Presented at ASPEN Nutrition Science and Practice Conference, April 22, 2023

BLENDERIZED TUBE FEEDING FORMULAS:
MICROBIOME BENEFITS, LATEST EVIDENCE, AND CLINICAL APPLICATIONS

Moderator:

Matthew Bechtold MD, FASGE, FACG, AGAF, FASPEN

Speakers:

Gail Cresci, PhD, RD, FASPEN

Katherine Bennett, RD, MPH, CLE

Cynthia Reddick, RD, CNSC

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Sponsor Disclosure

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Moderator / Speaker Disclosure

Speaker:
Nestlé Nutrition Institute
Exact Science

Advisory Board:
Medtrition

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Learning Objectives

Describe	• Describe the effects of different feeding options on the gut microbiome and its metabolome.
Explain	• Explain the clinical and health economic outcomes associated with use of a commercially blenderized tube feeding formula.
Identify	• Identify strategies for successful administration of food-based tube feeding formulas using various delivery methods for home enteral nutrition.

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Moderator and Speakers



Matthew Bechtold MD, FASPEN
Professor of Clinical Medicine
Co-Chair Enteral Nutrition Committee
Director of Endoscopy
Director of GI Ambulatory Services
University of Missouri, Columbia



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Pediatric Gastroenterology, Hepatology and Nutrition
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Cynthia Reddick RD, CNSC
Home Tube Feeding Expert
Educator and Strategist
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Blenderized Tube Feeding Terminology Is Confusing

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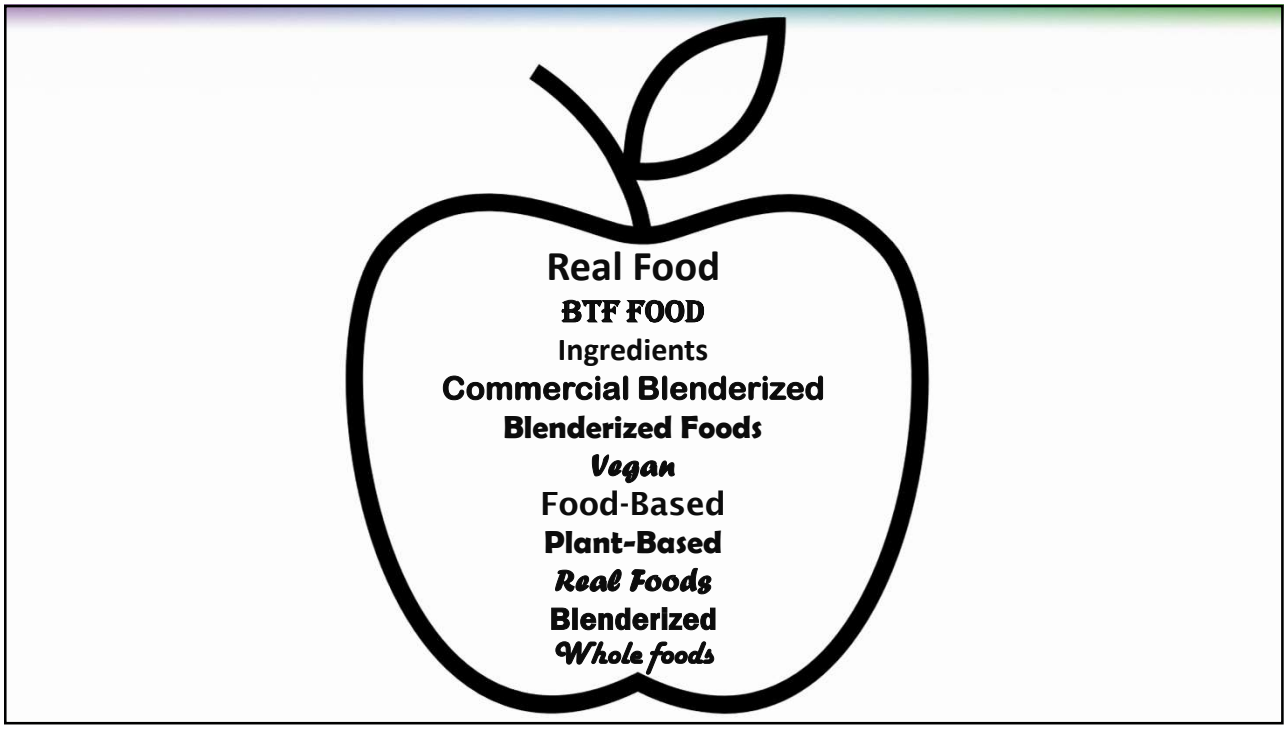

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What Do All These Terms Mean?

