Consensus Recommendation

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American Society for Parenteral and Enteral Nutrition

ASPEN Safe Practices for Enteral Nutrition Therapy

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Abstract
Enteral nutrition (EN) is a valuable clinical intervention for patients of all ages in a variety of care settings. Along with its many outcome benefits come the potential for adverse effects. These safety issues are the result of clinical complications and of process-related errors. The latter can occur at any step from patient assessment, prescribing, and order review, to product selection, labeling, and administration. To maximize the benefits of EN while minimizing adverse events requires that a systematic approach of care be in place. This includes open communication, standardization, and incorporation of best practices into the EN process. This document provides recommendations based on the available evidence and expert consensus for safe practices, across each step of the process, for all those involved in caring for patients receiving EN. (*JPEN J Parenter Enteral Nutr*. 2017;41:15-103)

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Common Terms and Abbreviations Used Throughout the Document

Blenderized tube feeding (BTF)
Computerized prescriber order entry (CPOE)
Electronic health record (EHR)
Enteral access device (EAD)
Enteral nutrition (EN)
Gastric residual volume (GRV)
Gastrointestinal (GI)
Head of bed (HOB)
Human breast milk (HBM)
Intensive care unit (ICU)
Parenteral nutrition (PN)

Introduction

Enteral nutrition (EN) refers to the system of providing nutrition directly into the gastrointestinal (GI) tract bypassing the oral cavity.[1] Each year in the United States, this nutrition support modality is used in 250,000 hospitalized patients annually from infants to older adults.[2] EN is also widely used in subacute, rehabilitation, long-term care, and home settings. For the purposes of this document, EN will include those nutrient formulas and human breast milk (HBM) delivered through an enteral access device (EAD).

The EN process (Figure 1) is the system within which EN is used. This involves a number of major steps: the initial patient assessment, the recommendations for an EN regimen, the selection of the EAD, the EN prescription, the review of the EN order, the product selection or preparation, the product labeling and dispensing, the administration of the EN to the patient, and the patient monitoring and reassessment, with documentation at each step as required. This process requires a multidisciplinary team of competent clinicians working in concert to provide safe nutrition care.[3]

Although clinician competence is assumed in the EN Use Process, an inherent risk of clinical complications is related to EN and the formulas used, as well as potential errors at each step in the process. Serious adverse events, including fatalities, can occur when lapses allow for errors.[1,4] These types of adverse events include the following:

- Clinical complications of using EN such as GI complications, refeeding syndrome, or gut ischemia
- Process-related errors, including those associated with process steps, such as administration errors and misconnections

Optimal communication and standardization across all steps of the EN Use Process is a risk management strategy.[3] To reduce the risk of adverse events and improve patient safety, effective communication among all members of the multidisciplinary team is necessary throughout the process.[4] Collectively, team members must also develop and adhere to policies and standardized procedures for daily practice and decision making related to patient care. Standardization does not refer to, and should not lead to, a one-size-fits-all strategy for patient care. Instead, it refers to the development and implementation of technical and practice standards into a process so that all healthcare providers deliver the same level of safe care.[5] Opportunities exist for standardization across the
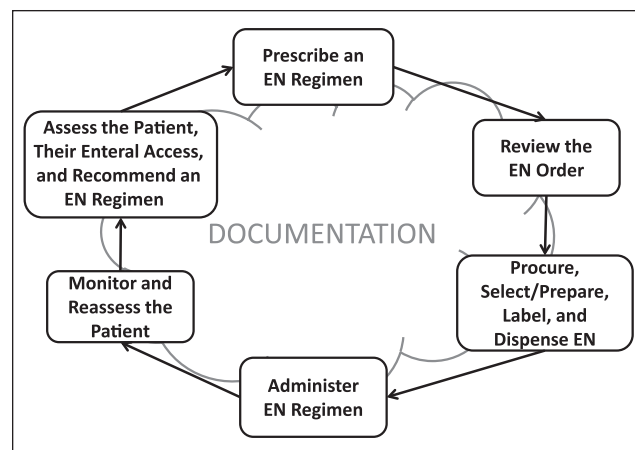

Figure 1. The Enteral Nutrition (EN) Use Process.

EN process (eg, EN order templates). Process standardization may include independent double-checks and automation with forcing functions to help improve EN safety. Policies include the organization's mechanisms to maintain competency of individual clinicians involved in EN.

Methodology

This document focuses on safe practices for EN therapy. The objective is to provide recommendations based on either evidence (when available) or expert consensus that supports safe practices by clinicians who recommend, prescribe, review, prepare, administer, and/or monitor patients receiving EN therapy and by their supporting organizational structures. Indications for EN and the ethics surrounding the use of EN are outside of the scope of this document.

To develop this document, an interdisciplinary group of American Society for Parenteral and Enteral Nutrition (ASPEN) experts identified key questions related to EN

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practice issues with safety implications. These questions were then grouped into relevant sections, including patient assessment, EN prescribing, order review, EN access, product handling, administration, monitoring and reassessment, and transition of care. The term *order* is used throughout the document to refer to an EN prescription or the act of prescribing EN. Administration was further divided to focus on tube patency, medications, and complications, as well as general approaches. A number of topics crossed sections. These are addressed in depth in only one section and cross-referenced elsewhere. Redundancy was built in purposefully as users will likely go to a specific section for guidance.

The experts contributed to the sections with which they had the most familiarity and experience. Under the direction of a section leader, the authors performed an English-language literature search using multiple terms relevant to the section and questions posed. The experts then reviewed the available literature and weighed risks against benefits to come to a set of best practice recommendations for each question. Each set of practice recommendations is followed by the rationale, which cites relevant references. The sections that comprise this document were reviewed in their entirety by task force members. Discussions and consensus took place to arrive at the final recommendations. This document has undergone internal and external review, including approval by the ASPEN Board of Directors.

The recommendations within this document are intended for discussion and adoption over time by organizations involved in the delivery of EN. These recommendations are not intended to supersede the judgment of the healthcare professional or employing institution based on the circumstances of the individual patient.

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Appendix 1. Water

Due to the repeated use of water throughout the enteral use process, this appendix will delineate the terms and definitions for the appropriate use of water terms. Reports in the lay press about water contamination are giving clinicians and patients a reason to pay closer attention to the source of their water. For the patient receiving EN, there are multiple points of interface with water and therefore will be discussed here briefly. Water is used to hydrate the patient, flush the EAD, and dilute medication and powdered formula. Clinicians should be familiar with the terms used when describing water (Table A1).[1] Regulations for drinking water (Environmental Protection Agency) and bottled water (Food and Drug Administration) are limited in the number of contaminants regulated and threshold concentrations allowed.[2,3] So although most drinking water may be considered safe for healthy individuals, the types and concentrations of contaminants may pose risks to patients requiring EN. Contaminants may be chemical or biologic; pathogenic microorganisms are included in the latter. Water contaminated with pathogens has been associated with colonization and infection with outbreaks attributed to the water supply.[4–10] A source of sterile water (eg, sterile water for irrigation) is considered best practice for the immunocompromised patient and for reconstituting powdered enteral formula. The same water could be used for preparing (diluting, reconstituting, compounding) medication because it is an example of purified water (ie, contaminant free), even though the sterility is not required. The same water (ie, sterile water for irrigation) could even be used for flushing the EAD and hydrating the patient when the degree of chemical contamination of the drinking water is unknown or excessive.

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Table A1. Water and Enteral Nutrition (EN) Use.

Term	Definition	Use in Patient Receiving EN
Source water	Nonsaline, freshwater found on the surface (eg, lakes) or in the ground (eg, aquifers)	No
Distribution water	Water flowing from site of storage (eg, municipal treatment facility, storage tank, or well) to point of use (ie, "tap" water)	Yes, for water flushes depending on the degree of contaminants
Drinking water	Distribution water and bottled water	Yes, for water flushes depending on the degree of contaminants
Purified water	Contaminant free after treatment steps (eg, distillation, ultrafiltration, UV light)	Yes, for medication preparation
Sterile water	Purified water free of microorganisms and pyrogens	Yes, for reconstituting powdered formula

UV, ultraviolet.

Section 1. Assessment and Recommendations

Background

EN is a complex therapy that may be associated with adverse events. Therefore, before making any recommendations about its use, a qualified nutrition clinician must evaluate indications and weigh risks and benefits for each patient who may be a candidate for this therapy. Nutrition assessment is a comprehensive approach to collecting and analyzing data from the patient (history, physical exam, anthropometrics, laboratory, and other tests) to diagnose any nutrition-related problem for which nutrition intervention may be appropriate. In both the adult and pediatric population, diagnosing malnutrition is essential to promote improved outcomes.[1,2] A documented care plan with consistent recommendations will follow the assessment. The first goal is to evaluate the indication for EN. Additional objectives of the assessment are to estimate macronutrient, fluid, and micronutrient needs; determine the most appropriate formula and route of administration; identify barriers to tolerance; and prevent or ameliorate potential adverse events, including GI intolerance, and metabolic and/or fluid disturbances. Meeting these objectives requires a thorough understanding of the patient's overall condition. By making the process of organizing and evaluating data as efficient as possible, institutions allow all members of the patient care team to access the relevant information about EN recommendations; thus, the electronic health record (EHR) may facilitate essential documentation and communication processes.

Question 1.1. What factors need to be included in the overall nutrition assessment to determine the safety and appropriateness of EN?

Practice Recommendations

1. Collect and organize relevant data on patient history, physical exam, anthropometrics, laboratory values, and other tests.

   a. Patient history includes clinical diagnoses, past and current medical and surgical interventions, medications, dietary supplements, nutrition history, social history, religious background, potential ethical dilemmas, and mental status challenges.

   b. Physical exam includes GI function assessment and existing access devices as well as nutrition-focused physical findings.

   c. Anthropometrics includes height, weight, body mass index (BMI), growth chart *z* scores, and any available objective measures of body composition or changes in any of these parameters.

   d. Laboratory values and other test findings include all relevant blood (eg, comprehensive metabolic panel) and urinary tests regardless of whether the findings are normal or abnormal, functional tests, radiologic findings, or predictive scores such as the Nutritional Risk Index.

2. Evaluate patient data to determine nutrition status, any nutrition-related problem (real or potential), indication for nutrition interventions via the enteral route, and estimated energy, protein, fluid, and micronutrient needs based on the patient's status or accepted standards.

Rationale

Each of the recommended types of nutrition assessment data provides essential information about whether EN is indicated and can be administered safely. Nutrition status, including presence or risk of malnutrition, also influences the effectiveness and safety of implementing EN administration.

Patient history. The success of EN therapy depends on the patient's clinical state and disease process. A review of clinical diagnoses and surgical/medical history will capture information that has bearing on the patient's ability to tolerate EN (Table 1).[3–8] A thorough social and nutrition history can determine if the patient is at risk for refeeding syndrome due to recent anorexia or food insecurity. This part of the assessment can also identify nutrient intolerance or allergy, which could result in an adverse

Table 1. Selected Clinical Conditions Relevant to a Patient's Ability to Tolerate EN.[3–8]

- Prematurity in the neonate results in immature GI motility and risk of developing necrotizing enterocolitis.
- Trauma and critically ill patients may have altered metabolism and varying needs during the different phases of illness.
- Critically ill patients with traumatic brain injury have a higher frequency of GI disorders, such as gastroparesis and subsequent feeding intolerance.
- Diabetes and certain neurological conditions place patients at risk for gastroparesis and poor EN tolerance.
- Chronic obstructive pulmonary disease predisposes patients to muscle atrophy and weight loss related to chronic inflammation, increased metabolism, and other physiologic derangements.
- Ventilator-dependent respiratory failure may affect decision of formula selection and concentration.
- Altered GI anatomy resulting from small bowel resection, bariatric surgery, other GI surgery, or fistula affects decision making about feeding route and formula selection.
- Altered GI anatomy also poses a risk of anastomotic leak, malabsorption leading to diarrhea, and subsequent loss of nutrients, which may result in metabolic derangements.
- Renal failure affects the patient's ability to tolerate fluid volume and electrolytes.
- Hemodynamic instability may preclude the safe initiation of EN in the critical care patient.
- Cancer and ongoing treatments such as high-dose radiation to the head/neck may result in inflammation of the esophagus with dysphagia.
- Dysmotility conditions associated with gastroschisis or scleroderma may impact ability to tolerate EN.
- Neuromuscular diseases such amyotrophic lateral sclerosis can result in dysphagia

EN, enteral nutrition; GI, gastrointestinal.

reaction to an EN product. The clinician evaluates GI symptoms that may affect EN tolerance, such as nausea, bloating, diarrhea, excessive ostomy output, constipation, abdominal discomfort or pain, and reflux. Constipation is associated with early satiety and feeding intolerance in addition to difficulty weaning from the ventilator, related to an increase in intra-abdominal pressure.[9] Fecal impaction, obstruction, and ileus identified radiologically will also affect EN tolerance. The nutrition clinician should also note the presence of existing access devices or plans for EAD placement and the appropriateness of these plans.

Prescribed medications that may affect safety and tolerance of EN should be considered. For example, liquid medications containing sorbitol may cause loose stools and abdominal discomfort, leading to cessation of the feeding. Enteral feeding administration should be rate adjusted and held with provision of medications known to interact with formula or clog the EAD. Medications should be scheduled for administration in conjunction with the feeding regimen. At all times, a flushing protocol should be in place to prevent formula-drug interaction and device clogging. Hemodynamic instability and the need for vasopressors increase the risk of gut ischemia, and the use of EN should be considered cautiously in these patients.[6]

Laboratory values and other test data. Closer review of pertinent laboratory values is an important component of the nutrition assessment. Attention to hydration status, using available markers such as urea nitrogen and urine sodium as well as fluid intake and output, helps identify appropriate formula selection and free water needs. Visceral proteins, including prealbumin, in the presence of inflammatory biomarkers (eg, C-reactive protein) may be useful as markers of inflammation and disease severity as well as predictors of morbidity and mortality for some populations.[10,11] However, these protein levels are not indicative of nutrition status.[12]

Anthropometry. Anthropometry, including weight and weight history, is assessed to identify an adequate and appropriate feeding regimen and to determine the presence or risk of malnutrition. Unintentional weight loss is well established as an indicator of malnutrition.[13] Malnutrition is associated with increased risk of pneumonia, *Clostridium difficile* infection, pressure ulcers, and postoperative complications.[14] In pediatrics, anthropometry includes weight for age, length for age, and head circumference for age and weight for length until 36 months. From age 2–20 years, weight for age, standing height for age, and BMI are assessed. Plotting children on the appropriate growth chart is important. For premature infants, the Fenton or Olsen growth curves are used.[15] For term infants, the World Health Organization (WHO) growth curve is used until age 2, and then the Centers for Disease Control and Prevention (CDC) growth curve is used.[16,17] Traditionally, these curves were used with percentiles. To be more accurate in assessment, it is now recommended that z scores be used. A z score is a statistical measure of how far a point is from the mean. Using percentiles, the only way to describe a very low-weight child was to state that he or she was below the third percentile. This could either describe a child just barely below the third or a child severely below the third percentile. With z scores, these points are given numeric values and they can be compared from one measurement to the next.[18,19]

Another useful measurement in the assessment of pediatric malnutrition is mid–upper arm circumference (MUAC).[2,20–22] The WHO has MUAC standards from 6–59 months,[20] and other references are available for older children and adults.[21] MUAC has been shown to correlate with BMI in children.[22] More information on assessment of pediatric malnutrition is available elsewhere.[20]

Physical exam. Along with weight status, nutrition-focused physical exam findings should include assessment of skin

integrity, fluid accumulation or deficit, muscle and fat loss, and functional status. Handgrip strength is a predictive indicator of postoperative complications, hospital length of stay and readmission, and physical status. Physical therapists may offer a valuable assessment of physical function. Muscle function correlates well and reacts quickly to changes in nutrition status. In pediatric patients, developmental status and risk of aspiration with oral intake should be evaluated.[23,24]

Assessment of malnutrition and nutrition needs. Malnutrition is also associated with longer hospital length of stay, higher cost of hospitalization, increased risk for readmission, and increased mortality.[25] Indeed, it is the third most common reason for 30-day readmission among selected surgical patients.[26] With up to 50% of hospitalized patients reported to be malnourished, it is a critical factor to consider during nutrition assessment.[13,26] In the neonatal population, data show that improvement in growth and neurodevelopment outcomes are correlated with better nutrition intake.[27]

Although there is no universally accepted approach to the diagnosis and documentation of malnutrition, standardized protocols should be put in place to assess each patient's anthropometric and laboratory data, previous and current food/nutrient/fluid intake, and functional recommendations from the Academy of Nutrition and Dietetics and the American Society for Parenteral and Enteral Nutrition.[1] The use of a standardized approach to identify and treat malnutrition can lead to cost-effective patient-centered nutrition support therapy.[28]

Question 1.2. What are the required elements of the EN therapy recommendation and where are they to be documented?

Practice Recommendations

1. Include these required elements in the EN therapy recommendations as listed below. These data will be consistent with the elements of the subsequent EN prescription.
    a. Indication for EN therapy and rationale
    b. Enteral formula name, concentration if appropriate (such as kcal/oz in pediatrics), and modular component names as appropriate
    c. Enteral access device, including tip placement
    d. Volume per feeding or total volume per day
    e. Initial rate, goal rate, and advancement schedule
    f. Rationale for recommending a specialized enteral formula or suggesting a change (as applicable)
    g. The specific method of feeding (such as continuous, intermittent gravity, or bolus) is specified, as well as the feeding route and access device
    h. Schedule and amount of routine water flushes, if applicable

    i. The daily nutrients to be provided at goal, including total daily volume of formula, calories, protein, and free water. Grams of carbohydrate may be useful in patients with diabetes. Record nutrients per kilogram of body weight such as grams of protein and kcal per kilogram.
    j. Monitoring required to identify adverse events, such as refeeding syndrome, GI intolerance, or tube malposition, as early as possible
2. Recommend modular products, such as additional protein, fiber, and other supplements along with administration schedule, as appropriate. Note final kcal/oz for pediatric patients.
3. Include additional elements of feeding protocols, such as keeping the head of the bed (HOB) elevated, oral care/decontamination or holding the feeding for abdominal distention, vomiting, new or worsening hypotension, or other indications of intolerance.
4. Specify baseline or routine laboratory markers and monitoring.
5. Document the recommendations of nutrition support clinician in the EHR that allows access for all healthcare providers.

Rationale

The success of EN relies on the expertise of nutrition support clinicians. The most current Standards of Practice for nutrition support clinicians outline the level of professional responsibility and clinical expertise required or expected of these healthcare professionals.[29–33] Important elements of the EN recommendation made by the nutrition clinician address the monitoring of biochemical data, anthropometrics, nutrient needs, enteral access, EN tolerance, and other indicators.[33] Communication and implementation of the EN recommendations are essential for successful nutrition intervention and may impact outcomes in terms of desired weight gain, improved markers of nutrition status, and reduced hospital length of stay.[34,35] Providing recommendations for use of feeding protocols has resulted in increased number of days on EN, more total EN volume and calories delivered, and improved GI tolerance.[34]

Documenting the nutrition assessment and recommendations in the EHR allows for quicker communication and implementation of the recommendations, as well as better accessibility and legibility than other documentation methods, such as paper charts.[36] A standardized uniform and complete recommendation will allow the prescribers and the rest of the healthcare team accessing the EHR to fully understand the nutrition recommendations and rationale.

Question 1.3. What is the most effective way to communicate the recommendation for EN therapy to the licensed prescriber?

Practice Recommendations

1. Communicate the recommendation in a standardized, timely, and accurate manner.
2. Use the EHR system to communicate the nutrition assessment and nutrition recommendations to the licensed prescriber.
3. Consider a facility policy that allows registered dietitians or other nutrition clinicians to order medical nutrition therapy, per state regulations and institutional privileges.
4. Program the EHR so the nutrition assessment and EN recommendation flow directly into the order entry section of the EHR for prescribers to review and accept.
5. Verbally communicate the recommendations to the prescriber in addition to permanent documentation through the EHR.

Rationale

Effective 2-way communication between nutrition support clinicians, the prescriber, and the primary care team is critical in order to implement nutrition support therapy recommendations in a timely manner. Where state regulation and facility policy grant EN order-writing privileges for the registered dietitian or other nutrition clinician, the plan may be reviewed and implemented immediately.[34,35,37] In these cases, the plan is always communicated with the healthcare provider, who has ultimate responsibility for the patient's care. This communication is safest and most direct when the nutrition plan is documented in a central location, such as the medical section of the EHR.[38]

Current methods of communication among healthcare providers regarding EN orders vary from one facility to the next. Perhaps the most easily standardized method of communication is the EHR. Communication via this method is more accessible, legible, and immediate than other methods and therefore may result in improved outcomes, including improved EN volume and calorie provision.[36,38] Whenever possible, additional communication between the recommending clinician and the prescribing physician is encouraged. Open dialogue between 2 or more people improves communication and information sharing in the context of healthcare.[39–44] In-person discussion is considered more effective than other methods of communication (such as telephone calls, e-mail, or text messaging) to reinforce the assessment and recommendations provided in the EHR (or paper chart if still in use). In the inpatient setting, in-person communication can occur during interdisciplinary patient care rounds, but follow-up written documentation is important.[39–44]

Topics for Future Research

- Multidisciplinary use of nutrition-focused physical examination indicators
- Integration of nutrition assessment parameters in the EHR
- EHR support in calculating nutritional parameters, fluid requirements, nutrition risk assessment tools, etc
- Methods of communicating nutrition assessment and recommendations and outcomes
- National standardization of EHRs
- Nutrition informatics, translational research, telemedicine

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Section 2. Prescribing and Communicating the Enteral Nutrition Order

Background

In comparison with the greater risks associated with PN, the prescription of EN may seem benign, but patient harm can occur when EN practice recommendations are not followed. Adverse events related to EN have been reported at each step of the EN process. Examples of these events include enteral feeding tube malposition or misconnection, EN formula contamination, and bronchopulmonary aspiration.[1] Therefore, patient safety is a fundamental consideration in the EN prescribing process. Prescribers of EN need in-depth knowledge of protein and energy requirements, electrolyte and fluid balance, acid-base homeostasis, and GI anatomy and function. Prescribers of EN must also be knowledgeable in proper indications and contraindications to EN, proper care and selection of EADs intended for gastric or small bowel placement, and potential complications related to EN.[2–5]

Currently, EN orders may be inconsistently worded and executed due to the individualized prescribing habits of clinicians, variance between institutions, and inadequate prescriber education. Furthermore, many organizations still sanction prescribing EN via telephone, verbal, or handwritten orders. The use of standardized electronic EN orders can help address problems of incomplete, ambiguous, or incorrect EN orders. This section will provide guidance for healthcare organizations when developing policies and procedures to safely prescribe and communicate the EN order.

Question 2.1. How can the approach to prescribing EN be standardized to reduce EN-related errors?

Practice Recommendations

1. Use a standardized approach for prescribing EN to minimize complications associated with incomplete or ambiguous EN orders.

2. Develop and implement policies and procedures that address all aspects of the EN order process and competency assessments for healthcare professionals involved in the prescription of EN.

3. Apply a standardized model of prescribing for safe EN practice, with each organization using the insight of their prescribers to determine how best to apply the model. Consider including EN prescribing in ongoing professional practice evaluation (OPPE) and focused professional practice evaluation (FPPE).

4. Incorporate interdisciplinary teams as available within the organization, allowing each member to address relevant issues as it relates to the EN process.

5. Develop and implement a process for the primary healthcare team to assess, document, and communicate the therapeutic goals and monitoring of EN therapy. Following the process, the primary healthcare team can:
   a. Evaluate the patient to assess that EN administration is safe and indicated.
   b. Confirm that the patient has an appropriately placed EAD that is appropriate in regards to current clinical status.
   c. Review the nutrition assessment and nutrition recommendations as documented by nutrition support clinicians (see Section 1).

6. Describe specific methods of communication to be used among physicians, advanced practice providers, dietitians, pharmacists, and nurses involved with the prescription, order review, administration, and monitoring of EN.

7. Involve clinicians specializing in nutrition support in the design of a standardized EN order process that will meet the needs of the organization's specific patient population.
   a. Prescribe EN for all patients using standardized electronic EN orders (eg, computerized provider order entry [CPOE] systems).
   b. When CPOE systems are unavailable, prescribe EN with a standardized order template using an editable electronic document, saved as a PDF, which will remain part of the EHR.
   c. Avoid handwritten, telephone, and verbal EN orders because of the potential for transcription errors.
   d. Design electronic EN order sets with clear instructions that are easily understood by all healthcare professionals involved in the prescription of EN.

8. Design a transitional EN order template that assists with the transition from acute care to long-term care or home care settings (see Section 11). Using a well-designed standardized template will facilitate communication of the following:
   a. Patient identifiers, previous EN formula and water flushes, delivery site and access device, and administration method and rate
   b. Previously trended laboratory values and clinical assessments relevant to EN tolerance
   c. Contingency plans for transition to oral feedings or PN as circumstances may dictate

Rationale

Organizations need proper, accurate documentation of nutrition interventions that is available to all members of the healthcare team. This documentation can promote effective 2-way communication between prescribers of EN and those reviewing EN orders and subsequently monitoring the patient regarding appropriate energy and protein delivery, changes in therapy, medication interactions, EN tolerance, and other pertinent information.

The implementation of a standardized EN ordering process that includes an electronic order template can eliminate the possibility for inappropriate EN orders due to omissions, transcription errors, or illegible documentation. When all elements of the EN order are included during electronic prescription, the risk for errors related to verbal order clarification and transcription can be lessened. Standardized EN orders can also guide all EN prescribers within an institution to use the same terminology when referencing EN.[6,7] Other advantages of standardized orders can include preventing incomplete orders and improving efficiency for the prescriber and enhancing patient safety. When all elements of the EN order are included during electronic prescription, there is a reduced risk for errors.[6]

The adoption of EHRs can give nutrition support professionals an opportunity to implement standardized EN order processes. In a recent national survey of hospital pharmacy directors by the American Society of Health-System Pharmacists, 80.9% of hospitals that responded were using CPOEs for general medication orders.[8] However, the degree of customization within electronic systems is low. Nutrition support clinicians will need to work closely with information technology personnel (who can in turn reach out to vendor and application architects as needed) to request adequate decision support capability and proper documentation for those prescribing EN. In a survey of the American Society for Parenteral and Enteral Nutrition's membership regarding the safety and efficacy of nutrition documentation and nutrition-related ordering processes, Vanek[9] found that nutrition support practitioners do not highly rate their institutions' EHR systems and concluded that the growing adoption of EHRs and CPOE systems offers nutrition support practitioners the opportunity to ensure that nutrition and nutrition support content within their system is adequate and safe. Ammenwerth et al[10] conducted a systematic review to determine the effect of CPOE systems on general medication error and adverse drug events. Within the systematic review, 25 out of 27 studies addressed medication errors. Of those 25, 23 studies showed a relative risk reduction for medication errors of 13% to 99% after implementation of CPOE. Ammenwerth and colleagues also concluded that a transparent culture of safety within healthcare systems can increase proper reporting of medication errors, which will provide better data for future research.[11]

Documentation of nutrition interventions should be available to all members of the healthcare team. Proper documentation allows prescribers of EN to communicate EN tolerance,

EAD status, changes in therapy, and any other pertinent information to the rest of the healthcare team. This documentation should allow for communication between prescribers of EN and those reviewing EN orders for appropriate energy, protein, and fluid delivery; medication interactions; and EN tolerance.[11]

Malone et al[12] reported a case of a 65-year-old woman who was supposed to receive EN through a gastrostomy tube and fluid and electrolyte replacement via central venous catheter. However, she inadvertently received 160 mL of EN through her central line when it was mistaken for the gastrostomy tube. She subsequently required hydration, diuretic therapy, and prophylactic antibiotics, after which she recovered and was discharged from the acute care setting 8 days later. This case is an example of errors among healthcare providers in a patient with multiple access devices. Electronic EN orders can specifically indicate proper EN administration directions and may help eliminate errors related to orders that could expose patients to harm.[10]

The use of a complete EN order specifically designed to prescribe EN for home or transitional use will promote the continuity of a patient's care. The EN regimen can be optimized while the patient is in an inpatient setting, and the nutrition support clinician can reassess nutrition needs before discharge. A complete EN transition order will also allow the primary outpatient clinician to take over patient care and determine the appropriate frequency of laboratory monitoring, reassessment of nutrition needs, and confirmation of tube placement. EN transition orders can also assist with self-management of home enteral feedings in those who do not receive skilled nursing services. A complete order for discharge can allow for adequate education to be provided to patients being discharged to home with EN.[13]

Overall, a standardized approach to the EN prescription process that is administratively supported by the organization can ensure patient safety, assist the entire healthcare team, and help provide cost-effective nutrition therapy. Nutrition support clinicians must be engaged and held accountable for the development and implementation of policies and procedures related to the EN prescription process.

> **Questions 2.2 and 2.3. What are the *critical* (required) elements for a complete EN order? What are the *supplementary* (auxiliary) elements to the EN order that may improve patient safety?**

Practice Recommendations

1. Include the following **critical** elements in the standardized electronic EN order template (Figures 2 and 3):
   a. Patient information
      i. Identify patients by the following: patient name, date of birth/age, and medical record number.
      ii. Transmit patient-specific information relevant to the electronic EN order such as height/length and dosing weight and allergies (eg, food, medication).
   b. EN formula name
      i. Describe EN primarily via descriptive generic names (eg, "standard," "high protein") to minimize confusion for prescribers. The product trade name could also be included along with the organizationally defined generic term. For pediatric patients, add final kcal/oz.
   c. Delivery site (route) and EAD
      i. Include the administration route in the EN order based on the enteral tube's distal tip position (gastric or small bowel).
      ii. The specific EAD to be used (eg, nasogastric [NG], orogastric, gastrostomy, nasojejunal, orojejunal, jejunostomy, or gastro-jejunostomy).
   d. Administration method and rate
      i. Include the specific method of administration in the EN order (eg, continuous, bolus, intermittent feedings).
      ii. Define the volume and rate of administration of EN for each method of administration.
      iii. Order sets that include advancement can be populated with the standard advancement and held, to be released each day after the clinician examines the patient and reviews orders with the team.
2. Develop nurse-driven EN protocols for volume-based feeding as per institutional policy.
   a. Include the volume and frequency of water flushes.
   b. Provide suggested methods to advance the volume and/or rate toward goal.
3. Create and implement policies and procedures that promote all elements of the EN order to be completed whenever the EN order is modified or reordered.
4. Design electronic order sets with elements that promote patient safety.
   a. Use required fields within the EN order to prevent submission of the order until it is complete.
   b. Use menus to facilitate standardization of EN prescribing.
5. When EN is reordered, require that prescribers take accountability for the proper monitoring of the patient's clinical condition, EN tolerance, and metabolic status.
   a. Monitor patients with newly initiated EN, newly placed permanent EADs, critically ill patients, patients at risk for refeeding syndrome, patients with poor glycemic control, or patients recovering from recent surgery as they will require more frequent monitoring.
6. Design and implement policies and procedures that address **supplementary** EN orders within the CPOE. See Figure 4.

INPATIENT ENTERAL NUTRITION ORDER

Patient Name: _____

Room Number:_____

Medical Record Number: _____

Dosing Weight (kg): _____

Date of Birth: _____

Allergies: _____

Total Energy kcal/day

_____

Total Protein g/day

_____

Total Carbohydrate g/day

_____

Total Fat g/day_____

Total Fluid mL/day_____

ENTERAL NUTRITION FORMULA

□ Standard

□ Standard High protein

□ Standard High Calorie

□ Fiber Containing

□ Carbohydrate controlled

□ Elemental include peptide-based

□ Immune modulating

□ Renal – low electrolytes

DELIVERY SITE (ROUTE AND ACCESS)

Route:

□ Gastric

□ Small bowel

Access:

□ Nasogastric

□ Nasoduodenal

□ Nasojejunal

□ Orogastric

□ Oroduodenal

□ Orojejunal

□ Gastrostomy

□ Jejunostomy

□ Transgastric G/J tube

ADMINISTRATION (Method and Rate)

Method:

□ Continuous

Rate:

□ Initial _____ mL/h

□ Advance by _____ mL/h every _____ h to goal of _____ mL/h

□ Intermittent

□ Initial _____ mL feeding over _____ min _____ times daily

□ Advance by _____ mL each day to goal of _____ mL feeding

over _____ min _____ times daily

□ Bolus

□ Initial _____ mL bolus over _____ min _____ times daily

□ Advance by _____ mL each day to goal of _____ mL bolus

over _____ min _____ times daily

OTHER

□ Flush feeding tube with _____ mL of water every _____ hours (minimum of 30 mL per flush)

□ Elevate head of bed 30–45 degrees

Figure 2. Enteral nutrition order template (specific content can be customized per institution). G/J, gastrojejunostomy.

a. Confirm that the initial enteral feeding tube position is correct via proper radiographic imaging that visualizes the entire enteral feeding tube. The exception to this may be in pediatric and neonatal patients who require multiple tube placements due to the x-ray exposure (see Section 4).

b. Establish proper EAD flushing in supplementary orders (see Section 7). Develop protocols that call for proper flushing before and after medication administration, during continuous feedings, before and after intermittent feedings, and before and after gastric residual volume (GRV) measurements.

c. Address reassessment of the appropriateness of HOB elevation and ongoing monitoring for EN tolerance in policies and procedures.

d. Integrate EAD care and assessment into policies and procedures to assist with infection prevention

- ☐ Start feedings of Human Breast Milk (HBM) at 1 mL q3h via NG tube (15 mL/kg/day, @ 10 kcal/kg).
- ☐ Continue for 3 days for trophic feedings.
- ☐ Increase feedings by 1 mL q3h per day on day 4, 5, and 6 of the feeding protocol until feeds on day 7 are at 75 mL/kg (5 mL q3h).
- ☐ On day 8 continue same feeding volume and begin fortification of feeds to 24 kcal/oz using human milk fortifier, 1 packet to 25 mL of human milk.
- ☐ On day 8 and thereafter the advancement continues at 1 mL q3h until the total volume is 160 mL/kg or 11 mL q3h on day 14. This will provide 160 mL/kg, @128 kcal/kg, @ 4.5 g/kg protein.
- ☐ Do not routinely check gastric residuals.
- ☐ Do not routinely flush NG tube.
- ☐ Continue daily weights.
- ☐ Obtain length measurements using (length board) and head circumference measurements (taking the average of three measurements) weekly.
- ☐ After reaching full-volume feedings, add vitamin D (400 International Units) and evaluate the baby for the need for additional elemental iron.

Figure 3. Example of neonatal enteral nutrition feeding protocol. NG, nasogastric.

SUPPLEMENTARY ORDERS

Auxiliary Orders:

☐ Assess gastric residual volume (GRV) every 6 hours or before each bolus/intermittent feeding

If GRV > 500 mL hold feeding for 2 hours and recheck GRV. If GRV recheck < 500 mL, restart feeding

☐ May give appropriate medications via enteral feeding tube, follow each medication by at least 15 mL water flush before and after medication as volume allowed (do not mix medications together or with EN formula)

☐ Consult Nutrition Support Team or Nutrition Support Clinician

Monitoring:

☐ Observe for signs of EN intolerance (include signs and symptoms of intolerance) every _____ hours

☐ Enteral feeding tube site care and assessment every _____ hours

☐ Obtain body weight every day, or every _____ days

☐ Strict fluid volume Ins/Outs

☐ Capillary blood glucose: per institutional protocol

Laboratory Orders:

☐ Comprehensive Metabolic Panel every day or every _____ days

☐ Serum Magnesium every day or every _____ days

☐ Serum Phosphorus every day or every _____ days

Figure 4. Suggested enteral nutrition (EN) supplementary orders (specific content can be customized per institution).

and allow for proper intervention if a complication occurs.

e. Ongoing monitoring includes laboratory monitoring, measurement of intake and output, weight measurements, physical assessment, and GI tolerance.

f. Identify the specific product for modular therapies along with the proper prescribed amounts and administration schedule.

g. State specific amounts of additional macronutrients per day with orders for modular nutrition therapies (eg, 12 g protein powder per day) along with directions for proper reconstitution and administration.

7. Make consultation to the nutrition support team or clinical nutrition service available for prescribers.

8. Determine the duration (time limits) of the EN order before it has to be renewed.

Rationale

The development of clearly defined policies and procedures regarding the required elements of the EN order helps the facility ensure that the orders are complete throughout the EN process and that the right patient receives the right product, in the right amount, via the right route at the right time. It is recommended that the essential elements of the EN order are made available for viewing by all healthcare professionals via proper electronic documentation in the EHR. Critical elements for a complete EN order must be addressed through a CPOE order or editable electronic document before supplementary elements can be acknowledged.[14] In a prospective study, Armada et al[15] evaluated the effect of the implementation of the CPOE system on the incidence of prescription errors and found that prescription errors decreased significantly from the error rate for handwritten of 44.8% to an error rate of 0.8% after CPOE implementation ($P < .001$). This prospective study demonstrates

the impact that healthcare technology can have on patient safety, and it helps nutrition support professionals justify the importance of nutrition-based software integration.[15] It is important when developing electronic EN ordering documents that institution specific and patient population customization is permitted (Figures 2 and 3).

The appropriate initiation and advancement of an EN regimen depend on the patient condition as well as the administration method and EAD type. Continuous EN administration via enteral feeding pump with small-volume, frequent water flushes is preferred in the critically ill, those at risk for intolerance, and for small bowel feedings. Directions for continuous EN administration identify the proper initial administration rate and can contain supplementary orders addressing timing of rate advancement to goal infusion volume. Bolus and intermittent methods of EN administration via syringe, regulated drip enteral feeding bag, or enteral feeding pump are preferred in patients who have proven tolerance with continuous EN administration and those who will transition out of the acute care setting with EN. Directions for bolus and intermittent EN administration document the proper number of feedings per day along with initial proper volume of EN administration rate and volume and frequency of water flushes. Bolus and intermittent feeding orders can also contain supplementary orders that give directions for volume advancement and goal EN volume.

The implementation of enteral feeding protocols may improve energy, protein, and fluid delivery to ICU patients who experience interruptions in EN delivery due to unavoidable procedures (reintubation/extubation, bedside procedures involving the GI tract or airway, and imaging studies).[16,17] The administration of large volumes of EN to compensate for EN that was missed during procedures can place patients at risk for intolerance of EN.[18–21] If enteral feeding protocols are going to be implemented, healthcare organizations should utilize multidisciplinary teams to determine if these protocols are beneficial for that institution's patient population and how to build this into the order entry process. See Figure 3 for an infant EN protocol.

