

- adequately for Maximum Effect (FEED ME)” protocol in a surgical trauma ICU: a quality improvement review. *Nutr Clin Pract*. 2014;29(5):639-648.
58. Ventura AM, Waitzberg DL. Enteral nutrition protocols for critically ill patients: are they necessary? *Nutr Clin Pract*. 2015;30(3):351-362.
  59. Woien H, Bjork IT. Nutrition of the critically ill patient and effects of implementing a nutritional support algorithm in ICU. *J Clin Nurs*. 2006;15(2):168-177.
  60. Bourgault AM, Ipe L, Weaver J, Swartz S, O’Dea PJ. Development of evidence-based guidelines and critical care nurses’ knowledge of enteral feeding. *Crit Care Nurse*. 2007;27(4):17-29.
  61. Cahill NE, Murch L, Cook D, Heyland DK. Improving the provision of enteral nutrition in the intensive care unit: a description of a multifaceted intervention tailored to overcome local barriers. *Nutr Clin Pract*. 2014;29(1):110-117.
  62. Klein CJ. Nutrient requirements for preterm infant formulas. *J Nutr*. 2002;132(6)(suppl 1):1395S-1577S.
  63. Raiten DJ, Talbot JM, Waters JH. Assessment of nutrient requirements for infant formulas: LSRO report. *J Nutr*. 1998;128(11S):2059-2294S.
  64. Guenter P, Hicks RW, Simmons D, et al. Enteral feeding misconceptions: a consortium position statement. *Jt Comm J Qual Patient Saf*. 2008;34(5):285-292.
  65. Dervan N, Dowsett J, Gleeson E, Carr S, Corish C. Evaluation of over- and underfeeding following the introduction of a protocol for weaning from parenteral to enteral nutrition in the intensive care unit. *Nutr Clin Pract*. 2012;27(6):781-787.
  66. Racco M. An enteral nutrition protocol to improve efficiency in achieving nutritional goals. *Crit Care Nurse*. 2012;32(4):72-75.
  67. Roy S, Rigal M, Doit C, et al. Bacterial contamination of enteral nutrition in a pediatric hospital. *J Hosp Infect*. 2005;59:311-316.
  68. Anderton A, Nwoguh CE, McKune I, Morrison L, Grieg M, Clark B. A comparative study of the numbers of bacteria present in enteral feeds prepared and administered in hospital and the home. *J Hosp Infect*. 1993;23:43-49.
  69. Perry J, Stankorb SM, Salgueiro M. Microbial contamination of enteral feeding products in thermoneutral and hyperthermal ICU environments. *Nutr Clin Pract*. 2014;30:128-133.
  70. Muytjens HL, Roelofswillems H, Jaspas GHJ. Quality of powdered substitutes for breast-milk with regard to members of the family Enterobacteriaceae. *J Clin Microbiol*. 1988;26:743-746.
  71. Baniardalan M, Sabzghabae AN, Badri S. Bacterial safety of commercial and handmade enteral feeds Iranian teaching hospital. *Int J Prev Med*. 2014;5:604-610.
  72. Centers for Disease Control and Prevention. *Enterobacter sakazakii* infections associated with the use of powdered infant formula—Tennessee, 2001. *MMWR*. 2002;51:297-300.
  73. Johnson T, Spurlock A, Galloway P. Blenderized formula by gastrostomy tube: a case presentation and review of the literature. *Top Clin Nutr*. 2013;28(1):84-92.
  74. Brown BM, Roehl K, Betz M. Enteral nutrition formula selection: current evidence and implications for practice. *Nutr Clin Pract*. 2015;30(1): 72-85.
  75. Jonkers-Schuitema CF. Basics in clinical nutrition: Diets for enteral nutrition home made diets. *Eur J Clin Nutr Metab*. 2009;4(4):168-169.
  76. Mortensen M. Blenderized tube feeding: clinical perspectives on homemade tube feeding. *PNPG Post Publ Pediatr Nutr Pract Group*. 2006;17(1):1-4.
  77. Pentiuik S, O’Flaherty T, Santoro K, Willging P, Kaul A. Pureed by gastrostomy tube diet improves gagging and retching in children with fundoplication. *JPEN J Parenter Enteral Nutr*. 2011;35(3):375-379.
  78. Novak P, Wilson KE, Ausderau K, Cullinane D. The use of blenderized tube feedings. *Infant Child Adolesc Nutr*. 2009;1(1):21-23.
  79. Jalali M, Sabzghabae AM, Badri SS, Soltani HA, Maracy MR. Bacterial contamination of hospital-prepared enteral tube feeding formulas in Isfahan, Iran. *J Res Med Sci*. 2009;14(3):149-156.
  80. Borghi R, Dutra Araujo T, Airoidi Vieira RI, Theodoro de Souza T, Waitzberg DL. ILSI Task Force on enteral nutrition; estimated composition and costs of blenderized diets. *Nutr Hosp*. 2013;28(6):2033-2038.
  81. Moe G. Enteral feeding and infection in the immunocompromised patient. *Nutr Clin Pract*. 1991;6(2):55-64.
  82. Guenter P, McMichael D. Further updates on blenderized diet use with the new enteral connectors. *Lifeline Letter*. 2014;35(4).
  83. Mundi MS, Epp L, Hurt RT. Increased force required with proposed standardized enteral feed connector in blenderized tube feeding [published online April 18, 2016]. *Nutr Clin Pract*.
  84. Santos VF, Morais TB. Nutritional quality and osmolality of home-made enteral diets, and follow-up of growth of severely disabled children receiving home enteral nutrition therapy. *J Trop Pediatr*. 2010;56(2):127-128.
  85. Sullivan MM, Sorreda-Esquerre P, Platon MB, et al. Nutritional analysis of blenderized enteral diets in the Philippines. *Asia Pac J Clin Nutr*. 2004;13(4):385-391.
  86. O’Flaherty T, Santoro K, Pentiuik S. Calculating and preparing a pureed-by-gastrostomy-tube (PBGT) diet for pediatric patients with retching and gagging postfundoplication. *Infant Child Adolesc Nutr*. 2011;3(6): 361-364.
  87. Ayers P, Adams S, Boullata J, et al. A.S.P.E.N. parenteral nutrition safety consensus recommendations. *JPEN J Parenter Enteral Nutr*. 2014;38: 296-333.
  88. Pery AG, Potter PA. *Clinical Nursing Skills & Techniques*. 8th ed. St Louis, MO: Mosby; 2014:775.
  89. Guenter P. Safe practices for enteral nutrition in critically ill patients. *Crit Care Nurs North Am*. 2010;22:197-208.
  90. Academy of Nutrition and Dietetics. *Pediatric nutrition care manual: Expression, handling, and storage of human milk*. <https://www.nutritioncaremanual.org/about-pncm>. Accessed June 14, 2015.

