Enteral Nutrition: an Overview

What is Enteral Nutrition?

Enteral nutrition (EN) is nutrition administered via a tube or catheter directly to the stomach (e.g., orogastric tube, nasogastric tube [NGT], gastrostomy tube [G-tube]) or small intestine (e.g., nasointestinal tube, jejunostomy tube [J-tube]) in a patient who has a functioning GI tract but is unable to meet his or her nutritional needs by oral ingestion. The American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) identifies three methods of EN delivery: pump-assisted (i.e., delivery of EN using an infusion pump), gravity-assisted, and bolus (i.e., EN delivered by gravity via a syringe over ~ 15 minutes). The focus of this paper is to provide a general overview of EN:

• **What**: Short-term administration of EN is usually provided using an NGT. Long-term administration of EN is most commonly provided using a G-tube, in particular a percutaneous endoscopic gastrostomy (PEG) tube. Other types of enteral feeding tubes include those that are inserted into the small intestine: the duodenal tube (inserted in the first part of the small intestine) and the J-tube (inserted in the middle section of the small intestine). There are variations of these tubes such as a gastrojejunal tube and gastroduodenal tube (GD tube), among others (for more information about the types of enteral feeding tubes, see *What You Need to Know Before Administering Enteral Nutrition*, below)

• **How**: In general, the registered dietitian (RD) must perform the following tasks when administering EN, with assistance by the nurse clinician:
  – Verify placement of the patient’s feeding tube
  – Complete the preprocedural patient assessment, including determining total energy requirements, macro- and micronutrient needs, and free water requirements. Confirm that treating clinician has ordered appropriate testing (e.g., serum glucose testing)
  – Place the patient in a semi-Fowler position (i.e., upper body elevated at 30–45°) during and for at least 1 hour following EN administration to reduce the risk for aspiration
  – Verify the accuracy and completeness of the order for EN (e.g., making sure the order includes the type of EN formula, method of administration, volume/rate of administration, timing of formula delivery within a specified period of time [e.g., over 24 hours], frequency of delivery, and details about the flush to be administered)
  – Confirm that EN is administered as prescribed, using aseptic technique where appropriate
  – Complete ongoing patient assessments to monitor for the desired response to and for any complications of EN (e.g., observe for abdominal distention, firmness, and/or discomfort, I & O, serum glucose level, and daily weight)
  – Periodically measure gastric residual volume (GRV) to determine whether the feeding is tolerated
  – Administer medications via the enteral feeding tube, as ordered and according to facility protocol

• **Where**: EN can be administered in inpatient and outpatient care settings, including the home setting

• **Who**: RDs are responsible for choosing the appropriate EN formula and calculating the appropriate volume, rate of administration, and length and frequency of delivery, as well as details about the flush to be administered. Nurse clinicians are responsible for the administration and patient-care-related management of EN. Appropriately trained
assistive staff can assist with glucose monitoring and notifying the nurse clinician of any malfunction of the infusion pump and any indication of possible displacement of the feeding tube. Patients and/or family members can be trained to administer EN in the home setting.

**What is the Desired Outcome of Administering EN?**

- The desired outcome of administering EN is to:
  - provide nutrition to patients with a functioning GI tract who are unable to meet nutritional needs by oral ingestion
  - promote normal GI functioning
  - limit proliferation of harmful intestinal bacteria

**Why is EN Important?**

- Enteral feeding is an important means of providing nutrition to patients. Indications include the following:
  - Inability to orally ingest adequate nutrition (e.g., due to disorders of sucking/swallowing that can occur with neuromuscular conditions, congenital abnormalities [e.g., cleft palate], trauma, critical illness)
  - Inadequate nutrition is associated with increased morbidity and mortality (e.g., infection, poor skin integrity, delayed wound healing, impaired catabolic response) and increased length of hospital stay
  - Disorders of absorption
  - Digestion (e.g., cystic fibrosis, immunodeficiency, intestinal fistula, enteritis)
  - Increased nutritional requirements (e.g., burn injuries, cystic fibrosis, congenital heart disease)

- Compared with parenteral nutrition (PN), EN is less costly and associated with fewer septic events (see **Facts and Figures**, below)

**Facts and Figures**

- Approximately 100,000–125,000 PEG-tube placements are performed annually in the United States (Arora & Lukens, 2017)
- Experts maintain that EN is more beneficial to patients than PN because, in addition to facilitating normal GI functioning and limiting the proliferation of harmful intestinal bacteria, when EN is initiated within 24–48 hours of admission to an acute care center it is associated with shorter duration of time spent in the ICU and lower mortality rates. Evidence is mixed regarding the superiority of either gastric or intestinal feeding, but evidence suggests that postpyloric (intestinal) feeding is associated with lower risk for aspiration and ventilator associated pneumonia, fewer infectious complications, shorter time to meet feeding goals, and significant cost savings compared to gastric feeding (Hauschild et al., 2012; Academy of Nutrition and Dietetics [AND], 2012; Jiyong et al., 2013)
- Investigators using 24-hour esophageal pH monitoring assessed the relationship between gastroesophageal reflux (GER) and aspiration pneumonia in stroke patients requiring NGT or PEG-tube feedings, and determined that close to 90% of patients with GER, and only 43% of patients without GER, developed aspiration pneumonia (Satou et al., 2013)
- Evidence indicates that checking GRV gives little reliable information on patient tolerance of enteral feeding, gastric emptying, or risk for aspiration, and can place the patient at risk for underfeeding (Makic et al., 2013). Current A.S.P.E.N guideline is to avoid withholding EN in ICUs for GRVs < 500 mL unless there are other signs of intolerance (Alexander et al., 2016)
- In critically ill patients, a moderate initial caloric intake has been shown to be associated with the most positive outcomes. Patients who are underfed are prone to malnutrition, which is associated with muscle wasting, weakness, infections, longer duration of mechanical ventilation, and death. Since some critically ill patients have poor tolerance to EN, those who are fed based on a standard caloric requirement may be at greater risk for vomiting and regurgitation (Choi et al., 2015)
- Researchers in a pilot study found that when doctors inserted an orogastric tube into a mannequin using an 18.4 French deflection flexible visual gastric tube inside a 15 French gastric tube, it was placed in the stomach 100% of the time versus 79% of the time with traditional insertion, placement time was shortened, there were fewer complications, and 85% of the doctors preferred the technique over the traditional procedure. This might in the future replace the conventional tube placement technique (Lie et al., 2018)