TERM	DEFINITION
CBTF	Commercially Blenderized Tube Feeding
HBTF	Home Blenderized Tube Feeding
Vegan	No animal-derived ingredients; no meat, poultry, fish, dairy, or other animal-derived foods (i.e., honey)
Non-GMO	No genetically modified ingredients; no plants or animals whose genetic material has been changed
Organic*	Produced without the use of chemical fertilizers, pesticides, or other artificial or genetically modified agents or ingredients
Vegetarian	No animal flesh; no beef, poultry, fish (can include dairy, eggs)
Plant-Based	Foods or diet consisting mostly or solely of vegetables, grains, pulses, or other foods derived from plants (no animal-derived foods or ingredients)
Food-Based	Contains blenderized whole foods or food ingredients
Food Ingredients	Foods that have been minimally processed (i.e., dehydrated, concentrated, pureed)
PBGT	Pureed By Gastrostomy Tube
PBTF	Prepared (or Patient) Blenderized Tube Feeding

*Organic food/ingredients are always Non-GMO

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THANK YOU & ENJOY THE SHOW…

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Presented at ASPEN Nutrition Science and Practice Conference, April 22, 2023

NUTRITION THERAPY'S IMPACT ON THE GUT MICROBIOME

Gail A.M. Cresci, PhD, RD, FASPEN
Associate Professor, Cleveland Clinic
Pediatric Gastroenterology, Hepatology & Nutrition
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Speaker Disclosure

Speaker:

- Nestlé Health Science Speaker Bureau
- Kate Farms Speaker Bureau

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Learning Objectives

- Review Gut Microbiome
- Discuss effects of enteral feeding formulas and parenteral nutrition on gut microbiome
- Discuss nutrition strategies to optimize gut microbiome health in acute and long-term enteral feeding patients

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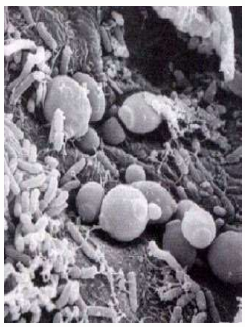
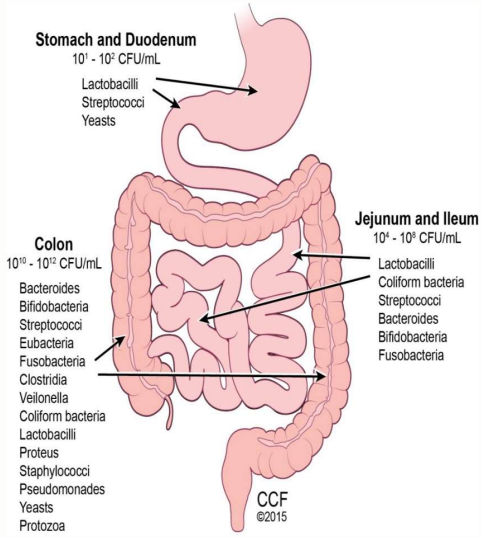
Human Gut Microbiota



Bacteria
Fungi/Yeasts
Viruses
Archaea



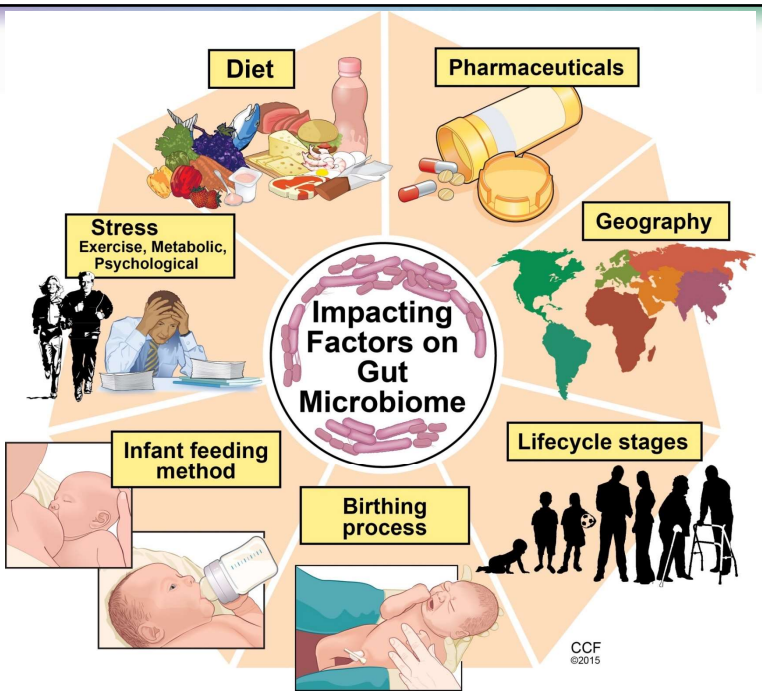
- >800 species, >7,000 strains
- 30-40 species comprise 90% total population

Phyla:
- Bacteroidota
- Firmicutes
- Actinobacteria
- Proteobacteria

} comprise ~90%

Cresci G, Bawden E. Gut Microbiome: What We Do and Don't Know. *Nutr Clin Pract*. 2015;30:734-746.