## 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 misconceptions, 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.<sup>1-3</sup> 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.<sup>4-8</sup> Heyland et al<sup>9</sup> demonstrated that protocols can significantly improve nutrition practices. Racco<sup>10</sup> 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<sup>11</sup> 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.<sup>12</sup>

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<sup>13</sup>:

- 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.<sup>14</sup> 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<sup>11</sup> 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<sup>15</sup> 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.<sup>11,16</sup> 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.<sup>17</sup> 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<sup>18</sup>
- 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<sup>19</sup> 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<sup>11</sup> 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.<sup>20,21</sup> Metheny and colleagues<sup>22</sup> 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<sup>23</sup> 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.<sup>24-26</sup> 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.<sup>27</sup>

It is important to obtain, ascertain, and maintain optimal enteral tube placement to help reduce potential reflux of EN. Metheny et al<sup>28</sup> 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<sup>29</sup> 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.<sup>2</sup>

#### **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 prone 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.<sup>30</sup>

Linn et al<sup>30</sup> 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<sup>31</sup> 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.<sup>30</sup> 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.<sup>32</sup> Schallom and colleagues<sup>33</sup> 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.<sup>34</sup>

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.<sup>16</sup> 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.<sup>35</sup>

Carron and colleagues<sup>36</sup> 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<sub>2</sub>O 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.<sup>37,38</sup>

**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<sup>9</sup> 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<sup>39</sup> 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.<sup>40</sup> Lichtenberg et al<sup>41</sup> 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<sup>42</sup> 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<sup>43</sup> 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.<sup>44</sup>

