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Delivering evidence-based nutritional therapy

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BECAUSE OF THE ever-growing responsibility of keeping your nursing practice current, your nutrition care practice may need updating based on the latest evidence published by professional societies and related peer-reviewed journals.[1-3]

As nurses in any practice environment, we have a moral and professional obligation to our patients and our colleagues to remain abreast of new findings, evaluate their relevance to our institutional processes, and translate them into clinical practice whenever possible.

In recent years, specialized nutrition in the form of enteral and parenteral solutions has finally been recognized for its contribution to improvements in clinical outcomes for acutely ill patients. Many advances in nutrition therapy demand attention so we can optimize patient outcomes.

Practice guidelines published by American, European, and Canadian nutrition societies in the last decade are available with evidence-based recommendations.[1-3] This review will address best practices in nutrition therapy and discuss five of the top challenges nurses face when delivering enteral nutrition (EN) to acutely ill patients.

High cost of poor nutrition

Some reports suggest that 30% to 55% of hospitalized patients are affected by malnutrition[4] and may experience negative outcomes such as increased length of stay, poor functional capacity and quality of life, an increased risk of adverse events such as pressure ulcers and surgical site infections, and higher mortality.[5] Especially troubling are reports that malnutrition is unrecognized in up to half of these patients and that their nutritional status declines further during hospitalization for up to 30% of them.[6] Formulated to support adequate nutrition in hospitalized patients, EN solutions now contain active nutrients that reduce oxidative damage to mitochondria and cells, modulate inflammation, attenuate the metabolic response to stress, and improve feeding tolerance.

The clinical nurse now has the advantage of scientific data to guide specialized nutrition therapy. For example, formulas supplemented with anti-inflammatory, immune-modulating, or tolerance-promoting nutrients can enhance natural recovery processes and prevent complications.[4]

Other advances that support nutrition therapy are bedside devices to quickly and safely establish and maintain access for small bowel feedings, which help minimize risk of aspiration, promote tolerance, decrease radiologic exposure, and reduce nursing time consumed by tube placements, gastrointestinal (GI)

dysfunction, and patient discomfort. It's easy to see how successful efforts to feed acutely ill patients may enhance nurse and patient satisfaction, while conserving costs.

Common challenges for nurses

As the body of evidence for nutrition therapy grows, nurses are challenged to stay abreast of current practice standards. The following discusses how to apply the evidence to meet five key nursing challenges.

Challenge #1: ***With so many nutrition guidelines and evidence-based recommendations for feeding acutely ill patients, how do I initiate and monitor nutrition therapy?***

This common question demonstrates conscientious patient advocacy. First, every nurse must accept the professional imperative to engage in lifelong learning. This means regularly reading research articles in interdisciplinary peer-reviewed journals. Many publications are available, some with graded evidence, for nurses to use in their clinical decision making regarding nutrition therapy.[1,7,8]

If your unit doesn't have a nurse-driven protocol or unit feeding protocol, this should be a priority for the unit practice council or evidence-based practice committee. A large and growing body of evidence suggests that feeding protocols should be the standard of care in all patient-care environments.[9]

Results from a large multinational, multicenter, observational study showed that the presence of an EN protocol was associated with significant improvements in nutrition practices compared with sites not using a protocol.[10] The use of a protocol in participating centers reduced N.P.O. and clear-liquid diet days, ensured timely initiation of feeding, and minimized interruptions, enhancing attainment of goal calories. Sites using a protocol started EN earlier (41.2 hours from admission to ICU versus 57.1 hours; $P = 0.0003$), used more promotility agents for patients with high gastric residual volumes (GRV; 64.3% of patients versus 49.0%, $P = 0.0028$), and attained greater nutritional adequacy (61.2% of patients' caloric requirements versus 51.7%, $P = 0.0003$).[9]

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If nurses follow protocols for administering sedation and analgesia, replacing fluids and electrolytes, initiating early mobility, and titrating insulin infusions, why not follow them for nutrition therapy? Internationally, about 80% of ICUs participating in the multicenter study reported using an EN protocol, although few of these ICUs were in the United States—only an estimated 30% of ICUs in the United States use EN protocols.[10]

