



Guideline

# A practical guide for enteral nutrition from the Korean Society for Parenteral and Enteral Nutrition: Part III. preparation of enteral nutrition formulas

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## Abstract

**Purpose:** This guideline was developed to provide evidence-based recommendations for the safe preparation and handling of enteral nutrition (EN) formulas in order to improve patient safety and promote standardized clinical practice in Korea.

**Methods:** The key questions addressed the selection of open versus closed feeding systems, the safe preparation and handling of EN formulas, precautions related to blenderized tube feeding (BTF), and essential labeling requirements. Recommendations were drafted and refined through multidisciplinary expert consensus under the auspices of the Korean Society for Parenteral and Enteral Nutrition (KSPEN).

**Results:** The choice of feeding system should be determined according to the patient's condition, risk of infection, and anticipated dura-

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tion of feeding. Closed feeding systems are recommended because they reduce contamination risk and nursing workload, whereas open feeding systems require strict adherence to aseptic technique. For open or reconstituted EN formulas, hang time at room temperature should not exceed 4 hours, whereas closed feeding systems should follow the manufacturer's recommended hang time. For BTF, administration time should be limited to 2 hours to minimize bacterial growth, and their use is contraindicated in medically unstable or immunocompromised patients. Accurate labeling, including patient identifiers, formula information, administration route, and hang time, is essential to prevent administration errors.

**Conclusion:** These guidelines provide a practical framework for the safe preparation and management of EN formulas. Adherence to standardized preparation protocols, including appropriate feeding system selection and strict hygiene practices, is essential for reducing complications and improving the safety of EN therapy.

**Keywords:** Consensus; Enteral nutrition; Food safety; Nutrition support; Patient safety

## Introduction

Following Part I, which addressed enteral nutrition (EN) prescription, and Part II, which focused on feeding route selection and EN initiation, Part III presents recommendations for the safe preparation and handling of EN formulas. Appropriate preparation practices are essential for ensuring patient safety and effective nutritional support, because improper preparation, storage, or handling may result in microbial contamination, administration errors, and adverse clinical outcomes.

In clinical practice, the preparation and delivery of EN formulas are influenced by the type of feeding system used, the characteristics of the formula, and the care setting. Appropriate selection between open and closed feeding systems, careful adherence to aseptic preparation techniques, and compliance with recommended storage conditions and administration times are all critical for minimizing contamination risk. In particular, powdered EN formulas require meticulous attention during reconstitution to maintain microbiological safety.

Additional caution is required when blenderized tube feeding (BTF) is used, because these preparations carry an increased risk of bacterial contamination if they are not properly managed. Safe use depends on strict control of preparation methods, storage conditions, and administration time, and BTF should be restricted in selected patient populations. Accurate and standardized labeling of EN preparations is also essential for preventing administration errors and maintaining traceability in clinical practice.

Part III summarizes practical, evidence-based recommendations to help healthcare professionals select appropriate feeding systems, safely prepare and handle EN formulas, apply necessary precautions when using BTF, and implement standardized labeling practices to improve patient safety.

## Methods

The methodology used for Part III was identical to that described in Parts I and II. This guideline was developed to provide standardized recommendations for the safe preparation and handling of EN formulas in clinical practice and to reduce the risk of contamination and administration errors. The target population includes adult and pediatric patients receiving EN in hospital settings.

The Enteral Nutrition Committee of the Korean Society for Parenteral and Enteral Nutrition (KSPEN) identified key clinical questions related to the safe preparation and handling of EN formulas and organized them into four areas: (1) selection of open versus closed feeding systems; (2) safe preparation and handling of EN formulas; (3) precautions for BTF; and (4) labeling requirements for preventing administration errors.

This guideline was developed through an expert consensus process that adapted existing international guidelines, particularly the 2017 ASPEN Safe Practices for Enteral Nutrition Therapy, to the clinical environment in South Korea. Relevant literature was reviewed using PubMed, Embase, and the Cochrane Library with search terms including "enteral nutrition," "tube feeding," and "blenderized tube feeding." International guidelines from the European Society for Clinical Nutrition and Metabolism, the American Society for Parenteral and Enteral Nutrition, and the Society of Critical Care Medicine were also reviewed.

