was calculated for each individual patient (Damratowski & Goetz, 2016; Friesecke et al., 2014; Reeves et al., 2012; Taylor et al., 2014). Only two of these identified specific values (Damratowski & Goetz, 2016; Taylor et al., 2014). Heyland et al. (2013) asserts that no standard for EN prescription exists.

Time to goal. Some of the studies examined the timeframe required for patients to receive EN at the goal rate (Compton et al., 2014; Jarden & Sutton, 2014; Kelly, 2014; Reeves et al., 2012). This is an important consideration because even if EN is initiated early, the starting rate is often low, such as 20 to 40 milliliters (mL) per hour or 50 mL every three hours (Compton et al., 2014; Jarden & Sutton, 2014; Kuslapuu et al., 2015; Reeves et al., 2012). Patients will not receive adequate nutrition if the rate is increased to the target rate too slowly or not at all (Heyland et al., 2013). For this reason, the algorithm developed by Heyland et al. (2013) focused on a daily, volume-based target rather than an hourly, rate-based target. Similarly, the protocol utilized by Jarden and Sutton (2014) aimed to promote rapid titration of the EN.

With implementation of the EN protocol, Compton et al. (2014) achieved target delivery rate in approximately 6 days and 2 days for gastric and jejunal routes, respectively, which were both improved from before use of the protocol. Similarly, Jarden and Sutton (2014) observed decreased timeframes to achievement of the target rate. With the rapid titration protocol, target rate was reached at an average of 34 hours from admission and an average of 10 hours from initiation of EN. The study by Kelly (2014) established a goal for the target rate to be reached within 48 hours. One hundred percent of patients achieved this with use of the protocol, with an average time of 18.5 hours, which was an improvement prior to the use of the protocol. Reeves et al. (2012) demonstrated achievement of the goal rate at approximately 12 hours.

Management of gastric residual volume. Significant variations in the definition and management of gastric residual volume (GRV) were identified (Compton et al., 2014; Damratowski & Goetz, 2016; Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Kuslapuu et al., 2015; Reeves et al., 2012; Taylor et al., 2014). The volume for GRV is defined anywhere from 200 mL to 500 mL. The response to the GRV also varies, from holding, stopping, or decreasing the EN rate to considering gastric motility agents. Two algorithms were developed specifically to standardize the management of GRV (Damratowski & Goetz, 2016; Kelly, 2014).

Complications. Complications of EN, such as gastric intolerance, regurgitation, emesis, aspiration, vomiting, and diarrhea, were measured in five of the studies (Compton et al., 2014; Damratowski & Goetz, 2016; Heyland et al., 2013; Jarden & Sutton, 2014; Taylor et al., 2014). Two of the studies did not report the findings (Compton et al., 2014; Heyland et al., 2013). Most researchers found no statistically significant change in the occurrence of EN complications with the implementation of a protocol (Damratowski & Goetz, 2016; Jarden & Sutton, 2014; Taylor et al., 2014). Specifically, Damratowski and Goetz (2016) identified that increasing the GRV threshold to 500 mL does not affect the rate of aspiration and regurgitation as long the head of the bed is elevated to 30 degrees. Only Taylor et al. (2014) observed an increase in the rate of a complication, specifically diarrhea, in patients receiving EN with the volume-based protocol.

Patient outcomes. Patient demographics were reported in six of the studies (Compton et al., 2014; Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Taylor et al., 2014). Unfortunately, patient outcomes were not measured in a majority of the studies (Damratowski & Goetz, 2016; Ellis, 2015; Jarden & Sutton, 2014; Kelly, 2014; Kuslapuu et al., 2015; Reeves et al., 2012). Those that did measure clinical outcomes observed no significant changes after the implementation of an EN protocol, including Heyland et al. (2013). Compton et al. (2014) noticed an increase in mortality rate, but reported that it was not statistically significant. Similarly, Taylor et al. (2014) observed an increased length of stay, but reported that the strength of the finding lessened when the deceased patients were removed. Frisecke et al. (2014) and Taylor et al. (2014) found that mortality was not

significantly affected by the implementation of an EN protocol. Neither did Taylor et al. (2014) observe a change in patients' time requiring mechanical ventilation.