Included in most EN protocols are recommendations for tube selection and feeding location, use of promotility agents, GRV monitoring, and head-of-bed elevation. In a large cluster randomized trial with an aggressive feeding protocol, patients experienced a greater number of days of EN, a shorter hospital stay by 10 days, and a 10% reduction in mortality when compared with an ICU with no protocol.[11]

Another study by McKenzie et al. showed that implementing an EN protocol resulted in more ICU patients receiving at least 80% of their estimated needs (from 20% pre-protocol to 60% postprotocol implementation; $P < 0.001$) with a reduction in the use of parenteral nutrition (from 13% to 1.6%; $P = 0.02$).[12]

According to Heyland et al., the nurse-led feeding protocol should be considered a tool that enables the clinical nurse to initiate, monitor, and modify the administration of EN to individual patients.[10] Overall, protocols reduce variance in nursing practice.

Challenge #2: ***My patient was admitted 36 hours ago and is hemodynamically stable following volume resuscitation. I know that early enteral feeding is recommended within 24 to 48 hours of admission. Can I safely feed this patient?***

The choice to begin enteral feeding is well justified in this situation. While caution is advised for patients who are hemodynamically unstable, enteral feeding can safely be initiated once the patient is volume resuscitated, vasopressor doses are stabilized, and mean arterial pressure is greater than 60 mm Hg.[1]

In a retrospective review of patients requiring stable low doses of vasopressors, those patients receiving early delivery of EN had lower ICU mortality (22.5% versus 28.3%, $P = 0.03$) and hospital mortality (34% versus 44%, $P < 0.001$) than those receiving late EN, respectively. In an observational study by Khalid et al., the incidence of pneumonia in

patients on stable doses of vasopressors who were placed on EN was reduced compared with patients for whom EN was withheld.[13]

It's correct to think that early EN, defined as within 24 to 48 hours of admission,[1] is recommended for most ICU patients. The decision about when to feed an acutely ill patient must take several factors into consideration such as presence of malnutrition upon admission, GI surgery precluding oral or EN diet, and intact gag and swallowing functions. Several studies link early oral nutrition or EN following surgery with favorable results, such as fewer infectious complications and earlier discharge.[14]

The universal consensus is that EN is the preferred route for nutrition therapy due to the superior physiologic response and lower risk of complications compared with parenteral nutrition. Keep in mind that changes in gut permeability tend to occur as illness progresses and consequences include increased bacterial toxin challenge, risk for multiple-organ dysfunction syndrome, and systemic infection. Nurses should intervene with nutrition while the likelihood of success and opportunity to impact the disease process is greater. Early initiation of feeding provides the necessary nutrients to support gut-associated lymphoid tissue, mucosa–associated lymphoid tissue, and gut mucosal integrity.

The intestine is a sufficient barrier against bacteria and intraluminal toxins due to the high rate of enterocyte turnover, the mucus secreted by the goblet cells, and the large amount of protective immunologic tissue; 80% of the immunoglobulins synthesized in the body are secreted through the GI tract.[15] Fasting states for procedures or delays in enteral feeding longer than 3 days contribute to disruption of intestinal integrity via multiple mechanisms including atrophy of the microvilli.[16]

Intestinal dysfunction leads to increased intestinal permeability and the possibility of bacterial translocation. Intestinal ischemia resulting from shock states and sepsis may produce hypoxia and reperfusion injuries, further affecting intestinal wall permeability.[16]

In surgical patients, early enteral feeding reduces inflammation, oxidative stress, and the catabolic response to anesthesia and surgery-induced stress; helps restore intestinal motility; reverses enteric mucosal atrophy; and improves wound healing. Although trophic feeding or "trickle feeding" (usually 10 to 20 mL/hr) isn't believed to be optimal, if it's used in the first few days, it's important to achieve at least 15% to 20% of daily caloric goals.[17]

After establishing tolerance, advancing daily intake to at least 80% of caloric goals for the highest risk patients may be required to achieve positive clinical outcomes.[17] Recent studies have attempted to correlate caloric intake and patient outcomes without success. Supplementing EN with parenteral nutrition to achieve 100% of the caloric goal doesn't favorably impact morbidity and mortality.[18]

Challenge #3: ***As the patient's nurse, I may be the one to decide when to initiate nutrition therapy, but I'm not certain where to feed the patient, in the stomach or in the small bowel. What should I consider when making this decision?***

