Formula for success: Deliver enteral nutrition using best practices

How to provide the best care and achieve the best outcomes for malnourished patients

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APPEARING POORLY NOURISHED, *Louis Marshall, age 68, is admitted to the hospital with decreased mental status. He has a history of alcoholism and has been drinking heavily since losing his job several months ago.*

Admission findings include an infiltrate on chest X-ray, crackles in the right upper lung lobe, and a white blood cell (WBC) count of 12,500/mm^3, which suggest pneumonia, likely from aspiration when he vomited before admission. He is given I.V. fluids and antibiotics.

During the first 24 hours, his oral intake is marginal because of his mental status. As he experiences withdrawal over the next few days, his mental status continues declining. On day 3, the multidisciplinary team decides against nutritional intervention, anticipating that his oral intake will return to normal when the withdrawal symptoms end. On day 6, he develops hypotension, increasing shortness of breath, and fever.

Over the last 30 years, 30% to 50% of adults admitted to U.S. hospitals have been malnourished. And like Mr. Marshall, many hospitalized adults are too sick or simply physically unable to ingest food. That makes providing adequate nutrition a challenge, especially in patients with impaired digestion, altered consciousness, dysphagia, depression, or weakness. And don't forget the hospitalized patients who are at risk for undernutrition. Almost any moderate or severe chronic disease or severe acute disease increases this risk.

Hospitalized patients who are malnourished or at risk for undernutrition can benefit from enteral nutrition (EN). To improve outcomes and shorten hospital stays, a multidisciplinary team, including a physician, nurse, dietician, and pharmacist, should administer and monitor EN therapy, using the current best practices described in this article.

CE 1.8 contact hours

LEARNING OBJECTIVES

1. Differentiate the techniques of enteral nutrition (EN).
2. Describe how to prevent complications of EN.
3. Discuss the nursing management of patients receiving EN.

Start enteral feeding early

Inpatients should receive EN when oral intake is absent or likely to be absent for more than 7 days. But patients with baseline malnutrition may experience fewer complications if EN is started earlier. EN improves the survival of surgical patients and those with liver disease and severe head injuries. When started within 48 hours of admission, EN benefits a variety of patients, including those receiving mechanical ventilation for more than 24 hours, critically ill patients with burns or trauma, and adults who have hip fractures or have had a stroke. The benefits of early enteral feeding include fewer days of mechanical ventilation, fewer infections, better wound healing, and shorter hospital stays.

EN may also support normal immune function. And early EN may prevent the normal bacteria in the GI tract from moving into the bloodstream and becoming pathogenic. Early EN may also reduce the hypermetabolic response associated with severe illness.

Enteral feeding methods

Continuous feedings are more cost-effective and safer than intermittent feedings, especially in the hospital. However, patients who can eat but can't meet nutrient goals may re-

ceive supplemental intermittent EN. (See *Pros and cons of enteral feeding techniques.*)

Typically, formula can be started at full strength. Most studies show that complete caloric goals can be achieved in 2 to 3 days. However, during the initial stress response to illness, permissive underfeeding may reduce inflammation, cytokine production, and oxidant damage. During permissive underfeeding, a patient receives 50% to 75% of his or her caloric requirement for 3 to 5 days, or until the patient's condition improves. Underfeeding may be used longer with an obese patient to promote oxygenation, diuresis, blood glucose control, and weight loss.

The right formula

The dietitian chooses a formula based on the patient's condition and nutritional goals. Enteral feeding formulas range from 1 to 2 calories/mL. If a patient's condition requires fluid restriction, as with heart or renal failure, the dietitian uses a higher caloric concentration. The optimal number of calories and combination of carbohydrates, protein, and fat required for best practices haven't yet been established for hospitalized adults.

For patients with malabsorption, a dietitian selects formulas that provide semi-elemental or elemental proteins. For those with metabolic and renal disorders, the selection may be a formula with reduced electrolyte levels. For immunosuppression or a risk of it, a dietitian may pick a formula providing nutrients, such as glutamine, arginine, or omega-3 fatty acids. Glutamine and arginine promote WBC function. Omega-3 fatty acids reduce inflammation from severe illness or injury.

On day 6, Mr. Marshall is transferred to the intensive care unit (ICU) with sepsis and intubated for respiratory failure. The team dietitian recommends starting EN with a standard formula at 25 mL/hour with a goal rate of 60 mL/hour.