Other EN considerations. Various other important topics were discussed in the articles but not with as much prevalence. For example, two groups of authors mentioned the need to consult dietary specialists, even with the use of an EN protocol (Damratowski & Goetz, 2016; Taylor et al., 2014). Only one author addressed the selection of EN type (Reeves et al., 2012). Two studies considered the supplemental use of parenteral nutrition with EN (Compton et al., 2014; Heyland et al., 2013). The administration of continuous versus bolus feeds is an important matter to address with EN (Ellis, 2015; Taylor et al., 2014). Another significant topic is tube placement in the stomach or small intestine (Compton et al., 2014; Frisecke et al., 2014; Kuslapuu et al., 2015; Reeves et al., 2012). Lastly, managing feeding interruptions is important for adequate delivery (Heyland et al., 2013; Jarden & Sutton, 2014; Reeves et al., 2012; Taylor et al., 2014).

Compliance. Compliance with the protocol was monitored in half the studies (Frisecke et al., 2014; Heyland et al., 2013; Jarden & Sutton, 2014; Kelly, 2014; Taylor et al., 2014). Surprisingly, Kelly (2014) aimed to have a compliance rate of only 50 percent, and met this goal at 67 percent. Jarden and Sutton (2014) reported increased compliance with nursing management of the protocol. Taylor et al. (2014) observed 90 percent compliance with the protocol during the study period but observed a decline to 80 percent after the initiative ceased, suggesting lack of sustainability.

Standardization. Numerous quantitative data has been presented, and accurate comparison between studies is difficult to ascertain. Importantly, however, several studies reported that implementation of the EN protocol produced noticeable standardization of practice in EN delivery and care (Damratowski & Goetz, 2016; Ellis, 2015; Kelly, 2014; Reeves et al., 2012).

Discussion

Study Characteristics

Framework. A majority of the studies did not indicate the theoretical framework that guided the research. However, just because a framework was not clearly stated does not mean that one was not used. For example, the management

of physiologic processes in unstable patients, such as in Benner's Clinical Wisdom for Critical Care Nursing, could be an implied framework for many of the studies. The explicit identification of a framework, however, would have allowed for greater applicability of the results to practice and theory (McEwen, 2011).

Research design. A majority of the studies utilized a pre- and post-implementation research design. While this is a credible, quasi-experimental design, advantages and drawbacks exist (Polit & Beck, 2011). The advantages are that the design is practical and does not require randomization. The primary disadvantage is that the lack of a control group limits the validity of the results. The possibility exists that the pre- and post-implementation groups are not comparable enough to attribute the comparisons and differences to the intervention alone.

Results

Standardization? Several studies demonstrated that the use of an EN protocol enhanced the standardization of practice. Thus, an EN protocol provides standardization against itself. However, lack of standardization between protocols was evident. Numerous elements of practice related to EN are included in each protocol, increasing the opportunity for variability. Each element must be individually defined, such as appropriate timeframe for "early" initiation of EN, a method for determining nutritional prescription and goals, ideal percentage of the goal to be delivered, and measurement and response to GRV. With any variation of these metrics between protocols, the results may not be generalizable.

Generalizability. The lack of standardization among EN protocols may have contributed to the variability in results between studies. Three researchers observed a decreased time to initiation of EN with the implementation of an EN protocol (Compton et al., 2014; Ellis, 2015; Friesecke et al., 2014). Three other studies, however, demonstrated no change (Jarden & Sutton, 2014; Kelly, 2014; Taylor et al., 2014). Four studies demonstrated that the implementation of an EN protocol increased the percentage of patients who received their target calories and/or protein (Ellis, 2015; Reeves et al., 2012; Heyland et al., 2013; Taylor et al., 2014). However, these results may or may not be comparable because the target timeframes and nutritional goals were different between the studies.