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.<sup>45</sup> 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<sup>46</sup> 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.<sup>47</sup> These authors published the review of enteral pumps, suggesting that formula delivery is accurate to within  $\pm 10\%$  of what is programmed. Some pediatric and adult systems report adhering to deviance rates of only  $\pm 5\%$ .<sup>46</sup>

Pump inaccuracy has been identified as a primary contributing factor in both underdelivery and overdelivery of feedings.<sup>48</sup> Tepaske et al<sup>45</sup> 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,<sup>49</sup> 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.<sup>50</sup> Additionally, incorrect key presses may cause a particular type of pump to appear to be infusing even though an occlusion exists.<sup>50</sup> 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.<sup>46</sup> 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;

- b. 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.<sup>1,51</sup> 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.<sup>52</sup> 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.<sup>38,53,54</sup> Blenders used in reconstituting formulas have been cited as a primary source of contamination.<sup>55</sup> 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.<sup>56</sup> 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<sup>57</sup> 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<sup>58</sup> and Hurrell et al.<sup>59</sup> In Juma and Forsythe’s study, some of the organisms were encoded for antibiotic resistance.<sup>58</sup> 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.<sup>59</sup> 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.<sup>60</sup> 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.<sup>61</sup> 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.<sup>62</sup> Mathus-Vliegen et al<sup>51</sup> 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.<sup>52</sup>

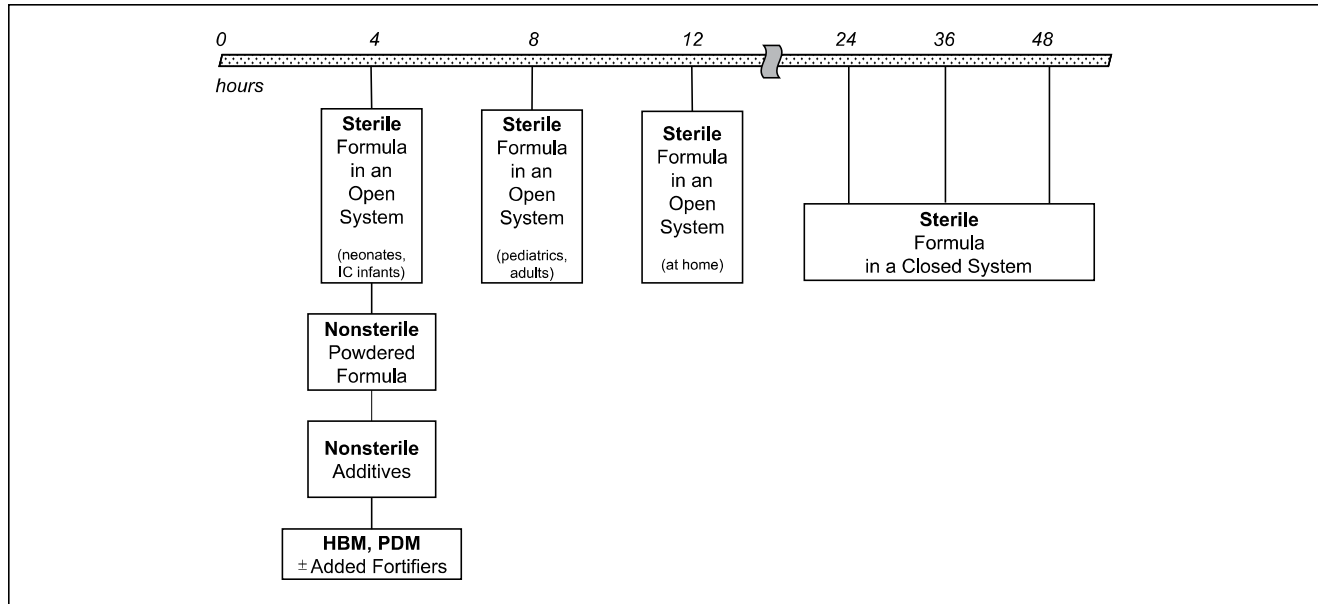
Ho and colleagues<sup>63</sup> found a strong correlation between cultures taken from staff hands and contamination of tube hubs, enteral feeding, and nasopharynx and gastric fluid, and the investigators noted a significant reduction in contamination in the group that received an infection control program (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,<sup>64</sup> 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<sup>65</sup> 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).<sup>66</sup>