Supplementary orders (see Figure 4) assist with adequate energy and protein delivery, maintain patient safety, and assist clinical staff with therapeutic monitoring of EN therapy. Although supplementary orders are not essential, they complement the EN order with additional guidance to better communicate and standardize EN for a patient. Supplemental orders will be based on institutional policies that advocate for the proper care of the enterally fed patient within the practice variations at each organization. These orders can also permit prescribers to consult an institution's nutrition support service to assist with management of EN. Supplementary orders address the use of adjunct modular therapies, which can allow clinicians to enhance macronutrient contents of an EN prescription.

Critical and supplementary elements of the EN order facilitate proper and safe EN prescription and administration. Nutrition support clinicians can help institutions determine and develop any supplementary orders that would benefit their

patient population. Continued review of institutional policies and procedures along with national clinical guidelines and practice recommendations will allow institutions to continue to improve the EN process.

Question 2.4. What is the safest way to describe EN formulas?

Practice Recommendations

1. Set policies and procedures on how EN formulas will be described throughout the healthcare organization, including in electronic order sets, patient-specific EN labels, and all other references to EN (eg, for product inventory, purchasing, healthcare provider documentation).
2. Describe EN primarily via descriptive generic names (eg, "standard," "high protein") to minimize confusion for prescribers. The product trade name could also be included along with the organizationally defined generic term.
3. Develop a patient-specific EN label template to reflect all the critical elements of the EN order.

Rationale

The EN prescription should be a patient-specific therapy that is prescribed, reviewed, prepared, and administered, with a process optimized for patient safety. The use of CPOE has been shown to reduce the opportunity for medication errors due to illegible orders, transcription errors, and prescriber error.[22] The use of electronic order sets in CPOE can positively assist prescribers when obtaining patient-specific and EN formula information. However, with constantly evolving medication trade names and EN formula brand names and product labeling, there is opportunity for transcription error when acting on an EN order, especially if it is handwritten. EN formula-specific information should be easily accessible to prescribers to allow for the delivery of adequate protein and energy, electrolytes, and fluid and to ensure proper EN formula prescription. Disease-specific formulas should be selected using clinical judgment with knowledgeable clinicians weighing efficacy, tolerance, cost, and clinical evidence (from randomized clinical trials).[14]

Determine descriptive generic names to be used to describe EN formulas throughout the entire healthcare system. The use of generic names to describe EN is encouraged because healthcare organizations often change EN formularies and because EN formularies will vary among the acute, chronic, and home care settings. Brand names for EN can be confused when other formula or medications have similar names. When institutions change EN formularies, it is important that clinicians have easy access to formulary changes and a "formulary card" or "conversion chart" with new EN formulas, old EN formulas, and modular products available. For example, an EN formula that

contains nonhydrolyzed macronutrients that is intended for those with normal digestive function can be generically identified as "standard." An EN formula that contains hydrolyzed macronutrients, which could be used for those with malabsorptive disorders, can be generically identified as "peptide-based" or "elemental." An EN formula that contains a higher percentage of calories from fat along with a higher fiber content to assist with glycemic control can be generically identified as "carbohydrate controlled."

Develop policies and procedures regarding patient-specific EN formula labels that can be affixed to EN formula administration containers. Develop patient-specific EN formula labels that contain all of the elements in the same sequence as the original EN order. Determine if patient-specific EN formula labels present all nutrients or only macronutrients and select micronutrients.

Question 2.5. How often should the EN order be reviewed for renewal in the acute care, chronic care, and home care settings?

Practice Recommendations

1. Determine an institution-specific or organization-specific policy for the frequency of EN order review and renewal based on the level of care provided by the institution (acute care vs subacute care vs long-term care vs home care).
2. Complete all elements of the EN order when the EN order is modified or reordered.
3. Review orders daily in conjunction with monitoring daily in unstable patients (eg, critically ill patients, postsurgical patients, patients with poor glycemic control, patients with unstable fluid and electrolyte status, and patients at risk for refeeding syndrome).
4. Review orders daily for neonatology and critical pediatric patients. Stable pediatric patients may need less frequent review.
5. Reduce monitoring of EN orders to every 2–7 days (1–3 times per week) in stable adult hospitalized patients.
6. Monitor patients in the long-term care or home setting who have demonstrated to be stable on an EN prescription with no signs of intolerance every 1–4 weeks. Less frequent review and reordering may be appropriate in select patients on long-term EN in keeping with regulatory requirements.

Rationale

Even though EN may seem to be a benign therapy, there are complications and adverse events related to the EN process. Policies and procedures addressing the timeframe for the renewal of the EN order will help facilities have the best EN order system based on the patient's current condition.

By monitoring the patient and reviewing the EN orders at appropriate frequencies, clinicians can provide nutrition support that is safe, able to detect any clinical or metabolic complications, and assess the extent to which nutrition goals have been reached. Unlike PN, which may require frequent adjustments, the EN regimen may not require therapeutic interventions as frequently. Often, the EN order is best reviewed and renewed when a patient changes levels of care or when the patient on EN is discharged to home or a long-term care facility.

Existing literature does not address the ideal frequency for reviewing EN orders. Therefore, practitioners must rely on expert clinical experience and consensus opinion to provide clinical practice guidelines. The ideal timeframe for EN order review and renewal may vary based on the healthcare setting and the acuity of the patient population. Patients newly initiated on EN will need more frequent monitoring than those whose tolerance of EN has been established. Special attention is also given to high-risk patients, such as those who are clinically unstable (eg, patients with preexisting metabolic abnormalities, critically ill patients, or postoperative patients) and those at risk for refeeding syndrome. The frequency of order review usually decreases as patients stabilize and transition to lower levels of care. In long-term care settings, time intervals between order renewals may be subject to regulatory standards.

Each healthcare organization can establish its own policy regarding the frequency of the EN order review and renewal. Clinicians with expertise in the area of nutrition support, preferably from multiple disciplines, are key players to engage in policy development. To ensure patient safety and assess the effectiveness of nutrition interventions, organizations will want to monitor compliance with policies.

Question 2.6. What educational programs and systematic changes can be implemented to prescribers of EN to improve EN ordering and reduce errors?

Practice Recommendations

1. Provide education regarding safe practices for EN prescribing and monitoring to all clinicians that prescribe EN.
2. Provide ongoing rigorous education about safe EN prescribing practices to improve communication and monitoring. Educational initiatives can include healthcare team in-services, pocket cards, and regular audits with reporting results at institutional quality improvement meetings.
3. Integrate education regarding safety in EN into the core curriculum for healthcare students and trainees. A multidisciplinary team of clinicians with expertise in the area of nutrition support can conduct this education.
4. Provide in-depth and rigorous educational content on safety issues to all clinicians who will care for patients receiving EN in the acute, chronic, and home care

settings and those who are training to specialize in nutrition support care.

5. Evaluate or design a physical environment for EN prescribing by assessing needs that may affect the performance of EN prescribers to safely communicate the EN order for transcription, interpretation, and review in the following 5 factors outlined by the United States Pharmacopeial Convention, USP General Chapter <1066>:

   a. Characteristics of the individual prescriber can vary in responses to physical environment. Therefore, adaptation to the physical environment to meet individual needs will optimize accuracy of all prescribers of EN.

   b. Tasks performed and workloads: Prescribers presented with large workloads often find workarounds and overrides that could place patient safety at risk.

   c. Tools and technology used to perform tasks: With the constant evolution of technology within healthcare, the tools and technologies implemented in healthcare systems must be user-friendly, easily accessible, and optimized to each institution's needs.

   d. Compliance of the physical environment in relation to USP General Chapter <1066>: Sensory interference from noise, light, interruptions, or poorly constructed work environments can adversely impact the ability of clinicians to safely prescribe EN.

   e. Organizational support: Offer support that helps address new and ongoing concerns related to the safe communication and transcription of the EN order.

6. Avoid verbal and telephone prescriptions except for communication between prescriber and nutrition support clinician to clarify the EN order that may result in order revision.

Rationale

Research is limited regarding whether educational programs about safe EN prescribing practices affect patient outcomes. However, studies have shown that patient care with multidisciplinary teams increases communication among healthcare professionals, which in turn contributes to higher rates of patient safety,[23] and this finding suggests that educational techniques that improve communication among members of the EN team may be warranted. Further research on the impact of the education of EN prescribers on the incidence of EN-related errors and inappropriate prescribing is needed.[23]

The implementation of education programs has been associated with safer practices for prescribing medication.[24] Elements of safe EN prescribing are appropriate topics for the core didactic curricula in professional programs (medical, pharmacy, advanced practice nursing, nutrition, and physician assistants). Safe practices for prescribing EN can also be integrated into the clinical training for professional programs, residencies, and specialty/fellowship programs for those who may be involved in the prescribing of EN.[7]

The process of prescribing EN requires an environment that is productive for each prescriber of EN and an environment that is designed with consideration of the following: prescriber characteristics, workload of prescribers and those implementing orders, technology available, and organizational support. The October 2010 bulletin by the USP, titled "Physical Environments That Promote Safe Medication Use," establishes work environment standards to reduce the risk of medication errors. This bulletin gives nutrition support professionals a resource to incorporate safe EN prescribing practices into policies and procedures for clinical practice.[25]

Question 2.7. What are the essential elements of safe communication and transcription of the EN order?

Practice Recommendations

1. Create policies and procedures that minimize the need for order transcription, therefore limiting transcription errors and increasing safe communication within the EN order process.

2. Use EHR communication technology to avoid transcription during the EN order process.

3. Institute and follow policies and procedures to encourage that transcribed orders are independently double-checked for completeness and accuracy before EN review and preparation.

   a. Whenever possible, avoid multiple transcriptions of EN order data.

   b. If manual data transcription is completely unavoidable, document any transcribed data that undergoes a double-check process and make it available for quality improvement audits.

4. Review and compare EN orders to the most current recommendations when reassessing patients. Whenever there are unexplained discrepancies between the order and the recommendations, communicate with the healthcare team according to institutional policies to ensure that recommendations were understood.

5. Develop protocols/algorithms to serve as communication tools and guides to safe EN practice for the healthcare organization. These may include guidance about the following:

   a. Initiation of EN prior to completion of nutrition assessment by the dietitian or other nutrition support clinician

   b. Approach to feeding through various EADs

   c. Water-flushing protocols, especially if using automated systems

d. Medications that can be given via EADs and if tube feedings need to be held (see Section 8)

Rationale

An incomplete order, missing data, required transcription step, or inadequate verbal communication between prescribers and those ultimately implementing the EN order increases the risk for errors that can adversely affect patient care. The use of technology can assist with the provision of safe EN therapy. The development of standardized EN order forms can facilitate consistent prescription of complete EN orders without the need for interpretation or transcription. As EN prescribers adopt the use of standardized orders, the process of standardized independent double-checks with stepwise checklists becomes easier as orders are prescribed and communicated to other staff in a consistent manner. To have an effective process, 2 clinicians must independently review the EN order prior to preparation and labeling. The use of independent double-checks should not be overused as to cause fatigue for healthcare providers, but they should assist with addressing potential breakdowns found in the EN process. Independent double-checks must be used in conjunction with other safety measures, and education should be provided to reiterate the importance of independent double-checks to healthcare staff.[26]

Multidisciplinary teams can assist with the facilitation of open communication between members of the healthcare disciplines. Teamwork between disciplines can also improve relationships between departments within the healthcare system, and this communication can lead disciplines to better understand the demand on other disciplines. This open communication can improve the EN process by increasing team members' knowledge and facilitate learning about problems. The relationships built with the use of multidisciplinary teams can also ease the communication between providers when clarifying or optimizing an EN regimen. Communication between teams can also lead to identification of a problem, finding the root cause of the problem, and development of a team-based multidisciplinary action plan.[27]

Evidence-based EN protocols/algorithms developed by nutrition support professionals serve as a guide for safe, standardized EN practice and communication. Their use has been shown to minimize the use of inappropriate EN, increase EN days, increase the percentage of prescribed calories delivered, and reduce hospital stays and mortality. In order for protocols/algorithms to be used in practice, ongoing and rigorous education and monitoring are needed.

Topics for Future Research

- Documentation of errors related to EN prescribing
- The impact of electronic EN orders on the accuracy, monitoring, and safety of EN therapy
- The effect of standardized orders on adequate protein and energy delivery
- Error rates related to incomplete, ambiguous, or incorrect EN orders
- Error rates associated with use of standardized EN orders vs error rates with the use of telephone, verbal, or handwritten EN orders
- Outcomes research regarding how the frequency of monitoring of EN orders affects the achievement of patient safety and nutrition goals
- The impact of education programs and annual competency assessment on errors related to EN ordering and patient safety measures
- The use of a standardized EN home transition order form in the continuity of care for patients discharged home with EN

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Section 3. Review of the Enteral Nutrition Order

Background

A dedicated review of the EN order by a nutrition support professional ensures that the order contains all the critical elements for a complete EN order and that it meets the specific patient's energy, protein, micronutrient, and fluid needs. This review is conducted independently from the EN recommendation and the EN prescription. Safety issues in the EN order review can involve the correct patient identification; the appropriateness of the prescribed EN formula for the patient; dosing, administration, and monitoring instructions; free water flushes; the EAD; concurrent medications and potential drug-nutrient interactions; the EN infusion site; and the effect of EN on the patient's electrolyte, acid-base, and fluid balances. Healthcare organizations must have policies and procedures that address the EN review process for nutrition support professionals and determine how interventions will be communicated to the primary team.

Question 3.1. What are the best mechanisms and practices for independent EN order review for safe and optimal EN preparation and delivery?

Practice Recommendations

1. Develop and implement policies and procedures at the healthcare organizational level that address the independent review of the EN order by a knowledgeable healthcare provider and the documentation of the review process for safety and clinical audits.

2. Prescribe EN using standardized electronic order templates (ie, CPOE system) that transmit the complete EN order.
   a. In the absence of a CPOE system with standardized templates, prescribe EN with a standardized order template that is maintained as an editable electronic document with each patient-specific order saved as a pdf in the EHR, and implement best practices to avoid transcription errors from handwritten or telephone orders.
   b. Enter EN order data in a standardized format, and transmit any supplemental orders in standard units. Include order instructions that are clear to those reviewing or administering EN.
   c. Make nutrition assessment and nutrition recommendations available in the EHR.

3. Include the EN order in the patient's electronic medication profile to allow a pharmacist to review the EN order and patient medication profile. The pharmacist will assess:
   a. The appropriateness of the medication route of administration
   b. The compatibility of medication with enteral formulas
   c. Methods to optimize the medication regimen

4. Evaluate the following elements as part of the clinician's independent review of the EN order:
   a. Patient allergies
   b. Proper dosing weight
   c. Current clinical status and nutrition needs
   d. Indication for therapy
   e. Appropriate energy, protein, micronutrient, and fluid delivery

5. Develop clear policies and procedures for the healthcare organization to address the clarification of EN orders if any of the following occur:
   a. Order elements are missing.
   b. Clinical dosing does not meet recommendations.
   c. Administration is inconsistent with guidelines or may be associated with incompatibilities.

6. Document any order clarification or change to the EN order within the facilities' EHR or, in the absence of

EHR, document any clarification to the EN order in the permanent record.

7. Do not use abbreviations, symbols, or dose designations that appear on The Joint Commission's Official "Do Not Use List" or on the Institute for Safe Medication Practices list of Error-Prone Abbreviations, Symbols, and Dose Designations.

8. Review the EN prescription independently whenever there are transitions in patient care (eg, admission to a facility, discharge from a facility, or any change in the level of care within a facility).

9. Develop criteria at the healthcare organization level to annually evaluate the competency of nutrition support clinicians and pharmacists to review EN orders and to assess associated patient laboratories, medications, and clinical monitoring.

Rationale

The standardization of the EN order process can increase compliance with independent double-checks and improve patient safety at all points of the healthcare model.[1] Use of CPOE systems along with clinical decision support software can facilitate the review of each element critical to a complete EN order. Ideally, a nutrition support clinician or other knowledgeable healthcare provider ("reviewer") will review EN orders in an environment with minimal distractions, appropriate lighting, and access to electronic patient and EN formula information. For optimal review, the electronic EN order will contain the critical elements required for a complete order (eg, patient identifiers, EN formula, free water flushes, delivery site and EAD, and administration method and rate) as well as any supplementary orders that meet institution-specific needs related to the safe prescription of EN and the adequate delivery of protein, calories, and fluid. If the reviewer concludes that a critical element is omitted or a therapeutic intervention would be beneficial, this reviewer must communicate with the prescriber to reconcile missing elements or recommend clinical interventions. Any communication with the EN prescriber should be electronically documented in the EHR.

When a patient on EN requires medications, it is advisable to consult a pharmacist to determine whether a medication can be safely prepared and administered via the EAD. The pharmacist can also review medication profiles for medications that could cause adverse effects when administered via either a gastric or small bowel EAD. Schier et al[2] reported a case of a 38-year-old woman who received crushed extended-release antihypertensive medications via a nasogastric tube. The instant release of medication that was intended to release over a 24-hour period led to the patient's death secondary to bradycardia and severe hypotension. This case shows how important the review process can be to ensure proper administration of medication via enteral feeding tube.

The inclusion of the EN order in the electronic medication profile and the medication administration record (MAR) enables the pharmacist to review the EN order along with medications to be administered to the patient. When CPOE systems are appropriately configured, prescribers enter orders for medications that specify the specific administration method (eg, nasogastric feeding tube, orogastric feeding tube, small bowel feeding tube, gastrostomy tube, jejunostomy tube, or designated port of gastrojejunostomy tube). The pharmacist can then review the record to assess the compatibility of any medications that are to be concomitantly administered with EN and determine the most optimal formulation of the medication to be administered through the EAD. The pharmacist will indicate whether EN is to be held for a period of time before or after medication administration (see Section 8).

Handwritten orders can increase the risk of transcription errors or incomplete EN orders. Bobb and colleagues[3] reviewed prescribing errors within a 700-bed academic medical center, and they used their findings to assist with CPOE implementation in their institution. Out of a total of 17,808 inpatient and emergency department orders that were processed during the week of the study, 1111 orders (6.2%) contained a prescribing error. The most common error types identified were wrong dose, wrong nomenclature, and wrong frequency. This group determined that CPOE systems can improve practitioner prescribing habits, and that the use of CPOE systems with clinical decision support software in conjunction with clinical staff involvement can mitigate most prescribing errors. The use of detailed standardized electronic order sets can limit the number of possible transcription errors and can promote safety by eliminating the option to choose incorrect elements of the EN order (eg, if jejunostomy feeding is selected, only continuous administration options would be available for selection).[4,5]

The Institute for Safe Medication Practices List of Error-Prone Abbreviations, Symbols, and Dose Designations and The Joint Commission's "Do Not Use" list are important considerations for healthcare organizations building electronic EN order forms. The Joint Commission's "Do Not Use" list currently does not apply to EHRs including CPOE systems. However, healthcare organizations will want to eliminate the use of these abbreviations, symbols, or dose designations from their EHR software so that they do not appear in standardized EN orders.[6,7]

Independent reviews and procedures to double-check EN orders require time and resources. If these requirements seem disruptive or burdensome to practitioners, the risk of noncompliance can increase. Organizations will need to allow resources to fulfill this critical step in the EN process.

As the patient's level of care changes, proper reconciliation and communication of the EN order is vital to patient safety and continuity of nutrition care. The World Health Organization reports that up to 46% of errors occur when new orders are written at patient admission or discharge.[8] As patients transition to different levels of care, the risk of errors related to the EN order grows. For example, if transfer orders need to be

printed and reconciled before a change in therapy is made, the patient may not receive the new therapy promptly after the transition in level of care.

Question 3.2. What are the critical elements of the EN order that need to be transmitted to optimize a complete review?

Practice Recommendations

1. Prescribe EN using a standardized electronic EN order template (ie, CPOE system). In the absence of a CPOE system, prescribe EN with a standardized order template (can use an editable electronic document) format (eg, using an Excel spreadsheet, with each unique order saved as a pdf).
2. A complete EN order contains all of the following critical elements:
    a. Patient information: Include the following patient identifiers: patient name, date of birth/age, and medical record number.
    b. Describe EN primarily via descriptive generic names (eg, "standard," "high protein") to minimize confusion for prescribers. The product trade name could also be included along with the organizationally defined generic term.
    c. Delivery site (route) and access device
        i.   Identify the delivery site by the enteral feeding tube tip position (gastric or small bowel).
        ii. Identify the specific EAD (nasogastric feeding tube, orogastric feeding tube, small bowel feeding tube, gastrostomy tube, jejunostomy tube, designated port of gastrojejunostomy tube).
    d. Administration method and rate
        i.   Document the method of administration (continuous, bolus, intermittent feedings).
        ii. Clearly define the volume and/or rate of EN administration for each method of administration.
        iii. Include any suggested methods to advance the volume and/or rate toward goal.
        iv. Guidelines for volume based feeding if applicable.
        v.   Address the advancement of EN to established goal along with transitions from PN to EN, EN to diet, or hospital to home/alternative care sites.
        vi. Document instructions for water flushes, including the solution to be used (eg, purified water), volume, frequency, and timing, as well as the volume to be administered in 24-hour period.

3. Use supplementary orders to assist with the care of the EN patient and help ensure patient safety. Supplementary orders can include:
    a. Confirmation of tube position
    b. Evaluation of skin
    c. Assessment of tolerance
    d. Specific laboratory monitoring
    e. Recommendations for modular products
    f. Instructions for EN preparation, including directions for reconstitution of powder (if indicated), shaking contents of can/container, wiping off can with alcohol prep
    g. Nutrition support consult
    h. Head of bed elevation
    i. Oral care/decontamination
    j. GRV checks
4. If EN orders are modified, reordered, or ordered upon hospital discharge/transfer, verify that all elements of the EN order are completed and independently reviewed by a nutrition support professional.

Rationale

A complete EN order will maintain patient safety while ensuring adequate EN formula delivery and proper EN administration. The EN order should contain the following critical elements: (1) patient identifiers, (2) EN formula type, (3) delivery site and access device with identification of correct port for infusion, and (4) administration method, EN infusion rate or volume of EN to be infused at stated intervals, and volume of water flushes at stated intervals. The EN order should be transmitted for review via CPOE or by an electronic editable document if CPOE is not available at a healthcare institution. These electronic orders can assist with the appropriate prescription of EN by decreasing improper EN prescription and eliminating order transcription.

Patient information. Patient identifiers, including the patient's name, date of birth, and medical record number (MRN), help ensure that the right patient receives the correct EN order. The use of standardized electronic EN orders could eliminate the possibility of the wrong patient receiving the EN order by requiring the use of adequate multiple patient identifers.[9]

EN formula name. The EN formula can be clearly identified in the electronic order by a descriptive generic name and/or trade name that is identified on the can, container, or package. For example, an EN formula that contains nonhydrolyzed macronutrients that is intended for those with normal digestive function can be generically identified as "standard." An EN formula that contains hydrolyzed macronutrients, which could be used for those with malabsorptive disorders, can be generically identified as "peptide based" or "elemental." An EN formula that contains a higher percentage of calories from fat along with a

higher fiber content to assist with glycemic control can be generically identified as "carbohydrate controlled."

EN delivery site, route, and access device. The EN delivery site with correct route (gastric or small bowel) and EAD is a critical element of the EN order. The proper identification of delivery site and device can decrease the possibility of enteral feeding tube misconnections. Route of administration identifies gastric or small bowel tube feedings, whereas enteral access identifies short-term devices, including nasogastric or orogastric feeding tubes (NGT, OGT), or percutaneous devices, including gastrostomy (G), jejunostomy (J), or gastrojejunostomy (G/J) tubes. The identification of site for EN administration and medication administration can decrease the possibility of EN administration via the wrong access when more than 1 port or access device is present.

Administration method and rate. The EN order includes the proper method of administration and EN infusion rate. The administration method identifies whether EN is to be administered via pump, gravity, or bolus methods. The infusion schedule lists the infusion times and initial rate or volume to be infused per feeding. It should also include an advancement rate/volume along with the total volume to be infused within a 24-hour period. The infusion schedule also identifies the volume and frequency for water flushes, which may change as the EN infusion and volume change in the absence of IV fluids. The EN schedule identifies whether EN is administered via a continuous drip, intermittent drip, cyclic drip, or bolus delivery.

Organizations can implement standardized electronic order sets that prevent prescribers from ordering improper administration methods for specific EADs. For example, electronic orders for jejunostomy feedings could only allow prescribers to order continuous feeding administration. The specificity of choices in essential and supplementary orders can make the EN order review process more efficient.

Supplementary orders. Supplementary orders can be developed according to each institution's identified needs and patient population. They can be used to assist with the advancement of EN, as well as transitions from PN to EN, EN to oral diet, or one facility to another facility/home. The care of enterally fed patients is also appropriately addressed in supplementary orders. For example, HOB elevation, enteral feeding tube care, GRV checks, and monitoring and laboratory parameters are to be addressed by supplementary orders.

Prescribers of EN refer to available information about EN formulas when they order EN. The use of electronic order sets can help prescribers determine whether a base EN formula will provide adequate macronutrient content for a 24-hour period or if a supplementary prescription of modular macronutrients can help meet the patient's needs. Patients with fluid tolerance limits (eg, pediatric patients; patients

with renal failure or heart failure) may need augmentation of base EN formulas with a modular macronutrient to increase calories without additional fluid. Populations with high protein needs may need additional protein modulars, whereas those who require protein restriction may benefit from carbohydrate or fat modulars. Institutions can decide whether to provide micronutrient, electrolyte, and water content of EN formulas to prescribers via information boxes within the CPOE system. The inclusion of micronutrient and electrolyte data in the ordering system can help prescribers select EN products for patients who have electrolyte imbalances or conditions where micronutrients are either not eliminated properly or are depleted with high-volume fluid losses.

Question 3.3. What steps can be taken to evaluate EN access, administration timing, fluid requirements, and other critical elements related to the enterally fed patient?

Practice Recommendations

1. Develop and institute policies and procedures at the healthcare organizational level that define the roles and responsibilities of each individual involved in the EN therapy process.
2. Support a multidisciplinary committee that reviews the healthcare organization's policies and procedures and analyzes errors related to the EN therapy process.
   a. Develop protocols for EAD assessment and care.
   b. Develop protocols regarding EN hang time and proper labeling of the beyond use date and time for EN formulas.
   c. Develop surveillance programs to monitor and review cases of EN formula contamination.
   d. Develop protocols for proper administration of medications through an EAD, as well as appropriate water flushes and EAD declogging procedures.
3. Optimize the EN prescription, administration, and order review process with methods, technology, and procedures that improve patient safety and decrease opportunities for lapses in clinician adherence to institutional policies.
4. Standardize the EN process at the healthcare organizational level to assist with the consistent delivery of patient care.
5. Develop EHR systems that can address the nutrition support clinician's concerns related to an institution's patient-specific population.
6. Institute policies and procedures regarding the documentation of the assessment of EN patients and independent double-check processes.
7. Develop protocols that incorporate checklists for each individual in the EN therapy process.

Rationale

The proper evaluation of the enterally fed patient can optimize patient safety while monitoring the provision of energy, protein, fluid, and medications. Patients receiving EN may have electrolyte abnormalities, acid-base disorders, and fluid imbalances that can be potentiated with administration of calories. Patient monitoring of the patient's metabolic status, feeding tolerance, and EAD placement are all essential in the delivery of EN. When monitoring also includes surveillance of high-risk steps within the EN process, healthcare organizations can improve the EN process as a whole.

Enteral access device placement and maintenance. The primary healthcare team should choose an EAD after evaluating current anatomy, clinical status, and estimated course of therapy. After the EAD is selected and its initial placement is confirmed via radiograph, the EAD placement must be continually reassessed. Patient movement, coughing, suctioning, emesis, or movement of the tube within the tube securement tape/device can cause the distal tip of a feeding tube to migrate distal or proximal to the intended site. A malpositioned EAD could lead to gagging/emesis of EN formula aspiration and sepsis. A malpositioned long-term EAD can lead to site leakage, blockage of the pylorus, and buried bumper syndrome. To confirm that the position of the EAD has not changed, the documented EAD length of the numerical marking at the exit site of the tube is assessed every 4 hours or before being accessed. Continue to confirm proper placement by comparing documented length or the numerical marking at the exit site of the EAD every 4 hours or prior to being accessed. If patient assessment leads a clinician to think that the EAD has migrated or is malpositioned, confirm the EAD placement by radiograph in adults[10] (see Section 4 for EAD placement).

Healthcare organizations also need protocols that address the care and maintenance of EAD sites. One protocol can outline the procedure for notifying the medical team if the patient has new or increasing pain, excess leakage, redness, swelling, induration, or bleeding from the enteral feeding tube site. Some incisional pain is expected after an initial percutaneous EAD insertion, but it should lessen over time. Protocols can also address the notification of the medical team if the patient has pain, nausea, feelings of fullness, or emesis during EN infusions as these signs could indicate a malpositioned EAD. Clinicians must follow institutional guidelines regarding dressing changes and wound care. In 2010, the National Patient Safety Agency reported the case of a patient who underwent percutaneous endoscopic gastrostomy (PEG) placement and had postprocedure pain and leakage from the gastrostomy site. This patient was discharged and then readmitted 4 days later with internal leakage. The patient died 3 weeks later secondary to sepsis from the PEG site.[11] This case reinforces that EAD site maintenance is important to patient care and appropriate observation can decrease the risk of adverse events.

Question 3.4. What systems need to be in place to make order clarifications and interventions to improve the safety and delivery of EN?

Practice Recommendations

1. Create policies and procedures that address the proper methods for order clarifications and clinical interventions for EN orders.
2. Document each order clarification or clinical intervention within the patient's EHR.
3. Conduct regular systematic reviews of all documented order clarifications and clinical interventions with a multidisciplinary team and create action plans to address any shortcomings identified within the EN process.
4. Independently review each EN order by a clinician whose competencies are assessed by the healthcare organization.

Rationale

The continual systematic review of oversight in the EN process helps identify gaps in the EN process. Many organizations review incident/event reporting and near misses, but problems can be substantially underreported if employees fear repercussions from error reporting. Healthcare organizations that create a culture of transparency allow employees to report errors without fear of repercussions.

Healthcare organizations need cost-efficient methods to identify and review medical errors. Meyer-Massetti and colleagues[12] performed a systematic review of 28 studies to assess the accuracy, efficiency, and efficacy of 4 medication safety assessment methods: incident report review, direct observation, chart review, and trigger tool. They found that each method of identifying drug safety–related problems has distinctive advantages and disadvantages and the various methods identify different types of safety issues. Therefore, they recommend that healthcare organizations select the methods that best fit the context and the nature of the suspected problems.

Accurate documentation of clinical interventions can provide objective data to justify clinical staffing and evaluate clinical staff performance. This documentation can also demonstrate that clinical staff takes accountability for patient care and avoids unnecessary costs. However, the interpretation of the quality of clinical interventions can be limited when quality improvement measures are lacking. Rector and colleagues[13] described the implementation of an education project to improve documentation of clinical interventions by pharmacists. They found that a pharmacist education initiative led to increased clinical intervention documentation with increased documentation of costs avoided. This initiative led the quality improvement project to stratify clinical intervention by their appropriateness and reinforce a new culture for pharmacy trainers.

Optimization of the independent double-check process ensures that practitioners think critically while conducting checks as designed. However, independent double-checks can be overused in the healthcare industry, and the improper use of such checks can lead to safety concerns, especially if checks are inconsistent or if clinicians become noncompliant. Standardization of the independent double-check process using checklists can reduce inconsistencies in the process, and a review of the process can help identify reasons for noncompliance or other problems. When coupled with other error reduction strategies, the use of properly implemented double-check processes can prevent errors from reaching patients.[1]

Topics for Future Research

- The effect of EN ordering via CPOE or editable electronic document on EN-related error rates
- Comparison of errors associated with the use of standardized EN order sets vs errors related to the transcription of handwritten orders
- The patient safety impact of pharmacists reviewing the EN order with a patient's medication profile to identify medication interventions
- Documentation of EN errors related to transitions in level of care
- Documentation of errors related to the misconnection of EADs
- The error-related consequences of standardizing the EN order process
- The use of systematic reviews to identify gaps in the EN process

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Section 4. Enteral Access

Background

The selection of the EAD can greatly affect the success of EN. The optimal device and location (gastric vs small bowel) must be determined as placement of any enteral access device entails associated risks. If patients with an EAD are transferred to a facility without complete documentation, the receiving facility, whether acute care, long-term care, or home care agency, will need to confirm the type and placement of that feeding tube prior to initiating EN. The practice recommendations in this section help guide that facility or agency to confirm the EAD type and placement prior to starting feedings and avoid feeding through an EAD that may no longer be at the appropriate distal site.

Complications following EAD placement can include **misplacement**, which is when the tip of the EAD is placed in an anatomical position not intended for the proper administration of EN. EAD **displacement** is when the device tip later migrates or is inadvertently moved to an anatomic position not intended for the proper position of the device. Proper EAD placement and maintenance help prevent aspiration of EN, dumping syndrome, and other adverse outcomes. Although risk of complications cannot be completely eliminated, minimizing placement errors reduces the complication rate and improves patient outcomes.

> **Question 4.1. What are the critical components to consider when selecting an EAD for a patient?**

Practice Recommendations

1. Select an EAD based on patient-specific factors (eg, GI anatomy, GI function, expected duration of EN).
2. Place a short-term nasoenteric or oroenteric EAD in patients who require EN for up to approximately 4–6 weeks in duration.
3. Place a long-term EAD in patients who require EN for longer than 4–6 weeks.

Rationale

The selection of an EAD requires an evaluation of the patient's disease state, GI anatomy (taking into account past surgeries), gastric and intestinal motility and function, and the estimated length of therapy. The healthcare team decides whether to place the distal tip of the EAD in the stomach or in the small bowel. In general, gastric access is appropriate for patients with a functional stomach free of delayed gastric emptying, obstruction, or fistula. Small bowel feedings are most appropriate for patients with gastric outlet obstruction, severe gastroparesis, and in those with known reflux and aspiration of gastric contents. Patients who need simultaneous gastric decompression with small bowel feedings can be best accommodated by a dual-lumen gastrojejunal EAD.

EADs inserted via nasal and oral routes. EADs inserted via the nasal and oral routes are usually intended for short-term use (no more than 4–6 weeks) in the hospitalized patient. However, there may be situations when use of a nasogastric access in the outpatient setting is appropriate. Some patients, particularly pediatric patients in the home, are able to self-place a nasogastric tube as part of their own care.

EADs for long-term access. The decision concerning placement of EADs for long-term EN depends on the estimated length of therapy, the long-term goals, the patient's disposition, and the special needs of the patient and caregivers. The use of gastrostomy tubes (balloon and nonballoon tubes) has become routine practice worldwide and is currently the method of choice for medium-term and long-term enteral feeding.[1] Two studies of adult patients with persistent dysphagia due to neurological disease randomly assigned patients to feedings via NG or PEG tube placement.[2,3] These studies found that the patients with PEG tubes had gained more weight and missed fewer feedings. The patients fed by NG tube received significantly less because of tube difficulties compared with the PEG patients, who had no such difficulties.[2,3] One of the studies allowed patients with an NG tube to cross over to a PEG tube if they had repeated tube difficulties (usually displacement), and, consequently, only 1 of 19 patients had an NG tube in place for 4 weeks.[3] At the end of the study, the last patient with an NG tube opted for a PEG tube, stating that the NG tube was cosmetically unacceptable.

Concerns for pediatric patients. In the pediatric literature, commonly accepted criteria for EN intervention depend on the clinical condition of the patient.[4–6] EN support is considered after other aggressive oral interventions have been tried. Pediatric patients who meet the criteria for EN include:

- Children with insufficient oral intake, particularly children older than 1 year who are unable to meet ≥60%–80% of individual requirements for ≥5 days and children younger than 1 year who are unable to meet ≥60%–80% of individual requirements for ≥3 days
- Children who meet the criteria for failure to thrive, wasting, and stunting

EN is also appropriate in a disabled child whose total feeding time is more than 4–6 hours per day. EN can also be an option when diet modification is used as a treatment of a disease (eg, Crohn's disease), food intolerance, and metabolic disorders.[7] Specific indications for feeding tubes in pediatric patients include cystic fibrosis, neurological impairment, oral/head and neck tumors, chronic liver disease, trauma, and extensive burns.[4]

Contraindications to EAD placement. The choice of EAD needs to take into account contraindications to the placement of the device. These can be divided into systemic and mechanical reasons and may be relative or absolute. Systemic contraindications are those where the overall condition of the patient precludes feeding tube placement. Mechanical ones are those where specific local conditions such as hepatomegaly or previous abdominal surgery preclude safe placement of the EAD. In some cases, the condition may be corrected. Absolute contraindications include mechanical obstruction of the GI tract (unless the procedure is indicated solely for decompression), active peritonitis, uncorrectable coagulopathy, or bowel ischemia.[8] Traumatic injuries to the head, face, and neck region as well as recent transphenoidal surgery may preclude a nasally placed EAD. A number of other conditions represent relative contraindications to enteral access, such as recent GI bleeding, hemodynamic instability, ascites, respiratory compromise, and certain anatomic alterations.[8]

Question 4.2. What steps are recommended to confirm placement of a preexisting EAD prior to initiating EN?

Practice Recommendations

1. Develop a policy at the healthcare organizational level to confirm the EAD type and placement prior to EN initiation.
2. Assess the patient and caregiver knowledge about the tube, such as agency or facility where the tube was placed, insertion date, where the patient was transferred from, and what type of tube and previous care and feeding orders were provided to the patient or caregiver.
3. Communicate with staff from the transferring institution, facility, or agency to obtain as much information as possible on the EAD type, tip position, and need for ongoing replacement and documentation.
4. Confirm type of EAD and tube placement via the accepted methods of tube verification (see Section 4, question 4 for methods used in adult patient and question 5 on pediatric patients).

5. Document the confirmation process and findings in the patient's health record.
6. Encourage transferring agencies to communicate the full information about EAD type, insertion date, and placement upon transfer.