**What You Need to Know Before Administering EN**

- Prior to administering EN, the RD should be familiar with the following:
  - Anatomy of the GI tract, particularly the location of the delivery site (e.g., where the stoma was created, placement of the tube or catheter). The most common sites used to access the GI tract for delivery of EN are the stomach, duodenum,
and jejunum. Following head and neck surgery, enteral feeding tubes are often placed in the mid-cervical esophagus or pharyngeal area, but these tubes are not widely used for long-term feeding.

- Methods for placing enteral feeding tubes (e.g., NGT, G-tube, PEG-tube, duodenal tube, J-tube). These devices are usually made of polyurethane or silicone; G-tubes, PEG-tubes, and J-tubes have a built-in mechanism (e.g., bumper or retention balloon) that provides an anchor to prevent migration, which reduces the risk for obstruction and aspiration. The size of the tube varies according to the age/size of the patient; neonates and infants typically require a 2.5–5.0 French tube and adults typically require a 14–20 French tube. Note: The French scale is used to denote the internal lumen size of catheters. One French unit equals 0.33 mm, which means the largest adult size tube is 6.6 mm/0.26 inches. Placement of long-term enteral feeding tubes (e.g., G-tube, PEG-tube, duodenal tube, J-tube) generally requires that the need for nutritional support is anticipated to be > 4 weeks.

- NGT and G-tubes permit the digestive function of the stomach to be utilized. Bolus feedings are easier to administer because the stomach has a fundus that permits expansion, while the duodenum and jejunum do not. NGTs are placed via the nasopharyngeal route, while G-tube placement can be accomplished through the abdominal wall laparoscopically, by open surgical technique, or percutaneously (see description, below). A drawback to NGT or G-tube use is that the risk of aspiration is greater than with other enteral feeding tubes.

- The G-D tube is inserted into the stomach and terminates in the first part of the small intestine.

- The J-tube is inserted into the middle portion of the small intestine. J-tubes are usually indicated for patients with significant gastroparesis (i.e., delayed emptying) or who are at heightened risk for aspiration (e.g., reflux problems).

- The decision to use a J-tube rather than a G-tube usually occurs because the patient’s gastric functioning is impaired (e.g., prolonged healing and/or atony following upper GI surgery, postoperative pancreatitis, enterocutaneous fistulas or hypermetabolic or hypercatabolic patients) or because there is a high risk of aspiration. Typically, clinicians prefer to utilize the stomach if it is viable.

- The gastrojejunal tube (G-J tube), also known as the transjejunal tube, is usually a double-lumen tube that enters the stomach through a gastrostomy stoma and is threaded to the jejunum. One port terminates in the stomach and the second smaller lumen continues on through the pyloric valve and into the small intestine. The lumen permits feeding through the J-port while the G-port provides a continuous vent.

- Enteral formulas. The EN formula is selected by the RD in collaboration with the treating clinician. Factors that are considered in the process of formula selection include the patient’s nutritional status and nutritional requirements, disease state, digestive and absorptive capacity, serum electrolyte values, and hepatic/renal function. In addition, most patients who receive EN therapy also require additional fluids to meet minimum daily fluid requirements. The RD determines the volume of water (in addition to that provided by the EN formulation) that the patient needs. Total free water is calculated by adding all infusions, including flushes, to the enteral feeding tube.

- Standard (polymeric) formulas (e.g., Isocal, Osmolite, Jevity, Deliver) are the most commonly used formulas in patients receiving tube feedings. Standard formulas are available with a wide variety of energy, protein (usually whole protein is the nitrogen source), complex carbohydrates, fat (in the form of long-chain triglycerides), vitamin,
mineral, fiber, and water contents. Standard formulas are isotonic (300 mOsm/L), nutritionally complete diets designed to match the nutrient requirements of a healthy individual. They typically contain 1.0–2.0 calories of nutrients per mL. Hypoallergenic formulations (e.g., gluten-free, lactose-free, or egg-free) are available for patients with dietary restrictions.

- Semi-elemental (oligomeric) and elemental (monomeric) formulas are formulas in which one or more nutrients are hydrolyzed.

- Semi-elemental formulas contain simple sugars, glucose polymers (starch), and fat, primarily in the form of medium-chain triglycerides. These formulas are easier to digest than standard formulas and therefore better tolerated in patients with GI diseases.

- Elemental formulas contain either predigested protein or pure amino acids, together with oligopeptides, amino acids, glucose polymers, and only about 2–3% fat. Elemental formulas require the least digestive effort for patients, are relatively expensive, and are used primarily for patients who have extensive impairment of GI digestive and absorptive functions.

