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CONSENSUS STATEMENT

Blenderized tube feedings: Practice recommendations from the American Society for Parenteral and Enteral Nutrition

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Abstract

Prior to the 1970s, blending food and liquids and putting them through an enteral access device (EAD) was the most common form of enteral nutrition (EN). However, in the 1970s, blenderized tube feedings (BTFs) became less popular due to the emergence of modern commercial enteral formulas (CEFs). Recently, a cultural shift toward consuming a natural diet, consisting of whole foods, has led to a resurgence in the use of BTF. The increasing use of BTF in a variety of patient care settings identifies a need for practice recommendations that provide guidance for nutrition professionals and patients. Members of the American Society for Parental and Enteral Nutrition (ASPEN) Enteral Nutrition Committee identified salient clinical questions concerning BTF,

Abbreviations: ASPEN, American Society for Parental and Enteral Nutrition; BTF, blenderized tube feeding; CDC, Centers for Disease Control and Prevention; CEF, commercial enteral formula; CFU, colony-forming unit; DRI, dietary reference intake; EAD, enteral access device; EN, enteral nutrition; ESBC, enteral small-bore connector; GER, gastroesophageal reflux; GI, gastrointestinal; HEN, home enteral nutrition; ICU, intensive care unit; IDDSI, International Dysphagia Diet Standardization Initiative; RCT, randomized controlled trial; RD, registered dietitian; RTH, ready to hang; USDA, United States Department of Agriculture.

conducted a comprehensive literature search, and subsequently developed practice recommendations pertaining to the use of BTF. This paper was approved by the ASPEN 2022–2023 Board of Directors.

KEYWORDS

blenderized tube feeding, commercial enteral formula, consensus, enteral formula consistency, enteral nutrition, real food tube feeding, whole food tube feeding

COMMON TERMS AND DEFINITIONS USED THROUGHOUT THE DOCUMENT

Terminology, style, definitions, and conventions throughout this paper are consistent with the "American Society for Parenteral and Enteral Nutrition (ASPEN) Definition of Terms, Style, and Conventions Used in ASPEN Board of Directors–Approved Documents" (https://www.nutritioncare.org/ASPEN-Definitions). In addition to those terms, the following are used throughout this paper:

1. Blenderized tube feeding (BTF): food and liquid pureed enough to be given via an enteral access device (EAD).
2. Blender types:
   a. Professional blender: usually contains a greater variety of speeds and strengths of blending than the average household blender; usually designed with a stronger motor to handle high-volume use.
   b. Jug: a blender in which items are added to a container with a rotating blade.
   c. Wand: a handheld tool that can be placed in any container to blend the ingredients in that container.
3. Caregiver: individual, family, parent, or support system worker caring for a patient receiving tube feedings.
4. Enteral small-bore connector (ESBC): an enteral connector used to link or join an enteral device for the purposes of delivering enteral fluid or water (International Organization for Standards 80369-3), commonly known by the trade name ENFit (https://stayconnected.org/enteral-enfit-main-page/).
5. Formula types:
   a. Commercial BTF: a formula manufactured with food ingredients or pureed foods. These formulas may or may not have added vitamins and minerals.
   b. Prepared BTF: a formula prepared in a home or hospital blender.
6. Legacy feeding tube: the EAD historically used before 2019, in which a syringe or feeding bag would be inserted into the tube.
7. Patient: the individual (pediatric or adult) receiving the tube feeding.
8. Pureed food: food that has been put through a blender, resulting in a smooth, thick paste.

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INTRODUCTION

While enteral feedings have been used for centuries, most of the major advances in enteral feeding techniques and the development of the science of enteral nutrition (EN) emerged in the 20th century. Prior to the 1970s, blending food and liquids and putting them through an enteral access device (EAD) was the most common form of EN. However, the introduction of commercial enteral formulas (CEFs) in the 1950s allowed for the development and packaging of modern enteral formulas that entered the market in the 1970s.[1] The availability of specialized enteral formulas experienced exponential growth between the 1970s and the 2000s, which led to the hundreds of formulas available today.[1] This growth of CEF resulted in a reduction in use of what we now call blenderized tube feedings (BTFs).

There are many factors that contribute to the food choices individuals make, such as medical, cultural, religious, ethical, or personal preferences. These principles also apply to the selection of nutrition for administration via an EAD. Recently, there has been a shift toward consuming a natural diet of whole foods, which has subsequently also led to the growth of use of

BTF. In a recent prospective cross-sectional study, as many as 55.5% of adult patients receiving home enteral nutrition (HEN) used BTF.[2] Some of the reasons patients choose BTF may be to feel more included in the social aspect of eating, to have the autonomy to select foods included in BTF, and to experience a more nurturing feeling.[3,4] Others may use BTF for medical reasons, such as improved bowel function[5]; decreased reflux, gagging, and retching[6,7]; improvement in diversity of the gut microbiome[7]; and decreased hospitalizations.[8] This increased interest in BTF has contributed to the validation of many concepts involved in the nutrition composition and preparation of BTF as mainstream practice. Use of BTF in a variety of healthcare settings stresses the importance of evidence-based practice recommendations to provide guidance for nutrition professionals and patients.

The purpose of this paper is to provide guidance to clinicians who wish to utilize BTF for patients in specific practice settings. Therefore, this paper provides expert practice recommendations and should not be confused with guidelines. Due to the lack of clinical evidence from many of these questions, Grading of Recommendations, Assessment, Development and Evaluation (GRADE) level recommendations have not been implemented for this paper. Additionally, recommendations in this paper rely mostly on weaker literature and expert opinion, used to formulate the recommendations. These recommendations are intended to provide healthcare providers help in everyday difficult clinical decisions to improve patient outcomes and patient safety. Recommendations in this paper do not constitute medical or other professional advice and should not be taken as such. To the extent that the information published herein may be used to assist in the care of patients, the primary component of quality medical care is the result of the professional judgment of the healthcare professionals providing care. The information presented here is not a substitute or replacement for the exercise of professional judgment by healthcare professionals; rather, it is intended to supplement professional training and judgment. Circumstances and patient specifics in clinical settings may require actions different from those recommended in this document; in those cases, the judgment of the treating professionals should prevail. Use of this information does not in any way guarantee any specific benefit in outcome or survival. This paper was approved by the ASPEN 2022–2023 Board of Directors.

A summary of the practice recommendations is provided in Table 1. The reader should review and understand the complete rationales provided supporting the practice recommendations.

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METHODS

Members of the ASPEN Enteral Nutrition Committee identified several clinical questions concerning BTF. This was followed by a comprehensive search of literature published between January 2016 and May 2021. This time interval was chosen to ensure that current relevant practice was reflected. The library services group at the Mayo Clinic searched PubMed, Medline, and Google Scholar databases with the following search terms: homemade tube feeding, whole food tube feeding, real food tube feeding, BTF, pureed diet via gastrostomy, EN and blended diet, feeding tube, and blended diet. Due to a paucity of randomized controlled trials (RCTs) on this topic, it was difficult to prioritize articles based on study quality. Therefore, scoping reviews, systematic reviews/meta-analyses, prospective and retrospective observational studies, case series, and abstracts from recent ASPEN Nutrition Science & Practice Conferences were included. The ASPEN EN committee then performed a manual search of full-text articles in the English language. All authors reviewed a total of 79 articles, which served as the basis for the development of these practice recommendations.

TABLE 1 Executive summary of BTF practice recommendations.

	Common BTF-related practice questions	Practice recommendations
Section 1: Practice recommendations for general use of BTF		
1.1	What factors should be considered when deciding whether to use commercial BTF or prepared BTF?	1. Before initiating BTF, consider the patient's entire clinical picture, including patient-related factors (psychosocial, socioeconomic, and clinical), EAD, nutrition needs and dietary requirements, dietary preferences, access to resources and food, tolerance, food safety issues, and costs. 2. Ensure that the patient, caregiver, and the health professional team have the availability, resources, and ability to analyze the BTF's nutrition profile. 3. Establish a shared decision-making process with the patient to ensure all food preferences including cultural and religious, allergies, and tolerance issues are considered in the choice of the commercial BTF or prepared BTF. 4. Determine whether an enteral feeding pump is required to administer the BTF. The use of feeding pumps may restrict the choice to commercial BTF formulas based on manufacturers' recommendations and/or to those with specific consistencies on the IDDSI scale (Figures 1 and 2). 5. Determine whether the patient or caregiver has the time, equipment, skill, and resources to shop for food and to prepare and store the prepared BTF. 6. Research and consider financial considerations. Costs vary significantly between commercial BTF and prepared BTF depending on the ingredients and level of health insurance support offered for BTF. 7. For inpatient services, review or revisit policies and training for appropriate use, storage, and safety of BTF.
1.2	What factors should be considered with respect to EADs, including type, size, timing of replacement, and clogging, when using BTF? Specifically: a. Which types of EADs are appropriate for BTF? b. What are the recommendations regarding appropriateness of BTF for jejunal feeding? c. What are the recommendations regarding appropriateness of ESBC EADs for BTF? d. What French sizes of the EAD are appropriate for BTF? e. How often do EADs need to be replaced when using BTF? f. What is the clogging potential of the EAD when using BTF compared with CEF?	1. Gastrostomy tubes are preferred, but nasal tubes as well as jejunostomy/gastrojejunostomy tubes may be considered based on the patient's clinical status. 2. At this time, specific recommendations for BTF for jejunal feeding are unavailable. The use of BTF in patients requiring jejunal feeding is limited due to the necessity for pump administration and a hang time of prepared BTF of only 2 h. However, commercial BTF may be appropriate for jejunal feeding in select patients and circumstances. 3. ESBC feeding tubes can be used for commercial BTF and prepared BTF. Patients choosing to transition to ESBC tubes may experience an increase or decrease in feeding times via gravity or an increase or decrease in force required for push mode (or syringe) of feeding. Clinicians should collaborate with patients to select the appropriate ESBC tube type and feeding mode to meet feeding preferences and desired flow rates. 4. A 14-French or larger EAD is preferred for BTF. BTF formulas may be used with smaller French sizes if good care and technique are implemented. EADs as small as 10 French have been used for administration of BTF. 5. EADs should be changed at the manufacturer-recommended intervals. 6. Tube clogging depends on the size of the EAD, particle size of the formula, and proper flushing technique with feedings and medications. Evidence is lacking comparing tube clogging between BTF and CEF.
1.3	What factors should be considered with respect to blenders when using BTF? Specifically: a. What specific blender is preferred for the preparation of prepared BTF? b. What is the optimal blending time for a prepared BTF formula?	1. Due to BTF variability, choose a blender with the recipe in mind and considering the types of foods used, blending frequency, and therapy duration. 2. When selecting a blender, consider the following: a. Professional, jug, or wand blender options b. High-powered motors or extended warranties 3. Depending on duration for BTF therapy and foods used, specific brands may produce a smaller particle size and last longer.

