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Blenderized Tube Feeding
Clinical Perspectives on Homemade Tube Feeding

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Introduction

Homemade tube feeding (HMTF) is food liquefied in a blender and bolus fed through a gastrostomy tube (g-tube) as an alternative to commercial formula, such as PediaSure® or Compleat Pediatric®. Homemade tube feeding may replace some or all bolus feeds, depending on the family's preferences. Families may desire to give the child a few foods through the g-tube, or rely solely on HMTF to provide their child's nutritional intake. To date, there are no peer-reviewed publications on the efficacious use of HMTF for the pediatric population. This article discusses clinical experience with the use of HMTF. The specific aims are:

- Describe reasons families might choose HMTF
- Identify criteria for HMTF candidates
- Outline the registered dietitian's role managing HMTF
- Provide case studies that illustrate effective HMTF management

Why families choose HMTF

In an age when convenience foods are the expectation of many families, the appeal of HMTF may seem counterintuitive because planning, preparing, and serving HMTF consumes more time than opening a can of formula. For families who are uninsured or underinsured, some HMTF can cost less than purchasing commercial formula #(i). Families seek expert advice on HMTF for several reasons in addition to cost, including perceived health benefits and psychosocial considerations.

Families respond to key health messages, such as "eat a variety of foods" or "mix up your choices within each food group" #(ii) leading parents to question whether using only one formula can be optimal. Two common complaints associated with enteral feedings are constipation and diarrhea #(iii); fiber can regulate the digestive process and prevent or reduce these side effects. Caregivers may want to offer HMTF recipes designed with high fiber foods to increase bowel regularity. However logical, it is difficult to make these claims without supportive research. Anecdotal reports by families include reduction of reflux symptoms and improvement in oral aversion behaviors. Possible benefits should not be discounted due to lack of published data; instead the use of HMTF provides research opportunities.

Beyond health considerations, families express other motivators for choosing HMTF. Family meals provide an opportunity for socializing and a mechanism for parents to provide attention. When traditional ways of offering nutrition are altered through placement of a g-tube, caregivers report a feeling of remorse because g-tube feeding seems "unnatural" #(iv). One useful coping strategy studied in families with children with special health care needs is spending time in activities with a spouse, children and relatives #(v). Families may cope with the presence of a g-tube by preparing HMTF together, the same way they enjoy making dinner together. Also, children receiving enteral nutrition may be served some of the same foods as other family members, allowing for sharing of family meals #(vi).

Identifying Candidates for HMTF

The many benefits of commercially available enteral formulas are well known and include: shelf stable; easy storage before opening; appropriate viscosity for small diameter g-tubes; and controlled, appropriate nutrient density. These characteristics assure safety and consistency, and are more appropriate than HMTF for many situations. Those patients who are good candidates for HMTF include children that are bolus fed via g-tube, who have stable growth patterns and are otherwise healthy. They should have a motivated family with a history of open communication and compliance. The medical team should evaluate if a child meets these criteria and if they are comfortable providing direction on implementing and advancing HMTF.

The following is a list of possible contraindications for HMTF:

- **Acute illness or immunosuppression** predisposes children to greater risk of infection from contaminated food.

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- **G-tube size less than 10 French** is in place. Greater than 14 French is preferred to prevent clogging.
- **Fluid restrictions or intakes less than 30 ounces per day** make it difficult to meet nutrient needs with HMTF.
- **Continuous drip feedings** requiring HMTF to be unrefrigerated for more than 2 hours.
- **Jejunostomy tubes** requiring continuous feeds and elemental formula to optimize absorption.
- **Multiple food allergies/intolerances or special diet restrictions** may severely restrict variety, limiting specific nutrients, or may expose children to possible allergens.
- **Lack of resources** for the family, including electricity, refrigeration, hot water, and/or supplies to make HMTF.

Registered Dietitian's Role

The registered dietitian (RD) advocates for a client's health by promoting and implementing safe nutrition practices. Homemade tube feedings can be safely used, but there are concerns that underscore the importance of having an RD involved as a team member for all nutrition interventions for children with special health care needs.