Rationale

Adequate and timely transfer of information between care settings during transitions in care is imperative for the safe care of patients.[9] A percutaneously positioned tube in a GI tract that has not fully matured may be displaced prior to or during transfer, particularly if the tube is inadequately secured. If the displacement is not identified, this complication may lead to intraperitoneal administration of EN. Incomplete or incorrect communication of the EN tube type and placement during patient transfer may delay the administration of adequate and appropriate nutrition. Poor communication during transitions of care may also lead to hospital readmissions and emergency department visits that may have been preventable.[10]

The EAD type, placement, and requirements for ongoing replacement need to be communicated in the available medical record and clinical information. Clear descriptions in plain language without ambiguous abbreviations will minimize misinterpretation and error. Ideally, this documentation is provided by the transferring agency to the new facility *prior to* discharge,[10,11] and the enteral prescription and regimen are transferred to the accepting care team via standard electronic information systems that are accessible to all healthcare providers and suppliers associated with the patient.[11] Use of these systems may improve communication; however, they may not be universally available or accessible. If this information must be communicated by telephone, the nutrition support provider at the new facility should repeat it back to ensure that it is received and interpreted correctly. Feeding tube information, such as brand, type, tube tip position, need for ongoing replacement, French size, and length (if applicable), is also verified at this time.[12]

Question 4.3. What steps can be taken to enhance the safety of bedside nasoenteric tube placement?

Practice Recommendations

1. Develop organizational policies to outline who is qualified to place a nasoenteric tube, under what circumstances, and with what supervision or competencies.
2. Assess patients prior to tube placement for potential contraindications, identification of high-risk patients for misplacement, or if bedside placement is medically appropriate.
3. Actively assess patient tolerance *during* tube placement.
4. Educate and assess competencies for all clinicians involved in tube placement.

Rationale

Addressing safety measures designed to enhance the safety of bedside blind insertion of feeding tubes *before and during* tube insertion is critical as this this is where the most serious, potentially life-threatening adverse events occur.[13,14] This is especially needed when considering that numerous disciplines, with varying degrees of training, commonly place these tubes today. The importance of training and competency assessment of all clinicians involved in tube insertion should be clearly delineated.[13–16]

Patient assessment prior to tube insertion is essential to preventing placement-related injury. This could include identification of patients at high risk for pulmonary misplacement; recognizing contraindications to nasal passage of tubes, including recent history of transphenoidal surgery or basilar skull fracture (ethmoid, sphenoid, or occipital bones); evaluation of bleeding risk, including coagulation values and safe limit cutoffs; recent bleeding from esophageal varices; time since banding; and so on. The presence of anatomical factors that can lead to perforation should also be part of the assessment: hiatal hernia or Zenker's diverticulum and previous bariatric surgery. Not all patients are candidates for bedside insertion, and fluoroscopic or endoscopic placement may provide a safer choice for tube placement.[14]

Alternate bedside methods of placement are available and include electromagnetic placement device (EMPD), use of carbon dioxide (CO_2) sensing, and direct visualization using a tube with a camera. These techniques are described below.[13–16] Development of institutional policies and procedures for placement and ongoing competency assessment is crucial. One institution temporarily stopped placement of tubes by untrained personnel until a quality improvement program could be put into place.[14] It is important to document the size and manufacturer/model of the tube once it is placed. The diameter plays an important role in types of formula and medications that can be infused, and internal diameter can change depending on the device material and model.

Question 4.4. What is the best way to confirm accurate EAD placement in ADULT PATIENTS?

Practice Recommendations

1. Obtain radiographic confirmation for any blindly placed short-term EAD to demonstrate that it is properly positioned in the GI tract prior to its initial use for administering feedings and medications in adult patients.
2. When attempting to insert a short-term feeding tube, obtain a tube aspirate for appearance and pH measurement. The appearance and pH are likely dependent on location.

3. Do not rely on the auscultatory method alone to differentiate between gastric and respiratory placement or between gastric and small bowel placement.

4. Mark the exit site of a feeding tube at the time of the initial placement and document either the incremental marking on the tube or the external length of the tube in the medical record.

5. Evaluate whether the incremental marking or external tube length changes, and, if a change is observed, use other bedside tests such as visualization and pH testing of tube aspirate to help determine if the tube has become dislocated. If in doubt, obtain a radiograph to determine tube location.

6. For long-term feeding tubes, document tube type, tip location, and external markings in the medical record and in follow-up examinations.

7. Avoid use of catheters or tubes not intended for use as EADs, such as urinary or GI drainage tubes, which usually are without an external anchoring device. Use of such tubes may lead to enteral misconnection as well as tube inward migration, which can potentially cause obstruction of the gastric pylorus or small bowel.

8. Avoid administration of feedings, fluids, or medications through the EAD until correct position has been confirmed.

Rationale

The patency and placement of an EAD should be confirmed before using it for feeding or medication administration. Proper radiographic imaging is recommended to confirm the position of any blindly placed enteral feeding tube. Healthcare professionals cannot rely on auscultatory methods to differentiate between gastric and bronchopulmonary tube placement because auscultatory methods cannot distinguish tubes improperly placed in the lung or coiled in the esophagus from properly positioned tubes.[17]

Nasal or oral insertion of a short-term EAD is often performed at the bedside. Nasojejunal tubes may be placed blindly or with the assistance of endoscopy, fluoroscopy, electromagnetic, carbon dioxide sensing (capnography), or direct camera visualization devices. Studies have demonstrated that errors in blindly placed NG tubes are not uncommon.[14,18–20] Sorokin and Gottlieb[14] reported a 1.3%–2.4% incidence of misplacement of a tube in 2000 NG tube insertions into adults. Of the misplaced devices, 28% resulted in pulmonary complications, with 2 of these misplacements culminating in death.

Confirmation that the newly inserted EAD is correctly positioned is mandatory before feedings or medications are administered. A variety of bedside tests to determine tube placement are used with varying degrees of accuracy. Usually bedside detection methods serve as precursors to radiographic confirmation, as they may serve to decrease the number of radiographs needed to a single one.[8] For a blindly inserted EAD, the gold standard for confirming correct placement is a properly obtained and interpreted radiograph that visualizes the entire course of the tube.[14,21–23]

Confirmation is usually provided through imaging, which can add significant cost and time to EAD placement. Recent adjuncts have been developed, including the use of carbon dioxide or pH sensors to confirm intubation of the stomach rather than the pulmonary tree.[24] Sensitivity and specificity of those 2 methods have been reported in one trial as high as 86% and 99%, respectively.[25] Newer technology provides the clinician with multiple options in confirming tube location prior to the initiation of enteral feeding. A multicenter study compared the use of an electromagnetic placement device (EMPD) for placement and tube tip confirmation to standard x-ray. Of the 194 patients in this study, only 1 had data showing discrepancies between the original EMPD verification and the final abdominal radiograph interpretation, providing a 99.5% agreement.[26] Other recent studies and a literature review demonstrated similar conclusions,[27,28] while 2 more recent papers point out the potential risk of eliminating x-ray confirmation with inexperienced operators.[29,30]

A more recent innovation is a disposable feeding tube with an integrated real-time imaging system to visually aid in the placement of small-bore feeding tubes. This technology method features a 3-mm camera integrated within a small-bore feeding tube to allow clinicians to identify anatomical markers during the placement of a tube.[31]

Although observing for respiratory symptoms is warranted during EAD insertion, malpositioning may occur without any apparent symptoms.[32,33] The appearance and pH of aspirates from a feeding tube may provide clues to an EAD location but has not been shown to be reliable as a single marker for tube tip location. Fluid withdrawn from a tube that has perforated into the pleural space typically has a pale yellow serous appearance and a pH of 7 or higher, whereas fasting gastric fluid typically is clear and colorless or grassy green or brown with a pH of 5 or less.[34–38] Several studies demonstrating the use of pH testing indicate a pH of ≤ 5.5 from tube aspirate is adequate to check the position of the tube in the stomach.

The auscultatory method of tube tip confirmation is unreliable.[17,39] Multiple case reports clearly indicate that clinicians cannot differentiate between respiratory and gastric placement by the auscultatory method.[32,40,41] Several studies have indicated that capnography can be helpful in determining when a tube has taken the wrong course into the trachea during the insertion process.[42,43] However, it is important to point out that this method cannot distinguish between EAD placement in the esophagus and the stomach. Thus, even though capnography may indicate nonbronchotracheal placement of a newly inserted tube, a radiograph is still required to ensure proper placement in the stomach.

A tube is malpositioned if it is located in the stomach of a patient receiving small bowel feedings. One study found that experienced nurses could not distinguish between gastric and

small bowel placement by the auscultatory method.[44] A higher level of accurate placement has been reported when clinicians observe the appearance and pH of the feeding tube aspirate.[45] Small bowel aspirates are typically bile stained, while fasting gastric fluid is typically clear and colorless or green or brown.[35] Gastric fluid usually has a lower pH than that of small bowel secretions. For example, Griffith et al found that most gastric pH readings were ≤ 5, with or without the use of gastric acid suppression therapy.[37] It should be noted that when gastric pH is ≥ 6, the pH method is of no benefit in predicting tube location in the GI tract (or in ruling out tracheopulmonary placement).

After feedings have been started, it is necessary to check that the tube remains in the desired location (either the stomach or small bowel). Securing tube with a bridle may be helpful for preventing accidental dislocation (see below for more detail on securement). Unfortunately, a small bowel tube may dislocate upward into the stomach or a gastric tube may migrate downward into the small bowel; a worse scenario is when a tube's tip dislocates upward into the esophagus.[46] Obviously, an x-ray cannot be obtained several times a day to confirm tube location; thus, clinicians rely on a variety of bedside methods for this purpose. Use of the above-mentioned bedside placement technology (electromagnetic, direct visualization, pH measurement, or CO_2 sensing) can help clinicians to verify tube tip position. A sharp increase in gastric residual volume may indicate displacement of a small bowel tube into the stomach.[47,48] For long-term EADs, incorrect feeding technique and complications in tube replacement and removal can result from failure to recognize the type of tube inserted (gastric vs small bowel), the insertion technique, and the location of the distal catheter tip. Follow-up of a long-term percutaneous EAD is indicated to ensure that the enteral retention device is properly approximated to the abdominal wall, there is no tube migration, and excessive tension to the exterior portion of the tube is avoided, as well as to assess the condition of the surrounding skin.

Question 4.5. What is the best way to confirm accurate EAD placement and evaluate risk versus benefit of radiation exposure especially in PEDIATRIC/ NEONATAL patients?

Practice Recommendations

1. Use accurate measurement of enteral tube insertion length, gastric pH testing, and visual observation of gastric aspirate as acceptable nonradiologic methods for assessing tube placement when radiographic verification is not available.
2. Obtain an abdominal radiograph when other nonradiographic methods for validation of tube location are not confirmatory.
3. Avoid using auscultation alone as verification for nasogastric feeding tube placement.

Rationale

Although placement of a nasogastric tube is a common procedure, it is not without risk of significant harm or death. Great care must be taken when placing tubes and confirming their correct placement. In 2012, the Child Health Patient Safety Organization issued a safety alert to recommend immediate discontinuation of the auscultation method for the assessment and verification of NG tube placement.[49] A study cited in the alert reported that 1.3%–2.4% of NG tubes in more than 2000 insertions were located outside the GI tract. Moreover, more than 20% of the misplaced NG tubes led to pulmonary complications.[14,49] This alert acknowledges an abdominal radiograph as the current gold standard when other nonradiographic methods for validation of tube location are not confirmatory.

When abdominal radiography is not readily available or advisable, the Child Health Patient Safety Organization safety alert identifies accurate measurement of EAD insertion length, gastric pH testing, and visual observation of gastric aspirate are acceptable nonradiologic methods for assessing tube placement listed in the alert.[49] In addition, the alert specifies children who are considered at high risk for misplaced or dislodged gastric enteral tubes: neonates, children with neurological impairment, children in an obtunded neurological state, and children who are encephalopathic, have a decreased gag reflex, or are sedated or critically ill. For these children, the alert recommends abdominal radiography as the best practice for verifying location of a gastric enteral tube.[49]

In addition to the above-mentioned alert, the American Association of Critical-Care Nurses issued a practice alert[50] and the American Society for Parenteral and Enteral Nutrition (ASPEN) published practice recommendations[51] to address the risks and potential complications associated with misplaced NG tubes.[50,51] Placement of a gastric EAD potentially poses risks to patient safety, and device dislodgement poses similar risks.

In a retrospective study of children, Ellett et al[52] demonstrated by radiographic documentation a prevalence of 21% for misplaced or dislodged NG, orogastric, and transpyloric tubes. In a follow-up prospective study, Ellett and Beckstrand[53] used abdominal radiography to evaluate device placement and reported a prevalence between 22% and 44% in NG tube placement error in children in their institution, a rate that exceeds the range found in adult studies. Although alternative methods exist, abdominal radiographic imaging is the "gold standard" for verifying NG tube placement.[18,51,54–56] However, even with radiographs, there may be variation in the interpretation of device location. This variation is due to a lack of consensus on identification of specific anatomical landmarks used to verify the NG tube position within the gastric lumen.[56] In addition, the lack of a relevant clinical history explaining the need for a radiograph along with omission of a specific request for device and device tip location in the radiology requisition can

influence the radiology report.[56,57] Despite these limitations, radiographic determination is the standard by which all other methods of verifying NG tube location are measured. An abdominal or chest radiograph that includes an abdominal view is considered the most reliable method to document the course of the tube and its tip location at the time the radiograph is obtained.[18]

Although the radiation exposure associated with a single abdominal radiograph may be low, repeated exposures for multiple placement verifications may, over time, result in high cumulative radiation doses. Both cohort and case-control studies have associated increased radiation doses with various types of cancer, including childhood leukemia.[58,59] Moreover, obtaining abdominal radiographs for home care patients and those in ambulatory and long-term care centers is not practical.[18]

The patency and placement of an EAD must be confirmed before any new EAD is accessed for feeding or medication administration. Healthcare professionals cannot solely rely on auscultatory methods to differentiate between gastric and bronchopulmonary tube placement because these methods cannot differentiate between properly placed tubes and tubes improperly placed in the lung or coiled in the esophagus.[8] In pediatrics, 2 methods are suggested for tube confirmation. X-ray confirmation is only valid for that moment in time, as an infant or child can dislodge the tube quickly. Due to the many times a pediatric or neonatal tube may be inserted, it may not be reasonable to have x-ray confirmation of each tube placement. In these situations, when ongoing x-rays are not possible, 2 methods of tube verification, such as tube length measurement and pH testing, are recommended.[60]

Question 4.6. What are the safe and effective methods to secure EADs to prevent their displacement?

Practice Recommendations

1. Provide practical education on EAD securement to clinical staff and assess clinical competencies on a regular basis.
2. Securement of enterally placed feeding tubes and prevention of dislodgement are the responsibility of all clinical staff.
3. Routinely assess patients with EADs to check tube securement in addition to appropriate tube position. Early detection of displacement reduces the risk of adverse events.
4. Consider bridling of nasally placed feeding tubes, which may help reduce displacement of tubes at risk for displacement. Understand, however, that there are insufficient data to recommend this technique on a routine basis.
5. Include routine assessment in patient monitoring for signs of tissue pressure, patient discomfort, and inadequate securement.

    a. Pressure on internal tissue related to technique has not been adequately explored and means to reduce pressure as well as monitoring for adverse effects on internal as well as external tissue should be routine.

6. Use trained staff to periodically assess the appropriate fit of percutaneous EAD external bolsters and skin integrity in order to help prevent tissue damage, leakage, and other issues.
7. Avoid maintaining a bridle for longer than 4 weeks.

Rationale

Nasal tubes. Once the nasally inserted tube has been safely placed and tip location verified, the challenge is to keep the tube in place. Nasal feeding tubes are frequently dislodged in hospitalized patients. In a study of 49 intensive care units by Mion et al,[61] 22.1 episodes of tube dislodgement occurred per 1000 patient days, for a rate of 28.9% for nasogastric tubes. Not surprisingly, EAD removal has been associated in several studies with patient agitation, disorientation, and restlessness; nosocomial infection; and a score of 9 or less on the Glasgow Coma Scale, as well as medication use.[61,62]

Aspiration is among the risks associated with dislodgment of nasal feeding tubes. The potential for aspiration may be greatest in patients whose tubes become only partially displaced so that feeding is infused into the pharynx or upper esophagus, especially if the displacement remains undetected for a period of time.

Nasal tubes are sometimes taped to the nose, with a type of wrap around the tube using adhesive tape, partially split bandage, or other material, which then may be pinned to a patient gown or clothing. The tube typically hangs from the nose, where it could be a patient distraction, and gown misplacement or change can tug on the tube secured to it. When a nasal tube is taped to the nose, the taping must be done in a manner to prevent pressure against surrounding tissue as pressure sores may develop. Monitoring for pressure on related tissue must be routine.

Another method of securing the nasal feeding tube uses a semipermeable transparent dressing from the tube exit at the naris and across the cheek, as is often noted in pictures of tube securement for children. Taping the tube to the neck (pinching it around the tube) provides additional securement in a stable area. This method may work well for smaller flexible tubes, although resecurement may be needed as facial hair grows. Skin cleansing and an adherent agent such as tincture of benzoin may be helpful in securing the dressing to oily skin. This method is more out of sight and discreet for the patient than a tube secured to the nose. If the patient has a visual deficit in one eye, placement of the tube in the naris and securement on the affected side of the face may reduce the patient's temptation to pull at the tube.

Manufactured fixation devices are also sometimes used for nasal tube securement. These devices may include adhesive

strips or a clip for attachment of the feeding tube, which has been shown to reduce nasal pressure ulcers. In a study of 205 patients, Ambutas et al[63] reported use of a commercial NG tube holder was associated with fewer nasal pressure ulcers than use of typical adhesive tape to secure 14 and 16 French sump tubes. The results for in this study did not reach statistical significance, but the findings were deemed to be clinically meaningful, suggesting that the method of securement may impact pressure on surrounding tissue.

Nasal tubes may be sutured to the naris in some situations to reduce inadvertent displacement such as after head and neck surgery; however, tubes can become displaced partially or completely through the sutures. The suture disrupts skin integrity, which carries a risk of infection. Additionally, the patient may experience discomfort at the suture site, especially if there is tension on the tube, such as from being snagged or tugged on.

The nasal tube retention device, also known as a "bridle" or "bridle loop" provides additional securement for patients at high risk for nasal feeding and occasionally nasogastric suction tube displacement. Various techniques and materials for bridling tubes have been described. In general, small-bore tubing or umbilical or twill-type tape wraps around the nasal septum with each end exiting a naris and the feeding tube is secured to the bridle tubing or twill tape. It is recommended that staff who bridle tubes be trained in the technique, demonstrate competency, and maintain skill through frequency of use.

One method of bridling a feeding tube involves the use of a manufactured device. This method uses a magnetic retrieval system to facilitate bridle placement. Another method is constructed with materials and supplies available in many nursing areas. This method involves retrieval of 5 French feeding tubes that have been inserted through each naris from the oral cavity and pulling one aspect back through a naris to create a loop around the posterior aspect of the nasopharynx, which is then secured to the feeding tube with skin securement strips and secured to the side of the face.[64]

Bridling is associated with low rates of morbidity and complications, the most common being failure to prevent feeding tube displacement. Even with the bridle in place, patients with fine motor skills can catch a small loop of the feeding tube between the naris and bridle and dislodge the tube. Patients with gross motor skills might tug on the bridled tube, especially if they do not associate the discomfort they experience with the tugging. When the small-bore feeding tube is used as a bridle, it may break and release if it is tugged on firmly, which may be viewed as a benefit in reducing or preventing tissue trauma. It is advisable to evaluate the patient for internal nasoseptal damage if any bridled tube is tugged on significantly. Nasal ulceration is another potential complication if securement is too tight. Ideally, the bridle material does not cause pressure on internal and/or external tissue or make the patient uncomfortable by being secured too tightly; however, the bridle must be secure enough to prevent tube dislodgement. To prevent undue pressure on the septum from the bridle loop,

the feeding tube might be secured to the patient's face. Other potential complications of bridling include sinusitis, bleeding, patient discomfort, and septal erosion or trauma. In a study of 80 patients randomly assigned to nasal bridle or adhesive device, bridled tubes were less likely to be dislodged than unbridled tubes; however, 5 cases of mild epistaxis and 4 cases of superficial nasal ulceration were associated with the bridle.[65] Two patients presented with retained system insertion stylets as nasal foreign bodies.[66] It has been suggested that the use of nasal bridles for greater than 4–8 weeks can result in nasal erosion, although longer term use of the bridle has been reported with no adverse effects.[67]

In a study of burn patients, Parks and colleagues[68] reported that 17 patients with bridled tubes had significantly fewer tube insertions than the prebridle control group of 33 patients with taped tubes. The investigators concluded that the use of a nasal bridle to secure tubes in burn patients had clinical advantages over traditional adhesive tape securement. A systematic review by Brugnolli et al[69] of published and unpublished reports of nasogastric tube securement in any language found 5 studies, 2 of which were randomized controlled trials. Four studies in that review compared bridled tubes with unbridled (taped) tubes and found a favorable advantage for bridled tubes. Three studies in that review measured time until failure, with 2 comparing bridle vs tape methods and the other study comparing types of tape. Of those 2 studies, one did not find a significant difference between groups and one demonstrated a longer time until securement failure in bridled tubes. Three studies comparing adverse events in bridled vs nonbridled tubes had contradictory findings. The authors of these studies concluded that despite the large number of patients receiving this intervention, "there is insufficient evidence to suggest one securing technique over another" and "there is little or no statistically significant evidence regarding bridling of nasogastric tubes but more research is needed." Patient discomfort was not measured in the studies in this report.[69] A meta-analysis by Bechtold and colleagues,[67] reviewing patients with nasal bridles, showed similar results, finding limited data regarding secondary outcomes such as pain, nasal septal erosion, and epistaxis. Proper care and technique are suggested to avoid skin irritation, breakdown, and ulceration, and it is important to limit pressure and remove the bridle once removal is clinically indicated. Bridling for those at high risk for tube dislodgement may be an effective strategy for access securement. Consideration of the benefits of placement of a nasal bridle in the severely agitated patient must be weighed against the potential for internal septal trauma. As with any healthcare decision, the clinician and patient/family must consider the safety, potential benefits, and potential risks to bridling a nasally placed tube.

Contraindications to the use of the bridle include nasal trauma or malformation, mechanical obstruction, craniofacial or basilar skull fractures, and propensity for epistaxis by history or related to coagulation status. Removal of the bridled tube is done by cutting one (and only one) aspect of the bridle.

The bridle can then be pulled through the naris along with the nasally placed tube. This information should be sent with a patient who has a bridled feeding tube when he or she transfers to another care facility.

Inability to maintain the nasoenteral route for feedings due to dislodgement may precipitate a decision point in therapy to answer the following questions. Will this patient continue on enteral feeds? Is oral nutrition now possible and will oral intake adequacy be obtained if EN is stopped? Or, have the goals of therapy changed? If ongoing EN is still indicated, the placement of a percutaneous EAD (ie, gastrostomy, jejunostomy, gastrojejunostomy tube) may be necessary to maintain enteral access. A percutaneous tube placement may be preferred in patients who are expected to need EN for more than 4–6 weeks and a more reliable feeding delivery system with a reduction of tube dysfunctions. However, patients who have repeatedly dislodged nasally placed tubes may also be at risk for dislodging a percutaneously placed tube, which can have dire clinical consequences, especially soon after placement and prior to tract maturation. Therefore, a strategy to avoid tube displacement must be included in the patient plan of care.

Percutaneous tubes. General categories of percutaneous EAD include gastrostomy, jejunostomy, and gastrojejunostomy tubes. Securement of these tubes is necessary to not only prevent dislodgment but also to prevent internal migration related to peristalsis that can result in feeding intolerance and in gastrostomy tubes; blockage can occur at the pylorus by the internal fixation device (eg, balloon, rubber bumper or pigtail loop). Percutaneous EADs typically have external bolsters (known as "bumpers" or "disks") to prevent this inward migration and are recommended for use as opposed to catheters not designed for enteral feeding, which may not have external bolsters (such as urinary catheters). External bolsters must fit appropriately to prevent both internal and external pressure (such as buried bumper). Fit should allow for easy rotation of the tube (gastrostomy tube only; jejunostomy and gastrojejunal tubes should not be rotated) and permit cleaning under the bolster (suturing of the bolster to the skin may prohibit cleaning and contribute to irritation; other means to reduce displacement may be preferable). A slim layer of light breathable gauze can be inserted under the disc, if indicated. An external disc that is too loose, permitting internal and external movement of the tube (positioning), may let gastric contents leak through the gastrostomy opening, which then may lead to skin excoriation and other complications. Appropriate fit of gastric (and jejunal) tubes and the integrity of surrounding tissue are key to successful tube usage as well as patient comfort.

Gastrostomy tubes placed endoscopically typically have an internal bolster as opposed to a balloon to keep them from being pulled out. Some types of these tubes may be more challenging to remove, but other tubes are called "traction removable," meaning that clinicians can intentionally remove them

with moderate traction for replacement or discontinuation. However, they can also be inadvertently removed by patients as well. As a result, means of securement are as important for these tubes as they are for other tubes. In a study of PEG tubes placed by one surgeon during a 3-year period, Rosenberger and colleagues[70] reported a 30-day mortality rate of 7.8%, a 7-day early dislodgement rate of 4.1%, and a lifetime early accidental dislodgement rate of 12.8% (72 of the 563 PEG tubes).

Internal balloons can secure gastrostomy or gastrojejunostomy tubes that are placed using fluoroscopy or open or laparoscopic surgical procedures. Tubes can potentially be pulled out with the balloon intact; additionally, balloons may rupture or slowly loose ability to hold fluid, resulting in tube looseness and dislodgement. Michaud et al[71] evaluated 165 gastrostomy tubes for 84 children and reported that the mean longevity of the balloon-type low-profile gastrostomy tube was 5 months (range, 14 days to 14 months). In that study, balloon failure was not correlated with underlying disease, age of the patient, or the use of antisecretory drugs. Some companies highlight the strength of the balloon, including low-profile tubes. However, literature on outcomes of specific internal fixation methods is sparse, and clinicians should follow manufacturer's guidelines for frequency of tube changes. Another internal fixation method uses a pigtail-type catheter where the internal end becomes looped when pulled on by an external string. One brand of gastrostomy tube has a right angle feature, which results in a lower profile and may have the advantage of being more discreet.

Low-profile, skin-level, or button-type tubes are used frequently, especially in children, although many adults also appreciate these types of EAD. They are less bulky to pull on (especially when not accessed by an adaptor for feeding), are less visible under clothing, contain antireflux valves, and do not require tape to secure them to the abdomen. However, they may cost more than other standard gastrostomy tubes. Use of a low-profile device requires periodic resizing in growing children to prevent compression injuries of the gastric mucosa or epidermis.

Accidental removal of gastrostomy tubes within 2–4 weeks of placement before the tract has matured may result in peritonitis and even death if gastric content leaks into the peritoneum.[72–74] Excessive traction on the tube in this period may also cause peritonitis if the bolster gets pulled through the gastric/jejunal wall.[75] Techniques such as gastropexy using temporary sutures or T-fasteners to secure the stomach to the abdominal wall until it affixes to the abdominal wall can help reduce potential for leakage into the peritoneum and aid in easier and safer tube replacement when needed.[76–79] These devices must be monitored to be sure they are not causing pressure on the skin.

Jejunostomy tubes might have low-volume (eg, 3–4 mL) balloons to prevent tube displacement. However, balloons can be dislodged in the tract. Fit of the bolster and care of surrounding tissue are paramount to successful use of these

tubes. To reduce pressure and tugging on the tube, it is important to adequately secure the tube to the abdomen with an appropriate tape (fixing tape around the tube, then to the skin) or another method of securement. Some jejunal tubes have a Dacron cuff that becomes embedded in the subcutaneous tissue and can help prevent displacement and serve as successful jejunal access for years. Secure these tubes low to the skin to allow the cuff to embed (as opposed to padding under the tube itself) and also to the abdomen, at least until the cuff is well embedded.

Other tubes (eg, red rubber catheters) may not have an internal means of fixation. If these tubes are not well secured, external migration resulting in dislodgement can occur more easily than with other types of tubes. In addition, if this type of tube irritates and reddens patient skin, securing the tube to the irritated skin may be difficult. External fixation devices are not always necessary or fail-proof. If they are used, the skin under them must be carefully monitored for moisture retention, which can lead to microbial growth and tissue breakdown.

Strategies to prevent tube dislodgement. Patients can cause serious harm to themselves by removing tubes essential for breathing or feeding. In the past, the use of medications or physical restraints, including wrist restraints or mittens, was suggested for high-risk patients. However, the use of physical restraints may actually increase a state of delirium and/or agitation and in turn contribute to tube removal by the patient.[62] The use of physical or chemical restraints is rightfully discouraged in today's healthcare environment. Alternative methods of securing tubes are advisable whenever and wherever their use is possible. Healthcare providers can also reduce risk of dislodgement by talking to patients and orienting them in a calm, person-centered manner, as people are generally more cooperative when they are well informed.

Healthcare organizations may choose to employ staff to prevent self-harm by patients without use of restraints. This approach may be effective, but it is an added expense. Family members who are visiting or caring for the patient are sometimes asked to monitor for patient safety. The range of effective alternatives to restraints may expand as patient cognition improves.

The acronym MARK can be used to guide steps for monitoring tube securement. **M** is for marking the tube at the exit with an indelible marker to help identify displacement at a glance. It is also important to record the external length at the time of placement by using the number on the tube at the exit site, which is often denoted in centimeters; this number can be used to monitor for feeding tube migration. **A** is for anchoring the tube (as previously discussed). **R** is for reassessment of the tube placement. Frequent reassessment is advisable, especially in patients at risk for displacement as well as during procedures that increase risk of dislodgement, such as patient positioning and transfers. **K** has 2 meanings. It stands for keeping pressure

off of skin or the septum, and it refers to the knowledge needed to ensure safe practice in policy, procedure, and clinical practice (Lorraine Linford, personal communication).

Other recommendations for preventing displacement of long-term tubes include using an abdominal binder for those at risk for pulling at tubes, using a gastrostomy tube that has an internal bolster that "cannot" be removed with traction (requires endoscopic removal), and changing to a low-profile tube.[80] Tubes can be hidden inside of a tucked-in shirt and other creative strategies can be used to secure the tube and keep it "out of sight and out of mind," reducing patient focus on the tube. If a tube securement device is used, the potential exists for moisture to be trapped under the coverage area until the device is replaced, which may be days, due to cost or protocol. Moisture retention can promote microbial growth and potential skin breakdown. Therefore, careful assessment and monitoring are recommended when tube securement devices are used. Feedings can be scheduled so that the patient receives needed feeding over shorter periods, such as gravity bolus feeding for gastric tubes, when more staff are available for monitoring, or jejunal delivery of feedings can be scheduled at night or day to reduce periods when the tube is accessed. Additionally, follow-up by trained personnel is key to preventing tube displacement, other issues (such as buried bumper due to tightness of securement), and minimizing problems if a tube should become displaced.[75,81]

Key strategies to reduce or prevent tube displacement include education of staff at inpatient and transfer facilities, education of patients and their families, and monitoring of practice and performance improvement projects. To ensure safety and efficacy while maintaining dignity and comfort for the patient as possible, the clinician is advised to use researched as well as innovative noninvasive methods to secure enteral tubes.

Question 4.7. How soon after placement of a long-term percutaneous endoscopic gastrostomy (PEG) can feedings begin?

Practice Recommendations

1. Use a PEG tube for feedings within several hours of placement. Current literature supports ≤4 hours in adults and children.
2. Educate providers on the appropriate timing of use of the PEG tube postprocedure.
3. Review procedural documentation for time of PEG insertion.

Rationale

Traditionally, tube feedings have been delayed after percutaneous placement of gastrostomy tubes to the next day and up to 24 hours after the procedure. No consensus exists regarding feeding initiation after placement. In 2011, a national survey

of practicing gastroenterologists found variation in the timing of feeding.[82] The response rate for the questionnaire was 28% (n = 1474), and 41% of the respondents were aware of the current literature on post-PEG feeding times. Those aware of the current literature were more likely to initiate early feeding. Eight percent of the respondents initiated feedings in general ward patients within the first 3 hours, and 32.5% initiated feedings 4–6 hours post-PEG in the same patient population.[82] Bechtold and colleagues[83] pooled the results of 6 randomized controlled trials that compared early (range, 1–4 hours) vs delayed feeding after PEG placement and found no statistically significant differences in complications or death in the first 72 hours after PEG placement.

A meta-analysis of 5 randomized controlled trials compared early feeding after PEG placement (≤3 hours) with delayed or next-day feeding and found no significant differences in complications, deaths in the first 72 hours, or number of significant gastric residual volumes at day 1.[84] A retrospective study examined the safety and outcomes of early feedings (≤4 hours) during a 5-year period at a tertiary care center where the majority of PEG procedures were performed on inpatients by gastroenterologists.[85] The mean time of feeding was 3.2 hours for the early group (≤4 hours) vs the delayed (>4 hours) feedings for either overall mortality within 30 days or overall complications such as wound infection, melena, vomiting, leakage, stomatitis, and aspiration pneumonia.[85] Kim and associates[86] evaluated the feasibility and safety of implementation of an early tube use protocol compared with the institution's policy on 4-hour post-PEG tube placement checks. The early tube use protocol involves immediate tube assessment by the gastroenterology fellow after return of the patient's preprocedure level of consciousness (within 1 hour of procedure completion). This study showed that an immediate-use protocol with a prompt assessment following recovery from sedation seems safe and effective. The difference in the rates of complication between the 4-hour placement group and the immediate-use group was not significant.[86]

In pediatric patients, the earliest reported time of feeding initiation after PEG tube placement had been 6 hours. Corkins et al[87] randomly assigned pediatric patients to use a PEG tube for feedings at 3 hours and 6 hours after placement. The researchers documented the change in abdominal girth from before the initial feeding to 1 hour after, any vomiting, and the gastric residual volume before the next feeding. The initial feeding was limited to Pedialyte (Abbott Nutrition, Columbus, OH) at a volume of 60 mL bolus feeding. The authors concluded that feedings after PEG tube placement can be started as soon as 3 hours with no increase in complications.[87] A recent prospective randomized controlled study compared early (4th hour) and late (12th hour) feeding after a PEG procedure in 69 children.[88] This study showed that initiation of feedings at the 4th hour was safe and well tolerated by patients and shortened the duration of the hospital stay.[88] In a retrospective chart review of 70 pediatric patients, the early initiation of feedings (6 hours post-PEG) also

led to a shortened length of hospital stay with no increase in adverse events or reported pain.[89]

Question 4.8. How often should you replace long-term EADs?

Practice Recommendations

1. Develop institutional protocols for replacing percutaneous EADs that reflect manufacturers' guidelines:
   a. Routine removal and replacement of a well-maintained percutaneous EAD may not be necessary.
   b. Replace per manufacturer guidelines.
2. Consider tube replacement sooner than indicated in manufacturer guidelines if any of the following are identified:
   a. Deterioration and dysfunction of the EAD
   b. A ruptured internal balloon
   c. Stomal tract disruption
   d. Peristomal infection that persists despite appropriate antimicrobial treatment
   e. Skin excoriation
   f. Nonhealing ulcer formation that will not heal despite good wound care technique
   g. Colocutaneous fistula or gastrocolic fistulas
3. Replace the percutaneous tube only after the stoma tract has fully matured (30–90 days from initial insertion) or per institutional protocols.
4. Consider routine replacement of the percutaneous tube after the stoma tract has matured (>30 days from initial insertion) or per institutional protocols.

Rationale

Eventually, tubes will require replacement. The most common indications for replacement include tube deterioration over time, inadvertent removal, device-related complications (leaking, unrestorable tube patency), fistula disruption, peristomal infection, skin excoriation, ulcer formation, colocutaneous or gastrocolic fistulas, or the device is being changed to a low-profile gastrostomy tube.[8,90,91]

In patients with a PEG tube, most major complications have been reported to occur within the first few days of initial tube placement when the tube tract is not yet mature. The tract begins to mature approximately 7–10 days after PEG placement, and it takes a few weeks for fusion to take place between the stomach and peritoneum. In malnourished or immunocompromised patients, this process can take longer.[84] Patients who are discharged home with a newly inserted PEG tube must be closely monitored to prevent inadvertent dislodgement. If the gastrostomy tube dislodges in the first 7–10 days after insertion, the inserting provider needs to be contacted as soon as

possible for further intervention. A dislodged PEG tube can become a medical emergency, as stomach contents are likely to leak into the peritoneum. The tube should not be reinserted blindly at this stage because it may be repositioned into the peritoneum. Possible approaches to management include immediate reinsertion under radiographic or endoscopic guidance, laparotomy, or conservative management (cessation of oral intake, nasogastric suction, and antibiotics) followed by reinsertion in 7–10 days.[21,80] If displacement occurs after the tract is mature (>30 days), prompt replacement with a percutaneously balloon gastrostomy tube is recommended.[92]

DiBaise and associates[93] evaluated the rate of tract disruption in adults requiring long-term EN and found that tract disruption occurs infrequently during replacement of gastrostomy tubes. Tract disruption seems to be an issue primarily during the initial tube exchange using a skin-level device. The minimum duration to wait before there is sufficient tract maturity to allow for safe gastrostomy replacement remains unknown, and the authors recommend waiting at least 2 or 3 months for safe tube replacement.[86]

Most gastrostomy tubes with internal bolsters (ie, PEG tubes) use soft, deformable internal bolsters, allowing transcutaneous replacement to be performed without endoscopy. A credentialled provider can remove the device from the skin by traction. In this procedure, the bolster is extended linearly so that it passes through the gastrocutaneous stomal tract. A new percutaneous EAD is then inserted through the gastrocutaneous stoma. The new EAD may be either a balloon gastrostomy tube that is followed by balloon inflation or a nonballoon bolster that is stretched taut by using an obturator and then released. With optimal care, most bolster-type gastrostomy tubes may remain in place for up to 1–2 years.[8] Manufacturers often do not recommend such a long duration because internal bolsters can wear off and potentially obstruct the GI tract. In accordance with the manufacturers' recommendations, some institutions routinely replace EADs at 6-month intervals, before the deformability of the bolster decreases.[87] Preventive maintenance of balloon gastrostomy tubes, which includes elective change at a fixed time interval (such as every 3–6 months), is the standard of practice in some facilities because of the potential for balloon failure.[8]

Topics for Future Research

- Comparison of nonradiographic methods of confirming tube position to abdominal x-ray
- Communication about EN during the transition of care and confirmation of EAD placement and EN orders after transition of care
- Obstacles and/or barriers in standardizing post-PEG feeding practices
- Optimal timing for initiation of feeding for other types of percutaneous gastrostomy tubes (eg, balloon G-tubes, gastrojejunostomy tubes, and jejunostomy tubes)

- The frequency of malposition and peritonitis after PEG and balloon gastrostomy tube replacement
- The optimal protocol for PEG and balloon tube replacement

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Section 5. Procure, Select/Prepare, Label, and Dispense EN

Background

With a wide variety of available EN products on the market, each organization makes clinical and fiscal decisions to establish an EN formulary. Each EN product, including human breast milk (HBM), procured and stocked within a facility, needs to be uniquely recognized by clinicians involved in EN therapy. Selection errors can occur when products have similar names or product labels. Whether dispensed from a central location or stocked on a patient care unit, EN products must be labeled to identify the intended patient, date of feeding, and duration of feeding. Some patients receive EN products that require preparation from powdered form, which increases the complexity and safety risk of EN use.