13



Cresci G, Bawden E. Gut Microbiome: What We Do and Don't Know. *Nutr Clin Pract*. 2015;30:734-746.

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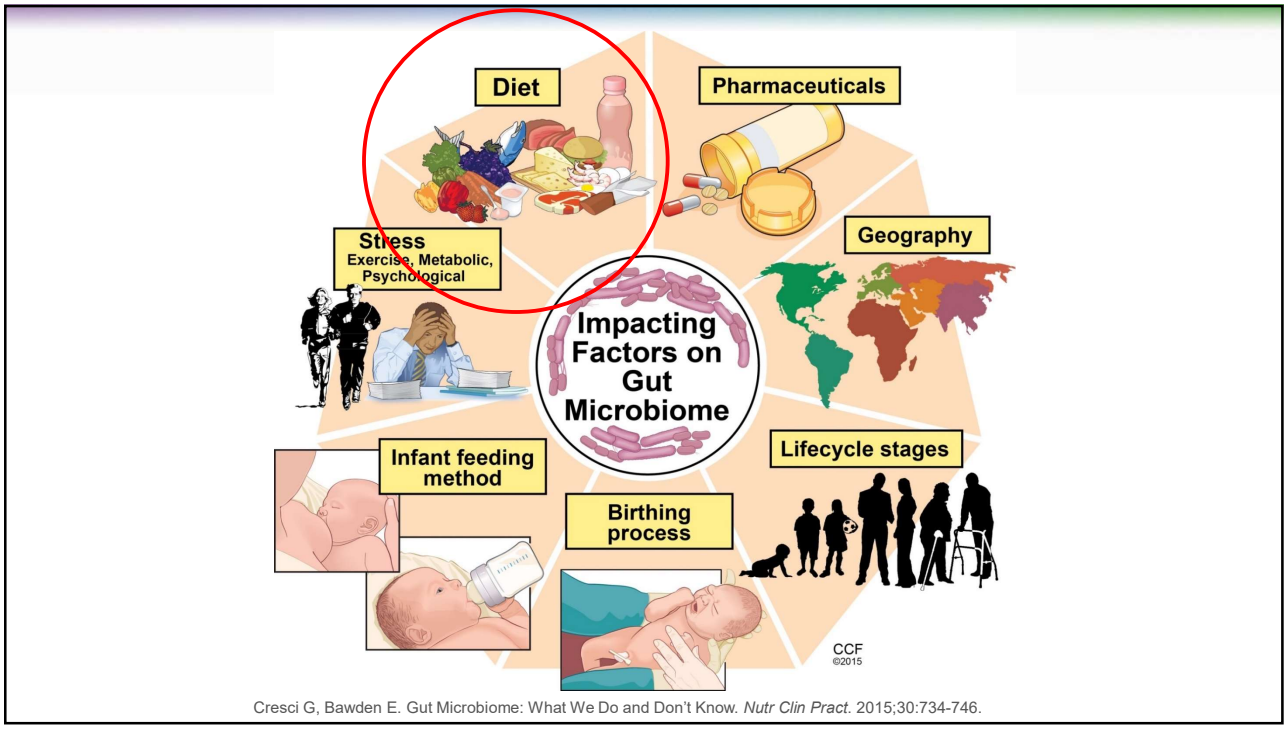

Cresci G, Bawden E. Gut Microbiome: What We Do and Don't Know. *Nutr Clin Pract.* 2015;30:734-746.