Williams and colleagues<sup>67</sup> 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<sup>16</sup> 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.<sup>68,69</sup> 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.<sup>70</sup> There are many potential causes of frequent and/or loose stools, including medications, underlying disease, and prior status, but bacterial contamination must be considered.<sup>70</sup> 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.<sup>71</sup> Jack et al<sup>72</sup> 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<sup>73</sup> 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.<sup>44</sup>

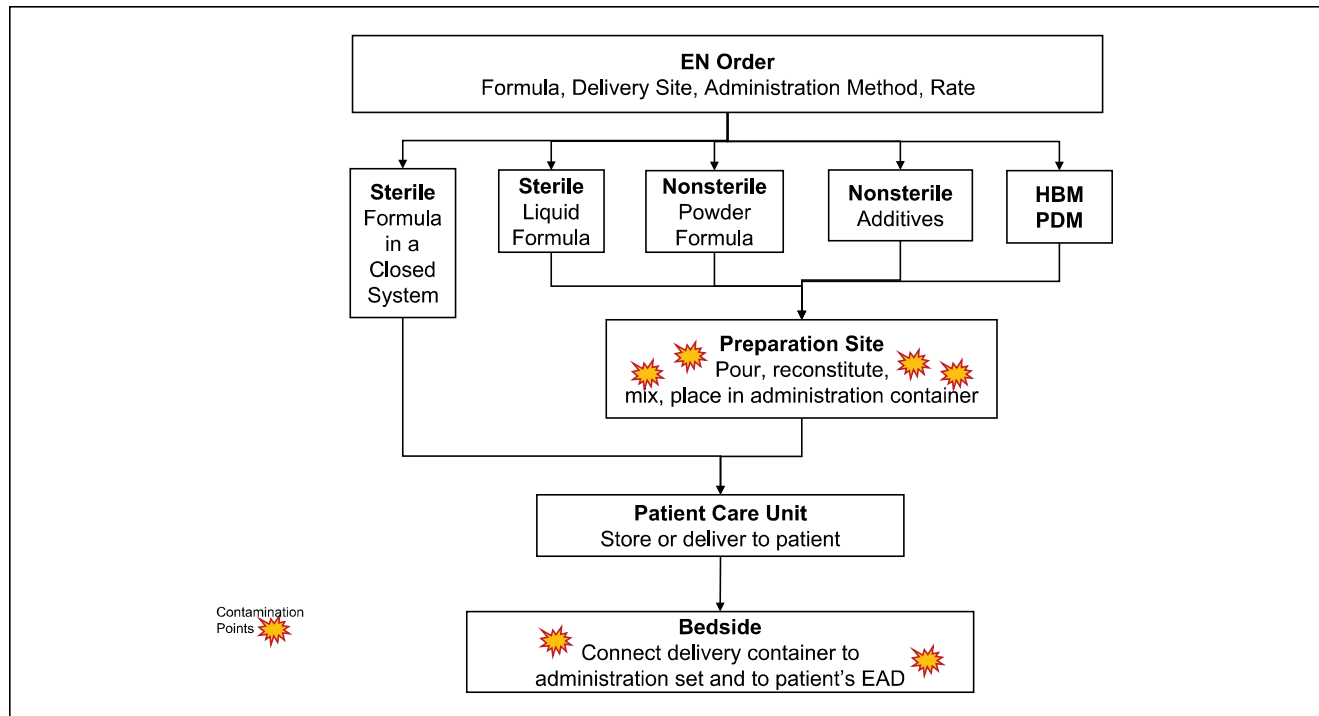
Healthcare organizations that follow national standards practice recommendations (eg, Hazard Analysis and Critical Control Point [HACCP] and National Institute for Health and Clinical Excellence [NICE] 2012) in training and monitoring staff who work with EN can reduce and contain microbial growth.<sup>74,75</sup> For example, Oliveira et al<sup>55</sup> 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.<sup>66</sup> 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<sup>76</sup>:
  - 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<sup>77</sup> 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<sup>16</sup> 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.<sup>78</sup> 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.<sup>28,34</sup> 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.<sup>79</sup> 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,<sup>80</sup> 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<sup>81</sup> 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.<sup>76</sup>