Pros and cons of enteral feeding techniques

Technique	Description	Pros	Cons
Continuous feedings	• Administered continuously, using an infusion pump	• Minimizes risk of aspiration from reflux or high residual volume • Allows controlled feeding into small bowel • Improves glucose control	• Requires ongoing monitoring and surveillance • May waste formula (the longest hang times are 24 hours in a closed system and 8 hours in an open system)
Cyclic feedings	• Administered less than 24 hours a day, using an infusion pump • Often used at night	• Allows controlled feeding • Reduces the time a patient is connected to a pump • Benefits patients using oral nutrition during the day who need supplemental nutrition	• Requires staff time for set-up and take-down • May require more vigilance at night
Bolus feedings	• Administered by gravity, usually via a syringe over 5 minutes or less • Preferred for patients going home still receiving tube feedings	• Provides fast administration • Doesn't require infusion pump • Allows gastric rest between feedings	• More likely to cause adverse effects • Can be used only to deliver EN to stomach • May require more staff time than continuous feeding
Intermittent gravity-drip feedings	• Administered using a feeding bag, via gravity drip over 20 to 30 minutes	• Provides faster administration than continuous and cyclic feedings • Is often better tolerated than bolus feedings • Doesn't require an infusion pump • Allows gastric rest between feedings	• Can't be used for delivery to jejunum • May require more staff time for set-up and EN delivery

Avoid complications

Frequent monitoring and early intervention can prevent complications—such as aspiration pneumonia, fluid and electrolyte disturbances, diarrhea, and hyperglycemia—or minimize their effects.

Aspiration pneumonia

To prevent aspiration, verify EN tube placement, elevate the head of the bed, and assess residual volume and abdominal status.

Radiology is the only reliable way to determine the position of gastric or jejunal feeding tubes. Air instillation, capnography, and pH testing don't consistently confirm tube placement. Immediately after an X-ray confirmation of proper placement, mark the tube with indelible ink at the point of entry, either the lips or nares. When manipulating the tube and every 4 hours, confirm that your mark is at the same place.

Elevate the head of the bed so the patient's oropharynx is above the stomach. Before decreasing the head of the bed below 30 degrees,

stop the EN feeding. Remember, an elevated head of the bed can cause problems for patients with fragile or impaired skin at the sacrum or hips. Frequent repositioning helps minimize shearing injuries.

Regularly assess gastric residual volume and abdominal status, including the size and firmness of the abdomen and the presence and quality of bowel sounds. Usually, you'll assess the patient every 4 hours and before interrupting EN. If a patient has symptoms of EN intolerance, such as nausea or a distended abdomen, assess more frequently. (See *When residual volume is high*.)

From days 7 to 10, Mr. Marshall's nurses frequently interrupt his EN feeding after finding residual volumes between 90 and 100 mL. The team decides to delay advancing to his goal rate until day 12. During days 7 to 10, Mr. Marshall's health improves as he recovers from sepsis. Still, he will need ventilator support for several more days.

Fluid and electrolyte disturbances

EN therapy may also produce fluid and electrolyte imbalances. Although most EN formulas are 70% to 85% water, a patient may need *free water* (water without nutrients or charged particles) for fluid balance or urine production. This water can be given as boluses two to six times a day and with drugs. If your patient is at risk for infection, consider using sterile water flushes to avoid biofilm (bacteria lining the pipes in hospital plumbing).

Severely malnourished patients run a high risk of *refeeding syndrome*, in which EN after a period of starvation triggers a release of insulin, driving electrolytes into the cells. The shifts in serum phosphate, potassium, and magnesium levels can cause adverse cardiac and neurologic signs and symptoms. To minimize the risk of severe serum electrolyte depletion from refeeding syndrome, correct existing electrolyte imbalances—especially hypokalemia, hypomagnesemia, and hypophosphatemia—before starting EN. To promote electrolyte balance in patients whose nutritional status is uncertain, increase feeding rates slowly. Consider limiting EN to 20 calories/kg/day until serum electrolyte levels are stable.

Malnourished patients should receive daily supplementation with thiamine, a coenzyme used in carbohydrate metabolism. Experts recommend daily—and sometimes twice daily—monitoring of electrolyte levels and repletion until the goal rate for EN is achieved. When the goal rate is sustained, you can monitor electrolyte levels two or three times a week.