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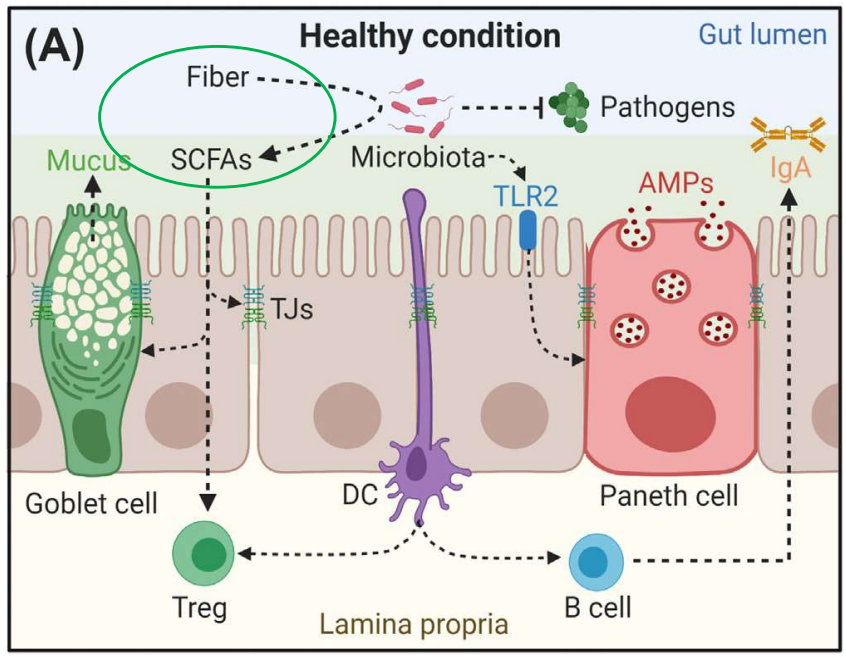

Martel J et al. Gut Barrier Disruption and Chronic Disease. *Trends Endocrinol Metab.* 2022;33:247-265.

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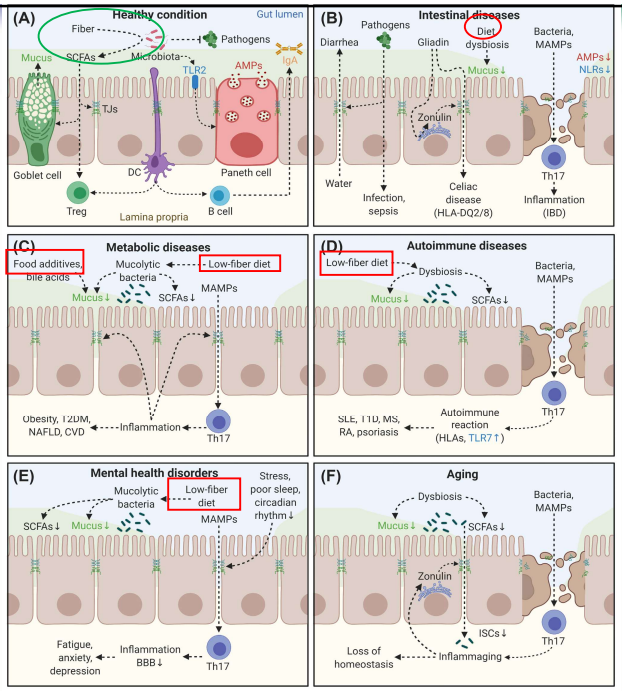

Martel J et al. Gut Barrier Disruption and Chronic Disease. *Trends Endocrinol Metab.* 2022 ;33:247-265.

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NOW THESE PEOPLE ARE ADMITTED TO A MEDICAL FACILITY

Acute- or Long-Term

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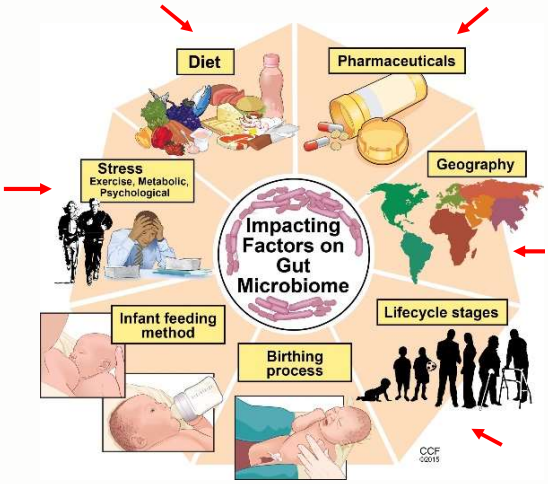
Common Therapies Encountered

- No or Sub-optimal Enteral Nutrition
  - Little to No fiber
- Parenteral Nutrition
- Medications:
  - Antibiotics, Acid reducing agents
- Shock / ischemia / low flow
- Resuscitation
- Sepsis/SIRS



Cresci G, Bawden E. Gut Microbiome: What We Do and Don't Know. *Nutr Clin Pract.* 2015;30:734-746.

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NOW WHAT HAPPENS TO THE GUT MICROBIOME?