The practice of holding EN for patient conditions also warrants critical appraisal. For example, McClave and Chang<sup>82</sup> 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.<sup>39,48,83</sup> 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.<sup>84–86</sup> Deficits of 0.5%–21% have been observed.<sup>84,85</sup> 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.<sup>76</sup> 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

### References

1. Bankhead R, Boullata J, Brantley S, et al. Enteral nutrition practice recommendations. *JPEN J Parenter Enteral Nutr.* 2009;33:122-167.
2. American Association of Critical-Care Nurses. AACN Practice Alerts: prevention of aspiration. *Crit Care Nurs.* 2016;36(1):e20-e24.
3. McClave SA, Taylor BE, Martindale RG, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *JPEN J Parenter Enteral Nutr.* 2016;40(2):159-211.
4. Mackenzie SL, Zygun DA, Whitmore BL, Doig CJ, Hameed SY. Implementation of a nutrition support protocol increases the proportion of mechanically ventilated patients reaching enteral nutrition targets in the adult intensive care unit. *JPEN J Parenter Enteral Nutr.* 2005;29(2):74-80.
5. McCarthy MS, Martindale RG. What's on the menu? Delivering evidence-based nutritional therapy. *Nursing.* 2015;45(8):36-44.
6. Ventura A, Cordeiro M, Waitzberg DL. Enteral nutrition protocols for critically ill patients: are they necessary? *JPEN J Parenter Enteral Nutr.* 2015;30(3):351-362.
7. Martin CM, Doig GS, Heyland DK, Morrison T, Sibbald WJ; Southwestern Ontario Critic Care Research Network. Multicentre, cluster-randomized clinical trial of algorithms for critical-care enteral and parenteral therapy (ACCEPT). *CMAJ.* 2004;170(2):197-204.
8. Stewart ML. Nutrition support protocols and their influence on the delivery of enteral nutrition: a systematic review. *Worldviews Evidence Based Nurs.* 2014;11(30):194-199.
9. Heyland DK, Cahill NE, Dhaliwal R, Sun X, Day AG, McClave SA. Impact of enteral feeding protocols on enteral nutrition delivery: results of a multicenter observational study. *JPEN J Parenter Enteral Nutr.* 2010;34(6):675-684.
10. Racco M. An enteral nutrition protocol to improve efficiency in achieving nutritional goals. *Crit Care Nurs.* 2012;32(4):72-75.
11. Kenny DJ, Goodman P. Care of the patient with enteral tube feeding: an evidence based practice protocol. *Nurs Res.* 2010;59(1):S22-S31.
12. Yantis MA, Velder R. Untangling enteral nutrition guidelines. *Nursing.* 2011;41(9):32-38.
13. Guenter P, Hicks RW, Simmons D, et al. Enteral feeding misconceptions: a consortium position statement. *Jt Comm J Qual Patient Saf.* 2008;34:285-292.
14. Dhaliwal R, Cahill N, Lemieux M, Heyland DK. The Canadian critical care nutrition guidelines I 2013: an update on current recommendations and implementation strategies. *JPEN J Parenter Enteral Nutr.* 2014;29(1):29-43.
15. Lyerla F, LeRouge C, Cooke DA, Turpin D, Wilson L. A nursing clinical decision support system and potential predictors of head-of-bed position for patients receiving mechanical ventilation. *Am J Crit Care.* 2010;19(1):39-47.
16. Williams TA, Leslie GD, Leen T, Mills L, Dobb GJ. Reducing interruptions to continuous enteral nutrition in the intensive care unit: a comparative study. *J Clin Nurs.* 2013;22:2838-2848.
17. Clark JR. What's in your policy manual? *Air Med J.* 2011;30(1):18-19.