TABLE 1 (Continued)

	Common BTF-related practice questions	Practice recommendations
		4. Given the variability of BTF recipes, the time needed for blending to decrease the particle size to be appropriate for administration via EAD varies. a. The general recommended blending time is 3–6 min. b. When using less-powerful blenders, increasing the blending time (eg, more than 3–6 min) may decrease the prepared BTF particle size.
1.4	What are the recommendations regarding preparing a large batch of prepared BTF to be frozen for later use rather than daily preparation?	1. Freezing prepared BTF is appropriate with proper education, proper food safety and sanitation technique, and proper formula or recipe storage to prevent microbial contamination. RDs or healthcare professionals should provide best-practices education to patients and caregivers. 2. Freezing keeps food safe almost indefinitely; therefore, recommended storage times are for quality only (Table 4). 3. Freezing unused prepared BTF within 24 h is recommended. 4. Thawed prepared BTF may be safely refrozen, although quality may be diminished.[1] Do not refreeze any foods left outside the refrigerator longer than 2 h or 1 h in temperatures above 90°F. 5. Once safely thawed, previously frozen prepared BTF recipes may need to be reblended to decrease particle size.[2]
1.5	What is the hang time of BTF, how should BTF be stored, and when should BTF be discarded?	*Hang time* 1. For BTF, follow standard hang time limits (Table 3). 2. For prepared BTF, the hang time should be limited to 2 h or less. a. Perishable food should not be left out of the refrigerator for more than 2 h at room temperature (77°F [25°C]). b. If the temperature is above 90°F (32.2°C), perishable food should not be left out for more than 1 h. 3. For commercial BTF, refer to manufacturer recommendations for hang time limits. *Storage* 1. Store prepared BTF in the refrigerator or freezer; if not frozen, discard after 3–4 days. 2. Store unopened commercial BTF per manufacturers' recommendations. Refrigerate opened commercial BTF and discard unused formula within 24 h of opening per manufacturer's guidelines.
1.6	What are the tools that may be needed to administer BTF?	1. The following tools are recommended for administering BTF: a. Syringes *Note: ESBC O-ring syringes may be easier to push compared with syringes with a full rubber stopper, due to decreased stickiness.* b. Administration sets i. Large-bore gravity bags ii. Reusable tube feeding pouches c. Pumps i. Select a pump with attention to food safety guidelines and hang times. ii. Consult with a nutrition support professional when selecting pumps, since accuracy is variable, which may affect feeding times and the ability to achieve nutrition goals. d. Other supplies i. Straight bolus extension sets (not right-angle bolus extension sets) are recommended for skin-level EAD because they allow for better flow and less clogging between the skin-level EAD and the extension set.

(Continues)

TABLE 1 (Continued)

	Common BTF-related practice questions	Practice recommendations
1.7	How should BTF preparation equipment be sanitized (for both hospital and home)?	1. Sanitize mechanical devices and equipment (eg, blenders) used to prepare BTF after each use per manufacturer's guidelines and with established protocols and recommendations. 2. In instances where additional guidance is unavailable, the FDA code should be followed, which follows the published guidelines for cleaning and sanitizing dishes and utensils. Specifically: a. Disassemble the blender and wash food-contact portions in warm, soapy water. b. Wash the microwave dish, measuring cups, and spoons—and any other equipment used—in warm soapy water. c. Rinse all items in warm water. d. Sanitize the items by soaking them in 2 gallons of water and 2 tbsp (30 ml) of chlorine bleach for 2 min. e. Remove objects from the chlorine solution and allow them to air dry; do not dry with a towel or a disposable towel.
1.8	How should BTF administration sets be cleaned (for both hospital and home)?	1. Rinse administration sets with safe drinking water between uses to clear any debris that may cause mechanical obstruction. 2. Change administration sets according to institutional policy for use in hospitals and care facilities. Use water designated in institutional protocols. 3. Strong evidence is lacking to support routine use of bleach in cleaning administration sets. 4. Store administration sets in the refrigerator in a plastic bag between uses. 5. Discard administration sets at the time interval recommended by the manufacturer, usually after 24 h.
1.9	How should BTF feeding supplies (eg, syringes, bottles) be cleaned (for both hospital and home) between uses?	1. Follow the manufacturer guidelines for cleaning and sanitizing feeding supplies. 2. In the absence of the manufacturer guidelines, follow the CDC guidelines for cleaning feeding items (Figure 3). 3. In hospital settings, feeding supplies should be discarded after a single use.
Section 2: Practice recommendations for prepared BTF recipe and BTF additives and consistency		
2.1	What resources are available to assist in creating a recipe for prepared BTF?	1. Respected resources should be used when creating prepared BTF recipes to identify how much of each food group is needed. Specifically: a. https://www.choosemyplate.gov/resources/MyPlatePlan b. Other available resources (Figure 4 and supporting information Appendix 1)
2.2	What is the necessity for nutritional analysis of the prepared BTF recipe in the hospital and home environments?	1. In hospital and home environments, a nutritional analysis is recommended. Analyses should occur following the initial recipe development and routinely thereafter to assess nutritional adequacy based on prepared BTF recipe adjustments and possible changes to the patient's nutritional status and needs. 2. A comparison of the recipe's nutrient profile to the patient's age-appropriate nutrition requirements is necessary. This ensures that macronutrient and micronutrient needs and goals are met. 3. Recipes should be continually adjusted, including the addition of vitamin/mineral, electrolyte supplementation, and/or modular products to meet nutrition requirements.
2.3	Which foods are appropriate to be included in prepared BTF?	1. In collaboration with the patient/caregiver and RD, most foods may be included in recipes for prepared BTF following careful consideration of nutrient composition. 2. The nutrient composition of the recipes should be developed based upon the patient's nutrition needs and lifestyle preferences.

TABLE 1 (Continued)

	Common BTF-related practice questions	Practice recommendations
2.4	What are the recommendations regarding maintaining the same prepared BTF recipe daily vs the appropriateness of recipe variability?	1. If the recipe is nutritionally adequate to meet the patient's macronutrient and micronutrient needs, the decision to vary the daily recipes is based on patient and caregiver preference.
2.5	What is the necessity to provide additional vitamin and mineral supplementation when using BTF?	1. Additional supplementation of vitamins and minerals may be indicated if assessment/analysis of the recipe demonstrates inadequate provision in comparison with the recommended age-specific dietary reference intakes and the patient's nutrition needs.
2.6	What is the necessity to provide additional sodium when using BTF?	1. Assess BTF recipes and composition for sodium content with individualized recommendations to add sodium based on recipe content and patient's nutrition and hydration needs.
2.7	What is the necessity to add modular products to BTF?	1. Individualized recommendations to add modular products should be based on the recipe and the patient's nutrition needs to ensure needs are met. Assess BTF recipes and compositions upon initiation and when there are changes in recipe or the patient's clinical and nutrition status for macronutrient and micronutrient content.
2.8	What is the recommended way to ensure that the BTF contains adequate fluid?	1. The patient's fluid needs should be calculated using standard clinical methods. 2. Account for the fluid added to BTF when determining fluid requirements and the need to provide additional fluid. 3. While adequate fluid is essential, the addition of water to BTF can dilute nutrient content, affect hang time, and adversely impact the medical effects of specific viscosity recommendations. These factors must be considered when determining appropriateness of adding fluid.
2.9	Which tool should be used to evaluate the consistency of BTF to ensure appropriateness for administration via EADs?	1. The IDDSI should be used to evaluate consistency of BTF to ensure appropriateness for administration via EADs.
2.10	What is the optimal consistency of BTF delivered by syringe, gravity bag, or pump?	1. Recommendations regarding the optimal consistency of BTF for delivery via syringe, gravity bag, or pump cannot be made, given the individualized nature of BTF in terms of recipe as well as patient-specific factors.
Section 3: Practice recommendations for BTF in the hospital environment		
3.1	What is the safety of use of BTF in pediatric and adult hospitalized patients (eg, ward, ICU, immunocompromised/transplant)?	1. BTF is considered a safe option in stable ward patients who have previously demonstrated tolerance to BTF and who can tolerate a method of feeding that is offered in the hospital. 2. Prepared BTF and commercial BTF are considered safe in hemodynamically stable patients in the ICU. However, due to a lack of evidence, concerns about composition and the ability to deliver these formulas to complex patients exist. 3. Use of prepared BTF in immunocompromised patients is considered safe, provided that attention to proper food safety practices and proper hang times is given.
3.2	Which BTF delivery methods are feasible for hospitalized patients?	1. The specific delivery method for BTF should be based on resources in the hospital's kitchen (eg, staff and equipment) and on the ward (eg, nursing demands, education of dietitian staff). However: a. Bolus feeding is the preferred delivery method for BTF (syringe push or gravity). b. A feeding pump may be used if delivery adheres to recommended hang time (Table 3). The feasibility of prepared BTF with continuous feeds is limited by the 2-h hang time and the demand this places on nursing time. If continuous BTF is desired, consider a commercial BTF with a longer hang time.

(Continues)

TABLE 1 (Continued)

	Common BTF-related practice questions	Practice recommendations
3.3	What are the unique considerations for the preparation of prepared BTF in the hospital kitchen, and how do they differ from the home kitchen?	*Hospital kitchen* 1. Specific, trained personnel responsible for making prepared BTF must be identified within the hospital kitchen. 2. Adhering to appropriate temperature for cooked foods and abiding by expiration dating are required. 3. The presence of safe food handling procedures must be confirmed. 4. A commercial-grade blender must be utilized. 5. All equipment used to prepare prepared BTF must be sanitized after each use per manufacturer guidelines. In the absence of the manufacturer guidelines, follow CDC guidance. 6. Commercial BTF availability should be assured as a backup plan. *Home kitchen* 1. A home kitchen should be clean and have access to safe water, electricity, and refrigeration. 2. Utilize a blender for formula preparation. 3. Review and confirm understanding of safe food cooking, handling, and storage procedures.
Section 4: Practice recommendations for follow-up and monitoring for patients receiving BTF		
4.1	What are the follow-up plan and monitoring recommendations for patients receiving BTF? Specifically: a) What is the recommended frequency for follow-up/monitoring for patients receiving BTF? b) What laboratory monitoring is recommended for patients receiving BTF?	1. Follow-up with an RD or nutrition support specialist knowledgeable in BTF is needed for a successful regimen. Experts in the field recommend initial visits occur every 1–2 months. Visit follow-up may be extended to every 4–6 months based on patient stability after the initiation phase. 2. Laboratory parameters should be monitored as indicated by nutrition assessment, and any signs or symptoms of nutrition abnormalities or deficiencies identified. The specific laboratory parameters are individualized based on the patient's clinical and nutrition status.