Primary RD responsibilities include interpreting nutrition information for families and individualizing nutrition care plans. For example, parents may be concerned that their child fed by g-tube is not benefiting from dietary variety. Dietitians can acknowledge concern that variety is an important dietary component, but emphasize that nutritional adequacy is the priority. Additionally, families may feel that their child is missing out on mealtimes. Dietitians have an opportunity to support families of children fed by g-tube in family meals without changing formulas: babies can be held while tube fed, toddlers can be fed by tube while sitting in a high chair during family meals, and children can be asked to help prepare the meal or their own tube feeding if developmentally ready to do so #(v). Nutrition professionals remind families that nourishment comes in many forms, and the social aspect is as important as the food.

For all children fed by g-tube, the goal is a formula providing adequate nutrients and fluids; balanced energy from carbohydrate, protein, and fat; an appropriate renal solute load; and the addition of fiber as needed for digestive health. The RD managing HMTF with families must have nutrition analysis software at her/his disposal and time to review recipes and make adjustments as needed. Table 1 is a list of some potential complications that may occur with poor management of HMTF.

Tolerance of HMTF is evaluated using the same parameters as any commercial formula. Dietitians instruct parents to monitor for allergic reactions, weight loss, and gastrointestinal disturbances such as diarrhea, constipation, emesis, and abdominal distention. Adverse reactions are reported to the team so the nutrition care plan can be adjusted. Frequent nutrition re-evaluations contribute to assessing the family's satisfaction with HMTF and altering the plan as needed based on the child's response.

Case Studies

Managing HMTF can be an intimidating task especially with the availability of excellent commercial products that are accompanied by complete nutrition analyses. However, HMTF is being used in the community and families are seeking guidance from RDs. Two case studies are included that demonstrate clinical experiences with HMTF. Being aware of how to safely implement HMTF and knowledgeable about appropriate candidates will aid dietitians helping families develop nutrition care plans for children fed by g-tube.

Case Study #1

Submitted by Melissa J Mortensen, RD, CD, Children's Hospital and Regional Medical Center, Seattle, WA

NUTRITION FOCUS: Transition from commercial enteral formula to HMTF while maintaining nutritional status and growth

J.M. is a toddler with oral aversion secondary to severe reflux and history of cow's milk protein allergy and constipation. J.M.'s family has been actively involved in managing his health care with their Primary Care Provider (PCP), gastroenterologist, and occupational therapist (OT).

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Table 1. Potential Complications of HMTF

Concern	Rationale	Prevention
Clogged g-tube	Excess fiber, residue, seeds, nuts, and lumps of food can clog g-tubes. Medications can also react with foods, causing blockages to form in the tube.	Foods must be blended well and strained. Always flush tube with water before and after giving medications and feeds.
Increased wear on g-tube requiring more frequent changes	Oils can degrade the plastics from which g-tubes are made.	Minimize contact time of oils on g-tubes. Determine if oils need to be added to feeds everyday. Flush tube with water after every feeding.
Aspiration of fats (for children at risk of aspirating)	Oils and fats may separate from HMTF due to lack of emulsifying agents. Fats rising to the top of a tube feeding bag may result in the final run of feeding being mostly fat.	Identify history or risk of aspiration. Use syringe boluses versus tube feeding bags when able. Make one feeding at a time instead of refrigerating 24 hours of recipe in one container.
Food-borne illness	Canned formulas are sterile before opening; HMTF are not. Repeated exposure to contaminated foods may occur after blending batches of formula.	Educate families on food safety. Emphasize importance of preventing food borne infections as an illness may be misinterpreted as non-tolerance of HMTF.
Nutrient deficiencies	Deficiencies may arise from continued use of insufficient HMTF.	Perform ongoing recipe analysis. Alternate ingredients within food groups and select foods from every food group for a complete recipe. Request labs for any nutrients of concern.
Hyponatremia/electrolyte disturbances	Low sodium levels result from chronic low sodium ingestion or excessive fluid intake. This may cause swelling of cells as the body attempts to adjust intercellular with intracellular sodium levels. Brain cells are susceptible to damage from swelling due to limited space to expand #(vii).	Calculate sodium and other electrolyte content of HMTF. Calculate maintenance fluid needs. Include free water flushes in daily fluid totals.