Recommendations were formulated through multidisciplinary expert consensus on the basis of available evidence and clinical applicability. Draft recommendations underwent internal review and cross-disciplinary peer review and were then approved by the KSPEN Guideline Committee. The structure of Part III follows the same format as the preceding parts and consists of key questions, practice recommendations, and supporting rationales.

## Practice guide

### Selection criteria for open and closed feeding systems

**Key question 1. What factors should be considered when selecting between open and closed feeding systems?**

#### Practice recommendation

Although the choice of feeding system depends on institutional resources and clinical circumstances, closed feeding systems should be preferred whenever feasible, especially for patients at increased risk of contamination or infection.

- Cost

Closed feeding systems may reduce nursing workload and lower the risk of infection, which may in turn contribute to cost savings.

- Safety

Open feeding systems require strict compliance with standardized handling procedures. Healthcare professionals should perform proper hand hygiene, prepare and administer EN formulas and feeding sets appropriately, and adhere to the recommended hang times.

#### Rationale

Open feeding systems are those that require manual transfer, decanting, or reconstitution of EN formulas before administration. In contrast, closed feeding systems use prefilled sterile containers that can be connected directly to the feeding set with minimal handling.

Commercially prepared EN formulas are sterile at the time of manufacture; however, contamination may occur during preparation or administration after opening. Contaminated enteral formulas have been associated with gastrointestinal complications, such as abdominal distension and diarrhea, as well as systemic infections, including bacteremia [1-4]. Several studies have shown that open feeding systems are more vulnerable to microbial contamination because they involve multiple handling steps, including decanting and formula reconstitution [1-4]. By contrast, closed feeding systems require minimal manipulation and have been shown to reduce microbial contamination and infection rates significantly. These advantages may also lessen nursing workload and shorten preparation time, thereby contributing to cost savings in clinical practice [1-4].

Nevertheless, open feeding systems can also be used safely if healthcare professionals follow aseptic techniques rigorously, including appropriate hand hygiene and standardized handling procedures [1-4]. Recommended hang time varies

according to the feeding system and the type of formula. In open feeding systems using commercially prepared formulas, administration is generally limited to 4 hours, whereas blenderized or reconstituted formulas require shorter hang times because of the greater risk of microbial growth. Closed feeding systems should follow the manufacturer's recommended hang time.

In Korean healthcare institutions, commercially prepared liquid EN formulas are widely used in routine practice. However, powdered formulas are sometimes prepared in open feeding systems for specific patient groups, such as preterm infants or pediatric patients, when suitable sterile liquid alternatives are not readily available. In pediatric practice, the powdered formulas commonly used in open feeding systems are not sterile. Therefore, powdered formulas should be avoided in immunocompromised infants whenever sterile liquid formulas delivered through closed feeding systems are available [5]. Although some international guidelines mention pasteurized donor human milk as a possible alternative when a mother's own breast milk is unavailable, donor milk use remains limited in the Korean clinical setting and may not be broadly applicable in domestic practice.

### Safe preparation of EN formulas

**Key question 2. What are the essential requirements for the safe preparation of powdered EN formulas and the decanting of EN solutions?**

#### Practice recommendations

- Preparation of EN formulas should be carried out by trained personnel using aseptic techniques.
- When powdered EN formulas are prepared, the preparation method should be selected according to the patient's level of risk.
  1. For high-risk neonates or immunocompromised infants, powdered formulas should be reconstituted using water at  $\geq 70^{\circ}\text{C}$  to reduce microbial contamination.
  2. For adult patients using modular powders or powdered enteral formulas, reconstitution should be performed with sterile water under strict aseptic conditions, and the prepared formula should be administered within 4 hours at room temperature.
- Prepared EN formulas should be refrigerated immediately after preparation and used within 24 hours. Any unused prepared formula should be discarded promptly.
- Prepared EN formulas should not be kept at room temperature for longer than 4 hours and should be discarded thereafter.