Abbreviations: BTF, blenderized tube feeding; CDC, Centers for Disease Control and Prevention; CEF, commercial enteral formula; EAD, enteral access device; ESBC, enteral small-bore connector; FDA, US Food and Drug Administration; ICU, intensive care unit; IDDSI, International Dysphagia Diet Standardization Initiative; RD, registered dietitian.

A question-answer format was employed to provide practice recommendations that address common clinical questions surrounding the use of BTF. The practice recommendations primarily represent expert opinions based on the review and synthesis of available evidence for each question. The intent was to provide provisional practice recommendations until more rigorous evidence becomes available and guideline level recommendations can be written.

SECTION 1: PRACTICE RECOMMENDATIONS FOR GENERAL USE OF BTF

1.1. What factors should be considered when deciding whether to use commercial BTF or prepared BTF?

Practice recommendations

1. Before initiating BTF, consider the patient's entire clinical picture, including patient-related factors (psychosocial, socioeconomic and clinical), EAD, nutrition needs and dietary requirements, dietary preferences, access to resources and food, tolerance, food safety issues, and costs.
2. Ensure that the patient, caregiver, and the health professional team have the availability, resources, and ability to analyze the BTF's nutrition profile.
3. Establish a shared decision-making process with the patient to ensure all food preferences including cultural and religious, allergies, and tolerance issues are considered in the choice of the commercial BTF or prepared BTF.
4. Determine whether an enteral feeding pump is required to administer the BTF. The use of feeding pumps may restrict the choice to commercial BTF formulas based on manufacturers' recommendations and/or to those with specific consistencies on the International Dysphagia Diet Standardization Initiative (IDDSI) scale (Figures 1 and 2).[1,2]
5. Determine whether the patient or caregiver has the time, equipment, skill, and resources to shop for food and to prepare and store the prepared BTF.
6. Research and consider financial considerations. Costs vary significantly between commercial BTF and prepared BTF depending on the ingredients and level of health insurance support offered for BTF.
7. For inpatient services, review or revisit policies and training for appropriate use, storage, and safety of BTF.

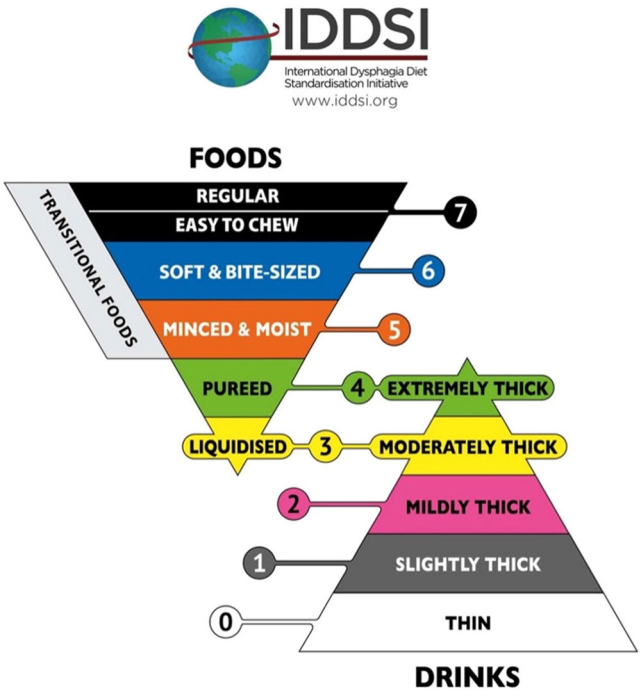

FIGURE 1 International Dysphagia Diet Standardization Initiative (IDDSI). The IDDSI Framework and Descriptors are licensed under the Creative Commons Attribution-Sharealike 4.0 International License. https://creativecommons.org/licenses/by-sa/4.0/

Rationale

When considering whether to use prepared BTF, or commercial BTF, there are several factors (Table 2) to consider regarding psychosocial, socioeconomic, and clinical concerns; nutrition needs; access to resources and food; tolerance; food safety issues; and costs. Patients must also have an EAD size that can accommodate the consistency and delivery method of the BTF.

Shared decision-making is integral to deciding on the use of commercial BTF and prepared BTF. This process considers the patient's preferences, goals, and practical realities as well as the expertise and recommendations of the healthcare team, which considers the risks and benefits.[3–6] Specific dietary requirements and clinical goals related to medical conditions, in conjunction with personal preferences, may influence the decision between the use of commercial BTF or prepared BTF. Prepared BTFs allow clinicians to individualize the recipe to meet specific dietary requirements regarding complex medical diagnoses, food allergies, and personal diet preferences (eg, vegan, vegetarian) as well as cultural, ethical, and religious preferences.[7] Ojo et al evaluated the nutritional value and physical properties of blenderized formulas and found significant variability regarding select macronutrients and micronutrients.[8] Patients preferring consistent nutrient composition may prefer commercial BTF over prepared BTF.

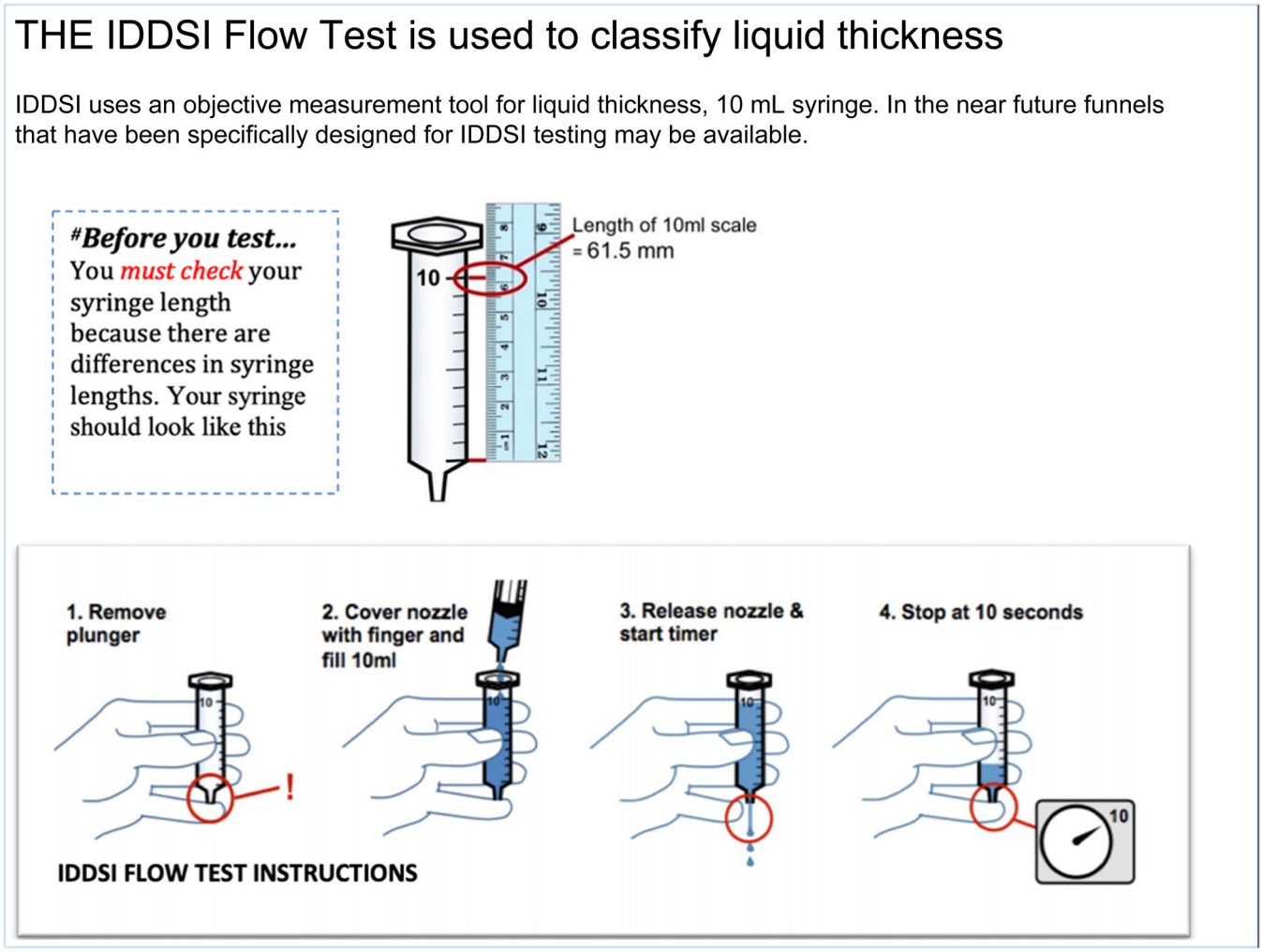

FIGURE 2 International Dysphagia Diet Standardization Initiative (IDDSI) Flow Test Instructions. The IDDSI Framework and Descriptors are licensed under the Creative Commons Attribution-Sharealike 4.0 International License. https://creativecommons.org/licenses/by-sa/4.0/

Physical properties of enteral preparations and the goal of nutrition therapy in the clinical management of certain diagnoses may also drive the decision between commercial BTF and prepared BTF. Recommendations regarding the optimal consistency of BTF cannot be made, given the individual nature of BTF. For example, thicker formulations may be preferred in the clinical management of reflux and aspiration, which may impact the choice.[9–11] Hron and Rosen demonstrated that the viscosity and the IDDSI fluid characterization of different commercial BTF and prepared BTF can vary significantly.[12] The effects of additional dilution, straining, blending, freezing, and thawing of commercial BTF and prepared BTF can further alter the IDDSI characterization, as well as particulate size.[12] When choosing between prepared BTF and commercial BTF, these potential variations must be accounted for in order to manage reflux or aspiration. Particle size and consistency of the prepared BTF should also be considered in patients with medical diagnoses requiring volume restriction and intolerance. Particle size and consistency can affect the ease of flow of the BTF. Larger particle sizes can be seen with short blending times, less-powerful blenders, and specific ingredients used. It is important to note that thicker formulations with larger particles may require additional water or increased blending times to flow through the EAD.

Additionally, a patient's decision to choose commercial BTF or prepared BTF may depend on the modality of the EN administration, feeding volumes, and infusion time. Guha et al noted particulate presence and size added considerable variability to the flow rate and feeding times in gravity feeding.[13] A thinner recipe or formula type may help to decrease feeding time. Moreover, clinicians may recommend syringe feeding for patients who may be negatively impacted by longer infusion times. However, Mundi et al demonstrated that larger particle size increased the force required to administer the feeding via syringe.[14]

TABLE 2 Potential benefits and risks of prepared BTF and commercial BTF.