> Question 5.1. How is a clinically appropriate and cost-effective formulary developed, and which experts should be involved in its development?
>
> Question 5.2. How are EN product shortages and substitutions managed?

Practice Recommendations

1. Establish a formulary of available EN formulas specific to the needs of the institution's patient population.
   a. Base the size of the enteral formulary on the specific needs of the facility, but limit the size to avoid product duplication, decrease inventory management, and lower costs.
   b. Prioritize formulas that meet the estimated nutrient needs of patients rather than the patient's diagnosis. Use evidence-based research to evaluate the inclusion of specialty formulas on the formulary.

c. Consider whether competitive bidding, group purchasing organizations, or the selection of all products from the same manufacturer can be cost-effective. If the facility participates in a corporate buying group, optimize the contractual agreement to allow for the purchase of a formula outside of the formulary if it better meets patients' nutrition needs.

2. Develop a multidisciplinary formulary selection committee of clinicians and administrators, including dietitians, nurses, pharmacists, and physicians.

3. Generate a substitution list for each EN formula during the development or restructuring of the EN formulary, which can be implemented in the case of product shortages.

4. Allow enough flexibility in the EN process to respond to manufacturer revisions to their product lines, as well as product shortages or outages.

Rationale

Over 200 different commercially prepared EN formulas are available for neonatal, pediatric, and adult use. Beyond standard formulas, a myriad of specialty formulas are marketed for specific disorders and disease states. As it is not practical or cost-effective to provide all available formulas, healthcare facilities create enteral formularies to control inventory and cost. In one study published in 1989, more than 75% of the hospitals had developed EN formularies. The documented reasons were cost containment, decreased product duplication, staff education, and inventory management.[1] Another method to control costs is participation in a group purchasing organization. Group purchasing may allow healthcare facilities to control costs while providing the best patient care. Typically, an established commitment level is set for institutional compliance and results in benefits for the purchase of products and services at lower costs.[2,3] Organizations can request a clause in the contract to allow for the purchase of a noncompeting product without penalty if it better meets the patients' needs.

The multidisciplinary formulary selection committee will represent the perspectives of dietitians, nurses, pharmacists, physicians, and administrators. The committee evaluates the institution's patient population and its specific nutrition needs to identify the enteral formula categories needed.[4] When available formulas in each category are evaluated, formulas that will meet the estimated nutrition needs of the patient are usually preferred to those tailored to specific diagnoses.[5] Evidence-based research can inform the selection of products and is especially helpful when considering specialty and disease-specific formulas.[6] Specialty formulas are considerably more expensive than standard formulas, and research to support the increased cost may be lacking. Evidence-based guidelines from the American Society for Parenteral and Enteral

Nutrition and the Evidence Analysis Library from the Academy of Nutrition and Dietetics can be utilized to identify indications and appropriate use for disease-specific formulas.

Although shortages of enteral formulas have not been as common as recent PN shortages, certain EN formulas may sometimes be unavailable due to demand, manufacturing issues, or disaster. By identifying which products have similar nutrient profiles and indications, the formulary selection committee can develop a substitutions list to systematically identify appropriate alternative formulas to use if a shortage occurs. This can then be implemented and communicated in a timely manner when needed. The substitutions list can also be used to select products for patients whose home formula is not available on the institution's current formulary.

Question 5.3. How should human breast milk (HBM) be managed as an enteral formula?

Practice Recommendations

1. Use HBM for infant feeding whenever possible and when there are no medical contraindications.

2. If maternal human milk is not available, use pasteurized donor human milk for premature infants.

3. Donor milk should come from an accredited (Human Milk Banking Association of North America [HMBANA]) milk bank or commercial company that uses HMBANA or more stringent guidelines. Do not purchase HBM from individuals or through the Internet.

4. Develop at the healthcare organizational level policies for the collection, receiving, storage, labeling, and feeding of HBM. Storage recommendations are described in Table 2.

5. The recommended length of time that milk can be frozen at −20°C (−4°F) should be shortened to 3 months.

6. HBM should not be preheated for feeding to a temperature greater than 40°C (104°F).

7. Use fortified HBM for premature infants.

8. Use sterile products to fortify HBM, whenever possible.

9. Fortify HBM in a milk lab under sterile conditions. The optimal timing between human milk fortification and feeding is not known.

10. Educate all mothers expressing HBM regarding lactation science, as well as human milk collection and storage, including cleaning of the breast pump.

Rationale

Human milk is the feeding of choice for infants.[7] Use of HBM offers many benefits to mothers and infants, including premature infants.[8,9] However, the nutrient profile of unfortified HBM is not adequate to support the growth of premature infants; therefore, HBM for premature infants must be fortified.[8–11]

Table 2. Recommendations for Human Breast Milk Storage for Hospitalized Infants.

Storage Method and Temperature	Recommended Storage Time
Freezer (home combined with refrigerator)	3 months; new evidence would suggest shortening this time
Freezer (–20°C, –4°F)	6–12 months; new evidence would suggest reducing this to 3 months
Freezer (–70°C, –94°F)	>12 months
Refrigerator (4°C, 40°F), fresh milk	New evidence would suggest lengthening this from 48 to 72 hours unit dosed, single entry 96 hours
Refrigerator (4°C, 40°F), thawed milk	24 hours
Refrigerator (4°C, 40°F), fortified milk	24 hours
Refrigerator (4°C, 40°F), thawed pasteurized donor milk	48 hours
Cooler with ice packs (15°C, 59°F) fresh milk	24 hours
Room temperature (25°C, 77°F)	<4 hours

Adapted with permission from Lessen R, Sapsford A. Expressed human milk. In: Robbins ST, Meyers R. *Infant Feedings: Guidelines for Preparation of Human Milk and Formula in Health Care Facilities*. Chicago, IL: American Dietetic Association; 2011:47.

Guidelines for use of HBM from mothers who abuse drugs. The Academy of Breastfeeding Medicine and the American Academy of Pediatrics have guidelines regarding the use of HBM from mothers who admit to abusing drugs.[12] Milk from adequately nourished mothers who are HIV negative, who have had consistent prenatal care, and who are participating in a treatment program can be used.[12]

Use of donor human milk. If maternal HBM is unavailable, the use of donor HBM is recommended for premature infants by the American Academy of Pediatrics and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition.[7,13] Because the protein content of donor HBM depends on the stage of lactation, various fortification strategies may be needed to ensure the protein content of all donor HBM is sufficient.[14,15] Organizations can acquire donor milk from an accredited Human Milk Banking Association of North America (HMBANA) human milk bank or a commercial company that uses similar stringent donor selection and HBM preparation guidelines. Buying HBM from the Internet is not safe.[16] The U.S. Food and Drug Administration recommends against feeding infants HBM acquired directly from individuals or through the Internet.[17]

Fortification of human milk. Powdered products can never be completely sterile. Therefore, it is recommended that liquid sterile products be used to fortify HBM whenever possible.[15] It is best to fortify HBM away from the bedside, in a sterile milk lab. The optimal time between HBM fortification and feeding is not known. It is suggested that this time be as short as feasible to limit the breakdown of nutrients in HBM. Articles using prior renditions of the current human milk fortifiers reported an increase in osmolarity over time.[18,19]

Human milk storage and handling. The Academy of Nutrition and Dietetics published recommendations for HBM storage for hospitalized infants in 2011.[20] More recent literature raises concerns about long-term freezing of unpasteurized HBM at –20°C (–4°F).[21] The dornic activity is a measure of the acidity of HBM and is used as an indirect method of assessing milk quality and bacterial contamination.[21] Lipoprotein lipase maintains its activity at this temperature, and this activity increases when HBM is frozen for more than 3 months, which is thought to result in a breakdown of triglycerides to free fatty acids that could damage the intestinal epithelial cells.[22]

Slutzah and colleagues[23] have recommended that fresh HBM can be refrigerated for up to 96 hours; however, their study was not conducted in a real-time environment with multiple entries of HBM into the same bottle. According to the Academy of Nutrition and Dietetics recommendations, refrigeration for 96 hours is acceptable with unit-dosed, single-entry access.[20] In a unit with multiple entries, it seems reasonable to be more conservative about refrigeration storage times, limiting refrigerated storage to 72 hours.

In 2015, Bransburg-Zachary and colleagues[24] raised concern about the heating of HBM for infant feeding. HMBANA advocates for the warming of human milk for premature infants to body temperature.[25] Term infants may have milk directly from the refrigerator or at room or body temperature.[25] At temperatures greater than 40°C (104°F), the nutritional and immunological properties of HBM begin to deteriorate. The amount of time that HBM is kept warm is also important; at 38°C (100.4°F), lipolysis is rapid with a 440% increase in free fatty acids in an hour.[26]

Published reports of infants becoming ill as a result of HBM contamination are few; however, contamination can be a problem. HBM expressed using breast pumps has a higher rate of contamination than HBM expressed by manual expression.[27] Educational intervention may decrease the prevalence of contamination.

Question 5.4. What are the best ways to determine clinical advantages/disadvantages of the closed EN system?

Practice Recommendations

1. Select an open or closed system for EN delivery based on the following factors of each system and the needs of the institution:
   a. Cost: The use of a closed system can potentially save money because it requires fewer nursing resources and lowers the risk of infections due to bacterial contamination.
   b. Safety: If an open system is used, facilities must be willing and able to implement protocols and diligently monitor compliance with all EN product handling and administration procedures, including hand hygiene, proper handling of enteral feedings and sets, and hang-time limits.

Rationale

Over the years, many healthcare institutions have transitioned from open enteral systems (in tetra-packs, bottles, or cans) to closed enteral systems (in bags or rigid containers) in efforts to reduce infection from contaminated enteral formulas and to reduce nursing time. Commercially available liquid EN products are sterilized before distribution but can become contaminated when used at the facility. Contamination of enteral formulas can cause abdominal distension,[28] diarrhea,[29–31] and bacteremia following administration.[32] Several studies have shown that the risk of contamination is greater with open systems because these systems increase physical handling of EN.[33–37] Closed systems can decrease manipulation and human contact with enteral formulas and feeding administration sets, which in turn reduces the risk of contamination.[38–43] However, some studies have shown that open systems can be safely used when staff practice good hygiene and comply with proper handling procedures.[44–46] Multiple studies have demonstrated that using a closed system reduces nursing time.[46–48]

Closed systems can be costly because of formula packaging and waste from unused formula (closed system products come in 1000-mL or 1500-mL containers, whereas open-system products come in 237-mL or 250-mL containers). Closed containers have an increased hang time of up to 48 hours (compared to 4–8 hours with open systems); however, most closed containers are discarded after 24 hours due to current manufacturer recommendations to change enteral feeding sets every 24 hours and to spike each closed container only once.[49] Nevertheless, studies have found that using closed systems with increased hang times reduces waste and costs.[49,50] A 2013 cost-analysis study showed that a closed system was more expensive than an open system when accounting for waste ($4.80 per patient day compared to $4.21 per patient day).[49] However, when nursing time was factored into the costs, the expense of the open system increased to $9.83 per patient day.

Pediatric Open Systems

Open systems will likely need to continue to be utilized in the pediatric population because many products are only available in powdered form. Powdered infant formulas are not sterile upon manufacture. In 2004, an infant died as a result of a *Cronobacter*, formerly called *Enterobacter sakazakii*, infection that was found in the infant's reconstituted powdered infant formula.[51] The organism was also found in unopened cans of the formula. Ready-to-feed and concentrated liquids are sterile products, but not all formulas come in this form as noted above. Therefore, it is recommended that powdered formula not be used for immune-compromised infants, if other options are available.

Over time, infant formula manufacturers have converted many products, such as human milk fortifiers, from powder to liquid forms. However, certain products are only available in powder, such as products for infants with inborn errors of metabolism, infant and pediatric elemental formulas, and a specialty infant renal formula. Some formulas only come as ready-to-feed or powder products and are not supplied in concentrated liquid form. If the clinician wants to use these formulas at a higher calorie density, nonsterile powder is commonly added to ready-to-feed formula, which increases the risk of contamination.

HBM is the preferred nutrition for infants. If mother's own milk is not available, donor human milk may be used. Donor milk is pasteurized, which diminishes the immunoprotective nutrients. Compared to fresh or frozen HBM, proliferation of bacterial pathogens in pasteurized HBM was 1.8–4.6 times.[52]

In 2011, the Academy of Nutrition and Dietetics issued guidelines for hang times for infant feedings,[53] and these stringent guidelines are recommended for neonates and immuno-compromised infants until there is sufficient further evidence. In a prospective, descriptive study of 30 pediatric patients, Lyman et al[44] found that "decanted enteral formula administered continuously over 12 hours in a pediatric hospital setting has a lower than expected rate of bacterial growth when recommended handling practices are followed." This evidence might influence the Academy of Nutrition and Dietetics to revise the hang-time guidelines to 12 hours for pediatrics; however, there is no evidence at this time that guidelines for immunocompromised or neonatal patients should be altered.[44]

Question 5.5. What are the critical elements of the EN order that need to be transmitted to ensure safe product preparation?

Practice Recommendations

1. Develop and design standardized EN orders (CPOE or editable electronic templates, or paper as a last resort) for adult and pediatric EN regimens to aid prescribers in meeting each patient's nutrition needs and to improve order clarity.

2. Include all critical elements in the EN orders: (1) patient identifiers, (2) the formula name, (3) the EAD site/device, (4) the administration method and rate, plus (5) water flush type, volume, and frequency. Incorporate the feeding advancement order, transitional orders, and implementation of complementary orders into protocols. All elements of the EN order must be completed when EN is modified or reordered.

3. Avoid the use of unapproved abbreviations or inappropriate numerical expressions.

4. Encourage the use of generic terms to describe EN formulas. All elements of the EN order must be completed when EN is modified or reordered.

5. Provide clear instructions related to modular products, including product dose, administration method, rate, and frequency.

6. Establish and enforce policies and procedures that clearly describe the preparation of powdered EN products, including who will evaluate compatibility, measure the dose, reconstitute the product, what diluent and source will be used, the location of preparation, labeling including beyond use date and time, and storage.

Rationale

Many problems associated with EN orders often result in inadequate delivery of formula to patients in critical care settings. These problems are attributed to underordering, frequent cessation of the enteral infusion, and slow advancement of the EN to goal rate.[54,55] EN protocols,[54,56–58] algorithms,[59] and clinical practice guidelines[60] have been developed to standardize enteral feeding practice, and many have resulted in an improvement in the delivery of enteral feedings to patients. One group developed a protocol that standardized ordering, nursing procedures, and rate advancement and also limited interruptions to EN administration. Use of the protocol improved delivery of goal volumes, although there was physician resistance to using a standard order.[55] A Canadian group improved delivery of the required formula volume using a protocol.[56] Woien and Bjork[59] reported on a feeding algorithm that was developed to increase the likelihood of meeting nutrition requirements in intensive care. The algorithm also resulted in an increased utilization of EN (rather than PN) and in the number of patients who met EN administration goals. Another study described a stepwise process to develop and implement a tailored action plan that could be adopted in ICUs with differing characteristic and used to help identify barriers to adequate provision of EN in critically ill patients (eg, EN formula and feeding pump availability on units, use of a protocol to reduce interruptions, an algorithm for managing diarrhea) and help those facilities tailor interventions to improve nutrition practice.[61]

Patient-specific EN orders should include all critical elements: (1) patient demographics, (2) the formula name, (3)

delivery site and access device, and (4) administration method and rate, plus water flush type, volume, and frequency. Orders can be provided as a single order representing a specific prescription, or they can be part of a larger protocol that directs advancement of EN from initiation to a goal rate or volume that represents a nutritionally adequate end point. Specific preparation or administration instructions can also be included in these protocols. Such instructions are especially important for safe use of modular products or reconstituted powdered products to meet patient requirements. The inclusion of transitional orders will direct weaning from EN, and ancillary orders may address various patient care issues. Orders may be communicated through a CPOE system or via editable templates in electronic format, with paper forms clearly being a last resort or for when electronic systems are down.

Patient identifiers: The order should clearly state the patient's name, date of birth, location, and medical record number (MRN).

Formula: The formula should be clearly identified in the order by a generic name as well as by the specific product brand depending on institutional policy. For example: A formula that contains 1 calorie per mL can be generically identified as "isotonic" or "standard"; formula that contains 2 calories per mL can be generically identified as "calorie dense"; a partially hydrolyzed formula can be generically identified as "semi-elemental" or "peptide based." Formula orders may also include the administration of modular products used to enhance the protein, carbohydrate, fat, or fiber content of the enteral regimen. In the adult population, these products are usually administered directly to the patient via the EAD in prescribed amounts and frequency with specific administration guidelines but are most often not added to the enteral formula. In the neonatal and pediatric population, fluid tolerance limits are a greater concern; therefore, the base formula is often augmented with a modular macronutrient as compatibility allows. When this type of manipulation to infant formula is prescribed, the base formula, the modular product, and the base and final concentration of formula per 100 calories are all considered.[62,63] If this is done in the home, it is important to teach the parents or caregivers the proper method to prepare a formula with additives.

Delivery site/device: The route of delivery as well as the access device for EN formula administration should be clearly identified in the order to prevent wrong-site administration. Enteral misconnections have been reported in the literature.[64] Identification of the infusion site (eg, jejunal port of gastrojejunostomy tube) also decreases the chance of inadvertent use of the wrong feeding port for enteral infusion.

Administration method and rate: Bolus, gravity, or continuous method (rate based or volume based): volume or rate of administration and timing of formula delivery within a specified period of time (24 hours or cyclic) should be clearly set forth in an EN order.

Supplementary orders: Orders that differ from the standard formula rate, route, and volume prescriptions. These can include:

Advancement orders: These orders direct the progression of an EN regimen from initiation through to an end point or goal formula volume infused over a specified time period. Increases in formula volume or rate of administration to achieve a goal should be clearly written. Protocols should visibly illustrate feeding adjustments when volume based feeds are utilized. Advancement orders also need to be coordinated with decreases in PN.[65]

Transitional orders: The incremental decreases in formula volume over a period of time to accommodate for an increase in oral intake.

Ancillary orders: Routine or ancillary orders will depend on both the population and setting. These orders are based on institutional policies for care of the enterally fed patient, such as orders for HOB elevation, tube occlusion treatment, bowel management,[66] and monitoring laboratory parameters.

EN orders contain all the elements that should be part of an EN order plus suggestions for ancillary and transitional orders. Many institutional settings already utilize CPOE systems, and these systems should be designed with detailed order sets that promote safety by using EHR drop-down menus within each element of an EN order, including required fields. Such menus may facilitate standardized advancement of initial administrations to goal volumes, uniform enteral access device flushing volumes and methods, and population-specific ancillary orders. Orders for monitoring, flushing, and transitioning from tube feeding can also be included.

Question 5.6. What are the minimum requirements for the safe preparation of EN formulas that need to be decanted from small commercial containers or reconstituted from dry powder?

Practice Recommendations

1. Use competent personnel trained to follow strict aseptic technique for formula preparation.
2. Immediately refrigerate formulas reconstituted in advance. Discard unused reconstituted and refrigerated formulas within 24 hours of preparation.
3. Expose reconstituted formulas to room temperature for no longer than 4 hours. Discard unused formula after this time.
4. Use a sterile water source for formula reconstitution.
5. Use formula decanted from a screw cap instead of a flip top.

Rationale

Between 0% and 57% of enteral formulas prepared in the hospital and over 80% of those prepared in the home have been found to be contaminated with bacteria.[39,67–69] EN preparation may include the mixing, reconstitution, or dilution of modular products and formula with sterile water, and/or pouring the formula into an administration container. The sterility of the commercially available liquid EN products, as well as that of the sterile bags and administration sets, is disrupted by any manipulation, which increases the risk for contamination. Commercially available EN products manufactured in dry powder form are not required to be sterile and may be contaminated by the end of the production process prior to reaching the market. A study of powdered infant formulas across several European countries revealed *Enterobacter* species contamination in 53% of 141 samples.[70] Although these bacteria were found in amounts within the accepted maximal limits, the organism would be expected to multiply rapidly once these products are reconstituted with water, especially if at room temperature.[71] A more recent study of EN powder formulas in the care of adults identified considerable contamination. Out of 28 samples of reconstituted powdered formulas, 27 (96%) had total viable bacterial counts greater than 10^3 colony-forming units (CFU)/g.[71] The CDC recommends that if a powder EN product is selected to meet a patient's needs, trained personnel should prepare it following strict aseptic technique.[72] Reconstituted formula exposed to room temperature for more than 4 hours should be discarded. In addition, the reconstituted formula that is not immediately used must be promptly refrigerated, and any formula that remains 24 hours after preparation must be discarded. In the absence of a formula preparation room, the pharmacy can support reconstitution of powdered formula in a laminar airflow environment.

The water supply may be a source of potential contamination if purified water is not used. All water supplied for feeding preparation must at least meet federal standards for drinking water and not contain contaminants. For reconstitution of pediatric and neonatal formulas, the water needs to be sterile.[53,72] This should also be considered for reconstituting formulas intended for adults. Weenk et al[35] compared various feeding systems and found a sterile glass bottle containing enteral formula to be associated with the lowest level of microbial growth from touch contamination. They also found that decanted formula poured from a container with a screw cap into a feeding bag was associated with lower levels of microbial growth than formula poured from a container with a flip top (similar to the type of top found on a soda can).[35]

Question 5.7. What are the safety issues when using blenderized tube feedings and how can the risk of complications be reduced?

Practice Recommendations

1. Prepare blenderized tube feedings (BTF) using safe food-handling techniques, and store it at refrigerator temperature immediately after preparation. Discard any unused portion after 24 hours.

2. Limit the hang time of blenderized tube feedings (BTF) to 2 hours or less.
3. Give BTF only via a gastrostomy tube that is 14 Fr in size or greater.
4. Do not use BTF in patients who do not have a proven tolerance to bolus feeds, those who are medically unstable, or those who lack a mature gastrostomy site that is free of infection.
5. Involve a registered dietitian or nutrition support clinician in the development of the BTF formula to ensure adequate nutrient delivery.
6. Sanitize mechanical devices (eg, blenders) used to prepare BTF after each use with an established protocol.

Rationale

An alternative to commercial enteral formulas, BTFs use foods that are blended to a consistency that allows for ease of use with a feeding tube.[73] BTFs can be provided exclusively or in conjunction with a commercial formula. In addition, commercially prepared, ready-to-use, real-food blenderized formulas are available for those patients who do not want to make their own homemade formulas.

There is limited research on the safety and efficacy of BTF in home-fed patients. Several studies demonstrate some benefit with this technique in, for example, postfundoplication patients. However, more research is needed to demonstrate the benefit in additional patient populations generally maintained on partial or complete home nutrition support.[74,75]

Home-prepared BTFs have a higher risk of cross-contamination and potential for foodborne illness than commercial EN products.[76–78] High risk of contamination was a major reason why institutions moved away from using BTF in the hospital setting when commercial enteral formulas became available. In the home environment, care should be taken to prepare BTFs using safe food-handling techniques to prevent cross-contamination. Once prepared, the BTF should be immediately used or immediately refrigerated at appropriate temperatures.[73,79] Access to adequate refrigeration, clean water, and electricity is imperative before considering a change to BTF.[80] Given the potential for infection associated with foodborne illness, use of BTF may not be appropriate among medically unstable patients, immunocompromised patients, or those without a mature feeding tube site.[73,81] BTF should not be held at room temperature for more than 2 hours due to concerns about food safety and bacterial contamination; therefore, a bolus regimen instead of a continuous infusion is recommended.[73,76] Patients with volume limitations or known intolerance to bolus feeds are not good candidates for BTFs. Refrigerated BTF formula that is not used within 24 hours of formulation should be discarded.

There may be an increased risk of tube occlusion with BTFs given their high viscosity. Therefore, BTFs are not recommended for patients with a feeding tube smaller than 14 French as smaller tubes are more likely to occlude.[75] A recent study was conducted to determine the flow rate of BTFs through the new enteral (ENFit) connector system compared to various other available feeding tube components. In this study, ENFit and Cath-tip syringes flow and pressure requirements were essentially equivalent. If BTFs can go through the Cath-tip syringe, they should also be able to go through the ENFit connector.[82] Another study by Mundi et al[83] observed a need for increased force with the ENFit connector to administer blenderized formulas compared to traditional connectors, but this study was conducted with device prototypes and not with FDA-approved products. Currently, the FDA and other independent labs are conducting flow and pressure studies with a variety of tubes and a variety of formulas, including blenderized diets.

Several studies have demonstrated that the macronutrient and micronutrient content of BTFs is highly variable and the energy content is often overestimated.[76,78,83–85] Registered dietitians should be involved in development of the BTF composition to ensure adequate nutrient delivery in the home environment and help maintain consistency of the regimen to prevent underfeeding.[74,76,86]

Questions 5.8–5.10. Does a standardized approach to labeling EN reduce errors and what are the critical elements of the EN order that need to appear on the patient-specific label? What elements on a commercial container must be present to meet the critical elements of the EN order/patient identification? How does one best avoid errors associated with sound-alike, look-alike product names and labels?

Practice Recommendations

1. Include all the critical elements of the EN order on the EN label: patient identifiers, formula type, enteral delivery site (route and access), administration method and type, and volume and frequency of water flushes.
2. Standardize the labels for all EN formula containers, bags, or syringes to include who prepared the formula, date/time it was prepared, and date and time it was started.
3. Express clearly and accurately on all EN labels in any healthcare environment what the patient was ordered. Given changes to administration rates/volumes, consider patient-specific labels that state:
   a. "Rate not to exceed _____"
   b. "Volume not to exceed _____"
4. Include on the label of HBM stored in the hospital: contents in container, infant's name, infant's medical record number, date and time of milk expressed, maternal medications, fortifiers added, and energy density.
5. State on the HBM label whether the milk is fresh or frozen, date and time the milk was thawed, and the appropriate expiration date. Bar codes, special colors, or symbols may be used to further identify the HBM.

Table 3. Components of the Formula Label.

Labeling of Enteral Formula	Labeling of Incoming Human Breast Milk

• Patient's name
• Medical record ID number
• Formula name and strength of formula, if diluted
• Date and time formula prepared[a]
• Date and time formula hung[a]
• Administration route
• Rate of administration expressed as mL/h over 24 hours if continuous administration or "Rate not to exceed _____" or "Volume not to exceed _____"
• Administration duration and rates are to be expressed on the label if the EN is cycled or intermittent
• Initials of who prepared, hung, and checked the EN against the order.
• Appropriate hang time (expiration date and time)
• Dosing weight if appropriate
• "Not for IV Use"
	• Infant's name
	• Medical record ID number
	• Dosing weight
	• Date and time that milk expressed
	• Medication or supplements being taken by the mother
	• Specify whether milk is fresh or frozen
	• Contents in syringe/container (expressed breast milk)
	• If frozen, date and time milk thawed
	• Expiration date (based on whether the milk was fresh or frozen)
	• "Not for IV Use"
	• Fortified human breast milk also includes:
	  ○ Name of fortifier
	  ○ Final concentration
	  ○ Date and time formula prepared
	  ○ Initials of who prepared, hung, and checked the EN against the order

EN, enteral nutrition; ID, identification; IV intravenous.
[a]Date-time formula prepared and date-time formula hung may be different, so note both.

6. Label commercial enteral containers "Not for IV Use" to help decrease the risk for an enteral misconnection.
7. Carefully check commercial enteral container labeling against the prescriber's order. Be aware of sound-alike or look-alike product names that may be mixed up on the order or during selection of the product.

Rationale

In any healthcare environment, patient-specific, standardized labels for EN express clearly and accurately what the patient is receiving at any time. Having standardized components on a label decreases potential confusion when a patient is transferred to a different unit within a facility or when a new staff member takes over a patient's care.[87] Clear labeling that the container is "Not for IV Use" helps decrease the risk for an enteral misconnection. Proper labeling also allows for a final check of that enteral formula against the prescriber's order.[88]

Standardized labels can be affixed to all EN formula administration containers (bags, bottles, syringes used in syringe pump). Each label lists the 4 critical elements of the EN order: patient identifiers, formula type, enteral delivery site (route and access), and administration method (see Table 3). It also identifies the individuals responsible for preparing and hanging the formula as well as the time and date the formula is prepared and hung.[88,89] See Figures 5 through 8 for examples of labels, which may also include nutrient information if the label is computer generated. Care should be taken in developing a label that is clear and concise and of a size that fits neatly on the container.

Special considerations regarding the labeling of HBM. Clear and concise labeling of HBM is essential to prevent errors in the delivery of HBM to the infant. The label of milk stored in the hospital should include the following information: contents in container (HBM), the infant's name, the infant's medical record number, the date and time when milk was expressed, maternal medications, fortifiers added to the HBM, and the energy density of the HBM.[90] Additionally, the label should state whether the milk is fresh or frozen, date and time the milk was thawed, and expiration date based on whether milk is fresh or frozen.[53] If the mother is separating fore and hind milk, this designation should appear on the label. Unique identifiers may be used to describe other factors such as colostrum, transitional, and mature milk. Bar codes, special colors, or symbols may be used to further identify the HBM. Hospitals may use computer-generated or, at last resort, handwritten labels (see Figures 7 and 8).

Topics for Future Research

• Efficacy of methods and objectives for developing EN formularies
• Best practice for formulary decision-making process
• The cost-effectiveness of including specialty formulas in formularies
• The optimal size of formularies
• The costs and benefits of participating in corporate-buying organizations
• Safe storage and hang times for all categories of human milk, including the concern for the dornic activity of unpasteurized human milk during freezing
• The optimal feeding temperature for HBM for premature infants to promote digestion without altering the beneficial properties in human milk and the length of time HBM can safely remain at this temperature
• The optimal time between preparation and feeding the infant using the newer HBM fortifiers and modular additives

ENTERAL USE ONLY

Institution and Department Name – Contact Information

Patient Name _____ Patient ID _____
Room Number _____

Generic (Brand) Formula Name

Formula: _____

_____ grams of protein / _____ kcal / container
_____ mL / container

Prepared by: _____ Date: _____ Time: _____

IV IV

Delivery Site

Route of Delivery: _____
Enteral Access Device: _____

Administration

Method of Administration: Bolus Intermittent Continuous
Rate of Administration: _____ mL/h
Formula Hung By: _____, Nurse Date: _____ Time: _____
Expiration vs Beyond Use Date: _____ Time: _____

Figure 5. Standard enteral nutrition (EN) label template (adult patient). ID, identification; IV, intravenous. Adapted from Bankhead R, Boullata J, Brantley S, et al. Enteral nutrition practice recommendations. *JPEN J Parenter Enteral Nutr*. 2009;33(2):122-167.

ENTERAL USE ONLY

Institution and Department Name – Contact Information

Patient Name _____ Patient ID _____
Room Number _____

Generic (Brand) Formula Name

Base Formula: _____ _____ kcal / 100 mL
_____ mL / container

Fortifier: _____
Final Concentration: _____ kcal/100 mL _____ mL / container

Prepared by: _____ Date: _____ Time: _____

IV IV

Delivery Site

Route of Delivery: _____
Enteral Access Device: _____

Administration

Method of Administration: Bolus Continuous
Rate of Administration: _____ mL/h
Formula Hung By: _____, Nurse Date: _____ Time: _____
Expiration Date: _____ Time: _____

Figure 6. Standard enteral nutrition label template (neonatal or pediatric patient). ID, identification; IV, intravenous. Adapted from Bankhead R, Boullata J, Brantley S, et al. Enteral nutrition practice recommendations. *JPEN J Parenter Enteral Nutr*. 2009;33(2):122-167.

Figure 7. Standard human breast milk label template (infant patient). HBM, human breast milk; ID, identification; IV, intravenous. Adapted from Bankhead R, Boullata J, Brantley S, et al. Enteral nutrition practice recommendations. *JPEN J Parenter Enteral Nutr*. 2009;33(2):122-167.

Figure 8. Human breast milk storage label. ID, identification. Reprinted from Bankhead R, Boullata J, Brantley S, et al. Enteral nutrition practice recommendations. *JPEN J Parenter Enteral Nutr*. 2009;33(2):122-167.

- Ideal fortification for mother's and donor human milk for the premature infant in and outside the hospital
- Methods to analyze and fortify human milk
- Best method of fortification for the infant who requires surgery or the infant with short bowel syndrome
- The safety and cost-effectiveness of the closed system on patient and nursing satisfaction

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Section 6. Administration: General

Background

The administration of EN therapy is a step in the process with significant potential for error. Errors can stem from incomplete evaluation of a patient's tolerance for enteral feeding that increases the risk for aspiration or GI complications. Enteral misconnections, poor positioning, pump misadventures, and contamination can all lead to less than optimal patient outcomes.

> **Question 6.1. What system-based measures can be implemented to enhance the safety of EN administration?**

Practice Recommendations

1. Develop policy and procedure documents for evidence-based practices to standardize the approach to and the administration of EN in all patient populations.

2. Maintain competency as defined within the organization to maximize safety of the patient for all caregivers involved in the administration of EN.

3. Develop and use enteral feeding and related protocols with order sets and checklists to optimize nutrition delivery and promote safe and effective practice, from patient evaluation to pump programming.

4. Initiate and update protocols periodically based on best evidence, including national guidelines and recommendations to meet the needs of the specific patient populations.

5. Monitor performance of EN delivery and related care and have in-place systems to enhance practice in terms of efficacy and safety as indicated.

6. Encourage change champions, such as nutrition support team members, to guide EN practice.

7. Include knowledgeable nurses in decision making for selection and purchase of EN administration sets, feeding pumps, and access devices.

8. Commit to adequately staffing patient care units on which many patients receive EN with nurses having documented competency in EN administration.

9. Support both the physical and cognitive efforts of nurses and other caregivers involved in maintaining safe practices around EN administration. For example:

   a. CPOE for EN orders with the full order available on the nursing medication administration record

   b. Bar coding on EN containers and patient-specific labels

   c. Prompts for documentation of essential steps in administration of EN as well as the care and monitoring related to feeding tube and EN use

10. Develop and implement interdisciplinary quality improvement programs, including systematic review and analysis of administration-related EN errors, then implement subsequent safeguards to address any identified errors in the process.

Rationale

A transparent and collaborative approach using guidelines, protocols, and standardized practice based on best evidence enhances patient care within the EN process. Guidelines are published periodically to provide recommendations for practice based on best available current evidence.[1–3] Although the practice of EN administration varies widely, protocols can standardize and guide practice toward safety. The benefit of using protocols to enhance clinical practice has been articulated.[4–8] Heyland et al[9] demonstrated that protocols can significantly improve nutrition practices. Racco[10] discussed development of a protocol to help overcome barriers to achieving goal rate and guide staff in areas such as holding feeding for gastric residual volume (GRV). Protocol order set included starting EN rate, energy, protein, and fluid goals as set by the nutrition support clinician, bowel management program, prokinetic agent use as indicated, and education of this order set. Data collection revealed that 23 protocol patients achieved goal rate in one-third the time of 13 patients who received EN in the usual manner. Patients with elevated GRV reached goal 16 hours sooner when the protocol was used, and those with elevated GRVs started on prokinetic agents after 3 elevated GRVs 75% of the time. In an evidence-based implementation project with pretest-posttest measures, Kenny and Goodman[11] showed that EN protocols in a military hospital improved practices, such as keeping the head of the bed up, medication administration, and

tube-unclogging practices, and also increased provision of family education. Institutional protocols can guide practice in areas such as tube placement verification, hang time and feeding set changes, monitoring tolerance of EN, and adequacy of EN. A nurse-driven protocol to assess stool for *Clostridium difficile* as appropriate can also be helpful. Protocols may be institution specific. It is advisable to periodically review protocols and update them as warranted by new evidence.

Order sets can guide appropriate EN product selection, initiation rate and progression to goal, delivery route, and administration method. Additionally, they can prompt safety features in EN care and monitoring. For example, routine monitoring of laboratory values could be especially helpful for those at risk for issues such as refeeding syndrome or hyperglycemia. Order sets can prompt additional fluid administration and offer guidance for staff in areas such as HOB elevation, residual volume check, and abdominal assessment. Safety practices and protocols can be embedded in the order set to populate the EHR to schedule and remind staff of necessary clinical tasks. Elements of EN ordering that should also be included in the order set include demographics such as patient identifiers, and body weight might also be included or readily accessible.[12]

Accountability is optimized when the system process identifies who is responsible for what. Organizations can standardize safety practices for EN, such as those related to decreasing risk for enteral misconnections[13]:

- Tracing tubings and lines with reconnections at handoffs

- Training nonclinical staff to ask a qualified clinician to reconnect lines instead of attempting reconnection themselves

- Discouraging the modification or adaptation of IVs or EADs even if the availability of adaptors and connectors is reduced

- Labeling of tubes and connectors

- Identification and confirmation of solutions label and labeling of bags with bold statements in terms of contents

- Identification and minimization of conditions and practices that contribute to healthcare worker fatigue and mitigate risk

- Purchasing of appropriate, safe equipment that meets standards and guidelines such as those from American National Standards Institute/Association for the Advancement of Medical Instrumentation (ANSI/AAMI)

- Careful evaluation of purchasing decisions by an interdisciplinary task force

- Following manufacturers' guidelines to promote safe connections

Assessing barriers to guideline adherence is key to effective and consistent use of guidelines and protocols. The 2013 update to

the Canadian Critical Care Nutrition Guidelines discusses key strategies to promote their previous guidelines and explores 5 thematic domains in analyzing barriers as well as offering system-level quality improvement interventions.[14] This guidelines update promotes evaluating and monitoring practice via performance improvement strategies to enhance nutrition care and improve patient outcomes. As noted earlier, Kenny and Goodman[11] have described the development and implementation of an evidence-based practice protocol for care of patients with EN tubes; after these performance improvement interventions, HOB elevation was achieved 100% of the time. Lyerla and colleagues[15] used a modified interrupted time-series design to collect data on 43 patients and 33 nurses in a 12-bed critical care unit. They found that a nursing clinical decision support system integrated into the electronic flow sheet increased adherence to guidelines. Change champions have been shown to facilitate change processes to improve care.[11,16] This is a role that can be played by appropriate staff who take an active interest in and accountability for enhancing practice.