- Disease specific or specialized formulas are used to provide nutritional support for patients with the following needs:
  - Diabetic – ↓ total carbohydrate, ↑ proportion of complex carbohydrates (e.g., oligosaccharides, cornstarch, fiber)
  - Renal – ↓ protein, increased caloric density (for lower total fluid volume), ↓ levels of potassium, magnesium, phosphorus
  - Hepatic—high calorie, ↑ branched-chain amino acids (i.e., valine, leucine, and isoleucine) and ↓ aromatic amino acids (i.e., phenylalanine, tyrosine, tryptophan) to reduce neurologic symptoms of encephalopathy
  - Pulmonary—high (30–50%) fat content for weight maintenance
  - High-fiber—to promote bowel regularity and decrease diarrhea in patients receiving long-term EN therapy
  - Immune-enhancing (e.g., with omega-3 fatty acids, glutamine, arginine, antioxidants)

- Formulas can be ready-to-use or can require reconstitution because they are in concentrated liquid or powdered form. Guidelines issued by A.S.P.E.N. recommend the use of sterile, liquid, ready-to-use formulas over those that must be reconstituted to minimize the risk of contamination (for more information, see types of enteral feeding systems, below). Sterile water and strict aseptic technique must be used when reconstituting formulas to reduce the risk for microbial contamination.

- Infusion pump-assisted method (i.e., delivery of EN using an infusion pump). An infusion pump can be used to administer continuous feeding (e.g., feeding delivered over 8–24 hours), intermittent feeding (i.e., feeding delivered over 30–45 minutes), and bolus feeding. **Due to the statistically significant decrease in adverse events associated with EN when infusion pumps are used, A.S.P.E.N. strongly encourages the use of infusion pumps for the administration of EN.** Administering EN via an infusion pump permits delivery at a controlled rate, which is especially important for infants and children, who are less likely to tolerate bolus feedings, and for patients with intestinal tubes (i.e., duodenal, jejunal) that require a longer duration for infusion because the jejunum is smaller in diameter than the stomach and does not have an expandable fundus like the stomach. Therefore, EN must be delivered to the jejunum at a low rate of flow to permit digestion and reduce the risk of distention, nausea, and vomiting. The infusion pump delivers the feeding under pressure (set by the pump manufacturer), but the machine is not capable of detecting abdominal distention. Therefore, the RD must check GRVs at frequent intervals to verify that the patient is tolerating the feeding.

- Gravity-assisted method (i.e., the use of gravity alone to accelerate the delivery of EN). The gravity-assisted method of administering EN can be used for delivery of a large volume (bolus) of EN over a short period of time (e.g., 30–60 minutes) and for intermittent feedings.

- Bolus method without infusion pump-assist (i.e., EN delivered by gravity via a syringe over ~ 15 minutes). This method of administering EN can be used for instilling a large volume bolus of EN using a syringe over a short period of time and for intermittent feedings several times daily. The syringe method increases risk of vomiting, nausea, gastric distention, and aspiration because of the large volume instilled in a very short period of time, and is not appropriate for duodenal or jejunostomy feedings because of the risk for refeeding syndrome (i.e., a potentially life-threatening physiologic process that can occur in malnourished patients once feeding is initiated due to the rapid shift of fluid and electrolytes from the bloodstream to the body’s cells following reconstitution of nutritional support), diarrhea, and dumping syndrome (i.e., a condition caused by partially digested food emptying from the stomach into the small intestine). **Always confirm the patient’s gag reflex is intact prior to administering bolus feeding.** Check for the reflex by using a tongue depressor to touch the back of the throat (posterior pharynx) or the soft palate (i.e., the soft tissue constituting the back of the roof of the mouth, including the uvula). A positive gag reflex (i.e., the integrity of the
vagus and glossopharyngeal nerves is intact) is demonstrated if there is a symmetric elevation of the palate, contraction of the pharyngeal muscles, and a retraction of the tongue

- Types of enteral feeding systems (i.e., open or closed)
  - Closed systems are those that involve use of ready-to-hang, closed containers that are pre-filled by the manufacturer and are accessed by spiking the container with the piercing pin of the administration set; closed systems are preferred to open systems because of the decreased risk for contamination
  - Open systems are those in which the clinician or caregiver must manually decant the formula through the enteral feeding tube via a syringe or add the formula to a container/bag. The use of open systems increases the risk of contamination. Formulas that must be reconstituted, liquid formulas not in a closed system, breast milk, and modular or supplemental formulas (e.g., fiber supplements or other specific nutrients) fall under the category of open system administration
  - Recommended formula hang time (i.e., the length of time a formulation is considered safe for administration to the patient beginning with the time the formulation has been compounded, reconstituted, warmed, decanted, or has had the original package seal broken)
    - A.S.P.E.N. guidelines limit the hang time of formula based on use of an open or closed system
      - When using an open system, reconstituted powdered formulas can hang for a maximum of 4 hours and sterile liquid formulas a maximum of 8 hours
      - When using a closed system, the formula may hang for 24–48 hours before being changed
  - Recommendations for flushing enteral tubes—**the importance of flushing to maintain tube patency cannot be overemphasized**
    - In general, to maintain patency, enteral feeding tubes should be flushed with 30 mL water
      - before and after administering intermittent feedings
      - before and after medication administration (with 15 mL water)
      - after checking GRV
      - every 4 hours during continuous feeding
    - Note: Small flush volumes may be necessary in fluid-restricted and pediatric patients
    - Typically for adults, a syringe ≥ 30 mL should be used to flush enteral feeding tubes—smaller syringes can exert excessive pressure and result in tissue damage or rupture of the feeding tube
    - It is acceptable to use either sterile (i.e., purified) or tap water to flush enteral tubes depending upon the purpose for use and the patient’s physiologic condition. A.S.P.E.N. guidelines specify that
      - in the majority of healthy adult and pediatric patients, sterile or tap water can be used for flushes; however, sterile water should be used to reconstitute powdered formulas
      - for immunocompromised and critically ill patients and infants, sterile water should be used for all enteral purposes
      - Note that normal saline (i.e., 0.9% sodium chloride in sterile water) can be used as a diluent or flush solution in place of water per the treating clinician’s instructions or facility/unit-specific protocol
    - It is not acceptable to use liquids other than water or facility-approved solutions for diluent or flush solutions—do not use cranberry juice, carbonated beverages, or distilled water without a physician’s order. Note: Even though distilled water has been vaporized and recondensed, impurities often remain
  - Facility and unit-specific procedures for EN administration. The United States FDA classifies enteral formulas, excluding formulas administered to infants, as medical foods (i.e., foods administered under the supervision of a physician) that do not require FDA regulation. However, in order to avoid administration errors, the components of patient-specific orders for EN should be evaluated in a manner similar to the safety checks completed before administering medication. Prior to administration:
    - Work with the treating clinician to verify the completeness of the EN order. The order should contain, at minimum,
      - identifying information about the patient
      - type of formula to be administered
      - route of delivery (e.g., via enteral feeding tube)
      - method of delivery (e.g., pump-assisted, gravity-assisted, bolus/syringe)
      - volume to be administered
      - frequency/duration of administration and requirement for formula delivery within a specified period of time [e.g., over 24 hours]
      - flush volume and the frequency with which flushes should be administered
    - Note: Initial orders are written to indicate the volume/rate by which the volume/rate should be advanced each day to reach the ultimate volume/rate goal
- Review the 6 “rights” of safe EN administration (e.g., right patient, right formula, right dose [volume/rate], right route, right time/duration of delivery, right documentation)