Diarrhea

In hospitalized patients receiving EN, diarrhea is common. Consider all possible causes of diarrhea and correct the reversible ones. Fiber-containing or semi-elemental formulas may improve diarrhea. Small studies of patients in the ICU indicate that *symbiotics* and *probiotics* (yogurt with active culture and lactobacillus preparations) may help prevent relapses of diarrhea. (See *Diarrhea: Causes and cures*.)

Hyperglycemia

Infection, stress, insulin resistance, diabetes, and EN contribute to hyperglycemia. Data suggest that glycemic control leads to better patient outcomes—fewer infections and decreased lengths of stay. Check blood glucose levels regularly. If hyperglycemia persists, the dietitian can adjust the calorie and carbohydrate contents of the formula, and the prescriber can add insulin to the drug regimen.

Prevent blocked tubes

Routine flushing can prevent clogged feeding tubes, as can flushing after interruptions to assess residual volume or give a drug. Between 20 and 100 mL of water provides an effective flush.

Acidic products can cause proteins in the formula to coagulate, so consider the pH of any solution before adding it. You may need to flush before and after administering acidic solutions.

When residual volume is high

Expert opinions and guidelines differ on the upper limit for gastric residual volume, with recommendations ranging from 200 to 500 mL. Consider using the most conservative value in vulnerable patients, such as those with an artificial airway and those who can't communicate, to avoid the risk of aspiration, vomiting, and abdominal discomfort.

If residual volume is elevated, recheck it within an hour. The volume should return to normal, unless the patient has GI signs and symptoms, such as nausea, vomiting, or abdominal discomfort. Don't stop enteral nutrition (EN) based on a single high residual volume. If the volume remains high over two or more assessments, inform the other team members.

When high volumes persist, the physician may order a prokinetic agent to improve peristalsis. Based on a meta-analysis of research on patients in intensive care units, the recommended agent is metoclopramide (Reglan). Some patients will benefit from a calorie-dense formula when residual volume remains high and caloric goals can't be met. Alternatively, EN can be delivered to the small intestine, which doesn't require peristalsis for nutrient absorption.

A word on postpyloric feeding tubes

Remember, postpyloric feeding tubes don't have gastric reservoirs for accumulated formula, so you can't check the gastric volume. Plus, attempting such a check may endanger the patency of these easily occluded and displaced tubes.

Diarrhea: Causes and cures

A common complication of enteral nutrition (EN), diarrhea has several causes. This table provides the usual causes with the appropriate interventions.

Causes	Interventions
Not related to EN formula	• Obtain history, including onset, duration, pattern, and severity of symptoms. • Perform focused abdominal and rectal exams. • Test stool for blood and leukocytes.
Drugs and additives • Sorbitol in liquid drug formulations such as acetaminophen (Tylenol) • Histamine$_2$ receptor blockers • Laxatives and stool softeners • Antacids containing magnesium or phosphate • Antiarrhythmics • Antineoplastics • Prokinetic agents • Osmotically active agents such as lactulose	• Use sorbitol-free preparations. • Substitute proton-pump inhibitors for ulcer prevention. • Review patient's drugs and discontinue ones that promote stool evacuation, such as antacids and prokinetic agents.
Hypersecretion of endogenous hormones associated with bacterial toxins and neoplasms	• Test stool for cytotoxin assay.
Sepsis and inflammatory syndromes	• Check for signs and symptoms of systemic infection. • Give prescribed anti-inflammatory and anti-infective drugs.
Pancreatic insufficiency	• Send stool specimen for evaluation of fat concentration. • Give prescribed pancreatic enzymes.
Bowel atrophy after prolonged period of no oral intake	• Reduce feeding rate or provide elemental formula until regeneration occurs.
Bacterial overgrowth and infection	• Make sure antibiotics are indicated for ongoing administration. • Send stool specimen for *Clostridium difficile* detection, ova and parasite evaluation, and Gram stain, fecal leukocyte count, and culture, as indicated.
Malabsorption syndrome	• Consider protein supplementation or albumin infusion.
Irritable bowel disease	• Consider antidiarrheal after ruling out intestinal infection. Usually, the drug of choice is loperamide.
Impaction	• Gently remove impaction with an enema or manually. • Add a stool softener to regimen.
Related to EN formula	• Evaluate the feeding formula, infusion rate, and hang times. • Assess tube position. Document volume, frequency, consistency, and daily intake and output.
Rapid infusion rate	• Slow the rate. • Switch to an alternative formula.
Rapid rate progression	• Return to previously tolerated rate and continue for 24 hours. • Consider permissive underfeeding.
High-fat intake	• Switch to a low-fat formula.
Microbial contamination	• If the system is closed, change the bag and tubing every 24 hours. • If the system isn't closed, rinse the bag with sterile water and replace the formula every 8 hours. • Consider using sterile water for flushes.
Insufficient fiber	• Switch to a formula containing fiber or add fiber to the feeding tube. • Don't add fiber to the formula.