Question 6.2. What are the essential components for EN administration to include in nursing policies, procedures, and practices?

Practice Recommendations

1. Define the quality control process for receipt, distribution, storage, preparation, handling, and administration of EN products.
2. Use sterile liquid EN formulations in preference to powdered, reconstituted, or blenderized preparations, whenever possible.
3. Administer EN by, or under the direct supervision of, competent personnel as defined by the organization. The personnel who administer EN will:
   a. Either accept the delivery of the EN container identified with the patient-specific label or select the product from the unit-based inventory and places the patient-specific label (depending on the organizational model).
   b. Visually inspect the product or preparation for damage to the container, altered formula characteristics, and expiration date limits.
   c. Confirm that the EN container with the patient-specific label reflects what has been ordered by the prescriber. Verify patient identifiers, product name, and route (and rate) of administration.
   d. Perform proper handwashing prior to entering the patient care area as well as prior to working with the feeding administration. Don clean gloves prior to working with the feeding tube and administration set.
   e. Use aseptic technique in setting up and connecting the feeding administration set and related equipment.

For example, use a small clean towel under the patient feeding tube connection to facilitate a clean area prior to working with the tube.
   f. Verify patient identifiers at the bedside matching those on the EN label, per institutional protocol, and verify appropriate patient positioning for feeding.
   g. Trace tubing from point of the enteral access device that was described in the EN order and confirm that there has been no dislocation of that device.
   h. Position the EN container appropriately for the patient and set up the administration set, priming it as indicated.
   i. Flush EAD and attach administration set using aseptic technique. The EN container and administration set make up the EN "delivery device" and are attached together until discarded.
   j. Cover the end with a clean cap for any disconnection, such as when the feeding is stopped and the distal end of the delivery device is disconnected as for nocturnal or gravity bolus feeding. If a pump is being used as for continuous feeding, program it based on the EN order.
   k. Base any change to the administration rate on documented EN orders (including prescribed rates for advancement or weaning).
   l. Do not interrupt feeding administration for routine care unless specifically ordered (as for medication administration). If the feeding must be interrupted, flush the tube to reduce the residue in the tube and decrease potential for clogging.
   m. Ensure that administration of enteral medication via the EAD is reviewed and approved with documentation as indicated by a knowledgeable pharmacist.
   n. Document EN processes in the patient's EHR, with a second entry for any independent double-check performed. This includes documentation of tolerance and administration volumes, including hourly rates as well as amount of intake, and water flushes.

Rationale

The purpose of policies and procedures is to ensure that staff follow a consistent standard of care and quality at all levels.[17] Policy statements guide practice by indicating what is to be done and by whom. They are often based on institutional protocol. Procedures describe the specific methods for following policies in practice. When staff understand the rationale for policy and procedures, they may be more likely to adhere to protocol and use critical thinking. Issues to address in policies and procedures related to EN delivery are listed in Table 4.

Table 4. Issues to Cover in Policies and Procedures for EN Delivery.

- How feeding tubes are to be inserted
- How verification of EAD placement is to occur and how EAD placement is monitored
- Care for enteral feeding tubes
- How to prevent or handle practice challenges such as tube dislodgement
- Elements necessary in a provider order for EN
- Administration of EN in terms of formula attainment and verification, labeling, administration route, and method (eg, pump use or gravity bolus feeding method)
- Rate or frequency of feedings
- Type, volume, and frequency of water flushes
- Hang times and equipment handling (eg, in terms of administration set changes)
- Medication delivery issues that involve or relate to EN or the enteral tube
- Issues related to safety in administration such as recommendations from The Joint Commission Sentinel Event Alert 53 and other safety issues such as head of bed elevation[18]
- How to optimize that the appropriate volumes of feeding product and fluid are actually delivered
- Methods to monitor for adequacy of EN as well as potential adverse effects, and identify who is responsible for overall and specific aspects of monitoring as well as patient/family education, especially when transition to the home setting when continued feeding is anticipated
- Frequency of residual assessment, what tubes are to be assessed, how assessment should be performed, and the rationale for the assessment (the rationale helps staff identify the need for abdominal and more global patient assessment as a guide for tolerance to EN instead of relying solely on gastric residual assessment)

EAD, enteral access device; EN, enteral nutrition.

Organizations can use a systematic plan to promote the periodic review of policies and procedures and the updating of policies and procedures based on relevant and current evidence as well as best practice for patients in the particular care setting or organization. By conducting quality or performance improvement, healthcare organizations can monitor practice and identify areas for improvement and then implement appropriate measures to address the findings. For example, Guenter[19] has discussed areas for potential human error related to EN and suggested the need for nursing oversight to minimize complications and enhance practice. Kenny and Goodman[11] describe the use of change champions to increase nursing knowledge of procedures and issues related to the environment of care.

Policies and procedures for the ongoing care and routine assessment of EADs can help with early identification of complications and proper interventions. Policies regarding EAD care and assessment can cover correct tube placement, mucosal and skin surfaces assessment, and infection prevention.

Question 6.3. What are the essential steps in EN administration to prevent aspiration?

Practice Recommendations

1. Maintain elevation of the HOB to at least 30° or upright in a chair, unless contraindicated, and then consider reverse Trendelenberg position.
2. Monitor the patient at least every 4 hours for appropriate positioning. In pediatrics, it is recommended that infants under 1 year of age sleep on their back and not have the head of the bed elevated.

3. Minimize the use of sedatives because airway clearance is reduced in sedated patients.
4. In patients who have difficulty clearing secretions, follow instructions from appropriate staff regarding how to clear secretions (eg, by oral suctioning), especially prior to lowering of the head of the bed and prior to extubation.
5. Understand that the method of administration (bolus, intermittent, continuous) and optimal site (gastric, small bowel) of EN feeding will depend on the patient needs, medical conditions, tolerance and goals (eg, if home use is anticipated), and resources available.
6. Monitor patient status for tolerance using measures such as assessment for abdominal distention, firmness, and large gastric residual volume (GRV), feeling of fullness, or nausea that might lead to gastric reflux.
7. Monitor patients for appropriate feeding tube placement at least every 4 hours or per institutional protocol. Monitor visible length of tubing or marking at tube exit site (naris or stoma) and investigate placement when a deviation is noted.
8. Monitor tube placement and abdominal distention, firmness for stable patients with longstanding EN therapy.
9. Place infants under 1 year of age on their back for sleep and do not have the HOB elevated.

Rationale

Aspiration may be related to oral pharyngeal secretions and/or reflux of esophageal and gastric content, including EN. Critically ill patients and patients with impaired swallowing

may have difficulty protecting their airways. Frequent, good oral care and oropharyngeal suctioning, especially prior to lowering the HOB as for positioning, can reduce adverse events related to aspiration of oropharyngeal secretions.[20,21] Metheny and colleagues[22] compared usual care with an aspiration risk reduction protocol (ARRP), which included HOB 30° or higher unless contraindicated; distal small bowel feeding tube placement, when indicated; and use of an algorithmic approach for high GRVs. With usual care, 88% of patients aspirated compared to 39% with the ARRP protocol. In the usual care group, 48% of patients developed pneumonia vs 19% in the ARRP group. The authors concluded that combining HOB at least 30° and use of small bowel feeding site can reduce aspiration and aspiration-related pneumonia dramatically in critically ill, tube-fed patients. In an earlier article (2006), Metheny[23] reported that 25 of 201 critically ill patients had malpositioned enteral feeding tubes and significantly higher risk for aspiration than those with tubes appropriately positioned. Risk for aspiration may be increased with enteral tube ports in the esophagus, especially if there are other risk factors for regurgitation. Some standard NG tubes (when used to deliver EN for short-term use) have end holes spaced 3 inches apart, and the standard tube placement measurement of nose to ear lobe to tip of xiphoid (NEX) may be suboptimal in guiding gastric tube tip placement. A nose to earlobe to mid-umbilicus (NEMU) method to estimate appropriate nasogastric tube placement has been recommended to promote placement of the tube end holes in or closer to the gastric fluid pool.[24–26] Appropriate location of the enteral tube's distal end must be ascertained prior to instillation of fluid or medication. It is recommended in infants aged 1 year or less that they sleep on their back and not have the HOB elevated. These recommendations are part of the American Academy of Pediatrics Safe Sleep Initiative, to reduce sudden infant death syndrome.[27]

It is important to obtain, ascertain, and maintain optimal enteral tube placement to help reduce potential reflux of EN. Metheny et al[28] performed a retrospective analysis of 428 critically ill, mechanically ventilated patients and found that the percentage of aspiration was 11.6% lower when feeding tubes were in the first portion of the duodenum, 13.2% lower in the second/third portion, and 18% lower in the fourth portion of the duodenum or lower ($P < .001$). In a randomized controlled trial of 33 ventilated patients randomized to gastric vs transpyloric feeding, Heyland et al[29] found that feeding beyond the pylorus was associated with significant reduction in gastroesophageal regurgitation and there was a trend toward less micro-aspiration. In critically ill patients, small bowel feeding may be associated with less pneumonia than gastric feeding, but without differences in mortality or days on a ventilator.

The American Association of Critical-Care Nurses recommend the following to reduce the risk for aspiration: maintain the HOB 30°–45° unless contraindicated; use sedatives as sparingly as possible; assess feeding tube placement at 4-hour intervals; observe for change in amount of external length of the tube; assess for gastrointestinal intolerance at 4-hour intervals; assess residual volume, patient, and abdominal status and advance the tube if indicated; avoid bolus feeding for those at high risk for aspiration; assess swallow before oral feedings are started for recently extubated patients after prolonged intubation; maintain endotracheal tube cuff pressure at an appropriate level; and ensure that secretions are cleared from above the cuff before it is deflated.[2]

Question 6.4. Can EN be administered safely in patients who require prone positioning?

Practice Recommendations

1. Assist the patient in clearing secretions as indicated and promote good oral hygiene.
2. Assess abdominal status every 4 hours and as indicated and monitor bowel status as a guide for GI motility status.
3. Consider short-term use of prokinetic agents if indicated clinically.
4. Consider transpyloric tube placement for patients who are at increased risk for aspiration or have persistently elevated GRVs.

Rationale

Evidence is limited, demonstrating the safety and tolerability of EN in the prone position, although the minimal available evidence does not suggest a substantial increase in complications compared to EN administered in a supine position. Strategies to increase enteral feeding tolerance in the supine position such as HOB elevation, small bowel feeding, and use of prokinetic agents may increase EN tolerance for patients in the prone position. When the patient's clinical situation favors positioning other than HOB elevation at 30° or greater, as in proned patients, the use of small bowel feeding and prokinetic agents with 25° HOB elevation has been shown to increase volume tolerance and progress toward feeding goals.[30]

Linn et al[30] reviewed the literature related to administration of EN in adult patients in the prone position. Only 2 of the 4 studies that they found that met their inclusion criteria were designed to compare outcomes associated with EN administered in the prone vs supine position. The conclusions of these 2 studies were that GRVs of patients in the prone position were similar to those noted in patients in the supine position; also, EN delivered to prone-positioned patients did not appear to increase risk of vomiting or pneumonia in the 2 studies where this risk was specifically explored. The limited evidence in this area is highlighted by these authors. Fineman and colleagues[31] compared 51 prone and 51 supine pediatric patients with acute

lung injury in terms of mechanical ventilation, airway management, and pain and sedation management, as well as EN. These authors determined that there was no difference in feeding complications between the supine and prone positions. They also noted that patients who were fed via the jejunal route reached feeding goal earlier than those fed via the gastric route; however, the study design monitored adverse effects as opposed to actively looking at outcomes.

Prokinetic agents (eg, erythromycin) and HOB elevation of 25° were specifically employed in prone patients who exhibited volume intolerance.[30] Delayed gastric emptying is reported in 50%–60% of critical care patients, and multiple factors, including use of vasopressors, and endogenous and exogenous catecholamines, can contribute to the delay. The efficacy of erythromycin as a prokinetic agent exceeds that of metoclopramide, although the effectiveness of erythromycin diminishes over time. Both agents may have a synergistic effect when combined. When the use of small bowel feeding tubes is feasible, it also may increase EN tolerance in prone patients.

The National Pressure Ulcer Advisory Panel (NPUAP) recommends limiting HOB elevation to 30° for an individual on bedrest, unless contraindicated by the patient's medical condition or feeding and digestive considerations. NPUAP also recommends that an individual not be positioned directly on a pressure ulcer.[32] Schallom and colleagues[33] have compared research to prevent aspiration and pressure ulcers in critically ill patients and suggest that the optimal elevation to balance the risks for both of these issues is unknown. They recommend that until more evidence is available, caregivers should make HOB elevation decisions in the context of the patient's overall condition. They recommend HOB elevation of 45° for patients receiving EN who require mechanical ventilation or are heavily sedated, but lowering the head to 30° might be done periodically for patient comfort. They also stated that for critically ill at less risk for aspiration (eg, non–mechanically ventilated patients), it is recommended to maintain HOB at 30° and take pressure-relieving measures.

Questions 6.5 and 6.6. Is elevated HOB required for patients without significant aspiration risk? Are there modes of ventilator support that can increase the risk of aspiration (eg, high-volume flows, BIPAP, APRV)?

Practice Recommendations

1. Maintain elevation of HOB at 30° or more for gastric feeding. However, pump feeding interruption for short periods of time to lower the HOB may not be necessary or recommended unless contraindicated.

2. Consider carefully the indication for EN in the patient receiving high-flow modes of ventilation, especially if that patient is concomitantly receiving any sedation.

Rationale

When evaluating the research related to EN and aspiration risk, it is important to note that much of this research has been conducted in patients with critical care status, a factor that may already increase aspiration risk. However, non–critically ill patients may also be at risk for aspiration related to EN.

Patients requiring EN may not be able to protect their airway due to difficulty swallowing or other reasons, and aspiration from oropharyngeal secretions may occur more readily in the supine position. Patients in the supine position may be at greater risk of aspiration due to gastric reflux than those whose heads are elevated either in a bed or chair, while stopping a slow-drip feeding for a brief period to reposition the patient in bed may not be necessary and may even be counterproductive. Assessment of the patient's abdominal and bowel status to check adequate gastrointestinal motility is an ongoing priority in caring for the patient receiving EN. Returning the patient's HOB quickly to at least 30° is imperative.[34]

High-flow ventilators and bag-valve-mask ventilations increase likelihood of aspiration. However, these therapies are essential in some situations because irreversible hypoxic brain injury trumps the risk of potential aspiration. High-flow volumes by noninvasive ventilation (NIV), noninvasive positive pressure ventilation (NIPPV), or other means can increase the risk of aspiration, and the risk is further increased in the sedated patient.[16] EN is not always indicated in patients on high-flow volume NIV as some patients have learned to eat with high-flow volume NIV without incidence of pneumonia, including patients with neuromuscular diseases such as amyotrophic lateral sclerosis. Guidance from a speech and language pathologist may help determine risk of aspiration, although eating may be a quality-of-life issue for the patient who exercises self-determination and elects to eat and drink while aware of the risk of aspiration.

Meeting EN volume targets for patients with gastrostomy tubes who are receiving respiratory therapies, especially with high-pressure settings, is challenging. Patients who are receiving high-pressure respiratory support via NIV may experience gastric insufflation. A patient with normal muscular function may belch (eructate) to relieve the abdominal distention and then be able to eat or take EN. However, a patient with a weak diaphragm may be unable to belch and may experience gastric bloating and fullness due to aerophagia. This phenomenon happens when pressures to support respiration and the work of breathing force air into the stomach. Early satiety and gastric bloating may cause the patient to be unable to meet EN goals due to feeling sated, sometimes despite feeling hungry. Venting the gastric tube may relieve this condition and increase feeding tolerance toward goals. Some medical centers have developed aerodigestive clinics devoted to serving this client base. When aggressive manual venting (eg, via open syringe) is not adequate, a gastric decompression valve bag may provide additional relief and allow feeding toward volume goals.[35]

Carron and colleagues[36] reviewed optimal head position and use of a nasogastric tube to ameliorate gastric distension, although this review was unrelated to EN use. They detail the sequelae whereby gastric distention compresses the lungs and decreases compliance, which in turn demands higher airway ventilation pressure. They suggest that airway pressures higher than 20–25 cm H_2O should be avoided. Moreover, considering recent evidence of the efficacy of high-pressure NIV in severe chronic hypercapnic COPD, this therapy should be carried out in an almost sitting position approximately half an hour after a meal or EN and with routine gastric decompression care.[37,38]

Question 6.7. What factors determine the best duration or rate of the feeding to improve the likelihood that the full prescribed dose is received?

Practice Recommendations

1. Minimize interruptions to EN as much as possible to help ensure optimal nutrition delivery.
2. Evaluate brief "NPO" status (eg, for procedures) for need and minimize those interruptions as much as possible. For example, the amount of time that a jejunal feeding must be stopped for a procedure may be different from the duration required for gastric feeding.
3. Accommodate interruptions to feeding delivery when they are anticipated, and plan the feeding schedule to maximize delivery of the daily feeding volume. A volume-based feeding protocol may provide the nurse with latitude in modifying EN administration to meet the patient's goal safely.
4. Consider patient condition factors and tolerance, lifestyle, goals and convenience, and placement of the distal end of the tube in formulating the feeding regimen to meet patient nutrition and fluid needs.

Rationale

Various scheduling techniques for EN may be used in clinical practice. Volume-based feeding protocols have been recommended to ensure that patients receive adequate nutrition in a given 24-hour period. In a pilot study, Heyland et al[9] demonstrated improvement in nutrition delivery using volume-based enteral feedings or the delivery of a daily feeding volume target over a 24-hour period that prompts makeup of missed feeding within set guidelines. McClave et al[39] evaluated a volume-based feeding (VBF) protocol designed to adjust for delivery interruptions in a prospective randomized controlled trial compared to rate-based feeding (RBF) in which the physician determined a constant hourly rate. On days where feeding was interrupted, VBF patients received a mean of 76.6% of goal calories vs the RBF group, which received a mean of 61% of goal calories (P = .001); furthermore, VBF was not associated with vomiting, regurgitation,

or feeding intolerance. These investigators concluded that VBF is safe and improves EN delivery compared to RBF.

In a prospective controlled trial where 164 critically ill patients were randomly assigned to intermittent feeding (one-sixth of the feeding goal was administered every 4 hours) vs continuous feeding, both groups reached the feeding goal by day 7, but the participants in the intermittently fed group reached the goal faster and had a higher probability of being at goal than those fed continuously.[40] Lichtenberg et al[41] found that 158 patients scheduled for a 20-hour rate to compensate for interruptions had a significantly reduced caloric deficit (and a higher level of overfeeding) compared to 110 patients fed for a 24-hour rate. Van den Broek and colleagues[42] observed that administered feeding amounts were significantly lower than prescribed in a 4-month study of 55 patients who received continuous pump feeding, portion drip, or combined feeding schedules. A mean energy deficit 1089 kJ/d (range, –7955 to +795 kJ/d) was noted largely due to interruptions for procedures. The delivered feeding was in goal range only in critical care. They suggest adapting EN schedules to accommodate periods when patients are off feedings as well as the use of formulations with higher energy density.

Outcomes of these EN administration protocols may be difficult to demonstrate. de Araujo et al[43] studied 41 critically ill patients who received continuous vs intermittent (per pump) feeding and found no statistically significant difference in terms of calories received per day, bowel distention, or emesis for patients who had 6 hours off at night vs those fed for 24 hours per day. It has been suggested that feedings held for a 6-hour period might result in reduced gastric microbial growth due to increased gastric acidity during the off period.[44]

Patient convenience, lifestyle, and preferences are factors to consider when creating the EN schedule, especially when EN is likely to continue postdischarge. A 24-hour feeding schedule is seldom needed, and periods without being connected to feeding may enhance patient lifestyle. It may therefore be advisable to individually assess the feeding schedule of each patient, including those in long-term care settings.

Although jejunal feeding may be better tolerated as periodic continuous feeding (eg, nocturnal feeding), the delivery schedule options are limited compared to gastric feeding. Nocturnal feeding may be used to encourage daytime oral intake; however, the patient's appetite may still be dampened, and it may be challenging to determine the adequacy of meals and modify the EN volume accordingly. If oral intake is encouraged and a gastric tube is being used, postmeal gravity bolus feeding can be infused immediately after each meal to promote the patient's appetite for the next meal, and the amount of feeding can be adjusted according to the adequacy of intake of each meal (eg, use half of the EN volume after half of the meal is eaten). When oral intake is discouraged (eg, because of marked dysphagia) but a patient is in an environment involving food, EN can be administered prior to encounters with people eating to dampen the patient's appetite and reduce the desire to eat.

When continuation of EN into the home setting is anticipated, clinicians can implement the home schedule (such as gravity bolus meal-like feedings) in the acute care setting before discharge. This approach allows the acute care team to not only work toward the feeding goal and assess patient tolerance but also provide the patient or family as much assistance and training as possible before discharge.

Question 6.8. What practices maintain safety throughout EN administration in regard to pump issues?

Practice Recommendations

1. Purchase best-performing pumps and follow manufacturer recommendations for pump use and maintenance.
2. Ensure that institutional biomedical engineering departments periodically test, according to manufacturer recommendations, whether pumps continue to meet the accuracy rates and whether alarms function.
3. Consider a volume-based ordering system as opposed to a rate-based delivery when appropriate to optimize delivery of the total volume in a set time period.
4. Compare time of container initiation with completion of infusion of container in terms of expected delivery amounts as a double-check of accuracy of delivered volume.
5. Zero the volume delivery amount on the feeding pump at the beginning of a time period, such as usual intake and output assessment period. This can serve as a check of amount delivered, especially when that volume is the same as the expected delivery volume. When the volume delivered varies from expectations, additional investigation regarding the variance is in order.
6. Use lightweight, portable, user-friendly, and accurate pumps. For patients who may require continued pump use in the home setting, consider the simplicity of use and reliability of the pump. If possible, begin use of the pump to be used in the home care setting before the patient is discharged from acute care.

Rationale

Enteral feeding pumps are used to ensure accurate, consistent feeding delivery with an alarm designed to signal interruption or alteration to this delivery. Patients and caregivers who rely on and are responsible to account for this consistent delivery expect that an alarm will sound for any deviation from what is prescribed in terms of delivery and that the volume-delivered feature represents actual volume delivered in a specific time period. However, pumps have been shown to deliver rates and volumes that vary from the prescribed settings.[45] Accuracy in delivery is important for all who rely on enteral feeding pumps because even small variances over time can have a significant impact on the patient's nutrition status. Particularly in vulnerable neonates and young children, small differences in the rate and volume of feeding can lead to major consequences.

White and King[46] discuss 4 areas for safety regarding the use of enteral feeding pumps: (1) the consistent and accurate delivery of formula, (2) the minimization of errors regarding tube misconnection, (3) the impact of feed delivery itself, and (4) the potentially toxic chemical composition of the casing used in pump manufacture, although sets free of di(2-ethylhexyl)phthalate (DEHP) are now marketed. They assert that accuracy, safety, and consistency are important for patient confidence and acceptance of feeding pumps.

The potential unreliability of pumps can be a source of stress not only for staff and caregivers but also for patients, including those in home settings, who may be concerned when fluid remains in delivery containers at the end of a programmed pump delivery period or, to the contrary, if feeding infuses more quickly than expected. In 1 study of home EN in 34 pediatric patients with inherited metabolic disorders, 75% of families of children surveyed reported sleep disturbances related to alarms, and 50% of home patients experienced faulty pumps that affected accuracy and, in 1 critical incident, led to underfeeding.[47] These authors published the review of enteral pumps, suggesting that formula delivery is accurate to within ±10% of what is programmed. Some pediatric and adult systems report adhering to deviance rates of only ±5%.[46]

Pump inaccuracy has been identified as a primary contributing factor in both underdelivery and overdelivery of feedings.[48] Tepaske et al[45] looked at 13 commercially available pumps tested in a laboratory setting in 12 sessions with different tubes and formulas. Formula delivery differed from preset to actual delivery over a 24-hour period, with deficits ranging from 0.5%–13.5%, and differences of +66 mL to –271 mL per 24 hours. Decreased accuracy was attributed to the feeding pump vs formula viscosity or resistance in delivery; however, only 1 pump of each type was tested in this study, and EADs varied between 6 and 16 Fr in diameter. Spronk et al,[49] who tested 14 feeding pumps (6 Kangaroo 324 pumps and 8 Kangaroo 224 pumps), noted that discrepancies of up to 24 mL/h below the preset volume occurred despite frequent calibrations by technical service using weight volume analysis. They discuss that differences in delivered volumes could be due to viscosities of formula or bending or twisting as the patient moves. They recommend monitoring pump function in various settings and conditions, suggesting that technical service, age, and depreciation of pumps influence their accuracy. For one brand of enteral feeding pump, a 2011 report was issued to warn that users who incorrectly pressed a certain key sequence might conclude that an inoperable pump was infusing and consequently be at risk of hypoglycemia due to lack of feeding.[50] Additionally, incorrect key presses may cause a particular type of pump to appear to be infusing even though an occlusion exists.[50] Older reports of inaccuracies exist from 2003 and prior, but these findings may not be generalizable to newer pumps.

Manufacturers establish accuracy rates for their specific pumps and generally fall within the accuracy rates as described above.[46] Low-flow rates combined with high-dose settings may exceed the life of the disposable set and should be replaced every 24 hours to maintain delivery accuracy, allow proper air and occlusion sensing, and prevent growth of bacteria. Therefore, avoid programming a rate and dose combination that exceeds a 24-hour feeding regimen. Pumps should be used exclusively for enteral formulas or human milk and not interchangeably for medications and EN. When using HBM in infants, syringe pumps are used to minimize the loss of HBM in a feeding bag.

Question 6.9. Can the EN feeding system be a source for contamination and infection and how can contamination in the EN feeding system be best prevented?

Practice Recommendations

1. Use a closed EN delivery systems when possible.
2. Follow the manufacturer's recommendations for duration of infusion through an intact delivery device (container and administration set).
3. Do not reuse the enteral delivery device for open or closed systems (container and administration set in excess of what is recommended by the manufacturer).
4. If open systems are used, follow recommended hang times and avoid topping off remaining formula, which may result in a continuous culture for exponential microbial growth.
   a. Limit infusion time for open EN feeding systems to 4–8 hours maximum (12 hours in the home setting).
   b. Limit infusion time for a reconstituted powder product or modular to 4 hours maximum.
   c. Change the delivery device (container and administration set) according to the manufacturer's recommendations for open systems.
5. Be aware that the addition of modular units to an open feeding system may result in an unacceptable risk of contamination in hyperthermal environments.
6. To limit the risk of microbial growth and biofilm formation, avoid unnecessary additions to the EN administration set. If additional equipment, such as 3-way stopcocks, are used, follow manufacturer recommendations or facility protocol for change and cleaning practices.
7. Establish and follow protocols for preparation, handling, and storage of commercial and handmade EN.
   a. Educate those who prepare and administer EN about hand hygiene (a critical point) and safe handling of EN preparation and administration; extend education to patients and family members/care givers who will continue this practice into the home setting.
   b. Use effective hand hygiene in all aspects of EN preparation and administration. When gloves are used, they must be clean gloves, not having been involved in other nonrelated tasks. The importance of hand washing in minimizing transference of microbial growth and preventing hospital-acquired infections cannot be overstressed.
   c. Give preference to selecting systems that require minimal handling.
   d. Use a clean work surface for EN preparation.
   e. Use equipment dedicated for EN use only.
   f. Store EN formula according to the manufacturer's instructions. Store prepared or opened ready-to-feed solutions in an appropriate refrigerator, discarding any used solutions within 24 hours of preparation or opening.
8. Periodically survey and regularly monitor adherence to the above-listed protocols. Document findings and take appropriate actions if protocols are not followed.
9. Reduce potential for touch contamination of EN-related equipment as well as risk of exposure to body fluids by reducing interruptions to the system, providing a clean work surface (eg, small clean towel under tube/administration connection) and when interruptions are necessary, and using only washed hands and gloves.
10. Keep all equipment, including syringes and containers for flush and medication administration, as clean and dry as possible. Store clean equipment away from potential sources of contamination.
11. Consider whether microbial growth related to EN might be implicated as part of the diagnosis when patients have adverse conditions such as diarrhea.

Rationale

Although microbial growth has been associated with EN in a variety of studies and in a variety of ways, contamination related to EN is an often overlooked source of bacterial infection.[1,51] In discussing microbial growth, questions arise such as which types and what amount of microorganisms are harmful, what are the associated adverse effects of harmful microbial growth, and what areas related to EN are most strongly correlated with harmful microorganisms.[52] Patients who require EN may be immunocompromised, at least until their nutrition status is improved, and they rely on healthcare professionals to minimize risk related to EN delivery.

Hospital-prepared EN poses the risk for foodborne illness or nosocomial infection.[38,53,54] Blenders used in reconstituting formulas have been cited as a primary source of contamination.[55] Diluting formula hung for a period of time is no longer

recommended because additions to the EN system increase risk of microbial growth.

Water that is hung as a separate infusion to the EN delivery device may also serve as a source for exponential microbial growth, especially when the water is hung for extended periods (eg, >8–24 hours); however, reporting of well-designed research in this area is lacking.

In a prospective, descriptive study, cultures were taken from 30 pediatric patients every 4 hours as they were administered continuous feeding of decanted formula over a minimum hang time of 12 hours with formula added per "current practice." Out of 111 usable cultures, 100 had no growth, 6 had growth below the FDA threshold for contamination, and 5 cultures in 2 patients grew coliforms with no evidence of bacterial gastroenteritis over the 48-hour data collection period.[56] In this study, decanted formula used for pediatric patients had a lower growth rate over a 12-hour period than anticipated when recommended handling procedures were followed.

Perry and colleagues[57] compared closed EN systems with open systems and open systems with modular additives in a critical care burn unit. No microbial growth was found in closed and open systems in the thermoneutral and hyperthermal critical care, nonpatient environment, although humidity was not reported. Microbial growth was noted in both temperature environments in the open system with modular additives. Significant growth in the open system with modular additives was noted in the hyperthermal environment, where 30% of samples exceeded FDA standards by 4 hours and CFUs were too numerous to count by 8 hours. These investigators concluded that the addition of modular units to an open feeding system may result in an unacceptable risk of contamination in hyperthermal environments.

A wide variety of organisms was recovered from neonatal feeding tubes in studies by Juma and Forsythe[58] and Hurrell et al.[59] In Juma and Forsythe's study, some of the organisms were encoded for antibiotic resistance.[58] Hurrell and colleagues reported that a multitude of organisms, including antibiotic-resistant ones, was identified in 129 feeding tubes collected from 2 neonatal intensive care units (NICUs), and *Klebsiella pneumoniae* and *Serratia marcescens* caused infections in the 2 NICUs.[59] The significance of biofilm formation in enteral feeding tubes, which constitutes a risk factor for susceptible neonates, is highlighted in another report by this group of investigators.[60] Biofilm growth on 3-way stopcock valves used within the feeding delivery system can cause nosocomial infections; *Pseudomonas aeruginosa* was found to develop a bacterial biofilm in these valves within 3 days.[61] These valves may be used with no routine change time or care practices and may be exposed to many interruptions and manipulations.

System design has been suggested to play an important role in reducing bacterial contamination. Retrograde spread of the patient's own flora has been identified as a source of contamination in EN administration sets, and system design improvements (such as recessed spikes on administration sets) have been recommended to reduce potential touch contamination.[62] Mathus-Vliegen et al[51] reported that the large amount of

potentially pathogenic bacteria found in delivery sets was likely related to the endogenous vs exogenous route, potentially due to retrograde microbial growth.

In a study of EN-related equipment, clean, dry feeding equipment had less microbial growth than feeding equipment that retained moisture, feeding formula, and other media for microbial growth. Syringes stored for up to 5 days in a clean, dry fashion as 2 pieces (ie, piston being removed from the barrel of the syringe prior to storage) had less microbial growth than more newly obtained syringes (eg, 12 hours) that housed moisture where cultures exceeded standards for both type and amount of microbial growth. Also noted, feeding tubing administration caps taped upright to IV poles had significantly more adverse microbial growth cultured from them than caps that were stored in a manner to prevent moisture retention.[52]

Ho and colleagues[63] found a strong correlation between cultures taken from staff hands and contamination of tube hubs, enteral feeding, and nasopharynx and gastric fluid, and the investigators noted a significant reduction in contamination in the group that received an infection control program (ICP). Hand contamination with methicillin-resistant *Staphylococcus aureus* (MRSA) was highly correlated with contamination of the EN system, and these authors recommend ICPs in long-term care settings. The effect of touch contamination has been demonstrated in syringes,[64] and healthcare professionals must take measures to avoid the transfer of microbial growth from hands to patient care items and areas, such as the inner aspect of a feeding tube. The importance of appropriate hand hygiene and clean glove use as indicated cannot be overstressed. Additionally, a clean surface (eg, a clean small towel under tubing prior to disconnections or manipulation) may reduce inadvertent touch contamination from less clean areas. Changing delivery systems at once is less risky than topping off the volume of formula.

Reuse of feeding bags for the home setting is sometimes considered a cost-saving measure. Oie and Kamiya[65] found that washing feeding bags with water and then 0.1% sodium hypochlorite (ie, bleach) solution significantly reduced microbial growth ($P < .01$) compared with washing with water alone. Rinsing of continuous EN sets used for 24 hours with tap water was not determined to decrease contamination when cultured at 8 and 16 hours in a 2-group comparison (rinse vs nonrinse).[66]

Williams and colleagues[67] conducted a randomized controlled trial and concluded that aspirating GRVs less frequently in critical care was not correlated with increased patient risk of complications from EN but could potentially reduce the risk of contamination of the feeding circuit and the risk of exposure to body fluid. In another study, Williams et al[16] identified other strategies to reduce interruptions to enteral feeding that might increase risks of contamination and negatively affect nutrition outcomes.

Adverse events related to microbial growth in EN have been addressed, but additional research in this area may prove to be of benefit. *Clostridium difficile* and associated diarrhea in hospitalized tube-fed patients have been correlated with EN, especially in those receiving postpyloric feeding.[68,69] With the steady increase in this very serious
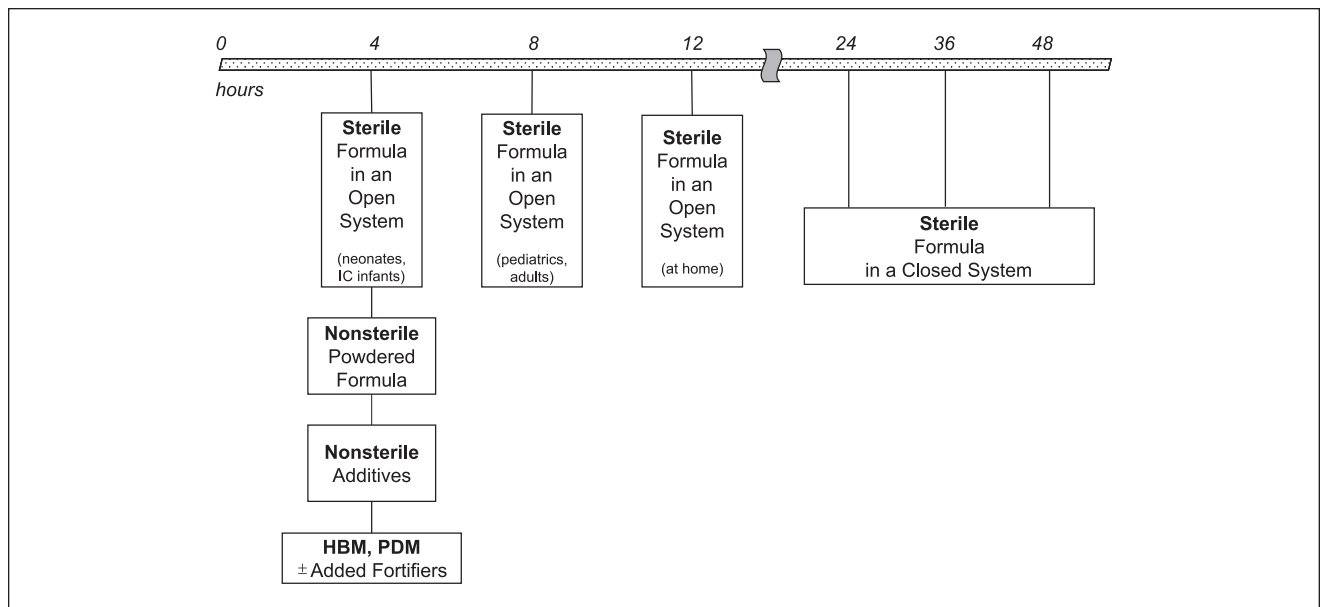
Figure 9. Hang times for enteral nutrition. HBM, human breast milk; IC, immunocompromised; PDM, pasteurized donor milk.

malady, every potential correlation must be considered, including medications, underlying disease, and prior status, but bacterial contamination must also be considered.[70] There are many potential causes of frequent and/or loose stools, including medications, underlying disease, and prior status, but bacterial contamination must be considered.[70] In an observational, retrospective study of EN use in 175 hospitalized poststroke patients compared 24-hour hang time vs 72- or 96-hour hang time, the 24-hour hang time was independently associated with a lower risk of diarrhea and longer diarrhea-free survival.[71] Jack et al[72] reported a 78% incidence of diarrhea in 55 patients using EN, and the frequency increased with longer periods of enteral feeding. They recommended that organizations use a diarrhea risk management algorithm. Hurt et al[73] suggested that incorporation of EN as a base strategy for stress ulcer prophylaxis to reduce the need for acid-suppressive therapy may reduce *C difficile* pseudomembranous colitis. Others have recommended allowing stopping EN for periods of time (eg, 6-hour break) to allow gastric pH to return to its more normal acidic pH to help reduce gastric microbial growth.[44]

Healthcare organizations that follow national standards practice recommendations (eg, Hazard Analysis and Critical Control Point [HACCP] and National Institute for Health and Clinical Excellence [NICE] 2012) in training and monitoring staff who work with EN can reduce and contain microbial growth.[74,75] For example, Oliveira et al[55] reported that a hospital reduced bacterial count from 10^5 CFU/mL to 10^1 CFU/mL by following HACCP guidelines for preparation, storage, and delivery of enteral feeds and using a flowchart and monitoring critical control points defined using a decision tree based on

HACCP guidelines. If using a threshold of 10^5 CFU/mL, then EN delivery sets should be used within 24 hours.[66] See Figure 9 for hang times for EN and Figure 10 for an overview of potential contamination points in EN.