- Medication administration through the enteral feeding tube. Feeding should be stopped prior to medication administration and the tube flushed before and after administration with at least 15 mL water. Feedings should be immediately restarted unless there is a need to hold the feeding longer to avoid altering the bioavailability of the medication. Other guidelines include
  - not adding medication directly to the EN formula
  - avoiding mixing medications together prior to administration to prevent incompatibilities or clogging of the tube
  - administering medications in liquid form, whenever possible; immediate-release medications should be crushed and mixed with sterile water prior to administration

- Considerations for RDs with assistance from clinical nursing staff to promote safe delivery of EN
  - Use the method approved by facility/unit-specific protocol to verify placement of the distal tip of the feeding tube. Tube placement should be confirmed by radiographic method immediately following insertion, prior to each bolus or intermittent feeding and/or enteral medication delivery, every 4 hours for patients who are receiving continuous EN infusion, or according to unit-specific/facility protocol or as indicated by physical assessment (e.g., indications of respiratory distress)

- Current best practice is to perform an abdominal X-ray after feeding tube insertion and prior to initial use—radiographic confirmation is the most definitive method of establishing placement but only if it shows the full course of the tube and the location of all the ports. However, radiographic confirmation each time the enteral feeding tube is accessed is impractical, dangerous (due to exposure to radiation), and too costly. The American Association of Critical-Care Nurses (AACN) recommends that radiographic confirmation be used for initial tube placement and that a variety of methods be used subsequently to confirm placement prior to feedings. AACN, acceptable methods of confirming placement include: (AACN, 2016)
  - Aspiration of gastric contents for visual check and pH analysis. A small volume of stomach contents should be aspirated and checked visually—gastric secretions typically appear clear and colorless or pale yellow or green, while small-bowel secretions are often brown colored due to bile. Follow-up the visual test with a pH analysis: A pH ≤ 4.0 is usually indicative of gastric acid unless the patient is receiving proton pump inhibitors, H₂ receptor antagonists, or acid-reducing medications, or is receiving a continuous enteral feeding infusion. However, the pH of gastric contents can occasionally be elevated and respiratory and small-bowel secretions are typically ≥ 6, all of which underscores the importance of radiographic confirmation of tube placement or whenever dislodgement is suspected
  - Clinical Tip: Reposition the patient to his or her left side to maximize the potential for withdrawing gastric secretions into the catheter
  - If unable to aspirate gastric secretions, slightly advance the enteral feeding tube and re-attempt aspiration
  - The pH method is insufficient for detecting retrograde dislodgement of the feeding tube in the esophagus or the gastroesophageal junction
  - Although commonly used, the air auscultation method (i.e., using a stethoscope to auscultate over the abdomen while insufflating a bolus of 20–30 mL of air into the enteral feeding tube with a syringe and listening for a “swish” as air passes into the stomach) is unreliable and should not be used to confirm placement of an enteral feeding tube (AACN, 2016)

- GRV should be assessed frequently for patients with gastric tubes due to risk for aspiration. A.S.P.E.N. guidelines specify that GRV should be checked every 4 hours during the first 48 hours of EN, decreasing to a frequency of every 6–8 hours in non-critically-ill patients, depending on the patient’s tolerance of the feeding (i.e., no signs and symptoms such as nausea/vomiting, diarrhea, or abdominal distention); GRV should continue to be checked every 4 hours in critically ill patients
  - If the GRV ≥ 250 mL for two consecutive checks in an adult patient, along with other signs of intolerance, hold the feeding and notify the treating clinician, because a promotility agent (e.g., metoclopramide) may be indicated
  - If GRV ≥ 500 mL, the feeding should be stopped, the treating clinician notified, and a full patient assessment performed. The patient should be assessed for GI pain, distention, constipation, emesis, or high serum blood glucose levels, which can impair gastric emptying
  - AND guidelines are in agreement with those of A.S.P.E.N. that EN should not be stopped for GRV < 500 mL in absence of signs and symptoms of intolerance. Stopping infusion for GRV < 500 has been associated with reduced EN delivery. AND recommends that clinicians strive to limit the number of times EN is stopped or held in order to deliver a minimum of 60% of the EN goal (AND, 2012)
- In acutely ill pediatric patients, GRV should be checked every 4 hours and held if the GRV is ≥ the hourly infusion rate.