Rationale

The following recommendations apply only to open feeding systems involving powdered formulas or circumstances in which EN formulas require modification. Preparation of EN formulas may involve reconstitution, dilution, mixing with single-nutrient modular supplements, and transfer into feeding containers. When sterile liquid EN is decanted into an open feeding container, the transfer should be performed by trained personnel using aseptic technique in a clean preparation area, and the allowable hang time should follow the limits for open systems. These handling steps may increase the risk of contamination not only of feeding sets but also of commercially prepared sterile liquid EN formulas. Water used for formula preparation may itself become a source of contamination. Accordingly, for pediatric and neonatal patients, EN formulas should be prepared using boiled and cooled water or sterile water [6,7]. In high-risk neonates, reconstitution with hot water ( $\geq 70^{\circ}\text{C}$ ) may further reduce the risk of *Cronobacter* and other microbial contamination. In adult patients, particularly those at high risk of infection, sterile water should also be considered for formula preparation [6].

Precautions when using BTF

Key question 3. What precautions should be considered when using BTF?

Practice recommendations

- BTF is contraindicated in medically unstable or immunocompromised patients and should not be used in patients who cannot tolerate bolus feeding or in those whose gastrostomy site has not fully matured.
- BTF should be administered only through gastrostomy tubes with a diameter of 14 French (Fr) or greater.
- The administration time for BTF should be limited to 2 hours.

- Food safety and hygiene standards for preparation equipment and ingredients should be followed strictly. Prepared BTF should be used immediately or refrigerated, and any unused feeding should be discarded if it is not used within 24 hours.

Rationale

Commercial EN formulas have been widely available since the 1970s and are now used as the standard method of EN support in many countries. In Korea, commercially prepared EN formulas have been available and widely used in hospital settings since the 1990s. However, according to a 2018 international survey, BTF continues to be used in selected situations, particularly in pediatric patients, because of intolerance or allergic reactions to commercial formulas [8-10]. BTF is prepared by blending whole foods to facilitate administration through enteral feeding tubes and may be provided either alone or in combination with commercial formulas.

Evidence regarding the safety and efficacy of BTF in patients receiving home EN remains limited [11-13]. Because of the potential risks of cross-contamination and foodborne illness, BTF is contraindicated in medically unstable or immunocompromised patients and in those with an immature gastrostomy site [8,13,14]. In addition, it is generally recommended to administer BTF as bolus feeding rather than continuous infusion [8,13,14]. Therefore, its use may be inappropriate in patients who require restricted feeding volumes or who are intolerant to bolus feeding (Table 1).

Because of its high viscosity, BTF is associated with an increased risk of tube occlusion [11,13]. Blenderized formulas contain intact food particles and dietary fiber, resulting in greater viscosity and particle density than commercial enteral formulas. Even when high-performance blenders are used, these particles may increase flow resistance in narrow feeding tubes. Accordingly, the use of gastrostomy tubes with a diameter of at least 14 Fr is recommended to reduce the risk of tube occlusion and to ensure adequate flow during administration [11,13,14].

Table 1. Situations in which BTF may be considered and those in which it is not recommended

| Situations in which BTF may be considered                                                                                                                     | Situations in which BTF is not recommended                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Medically stable patients; in children and adolescents, stable growth status                                                                                  | Acute illness or immunocompromised state (increased risk of infection) |
| Enteral feeding tube with a diameter of 14 Fr or larger                                                                                                       | Fluid restriction (difficulty meeting nutrient requirements)           |
| Bolus feeding                                                                                                                                                 | Situations requiring prolonged feeding (increased risk of infection)   |
| Family support                                                                                                                                                |                                                                        |
| Availability of appropriate resources and equipment (e.g., high-performance blender, refrigerator, electricity, clean water and food, and storage containers) |                                                                        |
| Access to healthcare professionals with relevant knowledge and expertise                                                                                      |                                                                        |

BTF, blenderized tube feeding; Fr, French.

When BTF is prepared at home, strict attention should be given to food safety and hygiene, including equipment cleanliness, water quality, and ingredient safety, in order to prevent cross-contamination [13-16]. To minimize bacterial growth, prepared BTF should not remain at room temperature for more than 2 hours and should instead be refrigerated (e.g.,  $\leq 7^{\circ}\text{C}$ ). Even under refrigeration, BTF should be discarded if it is not used within 24 hours of preparation [14].