Warm water can open clogged EN tubes. As an alternative, you can use a preparation of pancreatic enzymes with sodium bicarbonate, such as Clog Zapper. You can also use this preparation intermittently to prevent recurrent blockages.

Minimize interruptions

Patients receiving EN have as many as 13 interruptions a day, resulting in as many as 5 hours a day without EN delivery. Not surprisingly, less than half of EN patients achieve their caloric goal.

Avoid unnecessary stoppages. Experts recommend stopping EN feedings immediately before a procedure and 6 hours before surgery and restarting immediately afterwards. You may also consider altering an hourly EN rate to catch up on a daily goal after a brief interruption.

Monitor EN feedings for unnecessary interruptions. Communicate the actual volume of EN delivered daily to team members, so strategies for sufficient nutrition can be discussed and implemented.

Avoid overfeeding

Providing excess calories, protein, carbohydrates, or fat can lead to complications such as hyperglycemia, resulting in osmotic diuresis, electrolyte shifts, and infections. Excess calorie intake leads to more carbon dioxide production, which may increase ventilator dependence. Plus, overfeeding can damage the liver.

To avoid overfeeding, periodically reassess the need for calories, protein, carbohydrates, and fat, as your patient's condition changes. Typically, a dietitian determines caloric goals, using a formula based on the patient's age, weight, and condition and calculates protein needs based on wounds, skin breakdown, and the degree of stress. The best way to determine caloric goals is by using indirect calorimetry, in which a device

measures actual energy expenditure from exhaled gases. Most prescribers of EN use a predictive equation or estimate 20 to 35 kcal/kg/day with protein comprising 1 to 2.2 gm/kg/day. There's not enough evidence to recommend a uniform approach or optimal goals.

Mr. Marshall's condition begins improving, and on day 13, he achieves his EN goal rate of 60 mL/hour. However, he develops diarrhea and hyperglycemia. The physician orders an insulin drip, and the nurse monitors serum glucose levels. Test results for Clostridium difficile *in stool are negative. The physician continues the patient's antibiotic therapy for sepsis. The dietitian reassesses Mr. Marshall and switches to a semi-elemental formula.*

Over the next 2 days, his stool remains liquid, but his stool volume decreases with the change in formula. On day 15, the physician replaces the insulin drip with subcutaneous injections. On day 16, after extubation, the patient returns to the acute care unit, where he receives a regular diet during the day and intermittent EN at night. When he achieves 60% of his caloric goals on day 20, the team stops EN. On day 21, Mr. Marshall is discharged.

Evaluating Mr. Marshall's care

How well did the team do with Mr. Marshall? Did they miss any opportunities to implement best practices? Let's review.

Patients experiencing severe alcohol withdrawal often can't eat for a week. Because this patient arrived at the hospital malnourished and his mental status didn't allow him to eat safely or adequately, the team should have started EN within 48 hours of admission.

After team members started EN, they delayed his nutritional goals for several days because of gastric residual volumes, though he didn't have signs or symptoms of intolerance and the volumes were below the most conservative limit of 200 mL recommended by experts.

Team members did take the appropriate action by continuing EN and adjusting the formula while treating hyperglycemia and diarrhea. These complications are common in patients who are stressed. They aren't reasons for stopping EN.

Benefits of best practices

Best practices for EN include using a team approach, starting EN early, reviewing goals daily, and using recommended interventions to avoid complications. By using these practices for hospitalized patients who are undernourished or at risk for undernourishment, you and other team members can effectively and efficiently improve your patients' health and shorten the time they spend in the hospital. ✯

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Visit www.AmericanNurseToday.com/journal for a complete list of selected references as well as indications for specific enteral formulas and a list of guidelines for giving enteral nutrition.

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