Question 6.10. Under what circumstances (if any) should EN be held to improve patient safety (prior to transportation, prior to procedures, surgery, or extubation)?

Practice Recommendations

1. Avoid interruptions or holding EN for routine interventions, including endotracheal extubation and procedures where short periods of HOB lowering are needed.
   a. Perform a thorough assessment for oropharyngeal secretion retention and potential for reflux of gastric fluid by a qualified professional.
   b. Disconnection of EN equipment not only decreases nutrition delivery and increases potential microbial growth of related equipment but also increases the risk for tubing misconnection.
2. Consider risk vs benefit regarding disconnection of EN on an individual basis as it reduces needed nutrient delivery and may increase safety risk.
3. Follow the American Society of Anesthesiologists preoperative fasting recommendations[76]:
   a. Human milk—4 hours
   b. Infant formula—6 hours
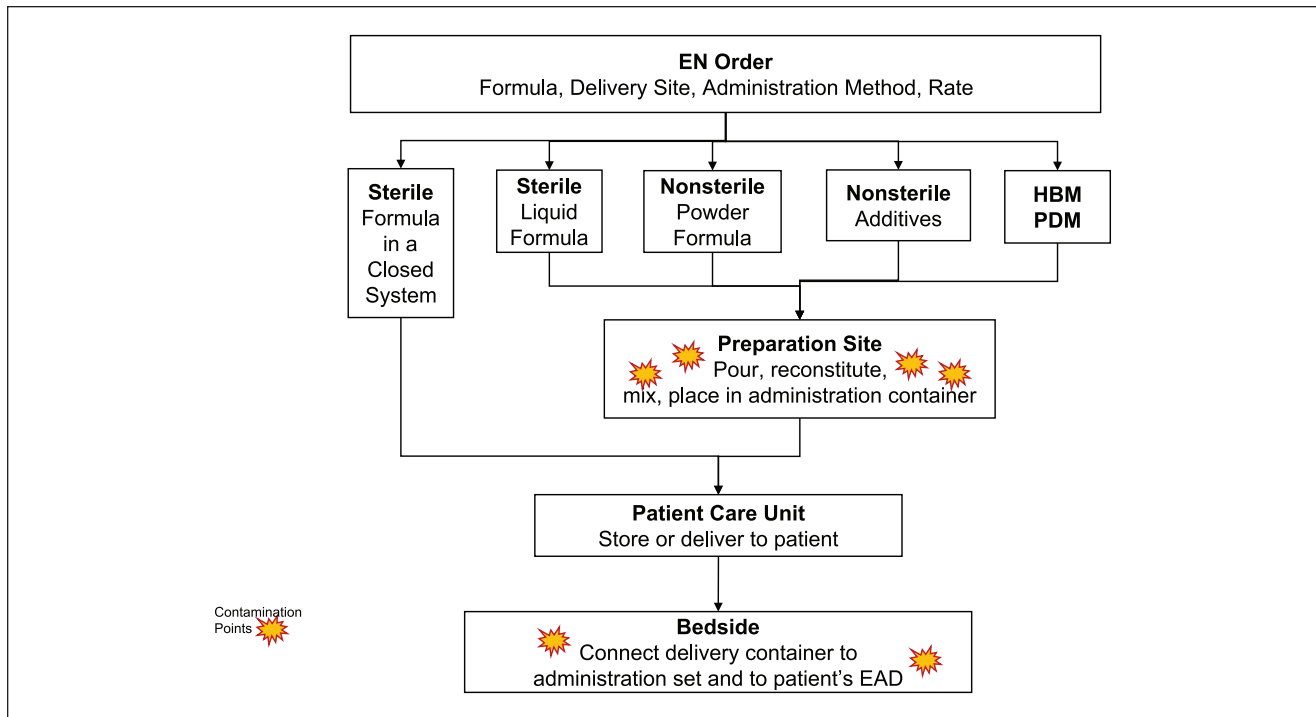   c. Nonhuman milk—6 hours

Figure 10. Contamination points in formula preparation. EAD, enteral access device; EN, enteral nutrition; HBM, human breast milk; PDM, pasteurized donor milk.

Rationale

Safety can be built into all aspects of patient care, and ownership for safety integration must be an expectation of all healthcare professionals. When EN is held for tests and procedures, patients are deprived of nutrition and fluid unless lost volume is effectively made up during the other hours of the 24-hour period. Peev et al[77] compared avoidable and unavoidable interruptions in EN and equated interruptions in EN delivery to undesirable outcomes such as underfeeding and prolonged length of hospitalization. Withholding feeding can be done as necessary, but decisions based solely on tradition are not advisable. Instead, clinicians are encouraged to use evidence and critical thinking to decide whether to interrupt feedings. Williams and colleagues[16] have reviewed means to reduce avoidable interruptions.

Transporting patients between departments, areas, facilities, or care settings increases the potential for disconnection and misconnection of the enteral feeding system, delay of feeding resumption, and potential tube clogging, as well as deviation from usual preventive practices, such as maintaining HOB elevation. Intrahospital transportation has been identified as a risk factor for pneumonia. In a cohort-matched design study of critically ill ventilated patients, 118 patients were transported (primarily for radiologic procedures) and 118 were not. Of those who were transported, 26% developed ventilator-associated pneumonia (VAP), as opposed to 10% of those who were not transported.[78] Three independent risk factors for VAP were identified in this study: the need for reintubation, EN, and intrahospital transport. It was not clear whether alteration in HOB positioning was a factor in these

outcomes. During transport, appropriate hand-off between qualified personnel is essential. Documentation of line tracing and ready access provide resources if concerns or questions arise.

Depending on the context, turning continuous EN off for lowering the HOB for a brief time may be unnecessary and even counterproductive in terms of reduced feeding volume, risk of forgetting to turn the feeding back on, and increased potential for tube clogging. If the HOB must be lowered, it should be quickly reelevated to 30°, or preferably 45°, unless contraindicated.[28,34] Another possible option is to reposition the patient in reverse Trendelenburg while feedings infuse. The patient clinical condition may be a more influential risk factor for reflux and aspiration than the small per-minute volume of feeding delivery. Oropharyngeal suctioning and assessment of patient condition, including abdominal assessment, may be more helpful in tempering aspiration risk than stopping small-volume feeding infusion for a short period for lowering the HOB.

The standard practice of NPO after midnight prior to procedures and surgery has been challenged and warrants patient-specific consideration regarding its appropriateness and risks and benefits.[79] For example, jejunal feeding may not need to be held for the same time period as gastric feeding, especially when gastric decompression may be an option prior to a procedure. In a study by Moncure and colleagues,[80] 46 patients with jejunal tube feeding that infused until they were transported to the operating room were compared to 36 patients who had jejunal feeding held for 8 hours prior to surgery. No aspiration was noted in either group, and the investigators concluded that jejunal feeding may safely continue until the time of surgery.

In a prospective, observational cohort study, critically ill, mechanically ventilated patients were fed via gastric tube until 45 minutes prior to selected operative and nonoperative procedures or via duodenal tube until the procedure started. Pousman and colleagues[81] found a trend in the intervention group toward increased nutrition administration and faster attainment of target goals, with no statistically significant difference between the usual practice group and the patients with the reduced fasting protocol.

The American Society of Anesthesiologists have published practice guidelines for preoperative fasting timeframes for elective procedures. These include discontinuing various liquids prior to an elective surgical procedure. Those liquids pertinent to the patient receiving EN include human milk, infant formula, and nonhuman milk. A 2-hour fasting time period for those receiving human milk is recommended, a 4-hour time period is recommended for infant formula, and a 6-hour time fasting period is recommended for those receiving nonhuman milk.[76]

The practice of holding EN for patient conditions also warrants critical appraisal. For example, McClave and Chang[82] have concluded that "evidence of gastrointestinal bleeding is not an automatic contraindication" to EN; rather, EN may protect the gut mucosa and further reduce bleeding, increase the risk for rebleeding, or "serve as a moot point with no relation to further bleeding." They discuss reasons to consider continuing or holding feeding for a period of time, depending on etiology of the bleeding. Other decisions about interrupting EN, such as whether to hold feeding for a period prior to endotracheal extubation or for medication administration, will also depend on the specific situation and the best evidence available to the clinician.

> **Question 6.11. What is the most accurate method to measure the amount of formula infused (ie, recorded I/O, marking the bottle or bag)? Who is responsible for monitoring whether the amount recorded was actually infused?**

Practice Recommendations

1. Do not rely on pump rate and volume settings **alone** to determining the amount of feeding infused. Calculate the hourly rate multiplied by the hours infused, allotting for any downtime and use other methods to double check and ensure accuracy of volume infused. Compare that volume to the pump history of volume infused for an accurate measure of intake.
2. Document the volume of EN and other fluid administered and investigate when suboptimal nutrition and fluid seems to have been delivered. Serve as patient advocates to promote best nutrition and fluid delivery.
3. Monitor nutrition and fluid trends, including any gaps in delivery, and pursue methods to enhance delivery as indicated.
4. Implement methods to ensure that adequate nutrition is being administered for patients who continue EN after they transition from acute care to another setting.

5. Tailor ordering methods to help ensure that accurate nutrition volumes are delivered:
   a. Consider volume-based feeding schedules where a specific volume is to be infused in a 24-hour period.
   b. Use an easily measurable volume, such as one or two 1-liter containers/d or 2 cartons (cups) of feeding per EN "meal," in orders for EN in the home care setting.
6. Institute systems to embed accountability and oversight for accurate delivery of nutrition intake, including methods of ordering and documenting actual intake. Have policies and procedures to determine whether systems are suboptimal or break down, and use system improvement methods to address problems.
7. Encourage use of electronic connectivity between enteral pump and the intake portion of the EHR to document EN volume infused.

Rationale

Many stakeholders are involved in ensuring that adequate feeding volumes are infused, including the patient/family, direct care staff, and those who oversee specific aspects or the overall management of the patient course, from recovery to healing and maintenance. Daily care staff are responsible to account for EN infusion volume over a specific period. If the infusion rate is multiplied by the number of hours infused, there is a risk that periods when feeding was held may be inadvertently omitted from the intake record. Feeding pump infusion volume may also be an unreliable measure. Volume-based ordering has been recommended over rate-based ordering for more accurate EN delivery.[39,48,83] Sometimes, staff or patients themselves question why 100 mL of EN remains after an overnight infusion when the total volume should have infused. However, when the less-than-optimal infusion volume is not noticed, nutrition deficits can accrue. Professionals who oversee the broad aspects of EN delivery volume use records of daily feeding volumes to assess the overall EN delivery trend and its effects. They may be responsible for establishing and updating the nutrition plan based on trends and outcomes. Delivery and calculation of EN formula may be more accurate when volumes can be ordered in specific amounts, such as 2 cartons/cans/cups of feeding 3 times per day or one 1000-mL container per night. Similarly, if water intake is ordered in specific amounts and accountability for it is built into the EHR, such as via the medication administration record, delivery may be more reliable and accurate. Also, when water is described in terms of household measurements, such as a cup of water, the patient, family, and staff might more easily equate feeding to meals.

Enteral feeding pump inaccuracy contributes to the discrepancy between ordered and delivered formula volume. Feeding pumps may either overdeliver or underdeliver prescribed volume within the prescribed timeframe.[84–86] Deficits of 0.5%–21% have been observed.[84,85] The set rate on the

pump does not always correlate with the amount of formula delivered, and this discrepancy may be responsible for up to 81% of cases where the patient does not receive the prescribed amount of formula.[76] Advances in enteral feeding pump technology may improve accuracy.

Double-checks and assessments for accuracy of delivered amounts such as comparing formula amount and time hung with amount remaining at the end of a time period compared to expected delivered amount can help detect inaccuracies of EN delivery.

Topics for Future Research

- Comparison of gastric vs small bowel feedings on clinical outcomes in patients requiring prone positioning
- The advantages and disadvantages of holding enteral feedings for surgical procedures and for what duration prior to the procedure
- Incidence of overt or microaspiration in patients fed via the bolus method
- Jejunal feeding transition from continuous to intermittent or bolus method for patient convenience
- Feasibility of transferring enteral volume data directly from enteral feeding pump to the EHR

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Section 7. Administration: EAD Patency

Background

Feeding tubes (EADs) are prone to clogging for a variety of reasons. The risk of clogging may result from feeding tube properties (narrow tube diameter and the tube material), the tube tip location (gastric vs small bowel), insufficient water flushes, formula contact with acidic fluid, aspiration for GRV, contaminated formula, and incorrect medication preparation and administration.[1–3] The importance of maintaining tube patency is well known. A clogged feeding tube can result in decreased nutrient delivery or delay administration of medication, and, if not corrected, the patient may require additional intervention to replace the tube. Replacement of the EAD can increase cost and cause patient discomfort. Replacement costs are higher for jejunal feeding tubes, as they must be replaced in radiology and require fluoroscopic confirmation of tube placement.[3]

A common cause for an enteral feeding to fail is tube occlusion, with an incidence as frequent as 23%–35%.[2] In most cases, tube occlusion delays administration of nutrition support and medications. Prompt restoration of tube patency reduces the clinical impact and may save healthcare resources devoted to tube replacement. Research supports water as the best choice for initial declogging efforts. Flushing a tube with water is an easy and often effective step. The use of cranberry juice and carbonated beverages may worsen occlusions because of the acidic pH of these fluids. Acid can cause proteins in enteral formula to precipitate within the tube, making the clog worse or leading to more clogging later on.[2–6] Papain, as a sole treatment option, has produced varying results.[2] If water does not work, a pancreatic enzyme solution, an enzymatic declogging kit, or mechanical devices for clearing feeding tubes are second-line options.

Question 7.1. What are the best practices to maintain tube patency and prevent tube clogging?

Practice Recommendations

1. Use the largest diameter feeding tube feasible without sacrificing patient comfort. This includes the largest inner diameter for a jejunal extension tube through PEG tubes.
2. Flush feeding tubes immediately before and after feeding with intermittent feedings. With continuous feedings, flush at standardized intervals.
3. Flush feeding tubes before and after medication administration and follow appropriate medication administration practices (see Section 8).
4. Limit gastric residual checks as acidic gastric contents may cause protein in enteral formulas to precipitate within the lumen of the tube.
5. Use aseptic technique when handling enteral formula, administration sets, and feeding tubes.
6. Use an administration pump when slow rates of enteral formula are required, such as in the neonatal population, and respond promptly to pump alarms.
7. Use purified water for flushing the EAD in adult and neonatal/pediatric population before and after medication administration.
8. Use purified water for tube flushes in immuno-compromised or critically ill patients, especially when the safety of tap water cannot be reasonably assumed.
9. Consider use of an automatic flush pump to prevent tube clogging and provide additional hydration.

Rationale

Small internal diameter and longer feeding tubes, such as nasogastric and nasojejunal tubes, have a higher risk of clogging compared to shorter and large diameter tubes such as gastrostomy tubes.[1–3,7] The larger the diameter of the tube lumen, the better the flow. Larger bore tubes are less likely to be occluded by either medication or highly viscous formulas.[3,4,8]

In a retrospective review of 560 long-term home EN patients, Ao et al[9] compared complication rates requiring tube replacement between jejunostomy tube and PEG tube patients. The study found that, compared with PEG tubes, jejunostomy tubes are associated with higher rates of complications that require tube replacement, with dislodgement and obstruction being the main causes for tube replacement. Polyurethane tubes are preferable to silicone because polyurethane better sustains patency.[10] However, in a laboratory study by Rucart et al,[11] the impact of different unclogging agents (sterile water, sodium bicarbonate, papain, digestive enzymes, cola, orange juice, and pineapple juice) on silicone and polyurethane tubes showed that silicone tubes seem to be less vulnerable to damage. In this study, only bare tubes were put in contact with the

unclogging agents, and the investigators concluded that occlusion is partly influenced by interactions at the tube surface, and damage would be aggravated during the administration of EN and medications.[11] One study found that surface modifications of polyurethane could reduce both the amount of material absorbed into the surfaces as well as occlusion in the tubes.[12]

The mechanism of clogging may involve denaturation and precipitation of proteins in enteral formulas when formulas come into contact with gastric acid from the stomach. Clogging may also be caused by interactions of the coagulated formula with feeding tube surfaces, especially during slow feeding infusion rates.[3,5] It has been observed that feeding tubes positioned in the highly acidic environment of the stomach may clog more readily than those positioned in the more neutral pH environment of the small bowel.[1] The technique of aspirating gastric juices into feeding tubes for GRV checks can increase clogging.[3]

The hubs of feeding tubes have been shown to harbor enteric bacteria that appear to have migrated from GRV and tube patency checks and further contaminated the extraluminal portion of enteral delivery sets.[13] Formula contamination must be minimized to prevent clog formation from formula coagulation. To reduce risk of formula contamination, administer water as separate flushes instead of adding it directly to the tube-feeding formula; also, wipe down enteral formula containers with isopropyl alcohol and allow them to air dry prior to use. Manufacturer recommended hang times must be followed to prevent bacterial growth.[1] When handling enteral feeding administration sets, individuals must follow standard precautions.

Prevention is the preferred way to minimize the risk of enteral feeding tube clogs. Consistent and scheduled flushing of all types of tubes during feeding and medication administration is the best way to decrease the incidence of tube occlusion. If formula infusion rates are slow, an enteral feeding pump can be used. Pump occlusion alarms must receive prompt attention.[3] Enteral feeding pumps with automatic flush systems are designed to decrease clogged feeding tubes and provide additional hydration.[14]

Flushing the tube is an effective preventive measure. No solution has been found to be superior to water for its effectiveness, accessibility, and cost.[3] Based on the available data, water is the preferred fluid for flushing feeding tubes, reconstituting or diluting enteral feeding formulas, and diluting medications for enteral administration. Water used for tube flushing could be drinking water or sterile water.[15] There are variations in practice, such as using purified water when the tap water is not proven safe from microbial or chemical contaminants. In a survey of 823 nurses, 26% always use sterile water to flush tubes before or after medication administration and 70% always use tap water.[16] Use of sterile water for tube feeding can minimize the risk of transmission of pathogens from water sources in high-risk patient areas.[17] In the home setting, either tap water or bottled water is generally used for water flushes, if tap water is free of contaminants.

In neonatal nutrition, flushes are used sparingly because the nutrient needs of neonates are so high and there is little room for fluids that do not contain nutrients. When necessary, flushes are used at a minimal volume (2 or 3 mL) to maintain the patency of the feeding tube. In pediatrics, depending on the size of the child, flushes are more commonly used to maintain tube patency and to give more water volume.

Question 7.2. What factors determine optimal frequency and amount of water flushes?

Practice Recommendations

1. In the adult patients, flush feeding tubes with a minimum volume of 30 mL of water every 4 hours during continuous feedings or before and after intermittent feedings.
2. Flush the feeding tube with 30 mL of water after GRV measurements in an adult patient.
3. In neonatal and pediatric patients, flush feeding tubes with the lowest volume necessary to clear the tube.

Rationale

There are variations in clinical practice with regards to volume, timing, and frequency of water flushes. However, consistent flushing before and after medication administration, bolus feedings, and periodically with continuous or cyclic feedings is very important to prevent tube occlusion.[18–21] For inpatients receiving continuous feedings, the amount of water recommended for flushing ranged from 20–100 mL, and the suggested frequency of flushing ranged from every 4 hours to every 8 hours. In patients receiving intermittent or bolus feedings, the amount of water recommended ranged from 15–100 mL, and sources recommended flushing both before and after feeding.[18,21] The larger the flush volume, the more likely the tube is to remain patent; however, the amount of water used in a flush must be determined by the patient's fluid needs and restrictions.[21]

In pediatrics, it is important to take the child's age into account when flushing an EAD with water. Routine water flushes are not recommended after each bolus feeding or interrupting continuous feeding for any tubes other than nasojejunal tubes. For most NG and OG tubes, 3–5 mL of water will suffice to flush a feeding tube.[1,22] In a recent survey conducted by ASPEN, 62 clinicians who care for pediatric or neonatal patients reported using water or air for flushing. The general flushing volume consensus was to use 2–5 mL in pediatric patients and 1 mL or less of water or air in place of water in neonates.

Question 7.3. What is the best way to open a clogged feeding tube?

Practice Recommendations

1. Provide proper training, credentialing, and privileging at the healthcare organizational level to staff responsible for unclogging tubes according to local practice acts and institutional privileging.

2. Instill warm water into the EAD using a 30- or 60-mL syringe, and apply a gentle back-and-forth motion with the plunger of the syringe.

3. If water flush does not resolve the clog, use an uncoated pancreatic enzyme solution by crushing one uncoated pancreatic enzyme tablet and one 325-mg sodium bicarbonate tablet mixed in 5 mL of water. The solution should be introduced to the clog and clamp the feeding tube for at least 30 minutes. If the clog is not cleared within 30 minutes, the solution should be removed from the tube and replaced with a fresh mixture.

4. If water flush does not resolve the clog, use an enzyme containing declogging kit or mechanical declogging device.

Rationale

Prevention is the best strategy to manage risk of EAD occlusion.[2] However, when EAD occlusion does occur, efforts to clear the lumen may be appropriate before resorting to EAD replacement. An approved institutional policy on declogging enteral feeding tubes will expedite the process. Several declogging methods are available. The success of the method has much to do with the cause of obstruction and the knowledge and skill of the provider. The declogging process may begin when resistance is met when attempting a flush or when an occlusion alarm sounds on an enteral feeding pump and the tube is not kinked. However, it may be prudent to begin the declogging process as soon as the tube becomes sluggish.[3]

Warm water is often effective and should be first-line treatment. A 30- or 60-mL syringe is attached initially to the tube and the plunger pulled back to help dislodge the clog. The flush syringe is then filled with warm water and reattached to the tube to attempt a flush. If resistance is met, the plunger of the syringe may be moved using a gentle back-and-forth motion to help loosen the clog, then clamp the tube and soak for up to 20 minutes to allow the warm water to penetrate the clog.[3,18] If resistance continues, a second-line approach is to use an activated pancreatic enzyme solution.

Pancreatic enzymes have been documented as effective agents in clearing feeding obstructions caused by enteral formulas.[2,6,23] While enteric-coated and extended-release pancreatic enzyme products are available, they are not as effective for dissolving obstructions in feeding tubes.[23,24] Klang[6] evaluated the removal of the enteric coating to release the pancreatic enzymes for the purpose of unclogging feeding tubes. The findings show that pancreatic enzymes in enteric-coated products can be released and that these pancreatic enzymes can disrupt clogs. If the clog is of considerable size, warm water is still the first choice to allow for the passage of fluid.[23] Another study evaluated the effectiveness of alkalinized Creon delayed-release pancreatic enzyme protocol to clear occluded feeding tubes. The protocol was administered to 83 patients, and tube patency was restored to approximately half (48.2%) of occluded tubes.[5] A recent in vitro study evaluated the efficacy of an uncoated pancreatic enzyme in comparison to water or cola in dissolving an enteral formula clog that would occur in feeding tubes.[6] When combined with sodium bicarbonate, the uncoated pancreatic enzyme effectively dissolved an enteral formula–associated occlusion, whereas water loosened the clog but did not dissolve the obstruction, and cola did not have an impact on the obstruction.[6] Well-designed in vivo studies are needed to better evaluate all options.

Commercially available enzyme declogging kits contains a syringe preloaded with a powder of food-grade papain, cellulose, and amylase enzymes, which can break down protein, fiber, and starch clogs. The powder is activated by pulling water into the syringe. An elongated hollow catheter is attached to the syringe so that the declogging solution is delivered closer in proximity to the clog and left clamped for 30–60 minutes. After that period of time, the tube is unclamped and a water flush is attempted. If the tube is still clogged, the declogging process may be repeated with the remaining solution in the syringe. In one study, 15 of 17 tubes were successfully declogged on the first attempt, and the remaining 2 were declogged on the second try, preventing the need for any tube reinsertions.[25] Other commercially available mechanical devices are designed to mechanically dismantle clogs and can be used for formula or medication-related occlusions.[2,18,24] If the clog is not resolved by these methods, feeding tube replacement is indicated.

Topics for Future Research

- Identifying incidence rates of EAD obstructions by unit, institution, and health systems to better understand the problem
- Understand the differences in maintaining tube patency between recommended guidelines and actual clinical practice
- The safety and efficacy of currently available methods to unclog enteral feeding tubes
- The safety and efficacy of commercially available agents marketed for resolving occlusions related to enteral formula or medications
- Maximum volume for flushing small bowel feeding tubes

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Section 8. Medication Delivery via Enteral Access Devices

Background

Medication administration through an EAD can be much more complex than it would seem. The vast majority of medications are not formulated to be administered through a feeding tube. In fact, not all drugs are safe or appropriate for this route of administration. Careful consideration must be given to each individual medication prescribed and the goals of therapy. Administration of many oral medications via enteral feeding tube can be an effective method of medication administration, but a number of medications carry complex drug-nutrient or drug-drug interactions that can impact drug efficacy and drug toxicity. When institutions create policies regarding medication administration via enteral

feeding tube, they can determine what supplementary order accompanies the EN order to facilitate proper medication administration. To prevent untoward consequences, including fatalities, it may be advisable to have a pharmacist review medication orders and the preparation of medications for administration via EAD.

It is essential that a necessary medication is appropriately prepared and administered through a feeding tube without increasing the risk for complications in the patient. Complications include impairing the patency of the feeding tube, reducing therapeutic effect of the medication, or increasing drug toxicity. Additionally, some medications can pose a hazard to the healthcare provider. Safety must be the focus of both the *preparation* of the medication and *administration* of the medication. Preparation refers to the retrieval of a medication and any alteration to a dosage form to make it suitable for delivery through a feeding tube. The alteration may be as simple as diluting a liquid medication or as complex as compounding a new formulation from multiple components, including the active pharmaceutical ingredient. The administration step involves the timing of drug delivery to the patient's GI tract with respect to flushing protocols, other medications, and the EN regimen. Practice recommendations have been available to practitioners for a number of years.[1] The rationale for such recommendations has been further described.[2,3] Despite these publications, recent surveys still identify that some preparation methods and administration practices do not follow best practices, which may contribute to adverse risk.[4]

Question 8.1. What factors should be evaluated to safely prepare and administer medication through an enteral access device?

Practice Recommendations

1. Evaluate factors related to the patient and to their enteral feeding tube.
    a. Identify the patient's current enteral status (oral, NPO, or NPO except for medications).
    b. Identify whether the patient can take medication by mouth or requires enteral medication administration.
    c. Identify what, if any, anatomical or functional abnormalities in the patient's GI tract that may preclude drug absorption.
    d. Document or retrieve the documentation in the EHR of the current feeding tube so that these data are available for all healthcare providers. Describe the device by its entry point and distal end (ie, nasogastric, percutaneous jejunostomy) and its diameter (eg, 12 French), rather than by the brand name or color of the feeding tube.
    e. Document or retrieve the documentation in the EHR, verifying the placement of the distal end of the feeding tube.
    f. Document or retrieve the documentation in the EHR regarding the feeding formulation and

flushing regimen being administered through the feeding tube.

    g.   Confirm tube patency.

2. Evaluate factors related to the medication and its dosage form.

    a.   Identify the route (oral vs enteral) and the distal site of drug administration as ordered (drug administration should match current enteral status).

    b.   Develop real-time communications to inform the pharmacy of any changes to the route or distal site of medications being prepared and dispensed.

3. Confirm the following aspects of enteral medication orders and resolve any inappropriate orders with the prescriber and nurse.

    a.   The drug *dosage form* is appropriate for enteral feeding tube administration (ie, immediate release).

       i.   Avoid any solid dosage form medications that would result in a significant change in the absorption of the active ingredient(s) if opened (capsule) or crushed (tablet).

      ii.   Evaluate each medication for its inherent solubility and release characteristics. If crushing the medication alters its delivery (eg, enteric coated, extended release, or novel excipients for alternative delivery systems), consider an alternative dosage form, drug, or route of administration.

    b.   The *drug and the formulation* are both appropriate based on the distal end of the feeding tube.

       i.   Avoid bypassing the primary site of drug absorption.

      ii.   Avoid high-osmolality or highly viscous preparations.

    c.   Any medication order that will require a preparation step (eg, crushing, diluting, mixing) prior to administration is identified.

       i.   Establish and follow organizational policies and procedures to prepare medications for enteral administration that will comply with USP chapter <795>.

4. Document in the EHR any clarifications or interventions related to the prescribing, reviewing, preparation, or administration of medications for the patient receiving EN.

5. Work with CPOE vendors and application architects to design systems such that each medication is ordered by the appropriately intended route of administration.

Rationale

The enteral route of drug administration is unique and differs from the oral administration in several ways. The topic of enteral medication administration is receiving more attention in the literature.[5] Organizations that develop and put into practice protocols for enteral medication administration are much more likely to prevent related medication errors than those that lack protocols.[6,7] Best practices include an evaluation of both the EAD and the medication profile in a systematic fashion. Although not widely recognized or reported, medication errors related to the enteral route of administration happen.[8] Inappropriate preparation and/or administration technique can lead to an occluded tube, reduced drug effect, or increased drug toxicity. These potential adverse outcomes are not always captured in medication error rates. Routine reporting of all enteral medication errors to the medication safety committee or other appropriate institutional committee is important so that systems improvements can be made to address them. The responsibility for preventing enteral medication errors should be shared by the prescriber, pharmacist, and nurse. The nurse is in a difficult position if a prescriber enters an inappropriate medication order and the pharmacist does not clarify it. An interdisciplinary group of healthcare providers, including knowledgeable prescribers, pharmacists, and nurses, can work together to develop protocols for administering medications through enteral tubes within their organization.[8] Summary documentation of clarifications or interventions related to medication use in the enterally fed patient can be reviewed on a regular basis. Unless a culture of safety already exists within an organization to consider, document, and report all errors related to EN and medication administration in patients receiving EN, institutions may assume that there are no safety issues or errors.

Emami et al[9] reported a case of a 53-year-old man who was in the ICU and subsequently intubated with a nasogastric tube being used for nutrition support and medication administration. During his 30-day hospitalization, this patient improperly received all of his scheduled oral medications via feeding tube, including multiple sustained-release and extended-release drugs, crushed and combined with each other in 40 mL of tap water. A multidisciplinary team with a pharmacist reviewing medications to be administered via enteral feeding tube could have prevented these errors and intervened with proper recommendations for medication administration.

Caregivers are typically confident that they prepare and/or administer drugs appropriately, although surveys have suggested otherwise.[1,4] Prospective observational studies suggest that these types of medication errors may occur with about 60% of doses; these finding highlight the need for pharmacists to be vigilant and work closely with prescriber and nurse colleagues.[10,11] In a study by Boullata and colleagues,[12] patients with "NPO" orders and unable to take medication by mouth were still prescribed drugs "PO" over 80% of the time. Of those, many orders were not corrected by the pharmacist reviewing the orders, which therefore placed the nurse in the precarious position of committing a wrong route medication error. In this same study of drug administration in enterally fed hospitalized patients, less than 20% of drugs administered directly into the small bowel were considered appropriate.[12] In these cases, therapeutic alternatives or a different route of administration may need to be considered.

A number of medications, including modified-release dosage forms (eg, delayed release, sustained release), are inappropriate for the enteral route. A listing of the many oral dosage

forms that should not be crushed or opened is readily available.[13] These dosage forms are implicated not only in potential for interaction or excessive bolus drug doses but also for exposing caregivers (including via inhalation) to allergenic, cytotoxic, and teratogenic products.

Liquid medications, while offering the advantage of an easier to administer dosage form for the feeding tube, rarely are the ideal formulation for that route. Ingredients such as sugars, preservatives, and thickening agents can cause significant side effects that may be interpreted as intolerance to the EN formula. The undiluted administration of liquid medications with an osmolality >500–600 mOsm/kg may be associated with significant GI disturbances, especially in vulnerable patients.[14–16] The healthy stomach is able to tolerate hyperosmolar liquids much better than the small intestine, although gastric emptying may be delayed. Gastric administration reflects the intended site of drug disintegration when administered orally, but postpyloric administration may alter bioavailability and affect the risk of GI complaints and malabsorption. The highest physiologic osmolality expected in the small bowel is ~600 mOsm/kg in the fed jejunum.

Crushing an immediate-release solid dosage form and giving the medication with adequate dilution is often the safest course of action. For a medication administered enterally to be absorbed, it must first be dissolved in solution. Preparing a liquid dosage form is fraught with complexities, and an appropriate reference should be consulted before assuming stability.[17–21] Even simple operations such as crushing an immediate-release tablet and mixing it with water must be examined because the safety and efficacy of the medication may be affected by the quality of the water (tap vs purified), degree of crushing (particle size), and time of exposure (as the drug may degrade in a liquid form). In the absence of drug-specific data, pharmaceutical principles should be used to make recommendations. Many newer drugs have poor water solubility. They are formulated with coprecipitates, solubilizers, and surfactants that should remain in close proximity to the active pharmaceutical ingredient (API) to ensure dissolution at the targeted time. Mixing these formulations in a separate vessel and then transferring the contents to the enteral feeding system may allow the separation of ingredients, precipitation of the API, and failure to absorb. Suggestions for drug products containing a poorly soluble API have included placing the product in the barrel of a syringe and adding a diluent to allow a slurry to form before administration. This methodology requires a larger EAD (≥14 Fr).

By addressing issues with drug administration in the patient with an EAD, the pharmacist plays a critical role in supporting the prescriber and the nurse.[22] When evaluating an enteral drug order in a patient receiving EN, the pharmacist needs to be aware of the patient's GI status, the EN regimen, and the location of the EAD to identify inappropriate administration routes, any potential interactions, or other administration route issues. The pharmacist must resolve conflicts when a prescriber orders a drug to be administered PO in the patient with NPO orders. If the drug is intended for administration through the EAD, the order must indicate this route; if it does not, the nurse who administers the medication by the "wrong route" seems to commit a medication error. More important, the pharmacist needs to decide whether the drug and its formulation are appropriate for EAD administration. Given the risks for physicochemical incompatibility and instability, drugs are not to be admixed together. Potential drug-nutrient interactions that result from a physical, chemical, physiologic, or pathophysiologic relationship between a drug and EN also need to be considered.[1] An interaction is considered clinically significant when it influences therapeutic response (or compromises nutrition status) with clinical consequences related to altered drug (or nutrient) disposition. For example, EN can alter drug bioavailability. The bioavailability of some drugs may benefit from administration in close proximity to EN, whereas the bioavailability of others may be significantly reduced in the same circumstances. In the latter case, administration of drug should be temporally separated from EN. Lists of drugs to be administered with, or separated from, EN are best used in conjunction with other considerations for drug administration via EAD (eg, flushing protocol, appropriate drug dilution, location of EAD distal tip).

Question 8.2. What steps offer the safest method to deliver medication through an enteral feeding tube?

Practice Recommendations

1. Develop policies and procedures to ensure safe practices by staff across all departments involved with enteral medication preparation and administration.
2. Identify drug, dose, dosage form, route (ie, enteral), and access device (eg, nasoduodenal tube) in the prescriber's order.
3. Review by a pharmacist of each medication order to determine whether the enterally administered medication will be safe, stable, and compatible as ordered.
4. Institute and follow nursing policies and procedures to prepare and administer each medication safely.
5. Provide nonsterile compounding pharmacy services to support medication preparation.
6. Use best practices as per USP <795> for any enteral drug preparations compounded in advance (ie, not for immediate use) and these should be based on:
   a. Published stability data and clearly described with citations in the organization's Master Formulation Records
   b. Documenting in a permanent Compounding Record
   c. Providing a beyond-use date
   d. Storage in a container consistent with the stability/compatibility literature and USP <795>
7. Do not add medication directly to an enteral feeding formula.
8. Administer each medication separately through an appropriate access.
9. Avoid mixing together different medications intended for administration through the feeding tube given the risks for physical and chemical incompatibilities, tube obstruction, and altered therapeutic drug responses.

10. Use available liquid dosage forms only if they are appropriate for enteral administration. If liquid dosage forms are inappropriate or unavailable, substitute only immediate-release solid dosage forms.

11. Prepare approved immediate-release solid dosage forms of medication for enteral administration according to pharmacist instructions. Techniques may include:

    a. Crush simple compressed tablets to a fine powder and mix with purified water.

    b. Open hard gelatin capsules and mix powder containing the immediate-release medication with purified water.

12. Use only appropriate instruments to measure and prepare enteral medication.

13. Use only clean enteral syringes (≥20 mL with ENFit device) to administer medication through an EAD.

14. Provide appropriate tube irrigation around the timing of drug administration:

    a. Prior to administering medication, stop the feeding and flush the tube with at least 15 mL water.

    b. Administer the medication using a clean enteral syringe.

    c. Flush the tube again with at least 15 mL water, taking into account the patient's volume status.

    d. Repeat with the next medication.

    e. Flush the tube one final time with at least 15 mL water.

15. Restart the feeding in a timely manner to avoid compromising nutrition status. Hold the feeding by 30 minutes or more only if separation is indicated to avoid altered drug bioavailability.