Although nasogastric (NG) feeding is appropriate and safe for most patients requiring short-term nutrition support, for those at risk for aspiration and GI intolerance, distal small bowel feeding may be safer and better tolerated. In a large group of critically ill patients, impaired gastric emptying presented challenges to feeding; up to 50% of patients on mechanical ventilation and up to 80% of patients with increased intracranial pressure following head injury demonstrated delayed gastric emptying.[19] In one prospective randomized controlled trial, Huang et al. showed that severely ill patients (defined by an APACHE-II score greater than 20) fed by the nasoduodenal (ND) route experienced significantly shortened hospital length of stay, fewer complications, and improved nutrient delivery compared with similar patients fed by the NG route. Less severely ill patients (APACHE-II score less than 20) showed no differences between NG and ND groups in daily energy and protein intake, feeding complications, length of ICU stay, or nitrogen balance.[20]

The American Thoracic Society and the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.), as well as the Infectious Diseases Society of America, have published guidelines supporting small bowel feeding in the ICU setting due to its association with reduced incidence of healthcare-associated infections and ventilator-associated pneumonia in particular.[1-3]

Although it's safe to feed the stomach in most patients, the A.S.P.E.N. Enteral Nutrition Practice Recommendations state that an enteral feeding route should be based on patient-specific factors; patients with persistent dysphagia should have a long-term enteral access device placed (for example, percutaneous endoscopic gastrostomy tube or surgical gastrostomy tube).[21]

When the decision is made to use postpyloric tube placement for nutrition therapy, the next decision is how to safely place the tube, ensure its location in the small bowel, and minimize delays in feeding. Challenges related to feeding tube insertion may preclude timely advancement to nutrition goals. Postpyloric feeding tube placement is often done blindly at the bedside without endoscopic or fluoroscopic guidance; however, the blind bedside approach isn't without risks. Success rates of this approach vary greatly

depending on the patient population and provider expertise. Placement using endoscopic or fluoroscopic guidance is a safe alternative, but usually requires coordinating a transport to the radiology department, posing patient safety risks and possible feeding delays. Bedside use of an electromagnetic placement device (EMPD) provides yet another alternative with reports in the literature of 98% success rates for initial placement in less than 20 minutes.[22,23] In a multicenter prospective study, data showing a discrepancy between the original EMPD verification and the final radiograph interpretation was found for only 1 of 194 patients enrolled, demonstrating a 99.5% agreement between the two readings. Median placement time was 12 minutes and no patient experienced an adverse event related to tube insertion using this device.[23]

The ability to monitor the location of the feeding tube tip in real time provides a desirable safety feature for the clinician performing bedside insertions. Nurses should consider incorporating the EMPD into the unit feeding protocol as this reduces the time spent initiating feedings, with early and accurate tube insertion. Procedural complications from placement of nasoenteral feeding tubes by all methods can be as high as 10%,[24] with complication rates of 1% to 3%[25] for inadvertent placement of the feeding tube in the airway alone. Radiographic confirmation of tube placement is advised prior to initiating feeding to eliminate any possibility of misplacement and administration of formula into the lungs.

Challenge #4: ***My patient has a nasoenteric tube with confirmed placement in the stomach. Feedings are infusing at 75 mL/hr. I'm worried that the patient won't tolerate gastric feedings, but I'm unsure how to assess for intolerance.***

A number of factors impede the delivery of EN in the acute care setting. Commonly cited reasons for underfeeding include GI intolerance, underprescription, and frequent interruptions for procedures, technical issues with tube patency and placement, and unexplained factors. GRVs don't correlate well to incidence of pneumonia,[26] measures of gastric emptying, or regurgitation and aspiration.[27]

Several high-quality studies demonstrated that raising the cutoff value for GRV from a lower number (50 to 150 mL) to a higher number (250 to 500 mL) doesn't increase risk for regurgitation, aspiration, or pneumonia.[26,28] A lower cutoff value for GRV doesn't protect the patient from complications, often leads to inappropriate cessation, and may adversely affect outcome through reduced volume of EN infused.[29] Gastric residual volumes in the range of 200 to 500 mL should raise concern and lead to the implementation of measures reducing risk of aspiration, but automatic cessation of feeding shouldn't occur for GRV less than 500 mL in the absence of other signs of intolerance.[27,28]

In a recent survey, more than 97% of nurses reported that they assessed intolerance by measuring GRV; the most frequently cited threshold levels for interrupting feedings were 200 mL and 250 mL. About 25% of the nurses reported interrupting feedings for GRV of 150 mL or less; only 12.6% of the respondents reported allowing GRV up to 500 mL before interrupting feedings.