18. The Joint Commission. Sentinel Event Alert #53: Managing risk during transition to new ISO tubing connector standards. August 2014. [https://www.jointcommission.org/sea\\_issue\\_53/](https://www.jointcommission.org/sea_issue_53/). Accessed May 12, 2016.
19. Guenter P. Safe practices for enteral nutrition in critically ill patients. *Crit Care Nurs Clin North Am.* 2010;22(2):197-208.
20. Halm MA, Armola R. Effect of oral care on bacterial colonization and ventilator-associated pneumonia. *Am J Crit Care.* 2010;18:275-278.
21. American Association of Critical-Care Nurses. AACN Practice Alert: oral care for patients at risk of ventilator-associated pneumonia. April 2010. <http://www.aacn.org/wd/practice/docs/practicealerts/oral-care-patients-at-risk-vap.pdf?menu=aboutus>. Accessed May 18, 2016.
22. Metheny NA, Davis-Jackson J, Stewart BJ. Effectiveness of an aspiration risk-reduction protocol. *Nurs Res.* 2010;59(1):18-25.
23. Metheny NA. Preventing respiratory complications of tube feedings: evidence-based practice. *Am J Crit Care.* 2006;15(4):360-369.
24. Ellett ML, Beckstrand J, Flockier J, Perkins SM, Johnson CS. Predicting the insertion distance for placing gastric tubes. *Clin Nurs Res.* 2005;14(1):11-27.
25. Ellett ML, Cohen MD, Perkins SM, Croffie JM, Lane KA, Austin JK. Comparing methods of determining insertion length for placing gastric tubes in children 1 month to 17 years of age. *J Spec Pedia Nurs.* 2012;17(1):19-32.
26. Chen Y, Want L, Chang Y, et al. Potential risk of malposition of nasogastric tube using nose-ear-xiphoid measurement. *PLoS One.* 2014;9(2):e88046.
27. Task Force on Sudden Infant Death Syndrome, American Academy of Pediatrics. SIDS and other sleep related infants deaths: expansion of recommendations for a safe infant sleeping environment. *Pediatrics.* 2011;128:1030-1039.
28. Metheny NA, Stewart BJ, McClave SA. Relationship between feeding tube site and respiratory outcomes. *JPEN J Parenter Enteral Nutr.* 2011;35(3):346-355.
29. Heyland DK, Drover JW, MacDonald S, Novak F, Lam M. Effect of postpyloric feeding on gastroesophageal regurgitation and pulmonary microaspiration: results of a randomized controlled trial. *Crit Care Med.* 2001;29(8):1495-1501.
30. Linn DD, Beckett, RD, Foellinger K. Administration of enteral nutrition to adult patients in the prone position. *Intensive Crit Care Nurs.* 2015;31:38-43.
31. Fineman LD, LaBrecque M A, Mei-Chiung Shih, Martha AQ. Prone position can be safely performed in critically ill infants and children. *Pediatr Crit Care Med.* 2006;7(5):413-422.
32. National Pressure Ulcer Advisory Panel. European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Ulcer Alliance. *Prevention and Treatment of Pressure Ulcers.* Perth, Australia: Cambridge Media; 2014.
33. Schallom M, Dykeman B, Metheny N, Kirby J, Pierce J. Head-of-bed elevation and early outcomes of gastric reflux, aspiration and pressure ulcers: a feasibility study. *Am J Crit Care.* 2015;24(1):57-66.
34. Metheny N. Turning tube feeding off while repositioning patients in bed. *Crit Care Nurs.* 2011;31(2):96-97.
35. Loh LE, Chan YH, Chan I. Noninvasive ventilation in children: a review. *J Pediatr (Rio J).* 2007;83(2)(suppl):S91-S99.
36. Carron M, Freo U, BaHammam AS, et al. Complications of non-invasive ventilation techniques: a comprehensive qualitative review of randomized trials. *Br J Anaesth.* 2013;110(6):896-914.
37. Mehta S, Hill NS. Noninvasive ventilation. *Am J Respir Crit Care Med.* 2001;163:540-577.