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Extreme Dysbiosis of the Microbiome in Critical Illness

Daniel McDonald,[a] Gail Ackermann,[a] Ludmila Khailova,[b] Christine Baird,[b] Daren Heyland,[c] Rosemary Kozar,[d] Margot Lemieux,[c] Karrie Derenski,[e] Judy King,[f] Christine Vis-Kampen,[f] Rob Knight,[a] Paul E. Wischmeyer[b]

115 critically ill patients

Admission, discharge

Controls: American Gut Project (AGP)

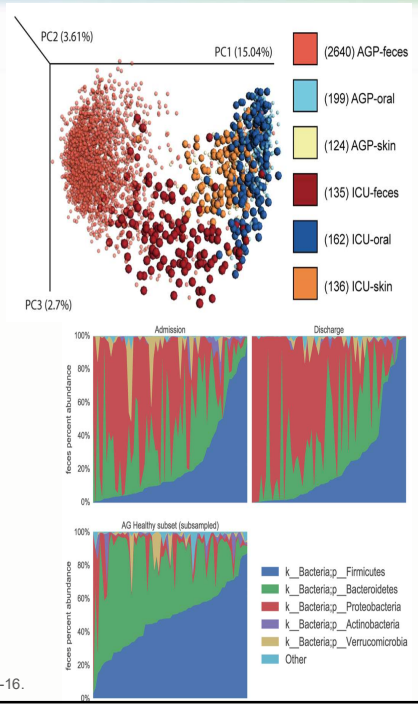
Feces, skin, oral samples

Principle Coordinate Analysis of UniFrac distances

- ICU vs healthy: strong separation

Phylum taxonomy

- Fecal samples:
  - Lower Firmicutes and Bacteroidetes
  - Higher Protobacteria



McDonald DM et al. Extreme dysbiosis of the microbiome in critical illness. *mSphere*. 2021;31:e00199-16.

21

NOW THEY REQUIRE NUTRITION SUPPORT: ENTERAL AND/OR PARENTERAL FEEDING

WHAT HAPPENS TO GUT MICROBIOME?

22

Gut microbiome and circulating bacterial DNA ("blood microbiome") in a mouse model of total parenteral nutrition: Evidence of two distinct separate microbiotic compartments

Eliana Lucchinetti [a], Phing-How Lou [b], Philipp Lemal [c], Lukas Bestmann [c], Martin Hersberger [d, e], Gerhard Rogler [e, f], Stefanie D. Krämer [g], Michael Zaugg [a, b, *]

Clinical Nutrition ESPEN 49 (2022) 278–288

Rationale: TPN causes gut atrophy, dysbiosis and "leaky gut"

Aims: Characterize gut and blood microbiomes in response to different TPNs

Male C57B/L6 mice randomized to groups for 7 days

- Chow control no jugular vein catheter (JVC)
- Chow with JVC + saline infusion
- TPN (lipids n:6:n3 **ratio 7:1**)
- TPN (lipids n-6:n-3 **ratio 1:8**)

Euthanasia: blood (cardiac puncture), stool collected – 16S rRNA sequencing

Lucchinetti E et al. Gut microbiome and circulating bacterial DNA ("blood microbiome") in a mouse model of total parenteral nutrition: Evidence of two distinct separate microbiotic compartments. *Clin Nutr ESPEN*. 2022;49:278-288.