Inconsistency between sample inclusion criteria also affects one's ability

to draw and generalize conclusions. For example, although the revised protocol by Taylor et al. (2014) demonstrated improved delivery of total protein and calories over the original study by Heyland et al. (2013), the sample population inclusion criteria were different, making the results difficult to compare. Both studies included patients who were mechanically ventilated on admission or within 6 hours of admission. However, Heyland et al. (2013) only included patients who were mechanically ventilated for greater than 72 hours and whose nutrition had been initiated after admission. Conversely, Taylor et al. (2014), only included patients whose length of stay was at least 7 days and who had demonstrated EN tolerance, as evidenced by EN administered for at least 72 hours after reaching the target EN goal.

The rate of complications was the most consistent finding among the studies in that most researchers found no significant change in the occurrence of EN complications with the use of an EN protocol. Only one study observed an increase of a relatively minor complication (Taylor et al., 2014).

Protocol compliance. Protocols serve numerous purposes that include guiding rapid decision making, providing guidance in overcoming barriers, and promoting standardization (Reeves et al., 2012; Taylor et al., 2014). A protocol is not developed with the intent of partial implementation. Without compliance, the protocol is rendered ineffective towards its purposes. Furthermore, lack of compliance skews measurable results and significantly limits sustainability. However, what is a reasonable target for the compliance rate? How is compliance measured and enforced?

The answer to the latter question is to examine barriers to compliance. Most likely, processes and systems issues are to blame, not individuals' efforts and intentions. Areas of non-compliance may be identified through regular chart audits. Process improvement tools can then be utilized to identify gaps, develop checklists, and improve adherence. In this way, protocol development and enforcement is an ongoing, quality improvement process.

Role of Nursing

Despite the initial impression that only two of the studies considered the EN protocols to be nursing-driven, several authors acknowledged in their discus-

sions that nurses hold a significant role in the implementation of the protocol in practice (Damratowski & Goetz, 2016; Ellis, 2015; Frisecke et al., 2014; Jarden & Sutton, 2014; Kelly, 2014; Reeves et al., 2012; Taylor et al., 2014). Nurses are often the first clinicians to assess nutritional status and identify potential malnutrition (Gerrish et al., 2016). Nurses are often then responsible for initiating, monitoring, and advancing EN as well as managing any complications (Colaço & Nascimento, 2014; Taylor et al., 2014). During the administration of EN, nurses have the ability to minimize interruptions, allowing patients to receive maximum nutrition (Damratowski & Goetz, 2016; Ellis, 2015). After all, the benefits of nutrition are not achieved if the EN is not adequately delivered. For all these reasons, nurses must be familiar with EN guidelines (Damratowski & Goetz, 2016).

Conclusions

Identification of Themes

This literature review has identified numerous, important themes relating to the administration of EN and the implementation of an EN protocol. Defining and implementing both early initiation of EN and adequate titration to goal are important for achieving the maximum nutritional advantage. The highest benefit is also derived from identifying and delivering an individualized caloric and/or protein goal. Interprofessional collaboration remains paramount such that any barriers to multidisciplinary communication must be addressed. Physicians, nurses, and dietetic professionals must work together to determine and deliver the most effective prescription, type, route, and rate of EN.

An EN protocol increases standardization of practice in relation to the aforementioned themes as well as the management of GRV, complications, and potentially for managing feeding interruptions. Because of the significant effects of nursing care on nearly all aspects of the management and delivery of EN, a nurse-driven protocol may yield higher compliance and greater effectiveness than a protocol that is not nurse-driven. Above all, current practice should align with best practice.

Limitations

In addition to the challenges of standardization and generalizability already

discussed, the greatest limitation to answering the clinical question was that patient outcomes were not measured in a majority of the studies. Further research is needed to determine the benefit of an EN protocol on clinical outcomes.

Gaps in Knowledge

The most apparent gap in knowledge is the identification of standardized guidelines for EN administration. Because of the variability in practice, each element of EN practice could seemingly have a protocol, algorithm, or decision tree of its own. For example, one algorithm could guide the initiation and advancement of EN while another directs the measurement and management of GRV. On the one hand, this could promote standardization if the elements are individualized. On the other hand, this would likely be too cumbersome for practical use.