- In order to minimize the risk for aspiration, patient positioning is critical. Patients who receive enteral feeding should remain in a semi-Fowler’s position (i.e., with the head of the bed elevated to a minimum of 30°, preferably 45°, during the feeding, and for a minimum of one hour following completion of the feeding), unless medically contraindicated. A reverse Trendelenburg position can be used for patients who cannot tolerate hip flexion. Positioning devices (e.g., specialized pillows) are available for infants and children who shift out of position easily. These devices can be used to support the upper body in an elevated position; frequent monitoring should be instituted to maintain the pediatric patient in a safe position.

- Check serum blood glucose levels every 6 hours or per order/facility protocol and administer treatment for hypoglycemia (defined in the adult patient receiving nutritional support as serum blood glucose < 70 mg/dL) or hyperglycemia (defined as serum blood glucose > 180 mg/dL). Strive to maintain target blood glucose in the range of 140–180 mg/dL (AND, 2012; McMahon et al., 2013).

- Avoid stopping an infusion of EN unnecessarily to promote adequate nutrition.

- Change equipment/supplies according to A.S.P.E.N. guidelines, which recommend that

  - Administration sets being used to administer EN by means of an open system be changed every 24 hours;
  - Administration sets being used to administer EN by means of a closed system should be changed according to manufacturer’s instructions.
  - Administration sets being used to administer breast milk must be changed every 4 hours.
  - Equipment used to administer EN to pediatric patients must be di(2-ethylhexyl) phthalate free.
  - Irrigation sets (i.e., typically consist of a 500 mL graduated container, 1,200 mL tray, and either a 60 mL bulb syringe or 60 mL piston syringe) be replaced every 4–8 hours.

- Complications associated with EN, which can be categorized as

  - Mechanical (e.g., aspiration, tube displacement/dislodgement or obstruction; post-operative complications, such as hemorrhage, wound dehiscence, and leakage of stomach contents; leakage due to inadequate attachment of infusion tubing to the feeding tube; tube displacement/recoil which increases the risk of aspiration—see Red Flags, below).
  - Aspiration of the enteral feed is a serious complication that can occur without evidence of vomiting and may become apparent only after development of signs of respiratory compromise or pulmonary infection; aspiration can result in necrotizing infection, pneumonia, abscess formation, and/or acute respiratory distress syndrome (ARDS). Be especially alert to the risk for aspiration in patients with a disordered swallowing function or who have an impaired gag reflex, or who are older or debilitated or have impaired mental function. The use of iso-osmotic feeds is suggested for patients who are at risk for aspiration because high osmolality can delay gastric emptying.
  - Fistula (e.g., abnormal connection or passage). A fistula between the stomach and the transverse colon is a risk if the transverse colon was inadvertently punctured during tube insertion—fistula should be suspected if the patient has recurrent diarrhea quickly after feeding is commenced (Note: Diarrhea is the result of the EN bypassing the small intestine and flowing directly into the transverse colon).
  - “Buried bumper” (i.e., a portion of the feeding tube migrates into the gastric or intestinal mucosa).
  - If the enteral feeding tube becomes dislodged, do not attempt to replace a G-tube, J-tube, or G-J-tube that falls out of the patient’s stoma. Cover the stoma with a dry, sterile dressing and notify the treating clinician immediately. Replacement of the tube within a few hours is necessary to prevent the stoma or tract from closing.
  - Infectious (e.g., infection of the insertion site, pneumonia by aspiration, contamination of the diet).
  - Contamination of the formula is most commonly the result of using an open enteral system (i.e., a system in which the clinician or caregiver must manually instill/decant the formula through the enteral feeding tube [via a syringe] or add the formula to an enteral feeding container). The high glucose content of EN formulas provides an optimal medium for bacterial growth. Open systems increase the likelihood of contamination and growth of microorganisms within the formula and can reduce the hang time. A.S.P.E.N. guidelines specify that when using an open enteral system, reconstituted powdered formulas should hang for a maximum of 4 hours and liquid formulas for a maximum of 8 hours. Irrigation sets should be changed every 4–8 hours and administration sets every 24 hours for an open system and according to manufacturer’s instructions for a closed system (typically 24–48 hours).
  - Aspiration can result in necrotizing infection, pneumonia, and abscess formation.
  - Cellulitis (i.e., infection of the skin) around the entry site.
  - GI.
  - Perforation of the bowel leading to peritonitis.
- Ulcer at the site of the internal bumper/button/balloon or on the wall opposite the stomach or intestine (due to intermittent rubbing against the feeding tube)
- Gastric retention (e.g., nausea, vomiting, bloating, diarrhea, constipation, GI pain)
- Constipation
- Dumping syndrome. The food pulls excess fluid into the small intestine, which causes the small intestine to swell, resulting in nausea, cramping, diarrhea, diaphoresis, palpitations, and vomiting
- Metabolic (e.g., fluid/electrolyte imbalances; hypokalemia, especially in patients with insulin resistance; hyperglycemia, most often observed in patients with a high-carbohydrate diet)
- Refeeding syndrome
  - Begin EN slowly and advance gradually, particularly in patients who are malnourished or with recent unplanned weight loss of at least 10%. Assess fluid and electrolyte levels prior to feeding and periodically during feeding
  - Note that with all methods, in order to reduce the risk for nausea, diarrhea, and other adverse effects, the feedings should be
    - initiated at a low rate of flow
    - advanced incrementally until the target delivery rate/volume is achieved
- The importance of standard precautions and aseptic technique in health care. Administering EN using an infusion pump is generally considered to be a clean, not aseptic, procedure because some of the equipment (e.g., ready-to-feed formula, enteral feeding tube) cannot be considered sterile. However, certain steps (e.g., changing administration sets, handling ready-to-use enteral formulas, confirming the sterile tip of the tubing used to puncture the seal of the container holding the enteral feeding does not touch anything prior to insertion) require general aseptic non-touch technique (ANTT; i.e., the skin should not be touched after it has been prepared with antiseptic cleanser and any item introduced into the patient is sterile prior to insertion) to minimize exposure of the formula, syringe, and enteral tube to microorganisms. A.S.P.E.N. guidelines require that aseptic technique be used when reconstituting formula and when decanting formula into the infusion container.