	Prepared BTF	Commercial BTF
Potential benefits		
Improved gastrointestinal tolerance	Yes	Yes
Increased oral intake	Yes	Yes
Increased caregiver/patient satisfaction	Yes	Yes
Potential risks		
Caregiver stress/burnout due to preparation	May be increased	May be decreased
Microbial contamination	Higher due to variable caregiver preparation methods, food safety knowledge, inherent microbial content of food, lack of processing	Lower due to processing/packaging
Growth/weight concerns and risk of inadequate nutrition	Increased risk depending on RD involvement and patient follow-up	Decreased risk due to consistent nutrient composition
Recommended hang time (in home setting)	2 h or less	2–12 h depending on product
Method of feeding	Appropriate for oral use, large-bore gravity bags, reusable tube feeding pouches, or syringe, depending on rating on IDDSI scale	Appropriate for oral use, gravity bag, pump, reusable tube feeding pouches, or syringe
Need for healthcare provider involvement	May be increased	May be decreased
Suitable for inpatient use	Yes, but with limitations and requires detailed policies and procedures	Yes
Preparation time	Increased	Decreased
Shelf stable	No	Yes

Abbreviations: BTF, blenderized tube feeding; IDDSI, International Dysphagia Diet Standardization Initiative; RD, registered dietitian.
Adapted with permission from Bennett et al.[3]

Therefore, patients with decreased hand strength may require thinner diets if using syringe feeding.[14]

Patients requiring a feeding pump should reference the pump manufacturer guidelines for use of both commercial BTF and prepared BTF. Pump infusion times may need to be extended to infuse thicker blends or formulas, which can be concerning given the 2-h recommended hang time for prepared BTF. The pros and cons of pump feeding vs alternative administration methods should be discussed.[5,15] Once the medical nutrition therapy goals and patient preferences have been determined, it must be ascertained if the patient has access to the food and equipment needed to prepare and store the food safely.[5,16]

The cost comparison between commercial BTF and prepared BTF varies depending on the patient's insurance coverage of commercial BTF vs the cost of the foods/ingredients used for the prepared BTF recipe and additional supplies required for preparation and sanitation.[5,7,16] For prepared BTF, the time cost also varies greatly. Individuals preparing prepared BTF must have the time, energy, and capability for shopping, food safety practices, cooking, blending, and safe storage required.[7] Lastly, all costs should be carefully considered when choosing between commercial BTF and prepared BTF.

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1.2. What factors should be considered with respect to EADs, including type, size, timing of replacement, and clogging, when using BTF? Specifically:

a. Which types of EADs are appropriate for BTF?
b. What are the recommendations regarding appropriateness of BTF for jejunal feeding?
c. What are the recommendations regarding appropriateness of ESBC EADs for BTF?
d. What French sizes of the EAD are appropriate for BTF?
e. How often do EADs need to be replaced when using BTF?
f. What is the clogging potential of the EAD when using BTF compared with CEF?

Practice recommendations

1. Gastrostomy tubes are preferred, but nasal tubes as well as jejunostomy/gastrojejunostomy tubes may be considered based on the patient's clinical status.
2. At this time, specific recommendations for BTF for jejunal feeding are unavailable. The use of BTF in patients requiring jejunal feeding is limited due to the necessity for pump administration and a hang time of prepared BTF of only 2 h. However, commercial BTF may be appropriate for jejunal feeding in select patients and circumstances.
3. ESBC feeding tubes can be used for commercial BTF and prepared BTF. Patients choosing to transition to ESBC tubes may experience an increase or decrease in feeding times via gravity or an increase or decrease in force required for push mode (or syringe) of feeding. Clinicians should collaborate with patients to select the appropriate ESBC tube type and feeding mode to meet feeding preferences and desired flow rates.
4. A 14-French or larger EAD is preferred for BTF. BTF formulas may be used with smaller French sizes if good care and technique are implemented. EADs as small as 10 French have been used for administration of BTF.
5. EADs should be changed at the manufacturer-recommended intervals.[1]
6. Tube clogging depends on the size of the EAD, particle size of the formula, and proper flushing technique with feedings and medications. Evidence is lacking comparing tube clogging between BTF and CEF.

Rationale

In practice, gastrostomy tubes are preferred due to shorter length and typically larger French size. Additionally, jejunostomy and gastrojejunostomy tubes are appropriate; however, administration of BTF via these tubes may require pump administration, which can be limited by the maximum hang times of BTF (Table 3). Although not preferred, nasal tubes may be used with thinner blends with diligent flushing technique.

A review of BTF by Martin et al found no studies of jejunal feedings using BTF.[1] However, concerns were raised regarding the introduction of intact and higher osmolar

TABLE 3 Hang times of BTF formulas.

Formula type	Hang time[a]
Commercial BTF, open system—Acute care	
Liquid formula with food ingredients[b]	4–8 h
Formula including pureed foods[b]	2–12 h
Commercial BTF, open system—Home	
Liquid formula with food ingredients[b]	8–12 h
Formula including pureed foods[b]	2–12 h
Commercial BTF, closed system—Acute care or home	
Liquid formula with food ingredients[b]	24–48 h
Formula including pureed foods[b]	24–48 h
Prepared BTF—Acute care or home	
Prepared BTF at room temperature (77°F [25°C])	2 h or less
Prepared BTF at temperatures greater than 90°F (32.2°C)	1 h or less

Abbreviation: BTF, blenderized tube feeding.

[a]Refer to manufacturer hang time for specific recommendations for commercial BTF.

[b]Food ingredients include components of foods, such as pea protein, dehydrated chicken, milk powder, brown rice syrup, and green bean powder. Pureed foods include whole foods, such as chicken, salmon, egg, carrots, brown rice, apples, and zucchini.[1,2]

nutrients directly into the jejunum as well as the need to traditionally administer jejunal feeding via a feeding pump for slower infusion. The slow infusions may impact food safety, pump efficacy, and clogging of the EAD. In patients with total gastrectomy or gastric bypass, gut adaptation may allow for adequate digestion and absorption when feeding intact nutrients directly into the bowel.[2] Select commercial BTF formulas indicate that they can be administered jejunally.[3,4] Due to food safety and prepared BTF hang time limitations, feeding jejunally with a pump using commercial BTF may be a viable option. Until additional research is conducted, the utilization of BTF for jejunal feeding is determined on a case-by-case basis.

An ESBC standard, commonly referred to by the trade name ENFit, was developed to reduce misconnections between enteral supplies and other EADs. Data are limited regarding the impact new standard ESBC tubes have on patients receiving BTF. Four studies suggest that ESBC feeding tubes, although not designed for BTF, can be used for commercial BTF and prepared BTF.[5–8] Guha et al compared the performance of legacy tubes to ESBC tubes using recipes, blender types, blender times, and gravity feeds or push mode via 60-ml syringe.[5] Based upon the ESBC for push mode via 60-ml syringe, the fast 5-s pushers saw a substantial increase in effort to administer the BTF with ESBC tubes. However, if pushed at a slower rate over minutes, a reduction in push effort via ESBC was observed when compared with legacy tubes. It was concluded that those using the push mode may not be impacted by the transition to ESBC.[5]

Patients choosing gravity mode may experience increased feeding times with ESBC. Guha et al indicated that clogging occurred in both ESBC and legacy tubes, more frequently in gravity mode, due to increased particle size with low-powered blenders and not necessarily related to tube type.[5] Another study by Guha et al researched five commercial nutrition diets, water, and orange juice to compare the flow-rate performance of legacy and ESBC tubes in 14-, 18-, 20-, and 24-French sizes.[6] Tests of commercial diets (ie, commercial BTF and CEF) administered via gravity through legacy gastrostomy tubes and their ESBC replacements revealed that flow rates through the ESBC devices were statistically lower in about 70% of the cases, particularly for the thicker diets.[6] Decreases in flow rates were observed for most transitions from legacy to ESBC in the 14-French size. The study indicated that differences in flow rates between legacy and their counterpart ESBC devices could be linked to the inner diameter of the straight tubing sections within and below the connectors rather than geometric features such as hole size where the syringe joins the connector. Patients transitioning to ESBC may experience large increases in feeding time and should work with a clinician to request an acceptable device with a larger inner-tube diameter to meet their feeding preferences.

Mundi et al studied the impact of transition from legacy to ESBC tubes in patients by administering EN formulas of variable concentration and viscosity via gravity mode.[7] It was noted that with each French size and formula used, there was significant variability in flow rates. Transition from a low-profile legacy tube to an ESBC with the same formula may not have any significant impact on the transition. Gravity feeds through a larger-bore (eg, 24 French or greater) legacy tube will be faster than through an ESBC, resulting in longer feeding times with the transition. The study concluded that the overall impact of the transition will be individualized for each patient and not based solely on the presence of an ESBC tube.[7] During the transition, close supervision is recommended so that the feeding time is not increased or premature cessation of gravity feeding does not occur. In 2019, Mundi et al compared the force required to provide syringe feedings with formulas of variable viscosity in commercially available ESBC tubes to currently available legacy tubes.[8] In the study, prepared BTF was prepared using three commercially available blenders and blended at 3- and 6-min intervals to determine the impact of blender type on syringe compression force. Only two tube sizes (ie, 14 French and 20 French) showed any statistically significant differences between ESBC tubes and legacy tubes. The force

and time required to infuse daily EN via syringe feeding, either commercial BTF or prepared BTF, will likely not be impacted by transition to ESBC outside the 14-French tubes for BTF. Findings indicated that variables (eg, formula, type of blender, amount of time food is blended, amount of water, and tube size) are more significant in predicting increases or decreases in syringe compression force than the legacy tubes vs ESBC tubes themselves. The study also acknowledged patients transitioning to ESBC tubes may want to consider their handgrip strength and current clinical disease state, as even a small increase in compression force may become more clinically significant of a change for those individuals with reduced handgrip strength.[8]

Although there is considerable debate regarding the tube size required for administering BTF, the minimum size required will vary from 10- to 14-French size depending on the blend.[9–14] The common reason for ensuring adequate EAD size is to decrease the risk of clogging. However, a scoping review performed by Breaks et al found no studies suggesting that blended diets cause more blockages than standard formula feeds.[11] This is in direct contrast to a systematic review and meta-analysis by Ojo et al that noted the higher viscosity and osmolality of BTF compared with CEF can increase the risk of complications, including EAD blockage and impaired delivery of food, water, and medications.[12] Expert opinion and the "ASPEN Safe Practices for Enteral Nutrition Therapy" commonly accept a 14-French EAD or greater for patients receiving BTF.[13–15] However, the Blenderized Enteral Nutrition Diet (BLEND) Study[16] found that a 12-French tube was also acceptable since the incidence of clogging was minimal.[17] Additionally, Machado de Sousa et al found that even 10 French was acceptable.[17] These smaller-French-size EADs, extension sets, and nasal tubes have been successfully used with BTF in clinical practice; however, smaller French size can result in longer feeding times and therefore may work best with commercial BTF and thinner home-prepared BTF.[17,18] Moreover, in many skin-level EADs, the narrowest point of the EAD is not the EAD itself but rather the point of attachment of the tube extension set to the EAD. For several brands of skin-level devices, the extension set is the same size regardless of the French size of the EAD. The clinician should maintain awareness of this when using BTF. Finally, the commercial BTF manufacturer's guidelines should be used as guidance to determine which tube types and equipment are most successful.