Future Research

Future research should focus on the measurement of patient outcomes in addition to utilization of the same EN protocol across practice settings to determine its effect. As complications and outcomes are measured, any negative trends deserve careful investigation. The existing clinical practice guidelines should be implemented into practice, although further research appears necessary for continued validation and standardization.

Recommendations

Nursing Administration

Nurse administrators, who guide the culture of an organization, should seek to foster a culture of safety and evidence-based practice. The latter requires a multi-faceted approach of clearly defined expectations, education and resource allocation, shared governance, and supportive, engaged leadership (Fitzsimons & Cooper, 2012). The identification of current practice, comparison to best practice, and implementation of changes to produce alignment between the two must occur throughout the facility. In some situations, this may occur via a top-down approach. However, in an environment that supports innovation and shared governance, many ideas for practice improvement will originate from a bottom-up approach. Administrators must recognize the valuable contributions of frontline staff and encourage their initiative and involvement. Furthermore, nursing administration must support not only the implementation of evidence-based practice, but also the development

and dissemination of evidence-based practice through research and education. Of note, these suggestions apply to all areas of practice, not just the delivery of EN to critically ill patients.

Nursing Research

Research begins with an identified problem or a clinical question (Polit & Beck, 2011). For example, data tracking and trending may reveal specific areas of opportunity. A clinical question may originate from a professional at any level in the organization. Further research may then be conducted to validate prior findings and develop new evidence.

In relation to an EN protocol, research may trigger the development, use, or improvement of a protocol. Ultimately, nursing research must focus on continuous, quality improvement of practice. For example, regarding time to initiation of EN, what are the delays? How can they be mitigated? What are the processes and procedures that cause interruptions in EN administration? How can they be lessened? Does continuous versus bolus feeding affect the total protein and calories delivered? Unlike many of the studies utilized in this literature review, future nursing research should follow a theoretical framework in order to give meaning to the findings. Once the research is completed, the findings must be disseminated.

Nursing Education

Education is extremely important for nurses at all levels of their experience. Whether novice or expert, education translates into knowledge, which translates into practice change (Taylor et al., 2014). Nurse educators must focus not only on disseminating information on best practice as it is identified, but also on empowering nurses to implement practice improvements.

In terms of the EN protocol, this translates into ongoing education for the use of the protocol. This is particularly important when the protocol is first introduced. The technical aspects of the protocol will be easy to instruct. The more difficult aspect will be engaging nurses in the need for a practice change, as described in Lewin's Theory of Planned Change (Shirey, 2013).

Once the change has been implemented and use of the protocol becomes the norm, ongoing education will be necessary to ensure knowledge and compliance. Compliance is driven by more than mere knowledge. Additional factors such

as attitude, sense of personal responsibility, and psychological safety must be considered (de Oliveira Dourado, da Costa Barros, Diogo de Vasconcelos, & da Silva Santos, 2017; Sholomovich & Magnezi, 2017).

Nursing Practice

The literature review has identified numerous EN applications to nursing practice because nurses are at the forefront of EN administration, perhaps even more so with the use of a nurse-driven protocol. Tying the conclusions of the literature review back to the theoretical framework of Patricia Benner's Clinical Wisdom for Critical Care Nursing will not only expand the theory but also enhance understanding of nursing practice.

Use of an EN protocol does not remove critical thinking from nursing practice. Rather, nurses must continue to demonstrate critical thinking and clinical judgment to manage the changing clinical picture of a patient receiving EN. Benner's theory refers to these as reasoning-in-transition and response-based practice. In other words, nursing practice requires clinical decision-making in a changing environment. Continuing the use of Benner's terms, application of the EN protocol further requires skilled know-how and self-agency. Nurses must possess the knowledge to implement the protocol and recognize their ability to impact patient outcomes either positively or negatively.

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