Summary of EN practice recommendations/guidelines (Druyanet al., 2012; AACN, 2016):

<table>
<thead>
<tr>
<th>Task to be performed</th>
<th>Time frame</th>
<th>Additional actions</th>
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<tbody>
<tr>
<td>Verify enteral feeding tube placement</td>
<td>Immediately following insertion, prior to each bolus or intermittent feeding and/or enteral medication delivery, every 4 hours for patients who are receiving continuous EN infusion</td>
<td>The initial verification should be by X-ray; thereafter, verification can be performed by visual and pH analysis of aspirated gastric contents</td>
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<tr>
<td>Verify hang time of EN formula within stated limits</td>
<td>Open system: 4 hours hang time for reconstituted powdered formulas and breast milk, 8 hours hang time for sterile liquid formulas</td>
<td>Discard refrigerated reconstituted powdered formulas after 24 hours</td>
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<tr>
<td>Replace irrigation set</td>
<td>Every 4–8 hours</td>
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<tr>
<td>Replace administration set/tubing</td>
<td>Open system: every 24 hours</td>
<td>Closed system administration sets are typically changed when a new container of formula is hung</td>
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<tr>
<td>Assess GRV</td>
<td>Every 4 hours during the first 48 hours of EN, decreasing to every 6–8 hours in non-critically-ill patients</td>
<td>Hold feedings and notify the treating clinician of GRV ≥ 250 mL x 2 or ≥ 500 mL x 1</td>
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<tr>
<td>Flush the enteral feeding tube</td>
<td>With 30 mL water: before and after administering intermittent feedings, after checking GRV, every 4 hours during continuous feeding</td>
<td>Use sterile water for immunocompromised or critically ill patients</td>
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Preliminary steps that should be performed prior to initiating administration of EN include the following:

- Review the facility/unit-specific protocol for administering EN, particularly the protocol for the specific method being used, if one is available
- Review the orders related to EN
  - Check the EN order(s) for completeness
  - Review any orders for laboratory tests, medications, and/or other treatments or procedures to be completed prior to initiating EN and any tests to be performed routinely (e.g., serum blood glucose measurements)
  - Review orders regarding patient monitoring parameters
  - Review the manufacturer’s instructions for all equipment to be used and verify that the equipment is in good working order
- Verify completion of facility informed-consent documents, if appropriate
  - Typically, the general consent for treatment that is executed by patients at the outset of admission to a healthcare facility includes standard provisions that encompass care of the patient receiving EN
  - Review the patient’s medical history/medical record for
    - information about any hepatic, renal (e.g., fluid volume overload/deficit), pulmonary, metabolic (e.g., hyperglycemia), or GI disorders that may impact EN type and volume of water flush administered
    - any allergies (e.g., to latex, substances contained in EN [lactose, gluten], or other substances); use alternative materials if appropriate
    - baseline weight and I & O records
    - laboratory test results to check for electrolyte or metabolic abnormalities. Notify the treating clinician of results prior to initiating EN, as necessary

Gather supplies necessary to administer the EN, which typically include the following: (Note: It is assumed that the feeding tube is in place, initial placement has been confirmed by X-ray, and an order to administer tube feeding has been written)

- Nonsterile gloves; additional personal protective equipment (PPE; e.g., eye protection, gown, and mask) may be necessary if exposure to body fluids is anticipated
- Facility-approved pain assessment tool
- Patient assessment equipment (e.g., stethoscope for auscultating bowel sounds)
- Supplies for verifying tube placement:
  - Syringe of appropriate size (e.g., catheter tip or bulb) or irrigation set—the size of the syringe will depend on the size/age of the patient. A.S.P.E.N. recommends using a syringe ≥ 30 mL; 60 mL syringes are often used for adult patients
  - pH paper
- Supplies for flushing the tube:
  - Sterile or tap water for flushing the tube
  - Catheter-tip syringe of appropriate size
- Prescribed formula
- Sterile water for reconstituting formula, as needed
- Alcohol swabs
- IV pole and infusion pump (if using pump-assisted method)
- Enteral feeding administration set (tubing). Confirm the type of administration set required for the type of EN to be administered. Some formulas are packaged in a ready-to-hang container that requires an administration set tubing with a spike. Other formulas must be decanted into a bag that is attached to tubing
- Protective barrier for the patient, such as a towel or waterproof linen-saver pad
- Soft toothbrush or moistened swabs for oral care
- Hydrocolloid barrier and tape, as needed, to secure NGT
- Copy of the order for EN
How to Administer EN