EAD changes are expected at standard intervals, and consideration should be based upon the patient's clinical status. There is no evidence supporting a recommendation for the specific length of time between EAD replacements when using BTF. Therefore, EADs should be changed per manufacturer's recommendations. Importantly, if there is good compliance with recommended BTF administration and flushing techniques, it is reasonable to expect EAD changes at standard intervals. However, careful inspection of the EAD and tube site at regular follow-up visits is recommended, and if indicated, EADs should be replaced. If EAD clogging occurs, more frequent changes may be needed.

Evidence is lacking comparing the tube clogging potential between BTF and CEF. In practice, tube clogging is dependent upon the size of the EAD, particle size of the formula, and flushing technique. Appropriate flushing before and after BTF and medication administration can help prevent clogging and occlusion. In a study evaluating mean viscosity of BTF, when the formula did not flow easily through the EAD, occlusions were more common.[19] If tube clogging is a recurrent problem for a patient, administration practices and techniques as well as the BTF formulation itself should be reviewed. In practice, experts agree that certain foods such as white pasta, white rice, breads, muffins, and bagels can increase risk of tube clogging. Uncooked protein sources (eg, meats, seafood, beans/legumes), eggs, flaxseed, olives, stringy foods (eg, celery and string beans), and fruit with skins may also increase the risk of a clogged tube if not strained. Increasing the fluid and blending time can reduce the particle size and help mitigate the risk of clogging; however, additional fluid may impact the caloric density of the BTF. CEFs and commercial BTF typically have a more consistent viscosity, which may decrease the risk of EAD obstruction compared with prepared BTF.

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1.3. What factors should be considered with respect to blenders when using BTF? Specifically:

a. What specific blender is preferred for the preparation of prepared BTF?
b. What is the optimal blending time for a prepared BTF formula?

Practice recommendations

1. Due to BTF variability, choose a blender with the recipe in mind and considering the types of foods used, blending frequency, and therapy duration.
2. When selecting a blender, consider the following:
   a. Professional, jug, or wand blender options
   b. High-powered motors or extended warranties
3. Depending on duration for BTF therapy and foods used, specific brands may produce a smaller particle size and last longer.
4. Given the variability of BTF recipes, the time needed for blending to decrease the particle size to be appropriate for administration via EAD varies.
   a. The general recommended blending time is 3–6 min.[1,2]
   b. When using less powerful blenders, increasing the blending time (eg, more than 3–6 min) may decrease the prepared BTF particle size.[1,2]

Rationale

Patients should choose the blender and blending time based on variables such as clinical need (eg, volume restriction), ingredients, and the amount of fluid added to BTF recipe. Patients with a longer length of need for BTF therapy may choose a professional blender, as this usually has a stronger motor and a warranty and may be more cost-effective than purchasing multiple less-expensive blenders during the therapy. When choosing between professional, jug, or wand blenders, the particle size and, subsequently, the propensity to clog EADs, the time required to administer the feeding, and the potential for bacterial contamination are important considerations.[1–4] Madden et al found no difference in tube clogging with syringe feeding when using professional, jug, or wand blenders.[3] Of 27 samples collected, only 2 resulted in tube clogging; both of these samples were prepared with a professional-grade blender and sieve and then administered through 10- and 12-French EADs. When administered via a 14-French EAD, regardless of the blender model or type used, tube occlusions did not occur. Additionally, there was no significant difference in the time taken to deliver feeds prepared using different blenders. Likewise, there was no significant difference between the total bacterial colony-forming units (CFU) of feeds prepared using different blenders (eg, professional, jug, or wand).[3] Based on this evidence, experts agree that there may be no preference between professional, jug, or wand blenders with respect to prepared BTF.

A group at Mayo Clinic tested five different prepared BTF recipes on the following blenders: Oster Blender, Cuisinart food processor, Magic Bullet, Mega Kitchen-Ninja System, and Vitamix blenders.[2] Recipes were blended for 3 and 6 min and put through sieves of various sizes.[2] The Vitamix and Mega Kitchen-Ninja

System blenders consistently produced smaller particle sizes—regardless of recipes used—compared with other blenders, resulting in variable particle size, depending on amount of fluid, specific ingredients, and overall consistency of formula.[2] The researchers found that using the Mega Kitchen-Ninja System Professional Blender resulted in an extremely thick liquid.[2] This issue may be resolved by increasing the blending time beyond 3–6 min with a standard jug blender.[2] Anecdotal reports state that the Vitamix blender is the gold standard for prepared BTF.[5,6] Some recipes can be used without a blender at all when baby foods are used for prepared BTF.[7,8]

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1.4. What are the recommendations regarding preparing a large batch of prepared BTF to be frozen for later use rather than daily preparation?

Practice recommendations

1. Freezing prepared BTF is appropriate with proper education, proper food safety and sanitation technique, and proper formula or recipe storage to prevent microbial contamination. Registered dietitians (RDs) or healthcare professionals should provide best-practices education to patients and caregivers.
2. Freezing keeps food safe almost indefinitely; therefore, recommended storage times are for quality only (Table 4).[1]
3. Freezing unused prepared BTF within 24 h is recommended.
4. Thawed prepared BTF may be safely refrozen, although quality may be diminished.[1] Do not refreeze any foods left outside the refrigerator longer than 2 h or 1 h in temperatures above 90°F.
5. Once safely thawed, previously frozen prepared BTF recipes may need to be reblended to decrease particle size.[2]

Rationale

Blending each meal separately is labor intensive. In order to alleviate this issue, caregivers can blend variable volume amounts to meet schedule and lifestyle preferences. RDs should work with patients and caregivers to develop a meal preparation, administration, and storage plan including large-batch preparation for future use. Recipes prepared in large batches require air-tight containers for freezing, freezer space for storage, and refrigerator space for thawing.[3,4] Large

TABLE 4 Recommended storage times for frozen foods.[a]

Item	Months
Bacon and sausage	1–2
Casseroles	2–3
Egg whites or egg substitutes	12
Frozen dinners and entrees	3–4
Gravy, meat, or poultry	2–3
Ham, hotdogs, and lunchmeats	1–2
Meat, uncooked roasts	4–12
Meat, uncooked ground	3–4
Meat, cooked	2–3
Poultry, uncooked whole	12
Poultry, uncooked parts	9
Poultry, uncooked giblets	3–4
Poultry, cooked	4
Soups and stews	2–3
Wild game, uncooked	8–12

[a]Freezer storage is for quality only. Frozen foods remain safe indefinitely.[1]

batches can be stored in the refrigerator for 24 h before freezing is required.[5] Since prepared BTF is prepared from food ingredients, US Department of Agriculture (USDA) guidelines regarding freezing food should be adhered to (Table 4).[1] Safe food freezing recommendations include keeping refrigerated prepared BTF no longer than 24 h before freezing and utilizing safe thawing practices (ie, 1–2 days in the refrigerator).[1] For optimal nutrient retention, the freezer temperature should be 0°F or lower so that the nutrient content is not altered.[1]

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1.5. What is the hang time of BTF, how should BTF be stored, and when should BTF be discarded?

Practice recommendations

Hang time

1. For BTF, follow standard hang time limits. (Table 3).[1,2]
2. For prepared BTF, the hang time should be limited to 2 h or less.[3]
   a. Perishable food should not be left out of the refrigerator for more than 2 h at room temperature (77°F [25°C]).
   b. If the temperature is above 90°F (32.2°C), perishable food should not be left out for more than 1 h.[4]
3. For commercial BTF, refer to manufacturer recommendations for hang time limits.

Storage

4. Store prepared BTF in the refrigerator or freezer; if not frozen, discard after 3–4 days.[4]
5. Store unopened commercial BTF per manufacturers' recommendations. Refrigerate opened commercial BTF and discard unused formula within 24 h of opening, per manufacturer's guidelines.[3]

Rationale

The ASPEN Safe Enteral Practices recommends discarding unused refrigerated formula (all formulas) after 24 h.[3] However, given that prepared BTF is considered food, not formula, the recommendation is to discard unused refrigerated prepared BTF after 3–4 days, as this is consistent with the USDA leftover guidelines.[4]

Microbial contamination is a commonly cited reason for hesitation to use BTF.[5–7] Clinicians have long been concerned that not adhering to proper hang times of BTF could lead to foodborne illness.[5] Likewise, the preparation and storage of prepared BTF has been deemed riskier than using CEF and thus increases the risk of microbial contamination. However, studies have not shown a clinical correlation with acute infection in patients and the microbial load of BTF.[8–10]

In a study by Milton et al, 50 patients prepared BTF recipes at home using the accepted food handling procedure, and of the samples taken, 88% met the criteria for safe consumption.[11] Only 1.3% had bacteria loads above the recommended amount, and this was thought to be due to milk that was close to its expiration date.[11] Johnson et al had similar results when they studied three types of formula: CEF, BTF made with baby food, and BTF made with whole foods.[6] The study showed that all formula types had bacterial loads within acceptable time limits at 0, 2, and 4 h.[6] Conversely, a study completed in Brazil compared nutrition composition and bacterial contamination in commercial products (powder and liquid) and in homemade formulas consisting of lean meat, poultry, eggs, milk, grain, vegetables, legumes, beans, cooking oil, and salt.[12] All ingredients were cooked, pureed in a food blender, and then passed through sieves in order to remove large food particles. The counts of mesophilic and coliform bacteria were significantly higher in the homemade enteral

diet. Only 6.0% of the samples complied with the standard for coliform bacteria.[12] The consensus was that inadequate cooking of raw foods and cross contamination may explain the high level of bacterial contamination. There is no recent literature that links microbial contamination of BTF with foodborne illness.

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1.6. What are the tools that may be needed to administer BTF?

Practice recommendations

1. The following tools are recommended for administering BTF:
   a. Syringes

Note: ESBC O-ring syringes may be easier to push compared with syringes with a full rubber stopper, due to decreased stickiness.

   b. Administration sets
      i. Large-bore gravity bags.
      ii. Reusable tube feeding pouches.
   c. Pumps
      i. Select a pump with attention to food safety guidelines and hang times.
      ii. Consult with a nutrition support professional when selecting pumps, since accuracy is variable, which may affect feeding times and the ability to achieve nutrition goals.
   d. Other supplies
      i. Straight bolus extension sets (not right-angle bolus extension sets) are recommended for skin-level EADs because they allow for better flow and less clogging between the skin-level EAD and the extension set.