Case Study #1 *(continued)*

Timeline	Clinical presentation	Nutrition therapy plan and assessment
5 mo	Nasogastric (NG) tube placed due to feeding refusal. GI studies revealed eosinophilic gastritis in addition to reflux.	Changed to NeoCate formula, goal of 26 oz/day of 24 kcal/oz formula to provide 110 kcal/kg.
8 mo	Growth meets expectations; parents interested in HMTF.	Begin trial of decreasing enteral feeds to promote appetite and oral intake.
13 mo	Percutaneous endoscopic gastrostomy (PEG) tube placed for prolonged enteral feeds despite gains from feeding therapy with increased acceptance of licks of foods, some chewing and spitting out, but not adequate swallowing.	Expect enteral feeds to meet 100% of estimated nutrition needs. Goal is 28 oz/day of NeoCate formula, 26 kcal/oz, with 2 kcal/oz as DuoCal to avoid excessive protein intake.
J.M.'s parents stated their motivation for starting HMTF was to increase the variety of foods his digestive system was exposed to given his limited oral intake. At a family conference, the PCP and OT were supportive of HMTF. The gastroenterologist accepted the plan with a change to a larger MIC-Key Button.		
16 mo	PEG tube changed to MIC-Key button. Gastroenterologist ready to challenge J.M. with cow's milk and soy proteins. Growth in channel. Family wants to try transitioning one bolus to HMTF, and then increase number of boluses/day as HMTF.	Weight gain excellent. Increased goal volume to 35 oz from 28 oz and discontinued use of DuoCal. J.M. receives 24 kcal/oz NeoCate formula – 5 x 210 ml boluses/day; taking some foods orally; tried crackers containing soy with no adverse reactions. Started by changing 25% of volume to soymilk with plan to increase soymilk amount 25% at a time.
The goal is slow change from infant formula to soy to cow's milk. (Test for cow's milk allergy may be warranted in some cases.) Plan one change every 3-5 days and monitor for tolerance. Increased volume to 35 ounces/day to provide maintenance fluids. Added 2 Tbsp fruit to help with constipation. Plan to add 2 Tbsp baby food vegetables.		
17 mo	J.M. tolerating changes. Gaining more wt than expected for age.	Decreased NeoCate to 22-kcal/oz. Reviewed nutrition analysis of HMTF recipe compared with total intake of NeoCate formula. Began adding 2 Tbsp rice cereal. Discussed low-allergen meats (turkey, chicken, beef); plan to add 2 Tbsp pureed meat; and 1/2 tsp oil.
17.5 mo	Wt loss noted (0.2 kg) at 2 week follow up.	Increased NeoCate back to 24 kcal/oz.
18 mo	Wt stabilized on 24-kcal/oz formula. Tolerating changes with no adverse events. Now on one bolus with soymilk as base.	Discussed trying cow's milk in same pattern to increase energy concentration of bolus. Added 1/4 tsp of salt/day with sodium and iodine levels lower than DRIs. Discussed addition of complete children's MVI or alternative foods to address diet's low folate and Vit E levels. Plan to switch to 2 boluses/day as HMTF.
Summary: Parents report J.M. is starting to explore more new foods by mouth, showing increasing interest in what they are eating at meals; the family states they are very satisfied with the transition to HMTF.		

Case Study #2

Submitted by: Deb Hutsler, MS, RD/LD, Children's Hospital Medical Center, Akron, OH

DS is an 8-year-old boy who has developmental delay, uses a wheel chair, but is able to move his arms. Parents provide diet history information. DS has been receiving the same formula for four years: 32 oz whole milk and 4 packets Instant Breakfast divided into 4 feedings each followed by 1 oz of water to flush the tube. He is given 4 oz of a juice blend once a day for constipation. He has bites of smooth solids on occasion for pleasure. Severe constipation resulted with commercial tube feedings per parents and their pediatrician had suggested the Instant Breakfast.

Weight: 18.5 kg, Length: 109 cm
BMI=15.6, 50th %ile for age
Ht age is 5 years of age
History of failure to thrive

Prealbumin-15 mg/dl, nl = 14-31; Albumin- 4.4 g/dl, nl = 3.2-4.5; CRP-<0.1 mg/dl, nl = 0.0-0.4

IgE-325 (nl 0-90), requested RAST for cow's milk at time of evaluation and result =2, low level of antibody

Computer analysis of tube feeding reveals meeting all of vitamin and mineral needs. Tube feeding provides 1185 calories or 64 calories/kg with 52% as carbohydrate, 28% as fat and 20% as protein. Fat content is 20.3 grams saturated fat, 8.2 grams oleic acid and 1.21 grams of polyunsaturated fat. Milk is a poor source of linoleic and polyunsaturated fatty acids and instant breakfast is fat free. Less than 1.21% of calories come from essential fatty acids (1).