› Nurse clinicians are generally responsible for administration and patient care related to management of EN, but the RD should be aware of the procedure
› Perform hand hygiene and don PPE
› Identify the patient according to facility protocol
› Establish privacy by closing the door to the patient’s room and/or drawing the curtain surrounding the patient’s bed
› Introduce yourself to the patient and family member(s), if present; explain your clinical role; assess the coping ability of the patient and family and for knowledge deficits and anxiety regarding administration of EN
   • Determine if the patient/family requires special considerations regarding communication (e.g., due to illiteracy, language barriers, or deafness); make arrangements to meet these needs if they are present
     – Use a professional certified medical interpreter, either in person or via phone, when a language barrier exists
   • Explain the procedure for EN administration and its purpose; answer any questions and provide emotional support as needed
› Observe standard precautions and use general ANTT when indicated throughout the procedure
› Position the patient in bed in a way that promotes privacy, comfort, and accessibility
   • Raise the bed to a height that offers optimal access to the enteral feeding tube access site
   • Lower bedside rail for greater access
   • Remove the patient’s gown/clothing only as necessary to expose the area around the insertion site, as needed, draping the patient for privacy so that only the area around the insertion site is exposed
› Assist the patient into a semi-Fowler’s position. To reduce the risk of aspiration, maintain the patient’s upper body elevated 30–45° during and for at least one hour after completion of the feeding
› Assess the patient’s general health status, including his/her pain level using a facility-approved pain assessment tool
› Assess the abdomen, noting absent or abnormal bowel sounds; whether the abdomen is tender, tense, and/or distended; and for any other abnormalities that may preclude or necessitate modification of EN administration. Abdominal assessment should include the following steps:
   • Auscultate bowel sounds over the four abdominal quadrants; for the purposes of the physical assessment, the abdomen is divided into the right lower quadrant, right upper quadrant, left upper quadrant, and left lower quadrant, with the umbilicus as the midpoint. Auscultating in this order tracks the path of the large intestine from the ascending colon to the transverse colon to the descending colon and sigmoid colon
   • Palpate for tenderness and distention
   • Ask about bowel patterns and verify that the patient has had a bowel movement within the past 3 days
› Assess the feeding tube insertion site
   • Assess for pain/tenderness, leaking, signs or symptoms of infection, and for skin breakdown
   • Confirm that the tube is not placing pressure on the nare, in the case of an NGT; reposition and re-secure using a hydrocolloid barrier, as needed
› Visually evaluate the position of the tube using one or more of the following methods:
   • Measure the length of the visible portion of the inserted tube and compare this measurement with the measurement taken immediately after insertion; clinicians should mark the tube at the time of insertion to provide a ready indication of tube misplacement (e.g., advancement into or from the patient). Note: This method will not indicate if the tube has recoiled upward into the esophagus or migrated into the duodenum or jejunum
   • Verify that the tube is anchored in place using sutures, inflated balloon, tape, and/or tube fixation device (e.g., bumper), as appropriate
› Verify placement of the enteral feeding tube prior to each bolus or intermittent feeding and/or enteral medication delivery, every 4 hours for patients who are receiving continuous EN infusion, or according to unit-specific/facility protocol or as indicated by physical assessment. If the EN has been infusing continuously, it is necessary to clear the tubing prior to checking gastric contents. Draw 30 mL of air into the irrigation syringe and flush the tube with air prior to aspirating fluid, avoiding excessive insufflation of air
   • Aspirate 5–10 mL of gastric contents and perform gastric content assessment. Clinical Tip: Reposition the patient to his or her left side to maximize potential for withdrawing gastric secretions into the catheter
   • Visually inspect gastric contents—gastric secretions typically appear clear and colorless or pale yellow or green, while small-bowel secretions are often brown or yellow colored due to bile
   • Perform pH analysis
     – Gently mix the aspirate in the syringe
– Apply some of the aspirate to pH strip (or dip the pH strip into a medicine cup containing aspirate, according to the test manufacturer’s instructions)
– Compare the color on the pH strip with the color on the chart provided by the manufacturer
– A pH reading of <5 is normal for a patient who is fasting; a reading of 5–6 can occur in a patient who is receiving continuous feedings. A pH of > 6 suggests that the tube lies in the esophagus or small bowel

• Return the aspirate to the stomach as dictated by facility/unit-specific protocol
• Flush the tube with 15–30 mL of water (use more or less water as indicated in the treating clinician’s order or the facility/unit-specific protocol, depending on the patient’s fluid volume status/needs)

› Complete any preprocedure testing (e.g., serum blood glucose analysis)
› Prepare the EN for administration
  • Check that the expiration date (“use by” date) has not passed
  • Inspect the formula within the container (if possible). Look for unexpected discoloration and precipitate
  • Verify that the formula is at room temperature
  • Review the 5 “rights” by checking the formula label against the patient’s medical record, and verifying the identity of the patient, prescribed formula, rate of administration, route, and frequency/duration of feeding
  • If using a powdered formula, reconstitute using sterile water and aseptic technique according to unit-specific/facility protocol and manufacturer’s instructions, and pour no greater than an amount that can be infused in 4 hours into the gavage bag or appropriate container for bolus administration. Refrigerate unused portion
  • If using a liquid formula that must be decanted (open system), shake the can well, use an alcohol swab to cleanse the top of the can, and open and decant into the gavage bag or appropriate container for bolus administration
  • If using a “ready-to-hang” (closed system) bag, use general ANTT to remove the protective cover from the top of the container and spike the container with the administration tubing
  • Label the container of enteral formula with the patient’s name, date and time of feeding, nurse initials, and any other information required by facility/unit-specific protocol
  • Label the tubing “Tube Feed Only” or “Not for IV Use” according to facility/unit-specific protocol

› Adjust the IV pole so that the container holding the EN is ~ 50 cm/20 inches above the patient’s head
› Stop the feeding immediately and notify the treating clinician if the patient becomes nauseated or has any change in respiratory status
› At the conclusion of the enteral feeding, if intermittent or bolus, disconnect the administration set from the feeding tube and cap the tube; flush the tubing in accordance with facility/unit-specific protocol