Although monitoring GRV is unnecessary with small bowel feeding, the location of the feeding tube tip should be questioned if gastric contents are obtained from a small bowel tube. Assessing tube tip location is also important prior to administering any medications via feeding tube to ensure optimal bioavailability without contributing to issues of tube obstruction, reduced drug efficacy, or increased drug toxicity.[21]

Findings from three well-designed clinical trials challenge the benefit of monitoring GRV at all because there was no difference between groups in regard to pneumonia. The investigators concluded that eliminating the practice of monitoring GRV improves delivery of EN without jeopardizing patient safety.[26-28]

Other objective measures for assessing tolerance include an abdominal assessment with documentation of changes in bowel sounds, expanding girth, tenderness or firmness on palpation, increasing NG output, and vomiting. If indications of intolerance occur, administering a promotility agent as prescribed, ensuring the tip of the tube is in the distal small bowel, and consulting the team registered dietitian to consider changing the patient's formula are all evidence-based steps the nurse can follow before terminating therapy.[30]

Challenge #5: ***My patient has a nasoenteric feeding tube and receives multiple medications that must be crushed. What's the best way to administer medications by feeding tube to prevent a clogged tube? How do I manage a clogged tube?***

Best practices for all patients with feeding tubes receiving medications are to document the tube tip location each shift and to communicate to the pharmacist that the patient will be receiving medications via feeding tube. Ideally, two methods of verification are used, such as radiographic confirmation (the gold standard) and marking the exit point at the naris. Patient complaints of gastric distress are also indicators of either a displaced tube or adverse reactions to medication.

Recent studies have demonstrated that air insufflation, bubbling of water in a cup, visual assessment of aspirate, pH measurement, or external tube length aren't reliable methods of determining tube placement.[31-33]

Ask yourself: Is the feeding tube in the distal small bowel, where hyperosmolar medications can be particularly problematic with the potential

for harm to the gut mucosa? Or is it in the stomach where gastric acid will negatively impact bioavailability of the drug once it's crushed?[34]

It's critical to consult with a pharmacist for patients receiving medications coadministered with EN. The pharmacist will know whether a drug or its dosage form is appropriate for delivery, depending on the type of tube and the location of its distal tip. For example, administering a drug into the jejunum will bypass a major drug absorption site, the duodenum. This may decrease the absorption of certain drugs, reducing their effectiveness.

To prevent problems, familiarize yourself with guidelines for medication administration that are available from professional organizations. The A.S.P.E.N. Enteral Nutrition Practice Recommendations offer these reminders:

- Use sterile water in adult patients to flush feeding tubes before and after medication administration.
- Adhere to protocols for properly flushing tubes before and after medication administration.
- Don't add medication directly to an enteral feeding formula.
- Don't mix medications together when administering them by feeding tube due to potential risks of physical and chemical incompatibilities, tube obstruction, and altered therapeutic response.
- Administer medications separately through an appropriate enteral access. Follow pharmacist recommendations for use of liquids, immediate-release solid dosage forms, and hard gelatin capsules.[21]

Before administering any medication, the feeding should be stopped and the tube flushed with sterile water to check for patency and to flush residual feeding formula through the tube. If not contraindicated, at least 15 mL of sterile water should be used for adults in the initial flushing, between medications, and following the delivery of all medications. The amount of fluid must be individualized according to the patient's volume status and diagnosis.[21]

When administering hyperosmolar liquid medications, diluting them with sterile water (15 to 30 mL) for gastric or small bowel delivery is recommended.[21]

Sorbitol is a sugar alcohol that's used as a sweetener in many oral liquid medications. When it's given undiluted into the small intestine, it can cause osmotic diarrhea, nausea, and cramping. As little as 10 g of sorbitol can cause GI distress. The exact amount of sorbitol in liquid medications isn't always evident on the container, but a common offender is acetaminophen elixir (65 mg/mL), which is just one of the many medications with osmolality of greater than or equal to 3,000 mOsm/kg.[35] (See *Selected liquid medications with osmolality ≥ 3,000 mOsm/kg*.) Typical daily dosing yields a considerable amount of sorbitol.[35]