38. Luria O, Reshef L, Barnea O. Analysis of non-invasive ventilation effects on gastric inflation using a non-linear mathematical model. *Resuscitation*. 2006;71:358-364.
39. McClave SA, Saad MA, Esterle M, et al. Volume-based feeding in the critically ill patient. *JPEN J Parenter Enteral Nutr*. 2015;39(6):707-712.
40. MacLeod JB, Lefton J, Houghton D, et al. Prospective randomized control trial of intermittent versus continuous gastric feeds for critically ill trauma patients. *J Trauma Injury Infect Crit Care*. 2007;63(1):57-61.
41. Lichtenberg K, Guay-Berry P, Pipitone A, Bondy A, Rotello L. Compensatory increased enteral feeding goal rates: a way to achieve optimal nutrition. *Nutr Clin Pract*. 2010;25(6):653-657.
42. Van den Broek PW, Rasmussen-Conrad EL, Naber AH, Wanten GJ. What you think is not what they get: significant discrepancies between prescribed and administered doses of tube feeding. *Br J Nutr*. 2009;101(1):68-71.
43. de Araujo VM, Gomes PC, Caporossi C. Enteral nutrition in critical patients: should the administration be continuous or intermittent? *Nutr Hosp*. 2014;29(30):563-567.
44. Stroud M, Duncan H, Nightingale J; British Society of Gastroenterology. Guidelines for enteral feeding in adult hospital patients. *Gut*. 2003;52(suppl 7):Vii1-Vii12.
45. Tepaske R, Binnekade JM, Goedhart PT, Schultz MJ, Vroom MB, Mathus-Vliegen EM. Clinically relevant differences in accuracy of enteral nutrition feeding pump systems *JPEN J Parenter Enteral Nutr*. 2006;30(4):339-343.
46. White H, King L. Enteral feeding pumps: efficacy, safety, and patient acceptability. *Med Devices Evid Res*. 2014;7:291-298.
47. Evans S, MacDonald A, Daly A, Hopkins V, Holden C. Home enteral tube feeding in patients with inherited metabolic disorders: safety issues. *J Hum Nutr Diet*. 2007;20(5):440-445.
48. Walker RN, Utech A, Velez ME, Schwartz K. Delivered volumes of enteral nutrition exceed prescribed volumes. *Nutr Clin Pract*. 2014;29(5):662-666.
49. Spronk PE, Rommes JH, Kuiper MA. Structural underfeeding due to inaccurate feeding pumps? *JPEN J Parenter Enteral Nutr*. 2007;31(2):154.
50. ECRI Institute. Hazard report: incorrect key presses may cause Nutricia Flocare Infinity Series enteral feeding pumps to appear to be infusing even though and occlusion exists. *Health Devices*. May 2011:170-171.
51. Mathus-Vliegen EA, Bredius MW, Binnekade JM. Analysis of bacterial contamination in an enteral feeding system. *JPEN J Parenter Enteral Nutr*. 2006;30(6):519-525.
52. McGinnis C. *The Prevalence of Microbial Growth in Enteral Tube Feeding in Two North Central Hospitals* [master's thesis]. Brookings: South Dakota State University; 1995.
53. Baniardalan M, Sabzghabae AM, Jalali M, Badri S. Bacterial safety of commercial and handmade enteral feeds in an Iranian teaching hospital. *Int J Prev Med*. 2014;5(5):604-610.
54. Jalali M, Sabzghabae AM, Badri SS, Soltani HA, Maracy MR. Bacterial contamination of hospital-prepared enteral tube feeding formulas in Isfahan, Iran. *J Res Med Sci*. 2009;14(3):149-156.
55. Oliveira MR, Batista CR, Aidoo KE. Application of hazard analysis critical points system to enteral tube feeding in hospital. *J Hum Nutr Diet*. 2001;14(5):397-403.
56. Lyman B, Gebhards S, Hensley C, Roberts C, San Pablo W. Safety of decanted enteral formula hung for 12 hours in a pediatric setting. *Nutr Clin Pract*. 2011;26(4):451-456.
57. Perry J, Stankorb SM, Salgueiro M. Microbial contamination of enteral feeding products in thermoneutral and hypothermic ICU environments. *Nutr Clin Pract*. 2015;30(1):128-133.
58. Juma NA, Forsythe SJ. Microbial biofilm development on neonatal enteral feeding tubes. *Adv Exp Med Biol*. 2015;830:113-121.
59. Hurrell E, Kucerova E, Loughlin M, et al. Neonatal enteral feeding tubes as loci for colonization by members of the Enterobacteriaceae. *BMC Infect Dis*. 2009;9:146.
60. Hurrell E, Kucerova E, Loughlin M, Caubilla-Barron J, Forsythe SJ. Biofilm formation on enteral feeding tubes by *Cronobacter sakazakii*, *Salmonella serovars* and other Enterobacteriaceae. *Int J Food Microbiol*. 2009;136(2):227-231.