Rationale

Available studies suggest that syringe push works better than gravity feeding for BTF.[1,2] Additionally, anecdotal reports suggest that syringes with an O-ring rubber stopper are easier to push than syringes with a full rubber stopper, due to decreased stickiness. Anecdotally, some clinicians recommend brushing a light layer of cooking oil on syringes before use, which may render them easier to push and allow them to last longer.

Large-bore gravity bags, reusable tube feeding pouches, and pump feeding sets may also be used to administer commercial BTF and prepared BTF. Some manufacturers indicate that commercial BTF can impact pump performance and accuracy. Therefore, clinicians must ensure that patients receiving commercial BTF via a pump receive the full amount of formula prescribed.[3] The specific pump manufacturer should be referenced when using both commercial BTF and prepared BTF. Patients utilizing pumps for CEF may benefit from a change in administration method when BTF is initiated.

It is recommended that strainers/sieves are avoided to decrease food waste and increase nutritional value of the

blend.[2,4] Up to 50% of nutritional value can be lost if using a sieve.[5] The use of a commercial-grade blender and/or increasing blending time, up to 6 min, can decrease the particle size of the blend and help with flow rate.[1,6]

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1.7. How should BTF preparation equipment be sanitized (for both hospital and home)?

Practice recommendations

1. Sanitize mechanical devices and equipment (eg, blenders) used to prepare BTF after each use per manufacturers' guidelines and with established protocols and recommendations.[1]
2. In instances where additional guidance is unavailable, the US Food and Drug Administration (FDA) code should be followed,[2] which follows the published guidelines for cleaning and sanitizing dishes and utensils. Specifically:
   a. Disassemble the blender and wash food-contact portions in warm, soapy water.
   b. Wash the microwave dish, measuring cups, and spoons—and any other equipment used—in warm soapy water.
   c. Rinse all items in warm water.
   d. Sanitize the items by soaking them in 2 gallons of water and 2 tbsp (30 ml) of chlorine bleach for 2 min.[3]
   e. Remove objects from the chlorine solution and allow them to air dry; do not dry with a towel or a disposable towel.

Rationale

BTF should be prepared with clean and sanitized equipment in order to prevent cross contamination. Kitchen equipment used to prepare prepared BTF should be cleaned and sanitized according to manufacturer's guidelines and established protocols.[1] In the absence of specific instructions, the US Food Code for cleaning and sanitizing should be followed.[2]

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1.8. How should BTF administration sets be cleaned (for both hospital and home)?

Practice recommendations

1. Rinse administration sets with safe drinking water between uses to clear any debris that may cause mechanical obstruction.
2. Change administration sets according to institutional policy for use in hospitals and care facilities. Use water designated in institutional protocols.
3. Strong evidence is lacking to support routine use of bleach in cleaning administration sets.
4. Store administration sets in the refrigerator in a plastic bag between uses.
5. Discard administration sets at the time interval recommended by the manufacturer, usually after 24 h.

Rationale

Although there is a lack of robust evidence supporting water as a method of cleaning, it is recommended to rinse administration sets to help clear debris and to prevent mechanical obstructions. Lyman et al compared cleaning methods of pump feeding bags between uses, which tested (1) cleaning with sterile water, (2) refrigerating the bag between feedings, and (3) ready-to-hang (RTH) bags for

bacterial growth.[1] RTH formula had the least bacterial growth; however, all three showed low bacterial growth overall. It is important to note that not all CEFs are available in RTH bags; therefore, in practice, home care clinicians recommend refrigerating the feeding bag in a sealed plastic bag vs rinsing the set with sterile water and find this to be a safe method for handling the bag between feedings that is more convenient from a time standpoint. This study did not specify which formulas were used in the RTH arm and specific testing of BTF is unknown.

Conversely, a Japanese study compared cleaning enteral feeding sets with water only vs immersing them in a 0.01% (100 parts per million) sodium hypochlorite (bleach solution) for more than 1 h.[2] The study found that washing feeding bags with water and then 0.1% sodium hypochlorite (ie, bleach) solution significantly reduced microbial growth compared with washing with water alone. The microbial contamination level of the formula left in the bag was significantly higher in the sets reused after washing with water only vs those reused after washing and immersion in the bleach solution. While this study suggests a potentially lower microbial growth when using a bleach solution, further evidence is needed before recommendations for routine use can be made. To date, no adverse outcomes from contaminated feeding sets have been reported.

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1.9. How should BTF feeding supplies (eg, syringes, bottles) be cleaned (for both hospital and home) between uses?

Practice recommendations

1. Follow the manufacturer guidelines for cleaning and sanitizing feeding supplies.
2. In the absence of the manufacturer guidelines, follow the Centers for Disease Control and Prevention (CDC) guidelines for cleaning feeding items[1] (Figure 3).
3. In hospital settings, feeding supplies should be discarded after a single use.

1. Prepare a bleach solution of 1 teaspoon of unscented bleach per gallon (16 cups) of water in a clean wash basin.
2. Submerge the bag and cap completely, checking that the solution touches all parts and there are no air bubbles in the bag.
3. Soak items in solution for at least 2 minutes.
4. Remove with clean hands or tongs. Do not rinse because germs could get back onto the sanitized items. Any remaining bleach will break down quickly.

FIGURE 3 Directions for use of bleach to clean feeding supplies.[1]

Rationale

In order to prevent cross contamination from soiled feeding supplies, it is important to clean this equipment between uses. To avoid contamination, BTF feeding supplies should be cleaned per recommendations provided by the manufacturer. If manufacturer recommendations are not available, the CDC provides guidance on cleaning, sanitizing, and storing infant feeding items (bottles and the nipples, rings, caps, syringes, medicine cups, spoons, or supplemental nursing system) in order to prevent contamination, which can be applied to cleaning BTF feeding supplies.[1] This is a process similar to the sanitizing done in commercial kitchens.

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SECTION 2: PRACTICE RECOMMENDATIONS FOR PREPARED BTF RECIPE AND BTF ADDITIVES AND CONSISTENCY

2.1. What resources are available to assist in creating a recipe for prepared BTF?

Practice recommendation

1. Respected resources should be used when creating prepared BTF recipes to identify how much of each food group is needed. Specifically:
   a. https://www.choosemyplate.gov/resources/MyPlatePlan.
   b. Other available resources (Figure 4 and supporting information Appendix 1).

Recommendations for Finding Appropriate Online BTF Recipes or Resources	
1. Use a site administered by federal agency, medical school, or large professional or nonprofit organization. 2. The website should provide information on individual who reviews the information before its posted on the website. 3. The date the information was updated or reviewed should be easy to find. 4. Avoid individual's personal blogs or a featured opinion.	
Nutritional Guidelines and Assessment Tools for Recipe Creation	
Additional Recipe Development Tools	• **National Guidelines** *(Note: Seasonal and cultural foods may vary in different countries)* (https://www.nal.usda.gov/fnic/dietary-guidelines-around-world) • **WHO 2020 Guidelines Healthy Diet** (https://www.who.int/news-room/fact-sheets/detail/healthy-diet) • **USDA My Plate** (www.choosemyplate.gov/) • **Canada's Food Guide For Healthy Eating** (https://food-guide.canada.ca/en) • **Recommended Dietary Allowance (RDA)—**average daily level of nutrition intake to meet the nutrient requirements of all healthy people (https://www.ncbi.nlm.nih.gov/books/NBK234926/) • **UK Public Health England—**recommendations for energy, macro-nutrients, and micro-nutrients for different age groups including 19-64 years in general population (https://www.gov.uk/government/organisations/public-health-england) • **Dietary Reference Intakes (DRI)** (https://health.gov/our-work/nutrition-physical-activity/dietary-guidelines/dietary-reference-intakes-dris) • **The Exchange Method** (https://www.nhlbi.nih.gov/health/educational/lose_wt/eat/fd_exch.htm) • **U.S. Department of Health and Human Services and U.S. Department of Agriculture Dietary Guidelines for Americans 2020-2025** https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf
Additional Information with Examples of BTF Recipes, Resources, and General Support for Home BTF Use	
• ASPEN Enteral Nutrition Formula Guide. https://www.nutritioncare.org/Guidelines_and_Clinical_Resources/EN_Formula_Guide/Enteral_Nutrition_Formula_Guide/ • ASPEN Enteral Nutrition Resources; included Blenderized Tube Feeding Video Series. https://www.nutritioncare.org/Guidelines_and_Clinical_Resources/Enteral_Nutrition_Resources/ (includes BTF video series) • Blenderized Tube Feeding Seattle Children's. https://www.seattlechildrens.org/pdf/PE442.pdf Accessed: December 20, 2022 • Children's Wisconsin blend teaching sheets.https://childrenswi.org/publications/teaching-sheets?keyword=blend. Accessed: December 20, 2022. • Blenderized tube feeding recipes. https://med.virginia.edu/ginutrition/wp-content/uploads/sites/199/2014/06/BLENDERIZED_TUBE_FEEDING.pdf. Accessed: December 20,2022. • Table 3: Sample homemade tube feeding recipe including nutrient analysis using Nutritionist Pro for an18-month child requiring 700 kcal/d in Walia C, Van Hoorn M, et al. The registered dietitian nutritionist's guide to homemade tube feeding. *J Acad Nutr Diet.* 2017;117(1):11-16. • Compleat.com; https://www.compleat.com/create-new-recipe. Accessed December 20, 2022.	

FIGURE 4 Additional BTF resources for clinicians, patients, and caregivers. BTF, blenderized tube feeding; USDA, US Department of Agriculture; WHO, World Health Organization.

Rationale

Reputable resources exist to aid in the creation of prepared BTF recipes.[1,2] Caregivers should remain cognizant of common mistakes when planning a prepared BTF recipe such as inadequate or excessive fluid, too many fruits and vegetables, or inadequate provision of carbohydrate or calories, for example. Since recipes are prepared at home, many patients or caregivers do not follow precise instructions for the recipes. Therefore, daily

variation is expected, which is one possible reason why patients require more calories from prepared BTF than from CEF. Bennett et al showed that pediatric patients required 20%–50% more calories to maintain their body mass index while receiving BTF compared with commercial formula.[3] This may have also been due to the thermal effect of food of 7%–10% or change in digestion due to diverse microbiota.[3,4] Referring to reputable resources assists in creating recipes that are appropriate to meet patient's nutrition needs.

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2.2. What is the necessity for nutritional analysis of the prepared BTF recipe in the hospital and home environments?