Other troublesome medications include liquid antibiotics, laxatives, and vitamin and electrolyte solutions, which far exceed the osmolality of GI secretions (300 mOsm/kg).[34] Information about compatibility of various drugs with nutrition formulas isn't always available for a particular drug preparation; don't assume that information about drug compatibility for one preparation applies to all of them. For example, morphine in a 2-mg/mL concentration decreases the pH of the feeding formula and results in a precipitate, but the 20-mg/mL concentration doesn't.[36]

The practice of crushing multiple tablets and mixing powders together before administration is unsafe; drug interactions and the loss of enteric-coated microgranules may complicate the patient's clinical status or cause GI distress. When administering liquid-filled capsules by feeding tube, the liquid must be fully extracted to ensure a complete dose and it should be diluted before instillation directly into the stomach or intestine.[36]

Open powder-filled capsules, remove the powder, and dilute it with water. Immediate-release tablets can usually be safely crushed, diluted, and administered without causing adverse reactions. However, sublingual, enteric-coated, or extended-release medications shouldn't be crushed because these can interact with the feeding formula and obstruct the tube or lead to dangerous and unanticipated adverse reactions.[36]

In addition to your hospital or unit pharmacist, a great resource is www.ismp.org/Tools/DoNotCrush.pdf. Using guidelines ensures safe medication administration and can prevent adverse outcomes such as reduced drug efficacy, increased drug toxicity, and tube occlusion.[22,37]

As soon as a nasoenteric tube that will be used for medication administration and feeding is placed, the pharmacist should be consulted to assist with changing tablets and capsules to liquid or I.V. preparations.

Selected liquid medications with osmolality ≥ 3,000 mOsm/kg[34,35]

- Acetaminophen suspension, 160 mg/5 mL
- Acetaminophen elixir, 65 mg/mL
- Acetaminophen with codeine elixir
- Chloral hydrate syrup, 50 mg/mL
- Dexamethasone solution, 1 mg/mL
- Docusate sodium syrup, 3.3 mg/mL
- Ferrous sulfate liquid, 60 mg/mL
- Lactulose syrup, 0.67 g/mL
- Multivitamin liquid
- Potassium chloride liquid, 10%
- Promethazine hydrochloride syrup, 1.25 mg/mL

Smaller bore tubes, up to size #14 French in particular, are at risk for clogging when used to administer crushed medications.

One of the most obvious and troubling safety issues is an obstructed feeding tube, which can lead to a disruption in nutrient delivery. The most common risk factors for an obstructed feeding tube include increasing tube length, decreasing tube caliber, inadequate water flushing, frequent medication delivery, and use of the tube to measure residual volumes.[37]

While a nurse attempts to clear a clogged tube, the patient may experience a calorie and fluid deficit that can contribute to poor outcomes over time. The key to a patent feeding tube and proper medication administration is to *flush, flush, flush!* The best evidence available indicates that warm water is the optimal solution and should be attempted numerous times with nothing smaller than a 30- or 60-mL catheter tip syringe, alternating injecting water and withdrawing tube contents. If success isn't achieved with water, pancreatic enzymes may be combined with sodium bicarbonate and instilled for 30 minutes into the clogged tube followed by an attempt to flush the tube.[38,39] The FDA has approved a clog-clearing device, which uses a clearing stem and a 40 Hz vibratory stimulus to break up the clog in either NG or small bowel feeding tubes in less than 10 minutes.[40]

A study shows that 30-mL flushes every 4 hours during continuous feeding, before and after intermittent feeding or medications, or with any interruption in feeding, is an evidence-based practice that should be part of all EN protocols.[22,37] Keep in mind that almost all patients receiving tube feedings require additional water for hydration, but document the amount of these flushes because they can add up quickly. For calculation purposes, most formulas are about 1 kcal/mL with 750 to 800 mL of water per liter. A good general guideline is that most patients will need 1 mL of water for every kilocalorie they receive daily, with the exception being patients with renal failure or other fluid restrictions.[41]

A quick bite of information

Now you're up to date with some of the latest evidence surrounding nutrition care practices for nurses managing nutrition therapy for acutely ill and critically ill patients. There's much we still don't know about the benefits or harm related to EN therapy, but we hope that future, high-quality, randomized controlled trials in this population will help nurses to close remaining knowledge and practice gaps. ■

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