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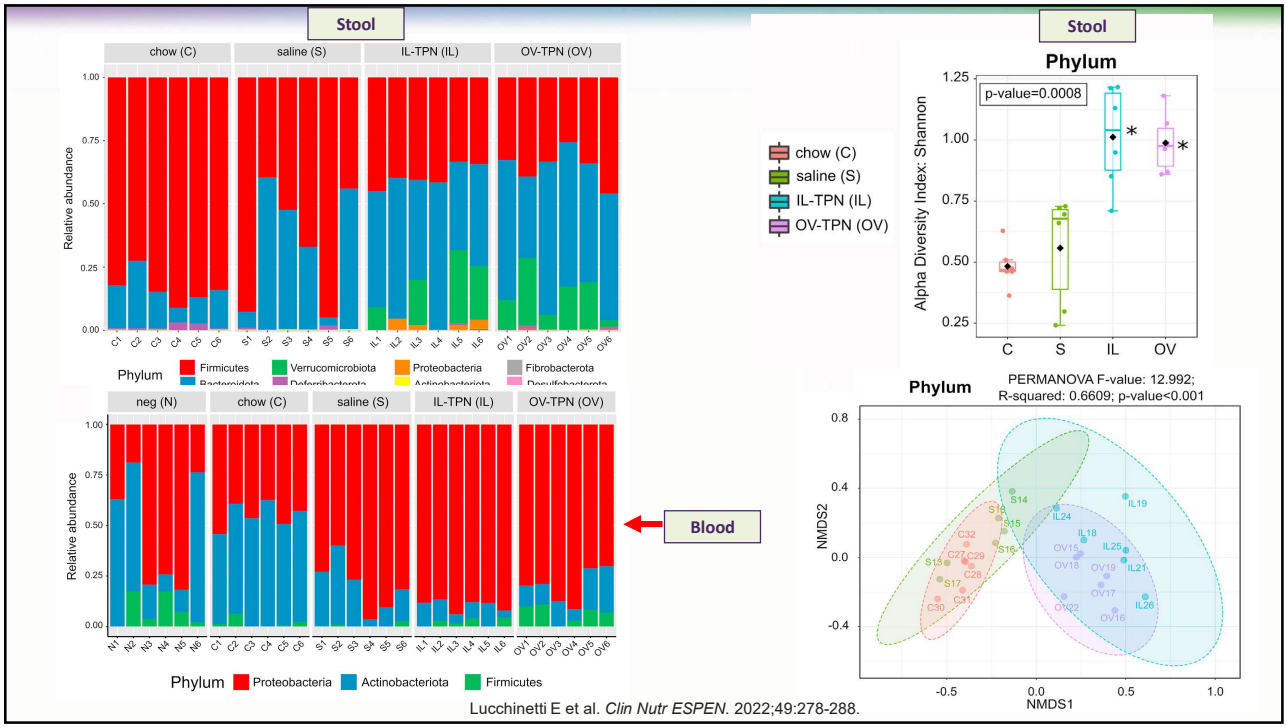

Lucchinetti E et al. *Clin Nutr ESPEN*. 2022;49:278-288.

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Nutrition Support and the Gastrointestinal Microbiota: A Systematic Review

Sarah Andersen; Merrilyn Banks, PhD, Grad Dip Nutr Diet, MHlthSc; Judy Bauer, PhD, Grad Dip Nutr Diet, MHlthSc

JOURNAL OF THE ACADEMY OF NUTRITION AND DIETETICS September 2020 Volume 120 Number 9

Effect of EN vs PN on gut microbiota

11 studies (n=367 patients; > 3 years)

Increased heterogeneity

- Clinical conditions: SBS (6), gut failure (1), CD (1), stem cell transplant (2), other (1)
- EN: oral diet (4), formulas: elemental (2), polymeric non-fiber (2), not reported (3)
- Microbiome analysis methods varied

Andersen S et al. *J Acad Nutr Diet.* 2020;120:1498-1516

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Nutrition Support and the Gastrointestinal Microbiota: A Systematic Review

Sarah Andersen; Merrilyn Banks, PhD, Grad Dip Nutr Diet, MHlthSc; Judy Bauer, PhD, Grad Dip Nutr Diet, MHlthSc

JOURNAL OF THE ACADEMY OF NUTRITION AND DIETETICS September 2020 Volume 120 Number 9

PN vs EN resulted in:

RESULTS

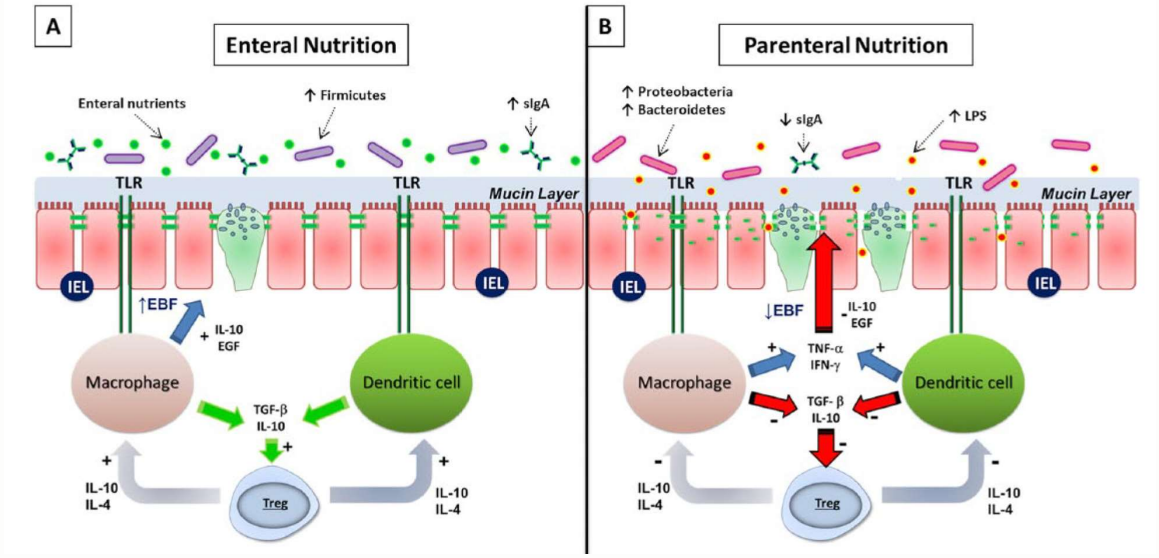
- Lower diversity with PN vs EN – 7 of 10 studies (n=282)
- Higher Proteobacteria (or a family/genus within this phylum)
  - 7 studies (n=237)
- Lower Firmicutes - 6 studies (n=172)
- Lower Bacteroidetes – 5 studies (n=155)
- 5 of 6 studies with SBS found higher Proteobacteria with PN
- Lower Bifidobacteria reported in 1 of 2 studies that reported it
- SCFA with PN – 4 studies