Practice recommendations

1. In hospital and home environments, a nutritional analysis is recommended. Analyses should occur following the initial recipe development and routinely thereafter to assess nutrition adequacy based on prepared BTF recipe adjustments and possible changes to the patient's nutrition status and needs.
2. A comparison of the recipe's nutrient profile to the patient's age-appropriate nutrition requirements is necessary. This ensures that macronutrient and micronutrient needs and goals are met.
3. Recipes should be continually adjusted, including the addition of vitamin/mineral, electrolyte supplementation, and/or modular products to meet nutrition requirements.

Rationale

In hospital and home settings, an RD should calculate the patient's age-appropriate macronutrient and micronutrient needs and design a recipe based on those estimated needs. Routine recipe analysis is recommended to ensure that the patient's changing nutrition needs (based on weight, growth, and laboratory findings) are met. Additionally, a nutritional analysis guides the RD's decision to recommend additional vitamins, minerals, electrolytes, and/or modular products. Routine laboratory monitoring is not recommended[1]; however the patient's nutrition and/or clinical status or the nutrient analysis of the prepared BTF may indicate laboratory studies in select cases.

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2.3. Which foods are appropriate to be included in prepared BTF?

Practice recommendations

1. In collaboration with the patient/caregiver and RD, most foods may be included in recipes for prepared BTF following careful consideration of nutrient composition.
2. The nutrient composition of the recipes should be developed based upon the patient's nutrition needs while accounting for lifestyle preferences.

Rationale

The USDA National Agricultural Library's Nutrient Data website provides resources regarding nutrient information and requirements such as the specific foods that may be considered in the prepared BTF recipe.[1] Other national nutrition databases are acceptable resources that may be used to assess nutrient composition such as the Canada Nutrient File[2] as well as updated computerized nutrition recipe development and analysis programs. The USDA provides a link to software programs that have been USDA-approved for nutrient analysis.[3] Multiple methods are available for recipe development (refer to Figure 4: Additional Resources for Clinicians, Patients, and Caregivers for recipe samples).

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2. Canadian Nutrient File (CNF). Government of Canada. Accessed January 5, 2022. https://food-nutrition.canada.ca/cnf-fce/index-eng.jsp
3. USDA Approved Nutrient Analysis Software. US Department of Agriculture. Accessed January 5, 2022. https://www.fns.usda.gov/tn/usda-approved-nutrient-analysis-software

2.4. What are the recommendations regarding maintaining the same prepared BTF recipe daily vs the appropriateness of recipe variability?

Practice recommendation

1. If the recipe is nutritionally adequate to meet the patient's macronutrient and micronutrient needs, the decision to vary the daily recipes is based on patient and caregiver preference.

Rationale

Prepared BTF recipes are highly variable and range from 0% to 100% of nutrition coming from whole foods. There are a variety of methods to develop prepared BTF recipes for adults and pediatric patients including standard recipes, food exchanges, and the plate method. A recipe for prepared BTF may also comprise a combination of commercial BTF and whole foods. For patients 6 months of age and older, partial nutrition (<25%) from food can be provided in addition to breast milk or infant formula with an increase to 100% by 12 months of age. Regardless of method, it is necessary to prepare a recipe that provides adequate macronutrient and micronutrient needs specific to the patient. Therefore, patients and caregivers may decide to vary the recipes daily if that is the preference, as long as it is ensured to provide the required nutrition balance.[1–3] The *Dietary Guidelines for Americans 2020-2025* continues to emphasize and encourage following a healthy dietary pattern including a variety of nutrient-dense whole foods.[4] RDs should work with patients and caregivers to create recipes tailored to meet the patient's specific nutrition needs, schedule, and preferences and providing a variety of nutrient-dense foods.

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2.5. What is the necessity to provide additional vitamin and mineral supplementation when using BTF?

Practice recommendation

1. Additional supplementation of vitamins and minerals may be indicated if assessment/analysis of the recipe demonstrates inadequate provision in comparison with the recommended age-specific dietary reference intakes and the patient's nutrition needs.

Rationale

BTF's nutrient content can be variable in composition due to the individualized nature of recipes. A knowledgeable RD should be consulted when developing recipes to ensure the recipe is providing adequate levels of macronutrients and micronutrients to prevent deficiencies.[1] Through the use of nutrient analysis software, the prepared BTF or commercial BTF nutrient content can be compared with the patient's macronutrient and micronutrient requirements. Additional vitamin and mineral supplements can be added to assure all requirements are met.[2] It is important for clinicians to be cognizant of outside factors that may increase a patient's risk for micronutrient deficiencies, including medication interactions, elimination of foods related to food allergies or diet preferences, and medical conditions such as malabsorption.[3,4] Clinical laboratory testing may direct the need for additional minerals and vitamins based on the clinical situation. Laboratory testing should be considered on a case-by-case basis and is not routinely recommended.[5]

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2.6. What is the necessity to provide additional sodium when using BTF?

Practice recommendation

1. Assess BTF recipes and composition for sodium content, with individualized recommendations to add sodium based on recipe content and patient's nutrition and hydration needs.

Rationale

Many BTF recipes are low in sodium and require additional supplementation to meet sodium needs. To increase sodium levels, the RD should assess the recipe composition compared with the patient's nutrition and hydration requirements.[1] Specifically, salt or sodium-containing foods (eg, broth, bouillon cubes, vegetable juice, canned soup or canned vegetables) may be added to the recipe in prescribed amounts to meet the age-specific dietary reference intake (DRI).[1–3]

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2.7. What is the necessity to add modular products to BTF?

Practice recommendations

1. Individualized recommendations to add modular products should be based on the recipe and the patient's nutrition needs to ensure needs are met. Assess BTF recipes and composition upon initiation and when there are changes in recipe or the patient's clinical and nutrition status for macronutrient and micronutrient content.

Rationale

Generally, there is a paucity of data on the use of modular products. However, depending on the nutrient composition of the BTF, modular products may be necessary to meet the patient's nutrition needs. Not all commercial BTFs provide 100% of DRIs, as some are intended for supplemental use and may not meet individual macronutrient and/or micronutrient needs. Bennet et al reported that some commercial BTFs exclude certain ingredients such as allergens and may use specialized ingredients.[1] In these instances, the clinician should review the ingredients to ensure the products include a high-quality protein, meet the American Heart Association's recommendations for added sugar, and contain an appropriate balance of fats. If modular products are indicated, ASPEN provides the EN Modular Products guide as a resource.[2]

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2.8. What is the recommended way to ensure that the BTF contains adequate fluid?

Practice recommendations

1. The patient's fluid needs should be calculated using standard clinical methods.
2. Account for the fluid added to BTF when determining fluid requirements and the need to provide additional fluid.
3. While adequate fluid is essential, the addition of water to BTF can dilute nutrient content, affect hang time, and adversely impact the medical effects of specific viscosity recommendations. These factors must be considered when determining appropriateness of adding fluid.

Rationale

Several methods are available to help estimate fluid requirements which are based on calculations estimates as well as patient specific factors.[1–3] The patient's estimated fluid requirements are the same regardless of the formula choice or decision to initiate BTF. The difference lies with the amount of fluid in the recipe vs how much additional free fluid is required to meet individual needs. The amount of free water in commercial BTF and prepared BTF is highly variable and depends on the solid ingredients used and the choice of liquids added. Although solids contain fluid, this is not counted toward patient fluid goals due to the practicality of measuring this. After determining the patient's fluid requirements, subtract the fluid added to the BTF and then provide the remainder of the fluid balance as free fluid via separate water flushes.[4]

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2.9. Which tool should be used to evaluate the consistency of BTF to ensure appropriateness for administration via EADs?

Practice recommendation

1. The IDDSI should be used to evaluate consistency of BTF to ensure appropriateness for administration via EADs.

Rationale

Viscosity measurements may provide important information about BTF; but other factors such as the flow of the recipe may be more meaningful in the home setting. Understanding the flow characteristics or viscosity of BTF is an important first step in standardizing the BTF used for different purposes.[1] The IDDSI score is an effective way to evaluate both prepared BTF recipes and commercial BTF.

The IDDSI (https://iddsi.org/framework) was developed with the goal of developing new international standardized terminology and definitions to describe texture of modified foods and thickened liquids.[2] The IDDSI group developed measurements of consistency, thickness, and flow properties of foods using utensils easily sourced for home use. The IDDSI Syringe Flow Test (Figure 2) can be used in the home setting for BTF to gauge the flow properties of the various blends.[1,2]

Hron and Rosen noted that the results of the Syringe Flow Test do not always match the viscosities measured by a viscometer.[3] The IDDSI Syringe Flow Test is impacted by the degree of blending and, among other factors, the residual fiber size and whether a kitchen strainer has been used. These fiber particulates can clog the test syringe and lead to overestimating the thickness or viscosity.[1] Therefore, if certain viscosities are recommended for the treatment of retching or gastroesophageal reflux (GER) or GER-related aspiration events, for example, a kitchen strainer may be required to measure flow rates per the IDDSI Syringe Flow Test. A strainer should not be used when preparing prepared BTF due to the potential for nutrient loss (refer to recommendation 1.6).

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2.10. What is the optimal consistency of BTF delivered by syringe, gravity bag, or by pump?

Practice recommendation

1. Recommendations regarding the optimal consistency of BTF for delivery via syringe, gravity bag or by pump

cannot be made given the individualized nature of BTF in terms of recipe as well as patient specific factors.

Rationale

Like most foods, BTFs are on a spectrum of texture and consistency depending on the specific foods the blends contain. Personal food preference, choice of administration route (eg, syringe, gravity, or pump), and the purpose of the specific blend consistency influences the composition of the blenderized diet. As such, optimal consistency of BTF is not well elucidated, and different consistencies may be required to meet individual patient goals.

Syringe feeding can be accomplished with a diet that is very thick on the IDDSI scale; the limiting step may be the force that the person administering it is able to exert on the syringe.[1,2] Gravity feeding requires foods not thicker than "slightly thick" on the IDDSI continuum of flow rates. BTF administered via a pump is dependent on the specific pump and should follow the manufacturer instructions for use. Some authors[3–5] have suggested that bolus feeding should be the delivery method of choice for BTF.

Decisions regarding the consistency, thickness, and flow rates of the BTF depend on indication, tolerance, preparation, and delivery equipment that is available as well as patient-specific factors (eg, dexterity and strength). Thus, decisions regarding optimal consistency are specific to the individual receiving BTF and their method of feeding.

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SECTION 3: PRACTICE RECOMMENDATIONS FOR BTF IN THE HOSPITAL ENVIRONMENT

3.1. What is the safety of use of BTF in pediatric and adult hospitalized patients (eg, ward, intensive care unit (ICU), immunocompromised/transplant)?