16. Consult with an adult or pediatric pharmacist for patients who receive medications coadministered with EN.

Rationale

The most consistent delivery of medication through an EAD comes from adequate drug dilution and flushing.[23–26] Medication that is in an appropriately powdered form, either from pulverized tablets, capsule contents, or dry powder products intended for reconstitution, needs to be diluted to ensure delivery through the EAD. Dilution may be necessary for the enteral administration of liquid medications (ie, solutions, suspensions) to reduce viscosity or osmolality. Reducing viscosity allows the full drug dose to reach the distal end of the EAD, especially for longer, small-bore tubes. Not diluting a suspension could result in a significant decrease in drug delivery and bioavailability when administered through an EAD.[23,24] In a crossover study in healthy volunteers, administration of an undiluted drug suspension (posaconazole) through a 16 Fr nasogastric tube resulted in a 23% lower bioavailability than the oral administration.[23] In another study, compared to 1:1 (v:v) dilution, 11%–24% of undiluted drug suspension (carbamazepine) was lost, depending on the diluent, despite all 12 Fr nasogastric tubes being flushed.[24]

Again, the most consistent delivery through an EAD comes from adequate drug dilution and flushing.[23,24] Water is the simplest fluid for diluting powdered or liquid medication (see Appendix 1). The U.S. Pharmacopeia requires that purified water be used for preparation of drug dosage forms. Purified water refers to water that is free of contaminants (chemical and biological) following source water selection, distillation, and filtration.[25]

Drinking water (tap, bottled, and well water) may contain chemical contaminants. Therefore, the use of drinking water to dilute medication prepared for enteral administration can increase the risk for potential drug interactions, which may, in turn, alter drug bioavailability.[26,27] For this reason, purified water is required. Sterile water for irrigation is an example of a purified water product, but there is no need for the diluent to be sterile.[26] However, the potential for acute drug-drug, drug-chemical interactions when contaminated waters are combined with medication has not been quantified. More data regarding the appropriateness of medication dilution and the potential for drug interactions are needed.

Dilution with 30–60 mL of water seems adequate for powdered medication.[28–31] The volume required to dilute liquid medication depends on the desired degree of viscosity and/or osmolality. Diluting viscous suspensions in a volume of at least 1:1 seems to be adequate for some drugs.[24,32] High-osmolality medication can result in localized adverse effects at the mucosa or create an osmotic effect throughout portions of the bowel. The higher the osmolality, the greater the volume of diluent required to lower the osmolality.[31] The case has been made that it would be more practical to crush an acetaminophen tablet to a fine powder and disperse in a smaller volume of water than to use a liquid formulation that requires significant volume dilution.[21] The time lapse between stopping the EN, administering the drug, and restarting the EN will depend on any potential for drug-nutrient interaction in the GI lumen.[1,33]

When an immediate-release solid dosage form needs to be prepared for EAD administration, there are several options available. A study compared 3 preparation methods in terms of crushing yield, microscopic observation, suspension stability, and aerosolization.[34] The data suggest no significant difference in efficiency of crushing between methods. However, the particle granularity differed by drug, indicating that crystal structure and excipients are a factor in determining how fine a powder can be produced, and this may predict interaction potential. Confined crushing yielded smaller particles, but all particles suspended similarly in water. Open crushing yielded significantly greater amounts of particulate matter ($>10^6$ particles) in the cubic meter of space directly above where the drug is prepared.[34]

Although more time-consuming, separation of each medication administered through an EAD reduces the risk of tube obstruction and interactions. Drug errors can additionally be related to inappropriate use of dosing instruments as well as health literacy.[35]

The ideal medication delivery system for EN administration would be to have the drug fully dissolved in a solution that has a neutral pH, tolerable osmolarity, and low viscosity. This delivery system does not exist. Most liquids are thick and

contain sweeteners and insoluble excipients. The drugs that are not available in liquid formulation have limited stability in that state, making them poor candidates for enteral administration.

To optimize patient safety, it is important to evaluate each medication for appropriateness of the specific enteral route. Factors to assess include the formulation, solubility of the API, and the use of excipients to deliver the medication. Each medication is unique, and global assumptions can lead to both ineffectiveness of the targeted medications or toxicity of enhanced absorption.

One approach that is becoming popular[21]:

1. Open an appropriate oral or feeding tube syringe by withdrawing the plunger.
2. Place the single medication dosage form in the syringe. This could be a capsule or tablet.
3. Replace plunger.
4. Add 15–30 mL purified water at room temperature.
5. Wait 20 minutes for slurry to form.
6. Once all solids have disintegrated, use the syringe to administer the medication through a flushed feeding tube.
7. Rinse the feeding tube with an additional 15–30 mL purified water.

This method is especially useful when handling hazardous medications ordered for administration through an EAD. It is also beneficial in administering drugs formulated with cosolvents that would precipitate if mixed in a separate container and transferred to a syringe. Some capsules are slow to dissolve in water and will form clogs in smaller bore feeding tubes (<12 Fr). In these cases, a special compounded liquid formulation will be needed.

Extra caution is needed when using specialty pharmacies that compound oral liquid formulations. Most formulations contain high amounts of sorbitol, a potent cathartic, which is added as a sweetening agent. There is no need for sweeteners and flavoring agents for drugs to be administered through an EAD. Ask the compounding pharmacist to use a low-osmolarity suspending agent for compounding drugs that will be more likely tolerated for feeding tube use.

Question 8.3. When prescribing medications to be administered via an enteral route, what is the safest and most effective way to name (communicate) the route and site of administration?

Practice Recommendations

1. Develop policies, procedures, and practices across departments for a uniform way of referring to short-term and long-term EADs across departments.
2. Describe each device by its entry point (eg, naso-, percutaneous) and its distal end (ie, gastric, jejunostomy), its diameter (eg, 12 French). Avoid references to brand names, shapes, or colors of the feeding tube.
3. Work with EHR vendors so that CPOE systems allow for a specific route of administration when medications are intended for feeding tube administration.

Rationale

The method used to prepare a drug for administration through an EAD depends on the internal diameter, total internal surface area, and distal site of drug delivery. The dimensions of the feeding tube are crucial in determining the appropriate selection of a formulation for the medication to be administered. Tubes with an internal diameter equal to or greater than 10 Fr work best for administering crushed or dissolved solid dosage medications. If the tube is less than 10 Fr, the medication must be in a liquid formulation with few, if any, residual solids. Some feeding tubes have internal dual channels to allow for the separation of stylus. Due to their small internal diameters, these tubes are especially prone to clogging.

The proximal site or entry point provides a clue as to the length of the tube and its overall surface area. Longer tubes are more prone to complications related to the cumulative resistance to flow as well as medication interaction with the tubing material. The distal site, whether gastric, duodenal, or jejunal, will determine the extent of dissolution that will be required in the formulation selection. For a jejunal feeding tube, the API should be fully dissolved and prepared in a vehicle with a final osmolarity of approximately 285 mOsm/L. In some cases, acid is added to the formulation to enhance API solubilization; in other cases, sodium bicarbonate is added to remove the medication's enteric coating and allow dissolution. Liquid medications administered into a feeding tube with the distal end placed in the stomach can have a higher osmolarity of approximately 500 mOsm/L. Drugs administered into the stomach can include slurries and suspensions since dissolution should occur in the gastric fluid.

It is troubling how few CPOE systems allow for selecting the specific feeding tube route as a designation when placing an electronic medication order for that route. The practice of using "PO" for the "allowed" route and then indicating special administration instructions in a free text field can contribute to error.

Question 8.4. What factors will determine whether the pharmacy or the nurse will prepare medication for enteral administration?

Practice Recommendations

1. Develop policies, procedures, and practices to determine how the workload of drug preparation for enteral administration will be distributed.
2. Only trained personnel can prepare hazardous medications or drugs that contain known allergens. Prepare these medications under conditions that protect all personnel, in compliance with OSHA and NIOSH publications as well as USP Chapter <800>.
3. Avoid environmental risks of cross-contamination between medications.
4. If permitted by the organization, a nurse may prepare nonhazardous and nonallergenic drugs with limited stability in a clean area of the medication room.
   a. Maintain practices and responsibilities consistent with USP chapter <795>.

    b.   Unless prepared for immediate use, label the final container (eg, enteral syringe) according to all applicable federal and state laws, and include a beyond-use date.

5. Appropriately trained personnel in the pharmacy are responsible for preparing drugs that require significant manipulation and fall within the context of compounding.

    a.   Follow the organization's policies and procedures as well as USP chapter <795>.

    b.   Unless prepared for immediate use, label the final container (eg, enteral syringe) according to all applicable federal and state laws, and include a beyond-use date.

Rationale

Ideally, all medications that must be compounded or mixed are presented to the nurse in the final dosage formulation to be administered. However, each organization will need to determine how best to approach this given its resources and administrative support structures.

The enteral administration of hazardous medications poses additional risk. For oral chemotherapy agents, crushing must be avoided. Ideally, a closed-system transfer device, similar to those used for reconstitution of injectable chemotherapy, would be used in compounding of chemotherapy for enteral administration. For more information on hazardous medication handling, refer to OSHA and USP chapter <800> guidance.[36,37]

Several reports indicate that the optimal way to prepare drugs is to place the drug inside a syringe, add water, and then mix to dissolve the medication. This method can be safer than crushing drugs because it limits the operator's exposure to some of the hazardous components of the tablet or capsule formulation. Furthermore, putting the uncrushed drug in a syringe and making a slurry keeps all components together and allows delivery similar to oral intake of the medication. Many drugs have poor water solubility and are formulated with excipients to enhance dissolution. Crushing the drug and mixing in a separate container risks that the components will separate and drug will precipitate.

Question 8.5. What is the optimal method for the pharmacy to dispense medications to the patient care unit for the nurse to administer via the feeding tube?

Practice Recommendations

1. Develop policies and procedures that describe the labeling and dispensing of enteral medications in a manner consistent with federal and state laws as well as USP chapter <795>.

2. Label the medication using:

    a.   Patient identifiers

    b.   Common (ie, generic) name of the drug using TALLman lettering as indicated

    c.   Dose of the drug

    d.   Scheduled date/time of the dose

    e.   Manufacturer name and lot number

    f.   Beyond-use date

    g.   The organization's Compounding Record number, if compounding was required

3. Affix the label to the container being dispensed (eg, the enteral syringe).

4. Dispense the medication in a manner consistent with organizational staffing.

    a.   Dispense the commercial unit dose product for the nurse to prepare.

    b.   Dispense unit doses prepared in the pharmacy in a suitable container.

       i.   Dispense dry powder medication with directions to dilute it with purified water.

      ii.   Dispense a stable slurry of the dry powder medication in an appropriate diluent.

     iii.   Dispense a commercially available liquid or extemporaneously compounded liquid medication with directions to dilute it further or administer it as is.

5. Dispense medication with appropriate directions for preparation and administration.

Rationale

To optimize safety, all medication dispensed for enteral administration must reflect practices related to stability and be appropriately labeled. Each medication must be compounded into a unique formulation appropriate for the specific type of EAD administration. Careful adherence to the recommendations of USP <795> is essential to ensure the medication reaches its intended target.[38] Even simple operations, such as crushing an immediate-release tablet and mixing it with water, must be examined because outcomes may be influenced by the quality of the water (tap or purified), degree of crushing (larger particles are more likely to clog EADs), or the time of exposure (the drug may degrade in a liquid form).

Many newer drugs have poor water solubility. They are formulated with coprecipitates, solubilizers, and surfactants that should remain in close proximity to the API to ensure dissolution at the targeted time. In some cases, mixing these formulations in a separate vessel and then transferring the contents to the syringe allows the ingredients to separate or the API to precipitate, which decreases absorption of the API. It is advisable to prepare all poorly soluble API drugs in a syringe, adding the diluent and allowing a slurry to form before administration. This methodology requires large-bore feeding tubes (≥14 French) for adults.

Question 8.6. What medications are of particular concern for enteral delivery?

Practice Recommendations

1. Maintain at the healthcare organizational level a list of medications that pose a concern for administration via EAD.
2. Ensure that this list of medications complies with NIOSH guidelines, OSHA regulations, and USP chapter <800> and reflects the release characteristics of the drug dosage form as well as data on interactions with EN formula and/or enteral feeding tubes.

Rationale

Safe handling of hazardous medications is imperative. According to USP chapter <800>, NIOSH guidelines, and OSHA regulations, when a hazardous medication is assigned for feeding tube administration and a liquid formulation is not available, the dosage form must not be crushed outside the confines of a biological safety cabinet.[36,37,39] An alternative to crushing is to place the intact hazardous medication in a syringe and add water to dissolve.[40] Another important safety issue is the release character of the drug dosage form. For example, the crushing of extended-release medications can cause the entire dose to be released immediately. Significant adverse effects, including fatality, can result from this bolus administration.[41]

A significant number of drugs are not to be administered through an EAD. These include hazardous drugs as well as some nonhazardous drugs. The number of drugs considered "hazardous" will vary with the practice setting, and the list will be determined by the experts within each organization. The characteristics of hazardous drugs include those that are carcinogenic, mutagenic, or teratogenic or that impair fertility, as well as those causing serious toxicity at low doses in treated patients.[36,37,39] For the purposes of enteral administration, nonhazardous drugs that would nonetheless be inappropriate to be manipulated and administered through an EAD are also important to incorporate into the list and include the modified-release versions of medication.[13] Lists of these substances can be readily accessed through NIOSH (http://www.cdc.gov/niosh/docs/2014-138/pdfs/2014-138_v3.pdf) and ISMP (http://www.ismp.org/Tools/DoNotCrush.pdf) for review by each organization in generating their own inventory.[13,39] The list should be periodically reviewed and updated to reflect new data and marketed drug products added to an organization's formulary.

The administration of drugs via a feeding tube can clog the tube, which may lead to serious complications for patient care. Clogs also form as a reaction of protein with the acidity of the gastric environment. The appropriate method for fixing the clog may depend on what caused it. Many drugs are a weak base and dissolve better in acidic fluid, whereas protein clumps in acid and responds better to protease enzymes.

Flushing the tube with water has been shown to work well for both forms of clogs.

Many drugs require the acid environment of the stomach to properly dissolve. Once they are dissolved, they are absorbed in the more basic milieu of the small bowel. Administration of these drugs directly into the jejunum will result in altered absorption and changes in efficacy.[42] Each medication administered through a feeding tube with the distal site past the pylorus must be evaluated for changes in absorption by that route.[43,44] Consideration must also be given to the action of gastric acid–inhibiting treatments, such as proton pump inhibitors, which may also alter absorption of medications.

The number of errors associated with the use of enteral-based medications is cause for concern.[45] Once syringes with enteral connectors, such as the ENFit design, are fully available, their use to dispense medications prepared for feeding tube administration may improve safety.[46] The ENFit design only allows for feeding tube administration and cannot to be confused with any other type of therapeutic access in the patient.

The administration of medications with poor solubility is another challenge in caring for patients on EN. These medications are specially formulated to allow dissolution under optimal conditions.[47] If these drugs are mixed in a container and allowed to sit, the excipients will separate from the active drug and precipitate out. Administering medication that has separated from the excipients can possibly lead to therapeutic failure.[48] Therefore, drugs with poor water solubility should not be compounded into a liquid formulation unless they are evaluated for clinical efficacy as well as stability. In some cases, the drug can be combined with water in an oral syringe and administered immediately after forming a slurry.

Topics for Further Research

*   Identify incidence rates of enteral medication preparation and administration errors to better understand the problem
*   Preparation of specialized formulations for feeding tube administration
*   Design a suspension vehicle with a low osmolarity (~285 mOsm/L) and neutral pH (~6.5–7.5)
*   Stability of oral medications in low-osmolar suspending agents and/or water
*   Prospective description of enteral drug preparation and administration systems such as type of water, degree of crushing, time to decomposition, EAD French, or surface area

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Section 9. Complication Avoidance and Error Reporting

Background

Complications associated with EN therapy are often preventable with standardized monitoring protocols and vigilant care. General complications of EN include GI, mechanical, and metabolic consequences. For a complete review of overall enteral complications, refer to Section 4 on tube placement as well as the ASPEN Adult and Pediatric Core Curricula. Most complications are not of an immediate safety concern and therefore will remain outside the scope of this document. The safety-related complications to be discussed here include refeeding syndrome, pulmonary aspiration, and enteral misconnections. An enteral misconnection is an inadvertent connection between an enteral feeding system and a nonenteral system, such as an intravascular catheter, peritoneal dialysis catheter, tracheostomy, or medical gas tubing.[1] Beginning in 2015, a new patient access connector called ENFit was made available on enteral administration sets, with enteral syringes and EADs to follow. These connectors will not be interconnectable with other therapy connectors such as those on intravenous, respiratory, neuraxial, or limb-cuff pressure devices.

Question 9.1. How can EN-related refeeding syndrome be prevented?

Practice Recommendations

1. Identify patients at risk for refeeding syndrome prior to initiation of EN. Risk factors include:
   a. Inadequate nutritional intake for >2 weeks
   b. Poorly controlled diabetes
   c. Cancer, both before and during treatment
   d. Anorexia nervosa
   e. Short bowel syndrome
   f. Inflammatory bowel disease
   g. Being an elderly patient living alone
   h. Low birth weight and premature birth
   i. Chronic infections (eg, HIV)
2. Monitor fluid balance, daily weight, and electrolyte status (eg, potassium, magnesium, phosphorus), as well as other metabolic parameters (eg, glucose) as needed based on the patient's presenting clinical situation.
3. Evaluate metabolic and nutrition parameters, and correct metabolic abnormalities or depleted electrolyte concentrations prior to the initiation of enteral feedings.
4. Initiate 25% of goal requirements on day 1 of EN.

5. Provide supplemental thiamin (IV or PO) with EN initiation.
6. Monitor parameters (serum potassium, phosphorus, magnesium, glucose) following EN initiation and replace as needed.

Rationale

Refeeding syndrome is a condition that occurs when malnourished patients are refed near their goal rate.[2–6] It is manifest by rapid shifts in both intracellular and extracellular electrolytes, which can cause life-threatening complications (Table 5). Monitoring of these metabolic parameters prior to the initiation of enteral feedings and periodically during EN therapy is based on protocols and the patient's underlying disease state and length of therapy. Prevention of refeeding syndrome is of utmost importance. Patients at high risk for refeeding syndrome and other metabolic complications must be identified and followed closely, and depleted minerals and electrolytes should be replaced prior to initiating nutrition support. Stanga et al[2] highlighted cases of refeeding syndrome, and each case developed 1 or more features of refeeding syndrome, including deficiencies and low plasma concentrations of potassium, phosphate, magnesium, and thiamin combined with sodium and water retention. These patients responded to specific interventions; however, in most cases, these abnormalities could have been anticipated prior to feeding and prevented. Other cases have been described in the literature.[4]

EN can be initiated at approximately 25% of the estimated goal and advanced cautiously over 3–5 days toward the goal rate. Serum electrolytes, volume status, clinical manifestations, and vital signs are monitored carefully after EN is started.[3]

Question 9.2. How can EN-related pulmonary aspiration be prevented?

Practice Recommendations

1. Routinely evaluate all enterally fed patients for risk of aspiration.
2. Actively employ steps to reduce risk of aspiration.
3. Verify that the feeding tube is in the proper position before initiating feedings.
4. Keep sedation level as minimal as possible.
5. Insert or advance the feeding tube with tip in the small bowel for patients with high risk of aspiration.
6. Keep the HOB elevated at 30° to 45° at all times during the administration of gastric enteral feedings.
7. Deliver EN continuously rather than intermittently in patients with intolerance to gastric bolus feedings.
8. Consider a course of promotility agents (eg, metoclopramide or erythromycin) where clinically feasible in patients with high risk of aspiration.

Table 5. Nutrient Deficiencies and Potential Complications Associated With Refeeding Syndrome.

Nutrient Deficiency	Manifesting Complication
Phosphorus	Cardiac arrhythmia and sudden death
	Congestive heart failure
	Respiratory failure
	Renal failure from osmotic diuresis
	Hemolysis
	Altered mental status
Potassium	Cardiac arrhythmia
	Respiratory failure
	Paresthesias, paralysis, seizures
	Ileus
	Rhabdomyolysis
Magnesium	Cardiac arrhythmias, sudden death
	Respiratory failure
	Paresthesias
	Paralysis
	Seizures, tetany
Thiamin	Korsakoff's syndrome
	Wernicke's encephalopathy

9. GRV measurements may not need to be used as part of routine care to monitor ICU patients on EN. For those patient care areas where GRVs are still utilized, holding EN for GRVs <500 mL in the absence of other signs of intolerance should be avoided. A gastric residual volume of between 250 and 500 mL should lead to implementation of measures to reduce risk of aspiration as defined elsewhere in this document.

Rationale

In most patient populations, pulmonary aspiration can cause chemical pneumonitis and lead to significant complications such as hypoxia and bacterial pneumonia. Aspiration can be defined as the inhalation of material into the airway. In the critically ill patient, this material may include nasopharyngeal secretions and bacteria as well as liquids, food, and gastric contents.[7] The risk factors for aspiration include sedation, supine patient positioning, the presence and size of a nasogastric tube, malposition of the feeding tube, mechanical ventilation, vomiting, bolus feeding delivery methods, the presence of a high-risk disease or injury, poor oral health, nursing staffing level, and advanced patient age and patient transfers for procedures to other units and facilities.[8] Much of the research and many of the recommendations presented here come from the critical care literature and may not explicitly be extrapolated to all patient populations; however, the principles generally apply.

EAD positioning. Proper positioning of the tip of the EAD is of major importance in the prevention of aspiration. Migration of the tube to an inappropriate position such as the esophagus can be a factor in the regurgitation and aspiration of gastric contents. The American Association of Critical-Care Nursing prevention of aspiration practice alert recommends that the position of feeding tubes be checked every 4 hours.[9] Radiographs are the "gold standard" for placement verification, but it is not practical to do frequent x-rays on most patients simply to confirm the position of the tip of the tube. Other suggested methods of checking EAD placement include marking the point where the feeding tube enters the nares or penetrates the abdominal wall (in the case of a gastrostomy or jejunostomy tube) and then assessing whether the mark shifts, or measuring and documenting the visible tube length. Although this technique can give some information, it does not verify the position of the tip of the tube. Methods such as aspiration of GI contents/tube feeds or insufflation and auscultation alone are unreliable in determining the position of the tube tip.[9]

Endotracheal intubation impairs the swallowing reflex. Modern, "soft-cuff" endotracheal tubes do not completely occlude the tracheal lumen and allow for the passage of small quantities of liquids into the pulmonary system. Also, the presence of an object in the trachea allows for the partial compression of the esophagus due to pressure of the object across the membranous portion of the trachea. Therefore, although endotracheal intubation may help prevent massive aspiration from vomiting, it does not prevent aspiration of small amounts and therefore cannot be considered protective against aspiration.

Changing the level of infusion of EN from the stomach to the small bowel has been shown to reduce the incidence of regurgitation, aspiration, and pneumonia.[10,11] In 13 randomized controlled trials, pneumonia was significantly lower in patients with small bowel EN. Compared to patients on gastric EN, the lower rates were significant even when studies were restricted to those using evidence of ventilator-associated pneumonia. However, there were no differences in mortality, ICU length of stay, hospital length of stay, duration of mechanical ventilation, or time to goal EN.[12–23]

It may be necessary to feed the child at risk for aspiration into the small bowel. Gastrojejunostomy tubes are recommended for pediatric patients who require long-term EN and have demonstrated intolerance to gastric feedings due to delayed gastric emptying, gastroesophageal reflux, or risk of aspiration.[24]

Sedation. Other steps to decrease aspiration risk include reducing the level of sedation/analgesia when possible and minimizing transport for diagnostic tests and procedures.[25,26] Any treatment that impairs the ability of the patient to clear contents in the pharynx increases the risk of aspiration. Under normal circumstances, the presence of any material in the pharynx induces a swallowing or coughing reflex, which helps to prevent aspiration. Sedation of a patient decreases or eliminates this reflex and increases the risk of aspiration. Keeping patient comfort and care in mind, it is advisable to keep sedation levels as minimal as possible to minimize the suppression of the swallowing/coughing reflexes.

Positioning of patient. One study compared patients in supine and semirecumbent positions. The investigators found that elevating the head of the bed 30°–45° reduced the incidence of pneumonia from 23% to 5% (P = .018).[27] Infants and children lying flat are at increased risk of reflux and aspirating formula. It is important to position the infant or child to prevent aspiration episodes, with the head of the child elevated at least 30° while receiving a feeding.[28,29] It is generally recommended that infants under 1 year of age be positioned on their back in a flat position. However, the American Academy of Pediatrics guidelines make exceptions for infants whose risk of death from complications of gastroesophageal reflux is greater than the risk of sudden infant death syndrome (SIDS), including those infants with anatomical abnormalities, such as type 3 or 4 laryngeal clefts, who have not had antireflux surgery. Otherwise, elevating the head of the bed while the infant is supine is not recommended.[30]

Chlorhexidine mouthwashes. In 2 studies, optimizing oral health with chlorhexidine mouthwashes twice daily reduced respiratory infection and nosocomial pneumonia in patients undergoing heart surgery.[31,32] Studies where chlorhexidine oral care was included in bundled interventions showed significant reductions in nosocomial respiratory infections.[33,34]

Bolus vs continuous infusions. The potential harm from aggressive bolus infusion of EN leading to increased risk of aspiration pneumonia was shown in 1 study.[35] A randomized controlled trial showed a trend toward decreased mortality with continuous EN (13.9% intermittent vs 7.4% continuous, P = .18).[36] Five small randomized controlled trials comparing bolus to continuous infusion have shown greater volume with fewer interruptions in delivery of EN with continuous EN, but there was no significant difference between techniques with regard to patient outcome.[37–41]

Use of prokinetic agents. Oral or intravenous use of prokinetic agents such as erythromycin or metoclopramide has been shown to improve gastric emptying and tolerance of EN. Erythromycin doses of 3–7 mg/kg/d have been used to treat gastric enteral feeding intolerance. Likewise, metoclopramide 10 mg given 4 times a day has been shown to be efficacious for elevated gastric residuals; however, dosage adjustments to metoclopramide may be necessary in patients with declining renal function. Use of prokinetic agents such as erythromycin or metoclopramide has resulted in little change in clinical outcome for ICU patients. A total of 8 randomized controlled trials using metoclopramide and 1 trial combining erythromycin with metoclopramide were reviewed by meta-analysis. The use of prokinetic agents was not found to make a difference in terms of mortality or infection.[42–49] Erythromycin has been associated with undesirable effects, including cardiac toxicity, tachyphylaxis, and bacterial resistance, and should be used cautiously with monitoring. Metoclopramide also has associated adverse complications, including tardive dyskinesia, more

frequently in the elderly. Both agents have been associated with QT prolongation, predisposing to cardiac arrhythmias.[50,51] Combination therapy with erythromycin and metoclopramide demonstrated improved GRVs allowing for greater feeding success; however, neither hospital length of stay (LOS) nor mortality was improved. Furthermore, the incidence of watery diarrhea was statistically higher in patients receiving combination therapy.[44] In pediatrics, the risks of the use of metoclopramide should be very carefully considered.

Measurement of GRVs. Measurement of GRV has traditionally been one technique used as an indicator for aspiration risk. Research regarding the efficacy of this technique has provided conflicting results. That is, no adequately powered studies have, to date, demonstrated a relationship between aspiration pneumonia and GRV.[52] In addition, no adequately powered studies have demonstrated that elevated GRVs are reliable markers for increased risk of aspiration pneumonia. Building a protocol around risk for aspiration could include several factors to reduce risk but not be solely based on measurement of GRV.[53] GRV cannot be correlated with pneumonia (after the initiation of enteral feedings), ICU mortality, or hospital mortality. Studies suggest that "the elevated residual volumes by themselves have little clinical meaning and that only when combined with vomiting, sepsis, sedation, or the need for vasopressor agents does the correlation with worsening patient outcome emerge."[54] Elevated and increasing residual volumes may be a symptom of another underlying problem manifesting itself as delayed gastric emptying. If serial measurements reveal a change in GRV, other potential causes must be investigated rather than simply holding the enteral feedings.[54] Results from 4 randomized controlled trials indicate that raising the cutoff value for GRVs (leading to automatic cessation of EN) from a lower number of 50–150 mL to a higher number of 250–500 mL does not increase the incidence of regurgitation, aspiration, or pneumonia.[20,54–56] Decreasing the cutoff value for GRVs does not protect the patient from these complications. Use of GRVs leads to increased EAD clogging, inappropriate cessation of EN, consumption of nursing time, and allocation of healthcare resources and may adversely affect outcome through reduced volume of EN delivered.[57] Note that GRV measurement may be dependent on type of EAD as well as patient position.

Three studies (2 randomized controlled trials and 1 prospective before/after implementation trial) have shown that eliminating the practice of measuring GRVs improves delivery of EN without jeopardizing patient safety.[57–59] All 3 trials showed no significant difference between groups with regard to pneumonia.[57–59] Two of the trials found that elimination of GRV measurement was associated with significantly greater EN delivery, either by increased volume of EN infused or greater reduction in energy deficit.[58,59]

If the practice of GRVs is eliminated, a number of alternative strategies may be used to monitor critically ill patients

receiving EN, including careful daily physical examinations, review of available abdominal radiologic films, and evaluation of clinical risk factors for aspiration. Those ICUs that are reluctant to stop using GRVs are advised to take care in their interpretation. GRVs in the range of 200–500 mL may raise concern and lead to the implementation of measures to reduce risk of aspiration, but it is not appropriate to stop EN for GRVs <500 mL in the absence of other signs of intolerance.[19,25,54–56]

Pediatric considerations. In neonatology, GRV measurement was once thought to be part of a prevention strategy for necrotizing enterocolitis.[60] However, because checking gastric residuals is associated with a high percentage of held feeds and failure to meet enteral feeding goals without being a good marker of feeding intolerance, some neonatal clinicians no longer check residuals.[61] Holding feeds in response to GRVs can be a major reason why infants do not meet their feeding goals,[62,63] but the clinical value of GRVs for assessing feeding tolerance in this population is not established. GRV levels are not considered a marker of feeding intolerance in premature infants due to their immature motility. Higher residuals in premature infants are thought to be related to position (with left lateral and supine positions being associated with higher volumes), as well as the degree of prematurity and normal dysmotility of prematurity.[64–66] Also, by the time an infant has residuals, he or she may already have necrotizing enterocolitis or an ileus from sepsis.

Question 9.3. What are the current methods to prevent enteral misconnections?

Practice Recommendations

1. Utilize enteral devices (tubes, syringes, administration and extension sets) with enteral connectors that comply with ISO standard 80369-3 (ENFit).
2. Review currently used systems to assess practices that include the potential for misconnection, including nonstandard, rigged work-arounds (Luer adapters, etc).
3. Train nonclinical staff and visitors not to reconnect lines but to seek clinical assistance instead. Only clinicians or users knowledgeable about the use of any device should make a reconnection.
4. Make connections under proper lighting.
5. Do not modify or adapt IV or feeding devices because doing so may compromise the safety features incorporated into their design.
6. When making a reconnection, routinely trace lines back to their origins and then ensure that they are secure.
7. When arriving at a new setting or as part of a hand-off process, recheck connections and trace all tubes.
8. Identify and confirm the EN label. Note that a 3-in-1 PN admixture can appear similar to an EN formulation bag.

Rationale

Reports of enteral misconnections date as far back as 1972, when a case of an inadvertent intravenous (IV) administration of breast milk was published.[67] In 1 literature review, over 115 cases of published enteral misconnections were reported.[68] The published reports consistently substantiate the highest level of severity for this type of error, which commonly results in the death of the patient by embolus or sepsis,[1] but current reporting may greatly underestimate the number of actual cases or near-miss incidents involving feeding connectors.

In April 2006, The Joint Commission issued a Sentinel Event Alert on tubing misconnections. It stated that multiple reports to agencies such as The Joint Commission, ECRI Institute, U.S. Food and Drug Administration, Institute for Safe Medication Practices (ISMP), and USP indicated that these misconnection errors were occurring with significant frequency and, in a number of instances, had deadly consequences. The alert also identified root causes and risk reduction strategies.[69] Despite many other healthcare alerts on medical misconnections from various safety and regulatory agencies, errors involving misconnections continued.[1] That Joint Commission alert in 2006 called for a connector design that prevents cross-connections between IV and enteral products and asserted that any other remedies might decrease risk but would not eliminate it. For example, color-coding enteral connectors (for which there is no current authorized standard color) simply alerts the clinician that the connector is not an IV connector, but a unique color does not physically prevent the misconnection.[69]

In 2008, the International Organization of Standardization (ISO) convened a working group to develop standards for the redesign of small-bore connectors. ISO standards are recognized by many national governments, organizations, and other entities as *the* resource to drive conformity. As such, ISO sets voluntary global standards to which various governments, purchasing organizations, manufacturers, and users subscribe.[70] The first step in this process was developing a master standard for small-bore connectors that contained certain requirements to which all small-bore connectors must adhere. That standard is ISO 80369-1: *Small Bore Connectors for Liquids and Gases in Healthcare Applications—Part 1: General Requirements.*[71] According to these general requirements, connectors must

- Not be connectable to others in the series
- Be made of rigid or semi-rigid material
- Pass a misconnection test
- Not be connectable with Luer or needleless connector ports

This master standard set the stage for redesigned connectors to be used in respiratory, enteral, noninvasive blood pressure monitoring, neuraxial, urology, and intravascular systems.

The first ISO-compliant patient access enteral connector, called ENFit, can be seen in Figure 11.

This new connector is available on enteral administration sets, enteral syringes, and enteral feeding tubes. These products began to be introduced into the market in 2015. To transition from the new connector to the current feeding tube, a transition set is available to provide connectivity so that patients receive their nutrition formula, hydration, and medications. Communication about these changes is available from the Global Enteral Device Supply Association (GEDSA), which has launched a campaign for the introduction of new small-bore connectors called StayConnected (www.StayConnected.org).

In August 2014, The Joint Commission issued a Sentinel Event Alert titled *Managing Risk During Transition to New ISO Tubing Connector Standards* which included the background on the issue and a series of actions suggested by The Joint Commission.[72] These suggested strategies included preparing for the new standards, development of effective processes and procedures, education and training of staff, effective communication, and leadership and emphasis on a safety culture. The alert also included a table of related Joint Commission requirements for institutions and agencies regarding the use of tubing.[72]

Question 9.4. What are the best practices to systematically identify, document, and report errors associated with EN within an organization and externally to patient safety organizations?

Practice Recommendations

1. Develop and provide education within healthcare organizations for clinicians responsible for the prescription, dispensing, and administration of EN.
2. Coordinate education with ongoing competency assessments and should be dynamic to each provider's practice setting, institution-specific errors, and changes in EN guidelines and practice recommendations.
3. Develop and provide education regarding EN and medical device safety for ancillary staff and healthcare students (medical, nursing, allied professions).
4. Support mechanisms to systematically report any and all errors associated with any step in the EN process, including those related to enteral medication administration.
5. Create a "culture of safety" within healthcare organizations where healthcare clinicians will not be reprimanded for reporting errors related to EN.
6. Develop interdisciplinary teams to evaluate and analyze errors related to EN within an organization.
7. Provide outpatient EN services with processes for evaluating patient and caregiver competency related to EN.
8. Develop and implement policies and procedures to systematically collect, document, and report errors associated with EN to the Institute for Safe Medication Practices (ISMP) Medication Errors Reporting Program.
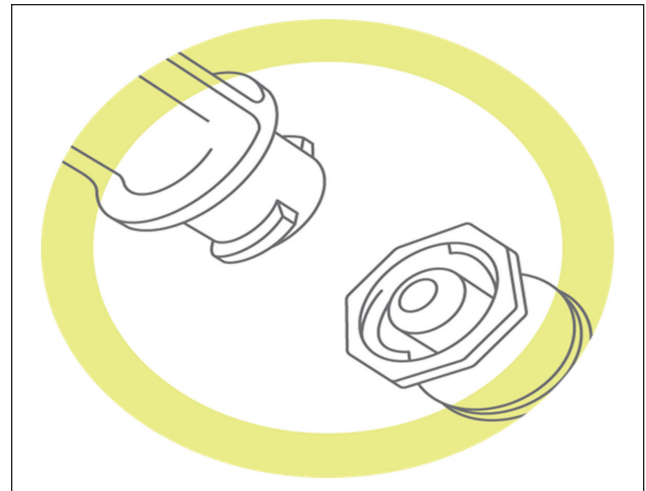

Figure 11. ENFit enteral connector. Reprinted with permission from the Global Enteral Device Supply Association (GEDSA).

9. Develop and implement policies and procedures to systematically collect, document, and report errors associated with EN infusion pumps and devices to the U.S. Food and Drug Association (FDA).

Rationale

Safe practices for EN therapy involve a broad interplay of providers, departments, and administrative support structures across the many steps of the EN process. Errors can occur from patient assessment to prescribing, order review, and documentation, although most recognized errors focus on product selection and administration. Maintaining a safety culture around EN depends on continuous surveillance, recognition of potential risk at *each* step in the process, and systematic reporting of all errors—including near misses. Monitoring and reporting safety issues can allow for subsequent system improvements upon review by an organization's committee or a national patient safety organization.[73]

The improper administration of EN has led to patient harm and even death. The use of resources such as patient safety reporting databases and national patient safety organizations is vital to identify issues associated with the delivery of EN. As clinicians report events, national patient safety organizations and local healthcare organizations can take the proper steps to analyze events, determine their root causes or weaknesses in the EN process, and establish changes and new recommendations to prevent future errors.