Fatty acid levels and triene tetraene ratio were ordered to evaluate for essential fatty acid (EFA) deficiency. Results revealed normal linolenic acid levels, low linoleic acid level=1408 umol/L (reference=1600-3500) and a triene tetraene ratio of 0.127 (reference=0.013-0.050). Reduced concentration of linoleic acid and an elevated triene/tetraene ratio is suggestive of a nutritional deficiency of essential fatty acids (Mayo Clinic Dept of Lab Med and Pathology).

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Chair's Corner

Aloha! I'm looking forward to meeting all of our members attending this year's FNCE and hope you will join us for all of the events and programs planned. Our member meeting/reception (sponsored by Mead-Johnson) is Sunday, September 17 at 3:30 p.m. (this takes the place of the Member Breakfast). Our educational session, Guarding Our Children's Healthy Future: Nipping Obesity in the Bud is Monday, September 18 in the afternoon. We have a new display board for the DPG showcase and are sponsoring a treasure box for the ADAF silent auction. See a complete listing of events in this newsletter. Congratulations to the following PNPG members receiving national awards: Marion Taylor Baer, Christina Biesemeier, Betty Lucas, and Ann Marie Krauthein.

The 2006-2007 year will be a busy one with plans underway for our second Pediatric Nutrition Symposium co-chaired by Josephine Cialone and Robyn Wong; the SSU forums on our website; Pediatric Nutrition Handbook revisions; another web cast (topic to be determined) by Bev Henry; and the Standards of Practice/Standards of Professional Performance for pediatric nutrition practitioners chaired by Pam Charney.

We would not be able to accomplish all of this without the time and talents of our fantastic executive board, including a great new group of co-chairs, busy learning the ropes, our eleven awesome SSU chairs and their co-chairs, and all of the dedicated members serving on the various committees. I am honored to be your chair and invite your involvement and input. Please feel free to contact me at dhutsler@chmca.org.

Deb Hutsler, MS, RD/LD

2007 Call for Pediatric Nutrition Practice Group (PNPG) Nominations: Leadership Opportunity

The PNPG Nominating Committee is accepting nominations for energetic and committed members who will provide leadership for our practice group. The following positions are on the 2007 ballot:

PNPG Chair Elect – PNPG Treasurer
PNPG Nominating Chair

If you are interested in one of these leadership positions or would like more information, please contact Anne Davis at adavis@martekbio.com or Linda Heller at lheller@chla.usc.edu2007

Case Study #2 *(continued)*

Poor growth and scaly skin lesions are symptoms of EFA deficiency (2). DS had some dry skin on his face, which his mother felt was due to his drooling. Growth was delayed (height age of 5 years with chronological age of 8 years) but DS was non-weight bearing. Weight was proportional for length.

The most recent DRI recommends a "lower boundary level" of 5% of energy from linoleic acid (3). Vegetable oil is an excellent source of linoleic acid with safflower, soy and corn oils all good sources. For this patient, a change from whole milk to 2% milk and the addition of 4 tsp of vegetable oil daily met his essential fatty acid needs with similar energy density and macronutrient composition. At 3-month follow up he was gaining weight appropriately and his skin was clear.

Case Study #2 References:

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2. Kleinman, RE, ed. Pediatric Nutrition Handbook, 5th Ed, 2004: 267.
3. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids. Institute of Medicine of the National Academies, 2002/2005.

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i Gaining and Growing: Assuring Nutritional Care of Preterm Infants. Home-Prepared Formula. Found at: http://depts.washington.edu/growing/Nourish/Tubekids.htm

ii Dietary Guidelines for Americans. Messages from the 2000 and 2005 Guidelines respectively. Found at: http://www.health.gov/dietaryguidelines/.

iii SM Campbell, J Hall. Enteral Nutrition Handbook. Ross Products Division, Abbott Laboratories, c1997.

iv R Adams, C Gordon, A Spangler. Maternal stress in caring for children with feeding disabilities. Journal of the American Dietetic Association Aug 1999; 99 (8): 962-966.

v A Garro. Coping patterns in mothers/caregivers of children with chronic feeding problems. Journal of Pediatric Health Care. May/June 2004; 18: (3).

vi E Duperett, J Trautlein, M Dunn Klein. Homemade Blenderized Tube Feeding. Nutrition Focus for Children with Special Health Care Needs, Volume 19, No5, Sept/Oct 2004.

vii Hyponatremia. Medline Plus. Found at: http://www.nlm.nih.gov/medlineplus/ency/article/000394.htm

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