61. Solseng T, Vinson H, Gibbs P, Greenwald B. Biofilm growth on the Lopez enteral feeding valve cultured in enteral nutrition: potential implications for medical-surgical patients, nursing care and research. *Medsurg Nurs*. 2009;18(4):225-233.
62. McKinlay J, Wildgoose A, Wood W, Gould IM, Anderton A. The effect of system design on bacterial contamination of enteral tube feeds. *J Hosp Infect*. 2001;47(2):138-142.
63. Ho SS, Tse MM, Boost MV. Effect of an infection control program on bacterial contamination of enteral feed in nursing homes. *J Hosp Infect*. 2012;82(1):49-55.
64. Stucki C, Sautter A, Favet J, Bonnabry P. Microbial contamination of syringes during preparation: the direct influence of environmental cleanliness and risk manipulations on end-product quality. *Am J Health System Pharm*. 2009;66:2032-2036.
65. Oie S, Kamiya A. Comparison of microbial contamination of enteral feeding solution between repeated use of administration sets after washing with water and after washing followed by disinfection. *J Hosp Infect*. 2001;48(4):304-307.
66. Kohn CL. The relationship between enteral formula contamination and length of enteral delivery set usage. *JPEN J Parenter Enteral Nutr*. 1991;15:567-571.
67. Williams TA, Leslie G, Mills L, et al. Frequency of aspirating gastric tubes for patients receiving enteral nutrition in the ICU: a randomized controlled trial. *JPEN J Parenter Enteral Nutr*. 2014;38(7):809-816.
68. Bliss DZ, Johnson S, Savik K, Clabots CR, Willard K, Gerding DN. Acquisition of *Clostridium difficile* and *Clostridium difficile*-associated diarrhea in hospitalized patients receiving tube feeding. *Ann Intern Med*. 1998;129(12):1012-1019.
69. Bliss DZ, Johnson S, Savik K, Clabots CR, Gerding DN. Fecal incontinence in hospitalized patients who are acutely ill. *Nurs Res*. 2000;49(2):101-108.
70. Chang SJ, Huang HH. Diarrhea in enterally fed patients: blame the diet? *Curr Opin Clin Nutr Metab Care*. 2013;16(5):588-594.
71. Arevalo-Manso JJ, Martinez-Sanchez P, Juarez-Martin B, et al. Preventing diarrhea in enteral nutrition: the impact of the delivery set hang time. *Int J Clin Pract*. 2015;69(8):900-908.
72. Jack L, Coyer F, Courtney M, Venkatesh B. Diarrhea risk factors in enterally tube fed critically ill patients: a retrospective audit. *Intensive Crit Care Nurs*. 2010;26(6):327-334.
73. Hurt RT, Frazier TH, McClave SA, et al. Stress prophylaxis in intensive care unit patients and the role of enteral nutrition. *JPEN J Parenter Enteral Nutr*. 2012;36(6):721-731.
74. Food and Drug Administration. Hazard Analysis Critical Control Point (HACCP). August 14, 1997. <http://www.fda.gov/Food/GuidanceRegulation/HACCP/ucm2006801.htm>. Accessed May 18, 2016.
75. National Institute for Health and Clinical Excellence. *Infection Control: Prevention and Control of Healthcare-Associated Infections in Primary and Community Care*. London, UK: NICE; 2012. <http://pathways.nice.org.uk/pathways/prevention-and-control-of-healthcare-associated-infections#path=view%3A/pathways/prevention-and-control-of-healthcare-associated-infections/enteral-feeding-prevention-and-control-of-healthcare-associated-infections-in-primary-and-community-care.xml&content=view-index>. Accessed August 8, 2015.
76. American Society of Anesthesiologists Committee on Standards and Practice Parameters. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures. *Anesthesiology*. 2011;114:495-451.
77. Peev MP, Yea DD, Quraishi SA, et al. Causes and consequences of interrupted enteral nutrition: a prospective observational study in critically ill surgical patients. *JPEN J Parenter Enteral Nutr*. 2015;39(1):21-27.
78. Bercault N, Wolf M, Runge I, Fleury JC, Boulain T. Intrahospital transport of critically ill ventilated patients: a risk factor for ventilator-associated pneumonia—a matched cohort study. *Crit Care Med*. 2005;33(11):2471-2478.
79. Lambert E, Carey S. Practice guideline recommendations on perioperative fasting: a systematic review [published online January 9, 2015]. *JPEN J Parenter Enteral Nutr*.