› Nursing will provide ongoing nursing care
  • Monitor the patient’s response to feeding (e.g., GI signs and symptoms, I & O, daily weight, serum blood glucose tests)
  • Administer flushes as prescribed or required by facility/unit-specific protocol
    – Flush with 30 mL water before and after administering intermittent feedings, after checking GRV, and every 4 hours during continuous feeding
    – Flush with 15 mL water before and after medication administration
    – Use sterile water for immunocompromised or critically ill patients
  • Replace formula according to expert recommendations for maximum hang time or facility/unit-specific protocols
    – Hang only a volume of reconstituted powdered formula that can be infused in 4 hours (i.e., reconstituted powdered formula has a 4-hour hang time) or sterile liquid formula that can be infused in 8 hours (i.e., sterile liquid formula has an 8-hour hang time), when using an open system. Discard refrigerated reconstituted powdered formulas after 24 hours
    – Replace formula and tubing in a closed system after 24–48 hours, according to manufacturer’s instructions and unit-specific/facility protocol
  • Measure GRV every 4 hours during the first 48 hours of EN, decreasing to a frequency of every 6–8 hours in non-critically-ill patients; hold feedings and notify the treating clinician of GRV ≥ 250 mL x 2 or ≥ 500 mL x 1
    – Return the GRV to the patient and flush the tube with 30 mL water prior to resuming feeding, unless otherwise indicated by treating clinician or unit-specific/facility protocol
  • Hold feedings (e.g., for 15 minutes minimum—longer for medications that must be administered on an empty stomach) before and after enteral medication administration
  • Avoid holding EN longer than necessary to promote adequate nutrition
  • Perform oral care at least twice daily—and more frequently depending on patient status—using a soft toothbrush or moistened swabs. Allow the patient to moisten mouth frequently for comfort, if desired and in accordance with treating clinician orders
• Respond promptly to pump alarms, as indicated
• Change the administration set every 24 hours or 24–48 hours for a closed system, and replace the irrigation tray every 4–8 hours, according to facility/unit-specific protocol
  – Take care to label all tubing appropriately when changed
• Dispose of used procedure materials and PPE according to facility protocol; perform hand hygiene
• Follow the facility/unit-specific protocol to document administration of the enteral feeding, which may include updating the patient’s plan of care, making the appropriate notation on the flow sheet, I & O record, medication administration record, patient’s medical record, and/or other patient care form; include the following information:
  • Date and time of enteral feeding administration, including the type, volume, rate, and mode of delivery
  • Patient assessment information, including
    – level of pain
    – assessment of the enteral tube access/insertion site
    – verification of enteral tube placement
    – GI assessment findings
    – GRV amount and time of assessment
  • Patient’s tolerance of the procedure
• Oral care provided
• Any medication administered and response to medication
• Amount and type of flush administered
• Any unexpected patient events or outcomes, interventions performed, and whether the treating clinician was notified
• Patient/family education, including topics presented, response to education provided/discussed, plan for follow-up education, and details regarding any barriers to communication and/or techniques that promoted successful communication

Other Tests, Treatments, or Procedures That May Be Necessary Before or After Caring for a Patient Who is Receiving EN

› Repeat X-rays may be required to verify tube position, especially if the tube is replaced after dislodgement or removal
› If the tube becomes occluded, follow facility protocol to remove the obstruction. A common method of breaking up clogs from nutritional feedings is to
  • crush 1 tablet of pancreatic enzymes with 1 sodium bicarbonate tablet in 5 mL of warm water. Instill into the feeding tube and allow to dwell for 30 minutes
  • irrigate the tube at the end of the dwell time
› The RD, assisted by other members of the patient’s clinical team, should develop a transitional feeding plan

What to Expect After Administering EN

› EN will be safely delivered through the feeding tube as prescribed
› Patient receiving EN will receive appropriate calories to prevent malnutrition and maintain intestinal structure and function
› Ongoing physical assessment and scrupulous care from nursing and clinical team will confirm the correct position of the feeding tube and maintain integrity of the skin and mucous membranes surrounding the insertion site

Red Flags

› Do not mix medications directly into the feeding formula as this may change the bioavailability of the medication and/or cause the solution to precipitate and obstruct the feeding tube
• Although many medications are absorbed by the small intestine and can be administered through both G-tubes and J-tubes, some medications (e.g., Carafate) must be absorbed by the stomach. Optimally, medications administered through enteral feeding tubes should be in liquid or suspension form. Tablets should be well-crushed or allowed to dissolve completely before administration. Tablets that do not dissolve and medication in bead form are particularly problematic because of the tendency to clog the tube, especially the narrower tubes
› Aspiration of EN formula can lead to respiratory compromise, pneumonia, or ARDS. Signs and symptoms of aspiration include choking, vomiting, cyanosis, decreased oxygen saturation by pulse oximetry, restlessness, wheezing, and stridor. If these symptoms occur, stop the feeding immediately and gently remove the nasally or orally inserted feeding tube. Begin oxygen therapy per facility protocol and/or the treating clinician’s orders to promote return to baseline respiratory status
› Using pH as a source for correct tube placement is unreliable as gastric fluid sometimes has a higher pH than normal. Radiography is the gold standard when there is a suspicion of tube migration to the lungs
Enteral misconnection describes an inadvertent connection between an enteral feeding tube and a nonenteral system (e.g., intravascular catheter, peritoneal dialysis catheter, tracheostomy, medical gas tubing), which can cause serious patient harm, including death. **Always label the tubing clearly to reduce the risk of enteral misconnection and always trace the tubing to the source before initiating EN.**

### What Do I Need to Tell the Patient/Patient’s Family?

Reinforce patient/family education regarding the purpose of and steps involved in providing EN. Provide written information, if available. Suggested topics include the following:

- how to care for the skin around the tube
- signs and symptoms of infection
- what to do if the tube is pulled out
- signs and symptoms of tube blockage
- how and what to feed through the enteral feeding tube
- how to check tube placement
- how to check GRVs
- how to operate the infusion device (if applicable)

- when to seek medical attention—provide contact information should questions or concerns arise that warrant the attention of the treating clinician; e.g., for signs of respiratory distress, such as violent coughing and/or gagging, blue color around the lips, “gurgling” sounds with breathing, and/or shortness of breath
- Blood in the gastric aspirate, abdominal distention, vomiting, and changes in the visible length of the feeding tube should also be reported immediately

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### References