Andersen S et al. *J Acad Nutr Diet.* 2020;120:1498-1516

	Higher abundance	Lower abundance
Phylum	Proteobacteria[35,37,40,41,42]	Firmicutes[36,41] Bacteroidetes[35,36,37,41]
Family	*Enterobacteriaceae*[37,39,40,41,43] *Lactobacillaceae*[37,41] *Enterococcaceae*[41] *Streptococcaceae*[41] *Prevotellaceae*[41]	*Bacteroidaceae*[37,41] *Ruminococcaceae*[37,40,41] *Lachnospiraceae*[37,38,40,41] *Peptostreptococcaceae*[41] *Erysipelotrichaceae*[41] *Rikenellaceae*[37] *Prevotellaceae*[37] *Alcaligenaceae*[37] *Coriobacteriaceae*[37] *Odoribacteraceae*[37] *Barnesiellaceae*[37]
Genus	*Proteus*[41] *Klebsiella*[35,41] *Streptococcus*[38,41] *Megasphaera*[41] *Enterococcus*[35,45] *Klebsiella_A*[35] *Ruminococcus_E*[35] *CAG-217*[35] *Agathobaculum*[35] *Pygmaiobacter*[35] *Kosakonia*[35] *Escherichia*[35]	*Bifidobacterium*[36] *Faecalibacterium*[35] *Ruminococcus_D*[35] *Lachnospira*[35] *Clostridium_J*[35] *Eisenbergiella*[35] *Dialister*[35] *Subdoligranulum*[35] *Staphylococcus*[35] *CAG-207*[35] *CAG-110*[35] *Escherichia*[35] *Alistipes*[35] *ER4*[35] *Agathobacter*[35] *Clostridium_A*[35] *Blautia*[37,38] *Bacteroides*[37,38] *Odoribacter*[37] *Oscillospira*[37,38] *Prevotella*[37] *Roseburia*[37] *Sutterella*[37] *Parabacteroides*[38] *Dorea*[38]

26

Schematic EN vs PN on Gut Microbiome, Barrier, Immune Function



Demehri FR et al. Changes to the Intestinal Microbiome with Parenteral Nutrition: Review of a Murine Model and Potential Clinical Implications. *Nutr Clin Pract.* 2015;30:798-806.

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IT'S NOT THE TPN SOLUTION; IT'S THE LACK OF NUTRIENTS DELIVERED TO THE GUT

DO THE NUTRIENTS FED ENTERALLY AFFECT THE GUT MICROBIOME?

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Fiber – How Much Should We Consume?

No RDA for fiber

Institute of Medicine:
Recommended adequate intake

- Based on age and sex

Most Americans consume only ½ of recommended intake

Low intakes are associated with health concerns

Western Diet: ↑Fat, ↑Sugar, ↓Fiber

- **GUT DYSBIOSIS**

	Men	Women
< 50 yrs	38 gm/d	25 gm/d
> 50 yrs	30 gm/d	21 gm/d

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Role Of Dietary Fiber in The Recovery of the Human Gut Microbiome and its Metabolome

30 Healthy subjects, 18-60 yrs

- Vegan diet (10), omnivores (20)
- Omnivores split 1:1 EEN vs omnivore diet
- Engineered omnivore diet = EEN composition

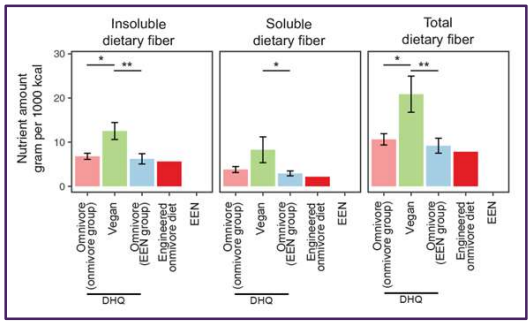
3 phases: baseline, microbiota purge & recovery

Vegan followed same diet outpatient

Omnivore – inpatient research unit

Stool & blood samples

- Microbiome
- Metabolomics



Tanes C et al. Role of dietary fiber in the recovery of the human gut microbiome and its metabolome. *Cell Host Microbe*. 2021;29:394-407.