Several studies have reported that BTF may be nutritionally inadequate, with deficiencies in macro- and micronutrients and lower energy density relative to prescribed volumes, highlighting the potential risk of nutritional imbalance [11,17]. Therefore, ongoing nutritional monitoring is essential whenever BTF is used. Nutritional intake, body weight, and clinical status should be assessed regularly to ensure adequate nutrient delivery. In addition, the nutrition support team, with an especially important role for clinical dietitians, should routinely evaluate whether BTF recipes meet the patient's age-appropriate requirements for energy, protein, micronutrients, and electrolytes and should modify formulations as clinically indicated [11-13]. As individualized, patient-centered care is increasingly emphasized, multidisciplinary nutrition support teams should maintain adequate knowledge of BTF and ensure that it is used appropriately in clinical practice [13].

### Essential labeling requirements for safe EN administration

**Key question 4. What essential information should be included on labels to ensure safe administration of EN?**

#### Practice recommendations

- EN labels should contain essential information from the EN prescription whenever possible.

Essential items: Patient name, registration number, ward and room number, date and time of preparation, prescribed EN formula or diet name, and administration information (total daily or per-meal amount: \_\_\_\_\_ kcal/\_\_\_\_\_ mL, route of administration, and method of administration).

- EN labels should use clear and accurate wording, and precautionary statements should be included whenever possible.

Examples: "Maximum rate \_\_\_\_\_," "Maximum volume \_\_\_\_\_," "Use within \_\_\_\_\_ hours after opening," and "Not for intravenous use."

- Labels for human milk stored in hospital settings should include the following information whenever possible:

Contents of the container, infant's name and registration number, date and time of milk expression, maternal medications, added fortifiers, frozen status of the milk, date and time of thawing, and the appropriate discard date.

(Optional) To improve identification, barcodes, special colors, or symbols may be used for human milk labeling.

#### Rationale

Standardized labeling should be applied to all EN formulas provided to patients in order to improve safety and reduce administration errors [15,18]. Verification of standardized labels before EN administration provides a final opportunity to check the formula against the physician's prescription, thereby improving both medication and nutrition safety [18,19]. Whenever possible, each label should include four essential elements: patient information, type of EN formula, route of administration, and method of administration (Table 2).

In neonatal and pediatric settings, human milk administered enterally requires additional labeling elements beyond those used for standard EN formulas.

When labeling human milk, additional information be-

**Table 2.** Components of enteral nutrition labels

| Enteral nutrition label                                                                                     | Human milk label                                               |
|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Patient name, registration number, ward/room                                                                | Infant's name                                                  |
| Prescribed enteral formula, volume, and energy density                                                      | Registration number                                            |
| Date and time of administration                                                                             | Dosing weight                                                  |
| Administration information                                                                                  | Date and time of milk expression                               |
| -Route of administration                                                                                    | Maternal medications or supplements                            |
| -Method and rate of administration (e.g., mL/hr $\times$ 24 hr, or "Max rate _____," or "Max volume _____") | Freezing status of milk                                        |
| Expiration date (or discard date/time)                                                                      | Date and time of thawing (for frozen milk)                     |
| -Statement: "Not for intravenous use"                                                                       | Appropriate discard date (considering milk storage conditions) |
|                                                                                                             | Statement: "Not for intravenous use"                           |
|                                                                                                             | For fortified human milk:                                      |
|                                                                                                             | - Fortifier name, concentration, and date/time of preparation  |

yond standard EN labeling is recommended, including the date and time of milk preparation and other relevant preparation-related details, in order to ensure traceability and safe handling [5,20,21].

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## Authors' contribution

Conceptualization: JMS. Formal analysis: JMS. Supervision: all authors. Methodology: JMS. Project administration: JMS. Writing—original draft: ISL. Writing—review & editing: all authors. All authors read and approved the final manuscript.

## Conflict of interest

Ye Rim Chang has served as the editor of the *Annals of Clinical Nutrition and Metabolism* since 2024. However, she was not involved in the peer review process or decision-making regarding publication. Otherwise, no potential conflict of interest relevant to this article was reported.

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## Data availability

Not applicable.

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## Supplementary materials

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