Healthcare organizations can use published clinical guidelines to develop nursing policies and procedures for EN administration. Review of these policies and procedures by a multidisciplinary team on at least an annual basis will identify issues related to the EN process and can prevent future breakdowns in the process. Healthcare organizations in all settings

can provide continuous education of healthcare providers, patients, and caregivers for those administering EN. Competency must be validated at critical times, such as the following[74]:

- During orientation of new medical and ancillary staff
- Before a change in organizational policy or procedure
- Before a change in equipment, EN products, or infusion sets
- When deficits in EN administration knowledge are present

The reporting of EN-related errors or close calls is best viewed as an opportunity to improve patient safety.[73] The underreporting of adverse events related to EN hinders a healthcare organization's ability to identify and address gaps in policies and procedures. For example, few organizations systematically report and review EAD occlusion rates. Healthcare organizations can create a culture of safety by reassuring workers that they will not be punished for reporting safety events and framing these events as an opportunity for education.[72]

The education of ancillary staff and student practitioners within a healthcare organization is important to the safety of patients receiving EN. Organizations also need to identify ancillary staff who could possibly be responsible for the connection, disconnection, or reconnection of devices attached to patients and develop policies and procedures that outline responsibilities for these staff members relating to the connection or disconnection of medical tubing.[74]

EN infusion pumps are a necessity in some patients receiving EN in both the acute and home setting. These pumps are not error free, and they can malfunction, leading to inappropriate delivery of EN. Evans et al[75] looked at overnight EN safety issues in children with metabolic disorders. In this study, 32% of patients had faulty equipment (leaking EN bags or tubing defects), and 50% of patients had total pump failure that affected feeding accuracy, with 1 patient becoming hypoglycemic and hospitalized. Policies and procedures related to the safe operation of EN infusion pumps can explain appropriate caregiver roles regarding alarm silencing, adjusting pump settings, and making the connection or disconnection from a patient.[76]

Healthcare organizations are advised to develop policies and procedures that address the collection, documentation, and reporting of errors related to EN to the ISMP's National Medication Errors Reporting Program (MERP). After analysis of adequately reported medication errors, the ISMP has responded with nationwide hazard alerts to healthcare professionals with safety issues and error reduction recommendations. The ISMP has also been able to distribute press releases regarding safety issues to both the lay and healthcare media. These reports have led to individual practice and organizational system changes. Analysis of errors reported to the MERP has led the ISMP to release guidelines regarding standardized order sets.[76–78]

Organizational policies and procedures related to EN administration that address EN infusion pump errors or failure are valuable. Organizations can use the voluntary MedWatch Form FDA 3500 to report device malfunctions to the FDA. Adequate reporting of any medical device issues allows for the FDA to detect potential device-related safety issues. Organizations are required to report all device-related deaths or serious injuries to the FDA and manufacturer within 10 working days of becoming aware of the event using Form FDA 3500A. User facilities are required to send an annual summary of deaths and serious injuries to the FDA with Form FDA 3419 by January 1 for the preceding year.[79]

Topics for Future Research

- Clinical outcomes from combination promotility therapy as well as the associated risk of adverse effects
- The transition to new enteral connectors in the marketplace, particularly in neonates and home care
- Adverse events reported by the FDA and ISMP as measures of change effectiveness
- Cost-effectiveness of workflow processes to prepare medications for EAD administration
- Identify existing error rates at each step in the EN process

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Section 10. Monitoring and Reassessment

Background

The goal of nutrition reassessment is to update the nutrition care plan based on changes in clinical or nutrition status as identified through ongoing monitoring and evaluation. Monitoring the patient receiving EN can help prevent iatrogenic malnutrition and other adverse events. The timeframe for follow-up of enterally fed patients is often driven by an organization's policy and procedures.

Making certain that the patient receives the amount of formula recommended and ordered is important to optimize nutrition status and prevent malnutrition. Volume delivered is often not the amount ordered. In most cases, volume delivered is less than what was ordered, with the most common reasons being GI intolerance, such as nausea, vomiting, abdominal distention, or diarrhea; tube obstruction or dislodgement; or feeding interruptions for nursing or physician care, procedures, or patient refusal. Measuring the volume the patient received within a specified timeframe is important to determine whether nutrient needs are being met. Methods to track volume delivered are not standardized and may include recording intake and output, documenting number of hours the feeding was held vs infusion hours ordered, marking the bottle or bag, or logging the volume measured by the enteral feeding pump, with the latter method possibly allowing the least room for human error. Reassessment will also include the transition from EN to oral nutrition as appropriate.

> **Question 10.1. What are the minimum monitoring parameters and timeframes for reassessment to allow for safe management of the patient receiving EN?**

Practice Recommendations

1.   Monitor and evaluate the patient receiving EN to identify all changes in physical examination findings, laboratory values, anthropometric data, and outcomes.

2.   Include a thorough review of changes in clinical status, new medications and therapies, EN intake and tolerance, biochemical indices, anthropometric

changes (eg, physical examination and weight), and malnutrition risk.

3. Assess nutrition risk of the patient receiving EN throughout the patient's therapy.
    a. Determine frequency of assessment by considering patient acuity and progression of clinical care.
    b. Provide regular documentation of patient reassessment—typically, daily and/or weekly. Monitoring of nutrition status may be more frequent than documentation of reassessment.
4. Reassess the tube-fed patient in institutionalized long-term care *at least* monthly.
5. Reassess the home tube-fed patient *at least* quarterly.

Rationale

Reassessment timeframes will depend on the practice setting. EN intolerance will likely be noted within the first 3 days of initiation, if at all.[1] Monitoring parameters focus on changes in clinical status that will likely affect tolerance of the enteral prescription. Tolerance is measured using various methodologies, which are discussed elsewhere in this document. It is important to monitor the adverse effects of medications or particular forms of medications that can affect the safety of EN. For example, liquid medications with high sorbitol content may contribute to loose stools, dehydration, and perceived intolerance of the enteral formula. Interruptions to EN, including those due to intolerance of EN, are monitored because they can contribute to undernutrition.[2] Energy deficit is associated with increased clinical complications, especially infections.[3] It is important to monitor that medications are administered separately and diluted appropriately to prevent clogging of the tube and missed nutrition.

Routine laboratory monitoring will assist the clinician in determining overall tolerance of the nutrition treatment plan.[4] The nutrition assessment and recommendations section found earlier in this document addresses this factor in more detail. Unintentional weight loss is a risk factor on validated malnutrition screening tools and therefore must be monitored closely in all patients on EN. Last, organizations need protocols to monitor and prevent potential adverse effects associated with EN, such as aspiration. The clinician can monitor oral hygiene and the use of other precautions, such as elevating the HOB to at least 30° to 45° during and after tube feeding.

Question 10.2. How is EN tolerance best determined?

Practice Recommendations

1. Assess tolerance to EN using a combination of parameters appropriate to the individual patient.
2. Evaluate patient subjective complaints, objective findings of GI function (eg, GRV, vomiting, diarrhea),

and physical examination findings (eg, abdominal distension).

Rationale

Patients in all settings and age groups must be monitored while undergoing EN support. Monitoring EN tolerance is essential in the delivery of EN because patients who experience EN intolerance frequently fail to achieve EN goals.[5] Monitoring for EN intolerance often includes multiple parameters such as GRV and assessment of GI function.[6] In a recent observational study, Wang and colleagues[7] reported that 32% of patients receiving EN in a large tertiary hospital experienced enteral feeding intolerance. Of those patients, approximately two-thirds demonstrated a single high GRV, whereas one-third experienced a combination or 2 or more of the following symptoms: high GRV, nausea/vomiting, and abdominal distention. Blaser and colleagues[5] recently evaluated EN intolerance in ICU patients with the objective to identify a definition most strongly associated with ICU mortality. They concluded the "best" definition of EN intolerance is based on "a complex assessment of GI symptoms" rather than a single measurement.

GRV monitoring and interventions to improve EN tolerance based on this assessment are covered elsewhere in this document. The American Society for Parenteral and Enteral Nutrition/Society of Critical Care Medicine nutrition guidelines, recommendation D1 states that "patients should be monitored daily for tolerance of EN (determined by physical exam, passage of flatus or stool, radiologic evaluations and absence of patient complaints such as pain or abdominal distention)." Inappropriate cessation of EN should be avoided.[8]

Question 10.3. What is the best way to transition from EN to oral feeding?

Practice Recommendations

1. Identify a safe oral feeding regimen through discussion with interdisciplinary team members, including speech and language specialists who evaluate swallowing and aspiration risk with various food consistencies. Provide an individualized diet with necessary modifications in the initial stages of oral intake.
2. Transition continuous EN to an intermittent schedule when clinically appropriate. Provision of either partial or full EN via this intermittent regimen will depend on the nutrition needs and status of the patient.
3. Coordinate oral feedings with times when EN is off to help stimulate appetite. Consider intermittent EN feedings that are administered as a supplement after a meal is consumed and/or continuous feedings at night.
4. Establish a consistent meal routine.

5. Document the percentage of food consumed at each meal or snack. Ideally, the type and amount of food are also recorded.
6. Document any identified issues with oral consumption.
7. Involve the patient and/or family members in food and oral supplement preferences regarding oral diet advancement.
8. Monitor swallowing performance, nutrition and hydration status, and respiratory complications with adjustment of EN as appropriate.
9. Consider a trial of eliminating the EN regimen when the patient is able to meet the majority of energy needs with oral intake.
10. Obtain weights at least weekly to ensure adequate caloric intake to meet weight goals.

Rationale

Transitional orders from EN to oral feeding have been defined as incremental decreases in EN volume over a period of time to accommodate for increasing oral intake. Minimal research or guidelines exist regarding transition from enteral feeding to oral feeding. Crary and Groher[9] recommends that at minimum, tube-fed patients with dysphagia must demonstrate a safe and efficient swallow on a consistent basis to be considered candidates to return to oral feeding. Additionally, patients must be able to consume adequate food or liquid to support nutrition requirements before they can be fully transitioned from EN to oral feeding.

Buchholz[10] developed a clinical algorithm specific to patients with acquired brain injury or stroke that provides suggestions for transitioning tube-fed patients to oral feeding. The initial transition phase is termed the *preparatory phase* and focuses on the patient's physiologic readiness for oral nutrition. This first phase incorporates medical and nutrition stability, intermittent tube-feeding implementation, and swallowing assessment. The second phase is termed *weaning* and includes a graduated increase in oral feeding, with corresponding decreases in tube feeding. In this algorithm, once a patient is consuming 75% or more of his or her nutrition requirements consistently by mouth for 3 days, all tube feedings are discontinued. Another proposed option is nighttime cycling of EN once patients are meeting more than 60% of target calories by the oral route.[11]

Clinical reality dictates that both patients and healthcare professionals will vary in terms of their readiness to discontinue enteral feeding. The process of transition should be thoroughly discussed with the patients, assuming that they are clinically able to communicate, and outline a plan of action. Simple and patient-specific goals are often helpful. Oral ingestion is best attempted at times when the stomach is not full, taking full advantage of the hunger drive. Continuous feedings can be modified to an intermittent schedule to stimulate normal hunger cycles, and ideally, intermittent feedings are tolerated before an oral diet is attempted. When patients attempt oral feedings, it is important that they are fully upright and alert. For patients with fluctuating mental status, try feeding when their pattern of alertness is maximal. Therefore, for these patients, return to oral intake may only involve attempts at 1 or 2 meals per day. If patients have swallowing difficulties, a speech-language pathologist can recommend appropriate types and textures of food to put on trays.

During the transition process, it is important to remember that the total time to wean from tube feeding to oral feeding is patient dependent. Also, weaning from tube to oral nutrition is not a goal shared by all patients.[12] Abrupt discontinuation of nutrition therapy predisposes the patient to hypoglycemia if an insulin regimen is not adjusted. A reduction in the nutrition support infusion rate without an adjustment in insulin therapy was the second most common cause for hypoglycemia in 1 retrospective study.[13] Close monitoring of glycemic control in patients transitioning from enteral to oral diet is critical to prevent sentinel events.

Topics for Future Research

- Optimal frequency of nutrition screening/reassessment based on outcomes
- Optimal protocol to transition EN to order feeding
- Updated data on pump accuracy studies using pumps currently in use in the United States

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Section 11. Transition of Care

Background

A major goal of transitioning the EN patient to home or an alternate care site is to prevent readmission to the acute facility. Therefore, many factors need to be considered to ensure that patients have everything for the safe and successful admission of EN at home or in another setting. Institutions play a critical role in ensuring the safe transition and adequate education of patients and caregivers to home EN therapy. Optimal transition to home EN requires a collaborative approach among all disciplines and professions involved in the care of the patient.[1,2] Disciplines involved in the transition of home EN patients can use guidelines, policies, and procedures to best serve the interests and safety of these patients. It is advisable to commence the education of the patient and caregiver as early as possible so potential problems and concerns can be identified.[3]

> **Question 11.1. What are the criteria and factors to consider to safely transition a patient on EN from the hospital to home or an alternate care site?**

Practice Recommendations

1. Establish tolerance to EN at the goal regimen prior to discharge.
2. Provide written and verbal instruction to the patient and/or caregivers well before discharge.
3. Ascertain that the patient/caregiver demonstrates competence in all components of the EN therapy.
4. Assess safety of the home environment by including home care provider and case manager in the process.
5. Utilize competent nutrition clinicians to monitor home EN therapy.
6. Prior to discharge, educate the patient/caregiver on how to obtain necessary supplies.

Rationale

To ensure a safe transition of the EN patient from the hospital to home setting, multiple conditions must be met. Most important, the patient must tolerate the EN therapy (formula, rate, and volume) to be continued in the home or alternate care setting. Patients experiencing EN intolerance are at much greater risk of developing complications that may require hospital readmission, including tube blockage, GI issues, and underhydration or overhydration. The patient/caregivers will need education about the EN therapy to be used in the new setting. Written and verbal instruction can begin well before discharge and will include the following: all elements of the EN prescription, including water-flushing regimen and treatment plan; care of the feeding tube; troubleshooting of common complications; and who to contact for help at any time. Instruction to specifically address water requirements and flushing is important. In a study of older adults receiving EN at home, 73% of patients reported decreased urination and 63% reported constipation.[1] As part of the instruction process, educators must evaluate the patient/caregiver's ability to demonstrate competence in the fundamental aspects of EN therapy.

Prior to discharge, the home environment must be screened for safety. A clean water supply, refrigeration and electricity, a sanitary environment, sufficient space to administer feedings and store supplies, and telephone access are required to safely administer EN at home.[2] In addition, the home must have resources available for use during emergencies. For alternate site care, the care team at the hospital thoroughly discusses the patient's plan of care with the receiving facility's nutrition support expert.

The lack of professional nutrition services in the home setting may increase the risk of preventable complications. In 1 report, one-third of older adult patients receiving EN at home reported tube clogs or leaks, problems that increase the risk for underfeeding, dehydration, or stoma complication. Almost one-third of patients using an EN pump reported pump malfunction, which increases the risk of underhydration and underfeeding.[1] The need for tube changes is another common complication of EN.[3] These patients need to be managed and monitored by healthcare professionals who are competent in nutrition support and are available to respond to complications. In addition, collaboration and communication between these professionals are essential.[2,4]

Patients receiving EN at home often feel isolated as a result of their therapy.[5] To help prevent such isolation, clinicians involved in preparing patients for EN at home can refer them to a support organization, such as the Oley Foundation or the Feeding Tube Awareness Foundation, which can help patients when the need for EN at home is established and prior to hospital discharge.[5] When preparing patients for home, the care team can also establish an initial and ongoing process for obtaining all necessary supplies, including initial review and verification of insurance and/or third-party coverage prior to discharge. In addition, the home medical supply company or alternate site must be able to supply formula, equipment, and supplies prior to or upon discharge. It is certainly advantageous to the patient's safety and comfort if the home supply company provides competent nutrition clinicians to address education needs, tolerance, complications, and nutrition adequacy of EN at home.

Questions 11.2–11.4. What components of EN education are important to promoting efficacy, safety, and quality of life for the caregiver/patient? What are the most effective methods of caregiver/patient EN education/instruction considering literacy and safety? When should education/instruction for patients receiving EN at home be performed?

Practice Recommendations

1. Begin the referral process once the decision for EN therapy is made.
2. Begin education for the patient receiving EN at home prior to placement of the EAD.
3. Provide patient and caregiver education that is comprehensive, includes education materials related to EN therapy, and uses a standard checklist.
4. Provide the patient and caregiver with verbal and written education that covers the following topics:
    a. Reason for EN and short-term and long-term nutrition goals (ie, weight goal)
    b. Feeding device, route and method, formula, and feeding regimen
    c. Identify necessary supplies needed to administer enteral tube feedings at home
    d. Use and cleaning of equipment, including administration/feeding set, infusion pump, and syringe
    e. Care of the feeding tube and access site such as securing, flushing, and unclogging the tube and stoma care
    f. Nutrition and hydration guidelines: feeding plan/regimen, water flushes, hydration monitoring
    g. Weight schedule, lab work recommendations
    h. Safe preparation and administration of formula
    i. Safe preparation and administration of medications
    j. Proper position during and after feedings
    k. Recognition and management of complications (mechanical, gastrointestinal, and metabolic)
    l. Available resources, emergency care plan, and healthcare contacts
5. Use demonstration and teach-back method of patient education to assess comprehension.
6. Use various methods of education for EN to take into account various learning styles.
7. Implement an EN education checklist to assist with the discharge coordination process.

Rationale

Effective patient and caregiver education is an integral part of discharge for patients going home on EN and can start soon after the decision is made to transition a patient. Inadequate initial EN education and follow-up have been reported as

challenges associated with EN at home.[6] A study of parents of children receiving EN at home reported that most parents indicated a need for improved EN services. Parents wanted a more structured follow-up and would have preferred that 1 healthcare professional coordinate EN education and discharge.[7]

Institutions need guidelines, protocols, and policies for the safe provision of EN to adult and pediatric patients as well as procedures for ensuring a safe discharge to home on EN. Home care and supply companies should continue this process after discharge. When possible, it is advisable to provide training for more than 1 person on all aspects of tube care and feeding management. Essential components of the education process include training on feeding tube and access site care, preparation and administration of formula, medication administration, enteral pump operation, monitoring and troubleshooting complications, and emergency care plan and contact information.[6,8–12] Thompson et al[13] have emphasized the need for clinicians to evaluate the effectiveness of their EN education process, provide comprehensive EN education and patient resources, proceed over more than 1 educational session, and prepare patients and caregivers to resolve foreseeable problems, such as tube occlusion and dislodgement, skin care issues, and psychosocial challenges.

Patients receiving EN at home may cope more effectively and comply more successfully with the EN plan when clinicians actively seek their input regarding the feeding plan and craft a plan that is as flexible as possible to conform with the family's lifestyle. Flexibility within feeding regimens may alleviate some of the stress that patients have and has the potential to improve the impact of EN on quality of life. Simplifying the EN regimen, minimizing the infusion time, and providing an ambulatory pump or feeding tube that best fits the patient's physical and lifestyle needs may help reduce EN-associated life disruptions.[13] For some patients with gastrostomy tubes, transition to home may be made easier by employing the syringe/bolus feeding method. Feedings are ideally scheduled to fit as conveniently as possible with the patient's home and/or work routine. In addition, the clinician can help the patient/caregiver understand why changes to the enteral or medication regimen could result in adverse outcomes.[6] Another opportunity to help patients cope with the day-to-day living on home nutrition support is to refer the patient to a support group or organization specific to the disease or therapy the patient is experiencing.

Various methods may be used to deliver education for the patient receiving EN at home. The most effective methods for a given patient or caregiver will take into account the individual's specific learning styles and provide visual demonstration and reinforcement with graphics, video, online tutorials, nutrition education handouts, or other approaches that best suit the learner. Language and health literacy are factors to consider in the instruction process. Clayton[14] authored an invited review to aid selection of effective patient nutrition education materials and has identified some key features of the healthcare delivery system that may detract from the effectiveness of EN education

and negatively affect the patient's ability to safely administer EN at home, including decreased patient-provider contact time, length of hospital stay, and increased patient responsibility for self-care. When selecting education materials, it is important to evaluate them for content, literacy level, graphics, layout, and typography. The motivating principles, cultural relevance and primary language, feasibility (cost, equipment needs), and accessibility are other factors to consider in patient education. When online sources are used, educators need to evaluate the references' credibility and help patients find reliable Internet resources. For example, websites can be reviewed for potential conflicts of interest, disclaimers, and disclosures, and the ease of navigation and interactivity can also be evaluated.[14]

An EN discharge checklist helps the educator and patient/caregiver document and track stepwise instruction. Use of a discharge checklist has been shown to enhance patient care and help streamline the discharge coordination process.[15] The Agency for Clinical Innovation and the Gastroenterological Nurses College of Australia clinician's guide provides an example of an EN checklist.[16] Items detailed in this example include tube/device and site care, the nutrition and hydration plan, regimen details and preparation instructions, procedures for supply procurement and refills, monitoring, follow-up care, and contact details. The checklist can also document the date(s) that instruction was given and whether the patient and/or caregiver can demonstrate the instructions, as indicated by patient/caregiver and educator signatures.[16]

Optimal EN education begins before the EAD is placed. Preoperative education may increase the patient's comfort level, allay anxiety, reduce the hospital length of stay, and improve patient satisfaction. Whenever possible, the patient and family must be made aware before the procedure of potential complications and scope of care of the feeding tube, as well as what costs of care will be reimbursed.[17] Identifying concerns early can help alleviate some of the patient's fears and potential misconceptions about having a feeding tube. Early educational interventions also provide opportunities to assess the ability of the patient to care or obtain care for the tube and administer feedings.

Question 11.5. What is the best method to communicate enteral prescriptions and care instructions during patient transfer or discharge home or alternate care site?

Practice Recommendations

1. Determine the safest and most effective mechanism for communicating the EN care plan. See Figure 12.
2. Involve representatives of the discharging site (nutrition support clinician, case manager, or prescriber) and the accepting site or home care team (nutrition support clinician, home supply company, home health agency) in planning the care transition.

3. Transfer the EN prescription and regimen to the accepting home care team (nutrition support clinician/home supply company/home health agency) via standard electronic information systems accessible to all healthcare providers and suppliers associated with the patient prior to discharge.
4. Communicate the EN regimen to the home care team caring for the patient.

Rationale

Adequate and timely transfer of information between inpatient and community settings is imperative for safe care of EN patients.[18] Incomplete or incorrect communication of the EN prescription and regimen during patient transfer may delay the administration of adequate and appropriate nutrition. It may also lead to hospital readmissions and emergency department visits that may have been preventable.[1] See Figure 12 for a template of information that should be available for safe transitions. Ideally, the enteral prescription and regimen are transferred to the accepting home care team via standard electronic information systems that are accessible to all healthcare providers and suppliers associated with the patient.[19] Use of these systems may improve communication; however, they may not be universally available or accessible due to technical limitations or institutional policies. The EN prescription and regimen are best communicated in the available medical record. Effective communication of the EN plan is written in plain language, includes all essential elements, and does not use abbreviations that might lead to misinterpretation and error. Ideally, the EN plan is provided to the home health agency or medical supply company prior to discharge.[1,19] If a change or clarification of the EN prescription must be communicated by phone, the person receiving the new information should repeat it back to ensure that it is received and interpreted correctly.

Clear and complete communication of the EN prescription will cover the feeding method, the name of the formula and any modular additives, the calorie concentration, the rate in milliliters per hour if pump fed, and the volume of formula per feeding or per day, as well as the duration of the feeding—for example, [full name of specific formula product, including concentration] at 75 mL/h times 22 hours to provide 1650 mL daily. Clear and complete instructions about water flushes are also part of the EN prescription and regimen communicated to the patient or caregiver and the home care team.[1] An example of these instructions would be as follows: 250 mL of water 4 times daily plus 50 mL water before, with, and after each medication. If feeding tubes are included in the EN prescription, instructions about the brand, type, French size, and length, if applicable, are also communicated.[16] Communication of the home EN regimen, including guidance on tube replacement and medication administration, is relevant to all healthcare providers and suppliers involved in the patient's care. An interdisciplinary team consisting of the case manager, prescriber, nurse, dietitian, and homecare provider can facilitate the effective communication of the nutrition prescription.[20,21]

CURRENT EN ORDER

Patient Name: _____   Medical Record Number: _____

Date of Birth: _____   Current Dosing Weight: _____ kg   Height _____ cm

Anticipated Discharge/Transfer Date: _____   To: _____

EN FORMULA

Energy _____ kcal/d   Protein _____ g/d   Carbohydrate _____ g/d   Fat _____ g/d

[] Standard   [] Fiber Containing   [] Elemental or Peptide-based

[] Standard, High Protein   [] Carbohydrate Controlled   [] Immune-modulating

[] Standard, High Calorie   [] Renal, Low Electrolyte

DELIVERY SITE
(Route and Access)

ROUTE:	ACCESS:		
[] Gastric	[] Nasogastric	[] Orogastric	[] Gastrostomy
[] Small Bowel	[] Nasoduodenal	[] Oroduodenal	[] Jejunostomy
	[] Nasojejunal	[] Orojeujunal	[] Transgastric G/J tube

ADMINISTRATION
(Method and Rate)

Method: Rate:
[] Continuous   [] Currently at _____ mL/h with goal of _____ mL/h

[] Intermittent   [] Currently _____ mL feeding over _____ mins _____ times daily
                                        With goal of _____ mL feeding over _____ mins _____ times daily

[] Bolus   [] Currently _____ mL bolus over _____ mins _____ times daily
                                        With goal of _____ mL bolus over _____ mins _____ times daily

Water Flush _____ mL every _____ hours (minimum volume _____ mL)

CURRENT CLINICAL DATA

Current Nutrition Assessment:

> History …
>
> Vitals including anthropometrics …
>
> Pertinent findings
> - Nutritionally focused physical exam
> - EN tolerance
> - Tests
> - Recent lab data

Date →			
Serum Sodium			
Serum Potassium			
…			

Anticipated Nutrition Care Plan:

> Maintain … with goal of ….
>
> Transition to oral diet …
>
> Transition to PN …

Figure 12. Enteral nutrition transition template. EN, enteral nutrition; G/J, gastrojejunostomy; PN, parenteral nutrition.

Question 11.6. If the patient is going home on a different formula (or different feeding method) than the one used in the hospital, is it advisable to try it first in the hospital?

Practice Recommendations

1. Use the type of formula that will be administered at home for a trial period prior to discharge.
2. Use the feeding method that will be administered at home for a trial period prior to discharge.
3. Avoid making last-minute changes to either the formula or method just prior to discharge.

Rationale

The hospital provides a safe setting in which patients are closely monitored for tolerance to EN. However, the patient may go home on a different enteral formula or feeding method due to patient preference, lifestyle or ability, insurance coverage, or product availability through the home health agency or the supply company. In this case, the new formula or feeding method should be used in the hospital setting for a trial period to avoid potential complications related to intolerance.[21] A trial may be more important when the patient is to transition from a more specialized formula to a standard or less-specialized product or to bolus or gravity feeding from continuous pump feeding. For example, a patient transitioning from a peptide-based to a standard formula may be at risk for intolerance and GI complications that may be more safely handled in the hospital setting. GI complications are common with EN at home and have the effect of reducing the amount of nutrition delivered to the patient, increasing the risk of malnutrition.[1]

Adequate instruction of the patient or caregiver on the feeding method and formula to be used at home can optimize safety and adherence to the treatment plan. Ideally, the method or regimen chosen for home care is one that fits well with the patient or family's ability and lifestyle.[8] Planning for discharge throughout the patient's hospital stay can reduce the risk of readmission.[22] Inpatient administration of the EN to be used at home and education on the EN regimen for home are part of the planning process.

Topics for Future Research

- Patient and caregiver ability, attitudes, and experiences
- Effect of insurance coverage for EN at home on outcomes
- Evaluation of EN patients' experience regarding the discharge process at home
- Evaluate support systems and potential interventions for caregivers of tube-fed children
- Appropriate mechanism for follow-up and monitoring for patients receiving EN at home
- EN and EHRs
- Ideal feeding method and formula for EN at home

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Section 12. Documentation and Quality Review Issues

Background

The EN process is highly complex, involving a multistep continuous process, including patient assessment and EN recommendations, prescribing, order review, the selection/procurement of enteral products, their preparation and labeling, and EN administration and monitoring/reassessment. Documentation throughout the EN process is important and provides a source for process evaluation from which to identify gaps in process and outcomes. For example, documentation of the nutrition assessment is core to the process and has a direct impact on patient care.

Question 12.1. What documentation needs to occur at each step in the EN process?

Practice Recommendations

1. Document nutrient requirements, including energy, protein, and fluid, in the medical record within 48 hours of admission.
2. Document data used for nutrition assessment, including nutrient/fluid intake, anthropometric data, weight changes and goal weight, lab work, functional and physical assessment, and any other assessment tools employed. If any data are extrapolated from another clinician's note, such as the physical examination, include from where the information was obtained.
3. Document the EN prescription and ancillary orders using the EHR as appropriate.
4. Document how the recommended EN regimen meets the estimated energy, protein, and fluid requirements initially and any time a different EN regimen is recommended.
5. Provide an EN prescription review mechanism for all clinicians involved.
6. Document the formula selection and preparation through policies and procedures and specifically for each patient in the EHR.
7. Develop and implement EN protocols to improve EN administration in patients.

Rationale

The first step of documentation in the EN process is determination of energy requirements to guide the nutrition plan of care. Wakeham and colleagues[1] performed a chart review in a cohort of pediatric ICUs and found that patients with documented calorie requirement were more likely to receive EN support than those without on each of the first 4 days of admission. Patients with documented calorie requirements had higher total daily energy intake by the enteral route and by the enteral and parenteral route combined. The authors concluded that documentation of calorie requirement in the medical record within 48 hours of

admission is significantly associated with higher total daily energy intake and more frequent use of the enteral route for nutrition. Importantly, in this study, the registered dietitian entered almost all of the calorie requirements that were present early in medical records. Documented protocols can also affect the quality of EN care. Kim and colleagues[2] performed a literature review to identify major barriers to adequate EN intake in critically ill adults. They found that interruption of EN is often due to avoidable causes such as routine nursing procedures and bedside care. Also, after an interruption occurs, EN may be restarted at a low rate. They suggest that standardized feeding protocols to prevent unnecessary cessation of feedings and restart of EN after interruptions may maximize EN delivery in the ICU.

Question 12.2. What organizational systems/administrative structures need to be in place to support a safe EN process?

Practice Recommendations

1. Provide leadership and oversight at the healthcare organizational level by competent clinicians knowledgeable in the EN process.
2. Develop and implement policies and evidence-based practice guidelines to support the individuals involved in the assessment and care of patients receiving EN.
3. Develop and implement policies and guidelines collaboratively among all disciplines involved in the EN process, and align policies and procedures from various disciplines, departments, and settings within the organization.
4. Create a formal committee or structure that includes expert clinicians from all disciplines to provide oversight of the EN process.

Rationale

Documentation needs to be supported by a strong infrastructure of organizational systems and administrative oversight. The EN process involves many disciplines and departments. An EN process that minimizes risks requires interdisciplinary collaboration, standardization through guidelines, and practice alignment among professions, departments, and settings. Evidence-based practice guidelines targeted at the clinical, departmental, and organizational levels support a safe EN process. Ideally, policies and guidelines addressing nutrition care, nursing care, and physician prescribing are developed to target each discipline's role in the EN process. These guidelines need to be aligned and complementary to avoid inconsistencies. Recent literature supports the use of enteral feeding practice guidelines and feeding algorithms to improve the safety and efficacy of enteral feedings. Gentles and colleagues[3] found that introduction of an enteral feeding practice guideline and participation by a dietitian in multidisciplinary bedside rounds

improved provision of nutrition support and overall energy intake. Similarly, Geukers and colleagues[4] demonstrated that the introduction of a nurse-driven, early EN algorithm and implementation of a nutrition support team safely and effectively increased the nutrition intake of critically ill children during the first few days of an ICU stay.

Organizations can use a governing body or committee composed of a multidisciplinary group of content experts, such as a nutrition committee, to support safe EN practice. This group can be charged with reviewing and approving guidelines and identifying educational programs and strategies to disseminate evidence-based guidelines and practices. This interdisciplinary group can also evaluate and respond to changes in the EN process, process failures, and data and outcome measures to continually improve the process to ensure safety and effectiveness.

Question 12.3. What is the role of clinical decision support in the EN order and review process?

Practice Recommendations

1. Use clinical decision support tools in guiding safe EN prescribing.
2. Develop and implement procedures for the EN order review process.

Rationale

The EHR provides the opportunity to use computerized clinical decision support (CDS) to guide accurate prescribing. CDS involves the use of alerts, algorithms, and rule-based recommendations to guide ordering. The impact of CDS is controversial. Shojania and colleagues[5] conducted a review of studies that evaluated the effect of computer reminders on processes or outcomes of care. Their goal was to determine the degree to which computer reminders changed provider behavior. They found that computer reminders delivered to physicians during routine electronic ordering achieved only small to modest improvement in care, with a median improvement of 4.2%. The authors concluded that these changes fall below thresholds that would be considered clinically significant and "constitute an expensive exercise in trial and error." Schedlbauer et al[6] performed a systematic review of alerts and other reminders and prompts to evaluate the impact on prescribing behavior. They evaluated 27 different types of alerts and prompts and found that 23 of 27 resulted in a significant improvement in prescribing behavior and/or reduction in medication errors, and many of the alerts and prompts were clinically relevant. The authors concluded that most of the studies that evaluated the impact of computerized CDS systems show positive and significant effects. Although these studies specifically target medication prescribing, the EN process parallels the medication management process and therefore the study findings are relevant to EN.

Question 12.4. What organizational quality control processes need to be implemented for EN safety?

Practice Recommendations

1. Develop and implement enteral feeding algorithms to improve the provision of nutrition and possibly reduce length of stay and mortality.
2. Develop organizational guidelines that address safe enteral practices collaboratively by a multidisciplinary team.
3. Disseminate the organizational guidelines by interactive communication/education methods utilizing individuals with nutrition expertise.
4. Monitor the EN process for safety and effectiveness.
5. Promote active involvement by members of the nutrition service in the development of electronic EN orders and clinical documentation to optimize safe and effective electronic communication.

Rationale

In a multicenter, cluster-randomized trial, Martin and colleagues[7] demonstrated that the implementation of evidence-based algorithms for nutrition support improved the provision of nutrition support, reduced hospital length of stay, and may decrease hospital mortality in critically ill patients in both community and teaching hospitals. Along with initiation of nutrition support algorithms, other strategies were used to improve the effectiveness of nutrition support care, including educational sessions, educational outreach, and audit with feedback. Guidelines alone are not adequate; they must be supported by professional collaboration, education, and effective communication strategies. In a review, Marshall and colleagues[8] identified factors that influence nursing nutrition practice around EN and how these factors contribute to variations in practice. Evidence-based guidelines were found to be important, but EN guidelines were often lacking strong recommendations and evidence related to nursing-specific practice, which limited their usefulness. To increase use of guidelines and effectively apply these standards to clinical care, the authors recommend that the implementation of guidelines be combined with contributions from resource personnel who have nutrition and clinical expertise. They emphasize that if the intent is to use guidelines to standardize and improve practice, the information is best delivered using strong communication strategies that incorporate social interaction as a component of this knowledge transfer. The authors also support an interdisciplinary, collaborative approach where professionals from different disciplines (namely, dietitians, nurses, and physicians) function in a supportive organizational environment that includes integrated and cohesive care and symmetrical power. This multidisciplinary team can collaborate in nutrition-related practice, education, and research.

Standardization of EN orders in the EHR is another avenue for supporting a safe EN process. Since the passage of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009, hospitals have been implementing EHR at increasing rates. Successful implementation of an EHR requires input from the clinicians who will use the EHR to provide patient care regarding how the EHR can be built and implemented to maximize patient care and avoid harm to patients. The safety and efficacy of nutrition and nutrition support content in EHR were the focus of a study that surveyed members of ASPEN. This survey indicated that most respondents (85.9%) were using an EHR, with the most common duration of use between 5 and 10 years. The results demonstrated a significant need for improvement in the safety and effectiveness of the nutrition and nutrition support content of the EHRs, with an overall rating of fair for this content (ratings ranged from unacceptable to excellent). The authors conclude that nutrition support content needs improvement and that nutrition support clinicians need to be actively involved in content development and optimization.[9]

Question 12.5. What competencies need to be maintained by clinicians involved in the EN process?

Practice Recommendations

1. Use discipline-specific standards and available competencies from professional organizations to create job descriptions for all clinicians involved in the EN process.
2. Encourage nutrition support clinicians involved in the EN process to be board certified by one of the accredited certifying organizations.
3. Develop at the healthcare organizational level competency evaluations that measure EN core elements and knowledge for all clinicians involved in the EN process.

Rationale

Given the complexity and scope of the EN process, each organization needs an oversight structure, which may reside within a standing committee. This group is uniquely qualified to oversee the EN process. In addition, all clinicians involved in the EN process must be competent and receive ongoing education/training to ensure safe and effective care. Education and competencies set by nutrition-related professional organizations are also important. For example, the standards of practice (SOP) and standards of professional performance (SOPP) for registered dietitian nutritionists (RDNs) in nutrition support have been developed by the American Society for Parenteral and Enteral Nutrition and the Academy of Nutrition and Dietetics.[10] These standards outline the competencies needed for dietitians to provide nutrition support care,

including EN. Similar standards are available for other clinicians involved in the EN process.[11–13] Board certification in nutrition support is highly desirable for those involved in the EN process. For example, the National Board of Nutrition Support Certification (NBNSC) certification examination validates that clinicians (dietitians, nurses, pharmacists, physicians, and physician assistants) have attained the threshold of skills and knowledge necessary to provide quality nutrition support care. Additional board certification processes are available for some of these healthcare professionals. Surveys of nutrition support professionals indicate that board certification is critical to providing safe and effective care to patients.[14] Brody and colleagues[15] conducted a survey of healthcare professionals affiliated with ASPEN and used a case-based scenario based on established clinical guidelines to evaluate knowledge of nutrition support practices. More than half of the respondents were board certified by NBNSC, and the results indicated that those holding the certification were significantly more likely to choose correct answers compared to those without the credential. Although a certification examination cannot guarantee patient safety, it can help ensure patient safety by identifying those individuals who can demonstrate knowledge through a standardized validated board certification process.[15]

Question 12.6. What essential EN administration and monitoring components should be documented by nursing staff and at what interval should EN clinical documentation occur?

Practice Recommendations

1. Document interruptions to enteral feedings, including reason and length of interruption; this is best done by the nursing staff.
2. Document HOB elevation, date/time of administration start and tubing changes, and residuals for gastric feedings at each shift.
3. Document amount, type, frequency, and rate of feeding; patient's response to tube feeding; abdominal assessment; patency of the tube; condition of the skin at tube site if placed in abdominal wall; amount of any additional water; flush volume, frequency, and rate; and patient and family education.
4. Record intake and output, weights, and methods used to verify placement of an EAD.
5. Complete the nursing documentation of EN at each shift or with any change in condition or order.

Rationale

Documentation of nursing care related to EN administration and monitoring is critical to a safe EN process and can be supported by protocols and evidence-based guidelines.[2]

HOB elevation, the time/date of EN administration, and residuals are common nursing documentation standards. According to Mosby's Nursing Skills,[16] the following documentation is also recommended: amount, type, frequency, and rate of feeding; patient's response to tube feeding; abdominal assessment; patency of tube; condition of the skin at tube site if placed in abdominal wall; amount of any additional water; flush volume, frequency, and rate; and patient and family education.

Topics for Future Research

- How well does documentation at each step of the EN process identify opportunities for safety improvement
- Data on clinical decision support systems and EN prescribing and safety

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Conclusion

The EN process consists of numerous steps involving several disciplines that perform a number of specific tasks at each step. These daily responsibilities are critical to ensuring safe care of the patient requiring EN therapy. Given the potential risk for error in the systems within which EN is used, ongoing systematic surveillance, critical process and outcome evaluation, and quality improvements will support patient safety. Organizations can incorporate into their system of care the best practice recommendations within this document, to support a culture of safety, by applying an interdisciplinary approach in an accommodating administrative structure.