Practice recommendations

1. BTF is considered a safe option in stable ward patients who have previously demonstrated tolerance to BTF and who can tolerate a method of feeding that is offered in the hospital.
2. Prepared BTF and commercial BTF are considered safe in hemodynamically stable patients in the ICU. However, due to a lack of evidence, concerns exist about composition and the ability to deliver these formulas to complex patients.
3. Use of prepared BTF in immunocompromised patients is considered safe, provided that attention to proper food safety practices and proper hang times is given.

Rationale

BTF can be used in stable ward patients in accordance with hospital policy and resources. In children, using BTF may allow food intolerances to be unmasked.[1] Prior to BTF initiation and throughout the hospital stay, patients should be assessed consistently by an RD to determine clinical appropriateness and gastrointestinal (GI) stability and for the absence of other contraindications or clinical changes affecting the ability to use BTF.[2]

The use of BTF may be safe in medically complex and critically ill patients; however, additional research and data are needed before stronger clinical recommendations can be made. While BTF use is in its infancy in critical care settings, it holds promise as a tool to mitigate the inflammatory risks posed by stress and sepsis.[3,4] It is important to note that barriers to its use exist. Patients in the ICU often have elevated nutrition needs to maintain lean body mass after the early acute illness phase which may be difficult to meet with BTF. In certain patients, caloric density and high protein needs may be easier to achieve with a CEF. The BLEND study (conducted in a pediatric population) showed that participants required 50% more calories to maintain BMI while receiving BTF compared with commercial formula.[5] Jonkers-Schuitema et al stated that the BTF diet often has a lower calorie density and requires larger volumes, making it difficult to

meet needs in critically ill patients who are often volume restricted in addition to having elevated nutrition needs.[6] Additionally, for patients in the ICU, there is concern that they may receive BTF with high levels of fiber. The appropriate fiber quantity and type are highly debated topics in critical illness, with current guidelines leaning toward use of soluble fibers.[7] Caution is recommended when administering fiber in patients with hemodynamic instability or who have not been fully volume resuscitated. The evidence for nonocclusive mesenteric ischemia and nonocclusive bowel necrosis is controversial. Current practice recommendations are to avoid fiber in hemodynamically unstable patients. BTF formulas contain a mixture of fibers and would be contrary to some opinions on fiber in critical illness. Fiber is also contraindicated in delayed gastric emptying, which occurs in a high proportion of critically ill patients. On the contrary, emerging research suggests that EN with fiber plays a role in preserving the gut barrier and microbiota, which may lead to more acceptance of mixed fiber–containing enteral formulas in critical illness.[4,8,9]

The delivery of BTF in the critically ill population may place logistical demands on nursing staff in the ICU. Specifically, nursing demands may not be compatible with shorter hang times, especially in the setting of other cares that must be provided to critically ill patients. Likewise, time constraints of the nutrition professional to develop personalized recipes may be a barrier to using prepared BTF in the ICU setting. A commercial BTF product with a longer hang time, and possibly pump compatibility, would be the most reasonable choice if BTF is desired and implemented in the ICU.

Historically, prepared BTF has been cautioned against in immunocompromised patients (eg, transplant patients) due to assumed increased risk of microbial contamination. However, this caution is not supported by any robust evidence suggesting risk. There is a growing body of evidence supporting the importance of a diverse gut microbiome for improved outcomes. Recently, food safety recommendations against use of prepared BTF in immunocompromised patients citing general food safety concerns have been modified.[10–19] Recent papers do not discourage immunocompromised patients from using BTF but rather support more education and attention to food safety, including adhering to hang times.[20,21]

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3.2. Which BTF delivery methods are feasible for hospitalized patients?

Practice recommendations

1. The specific delivery method for BTF should be based on resources in the hospital's kitchen (eg, staff and equipment) and on the ward (eg, nursing demands, education of dietitian staff). However:
   a. Bolus feeding is the preferred delivery method for BTF (syringe push or gravity).
   b. A feeding pump may be used if delivery adheres to recommended hang time (Table 3). The feasibility of prepared BTF with continuous feeds is limited by the 2-h hang time and the demand this places on nursing time. If continuous BTF is desired, consider a commercial BTF with a longer hang time.

Rationale

The addition of BTF to an inpatient formulary impacts several systems within the hospital. Prior to including BTF as an option, an assessment of feasibility with the kitchen staff and equipment, the demand on nursing, and the education of the dietitian must be considered. BTF requires additional kitchen preparation and nursing time, which should be included in the analysis to implement. For example, it has been demonstrated that the management of open systems of EN consumes almost twice as much nursing time daily as closed systems.[1] Once integrated into a hospital formulary, a protocol determining one specific delivery method, such as the recommended bolus feeding, may be useful as a starting point to incorporate BTF safely.

The ideal method of administration for BTF in acute care is via bolus feeding (syringe push or gravity).[2] Prepared BTF should not be held at room temperature for more than 2 h due to concerns of microbial contamination; therefore, a bolus regimen is recommended over a continuous infusion.[3–5] The few published studies that report high bacterial loads of BTF were conducted in countries with very different hospital conditions than the United States. The higher microbial growth is due to improper food handling rather than route of administration. Theoretically, with trained registered nurses' expertise and aseptic protocols, these risks may be minimized. Formula separation that may occur when it is allowed to sit for long periods of time is another reason why the quicker bolus delivery method is recommended.

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3.3. What are the unique considerations for the preparation of prepared BTF in the hospital kitchen, and how do they differ from the home kitchen?

Practice recommendations—Hospital kitchen

1. Specific, trained personnel responsible for making prepared BTF must be identified within the hospital kitchen.
2. Adhering to appropriate temperature for cooked foods and abiding by expiration dating are required.
3. The presence of safe food handling procedures must be confirmed.
4. A commercial-grade blender must be utilized.

5. All equipment used to prepare prepared BTF must be sanitized after each use, per manufacturer guidelines. In the absence of the manufacturer guidelines, follow CDC guidance.
6. Commercial BTF availability should be assured as a backup plan.

Practice recommendations—Home kitchen

1. A home kitchen should be clean and have access to safe water, electricity, and refrigeration.
2. Utilize a blender for formula preparation.
3. Review and confirm understanding of safe food cooking, handling, and storage procedures.

Rationale

Concerns regarding bacterial contamination of prepared BTF have been a consistent deterrent for hospital environments. Protocols for training as well as clean preparation techniques adherent to cooking temperatures and expiration and safe food handling and storage procedures must be followed to mitigate these risks. Importantly, although several published studies have shown increased microbial contamination,[1,2] recent studies have demonstrated that when safe food preparation procedures were followed, contamination risk is significantly lowered.[3,4]

It is important to recognize that the home kitchen environment does not specifically carry the same risks for contamination in the hospital. The conditions outlined for hospital-prepared BTF preparation are not required in the home environment. A commercial-grade blender is recommended in the hospital environment due to the strength of the motor to handle repeated and ongoing use.

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SECTION 4. PRACTICE RECOMMENDATIONS FOR FOLLOW-UP AND MONITORING FOR PATIENTS RECEIVING BTF

4.1. What are the follow-up plan and monitoring recommendations for patients on BTF? Specifically:

a. What is the recommended frequency for follow-up/monitoring for patients receiving BTF?
b. What laboratory monitoring is recommended for patients receiving BTF?

Practice recommendations

1. Follow-up with an RD or nutrition support specialist (NSS) knowledgeable in BTF is needed for a successful regimen. Experts in the field recommend initial visits occur every 1–2 months. Visit follow-up may be extended to every 4–6 months based on patient stability after the initiation phase.
2. Laboratory parameters should be monitored as indicated by nutrition assessment, and any signs or symptoms of nutrition abnormalities or deficiencies identified. The specific laboratory parameters are individualized based on the patient's clinical and nutrition status.

Rationale

Without the support of an RD or an NSS knowledgeable about BTF, there is potential for an increased risk of inadequate nutrition, poor weight status, electrolyte imbalances, and equipment malfunction.[1] These increased risks are cited as a reason for hesitancy in recommending BTF.[2] However, many adult and pediatric patients safely and effectively use BTF for partial or complete nutrition.[3]

To mitigate the potential risks, frequent visits when initiating BTF are recommended every 1–2 months. Follow-up visits may be extended to every 4–6 months based on patient stability and experience after the initiation phase. During all follow-up visits, monitoring parameters should include anthropometrics; adherence to the recommended regimen and feeding technique; assessment of feeding tube and site; review of inputs and outputs; weight changes; GI symptoms; and caregiver assessment for signs of stress and burnout.[4] Additionally, it is important to assess the recipe for nutrition adequacy and make changes as needed.

Frequent patient follow-up helps identify abnormalities in nutrition goals prior to patient detriment. Troubleshooting aspects such as formula consistency

or other administration strategies as well as nutrient provision, for example, and ongoing education on the optimization of BTF should occur at these visits. Previous studies have demonstrated the inaccuracy of calorie intake for blended foods when patients attempt to produce BTF without appropriate guidance.[5] For example, self-made blends have resulted in inadequate fluid and protein intake.[6,7] Therefore, frequent follow-up increases adherence to the recommended regimen through open dialogue and education and provides opportunities to discuss new recipes desired by the patient and caregiver and ways to reach shared nutrition goals.

Laboratory parameters should be monitored if indicated based on the RD's assessment (eg, nutrition-focused physical exam) if signs or symptoms of micronutrient or macronutrient abnormalities are identified. Patients with altered GI tracts or altered absorption may require more frequent laboratory monitoring based on the areas of the bowel that are affected. The specific parameters that should be monitored should be based on these assessments.

AUTHOR CONTRIBUTIONS

L. Epp, A. Church, I. Ford, B. Grandee, C. Larimer, J. Lewis-Ayalloore, A. Malone, L. Pataki, and G. Rempel equally contributed to the conception and design of the research. L. Epp, A. Church, I. Ford, B. Grandee, C. Larimer, J. Lewis-Ayalloore, A. Malone, L. Pataki, and G. Rempel contributed to the acquisition and analysis of the data. L. Epp, A. Church, I. Ford, B. Grandee, C. Larimer, J. Lewis-Ayalloore, A. Malone, L. Pataki, and G. Rempel contributed to the interpretation of the data. L. Epp, A. Church, I. Ford, B. Grandee, C. Larimer, J. Lewis-Ayalloore, A. Malone, L. Pataki, and G. Rempel drafted the manuscript. All authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

Lisa Epp is a consultant for Avanos and speaker for Nestlé. Allison Blackmer performs consultative services to Wolters Kluwer and Pediatric and Neonatal Lexi-Drugs and has served as a member of the Drug Utilization Review Board for the Colorado Department of Health Care Policy and Financing through March 2021. Cara Larimer is an employee of Zevex, a Moog company. The remaining authors declare no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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