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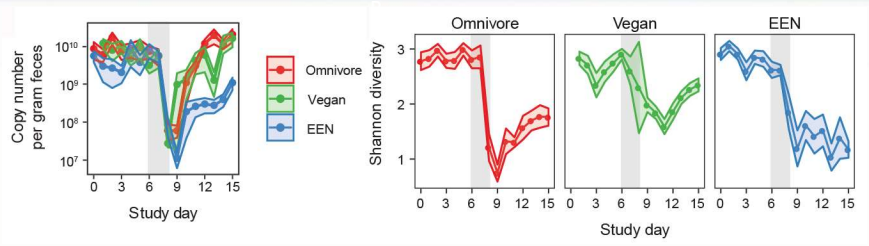

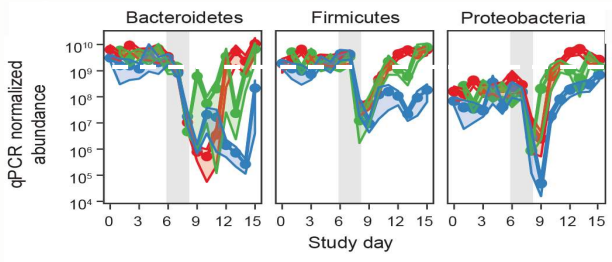

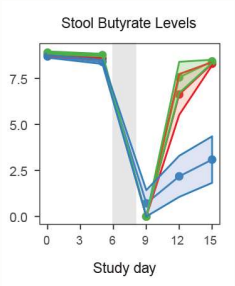

This emphasizes the importance of diet and dietary fiber in gut microbiome recovery

Tanes C et al. *Cell Host Microbe*. 2021;29:394-407.

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Takeaways

1

Delivery of nutrients to GI tract is important for support of gut microbiome

2

Quality of nutrients drives composition and function of gut microbiome

Holmes ZC et al. Microbiota responses to different prebiotics are conserved within individuals and associated with habitual fiber intake. *Microbiome*. 2022;10:114.

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Blenderized Enteral Nutrition Diet Study: Feasibility, Clinical, and Microbiome Outcomes of Providing Blenderized Feeds Through a Gastric Tube in a Medically Complex Pediatric Population

Gallagher K et al. *JPEN.* 2018;42:1046-1060.

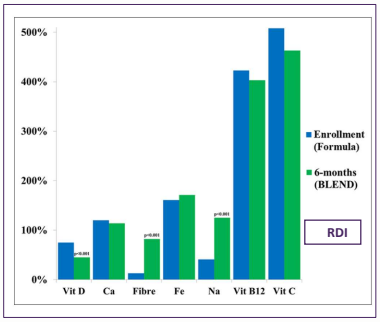
- 20 pediatric outpatients (1-16 yrs)
  - Caregiver interest in BTF
- ≥ 75% total energy from commercial formula via G-tube (≥12 Fr)
- Visits 0, 6 wk, 3, 6 mo after BTF
- BTF met goal nutrition needs
- Transitioned to BTF over 4 weeks

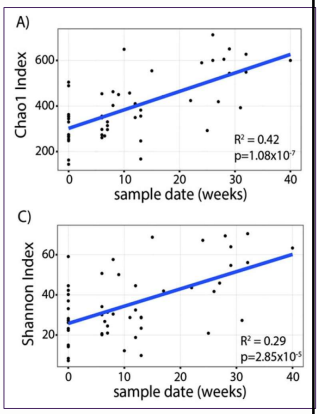
RESULTS

- 50% higher caloric intake with BTF to maintain BMI
- Similar or greater micronutrient intake with BTF
  - Except vit D was lower
- Tolerance improved with BTF
  - decreased vomiting, acid-reducing agents, no change stool frequency, increased stool softeners with BTF
- Increased α-diversity (Shannon) and richness (Chao1)

Table 1. Macronutrient Distribution: Enrollment Versus 6 Months.

	Enrollment	6 Months	
	Mean (SD)	Mean (SD)	*P*-Value
Energy Intake (kcal/kg)	74 (17.2)	111 (39.9)	0.0002
Protein (%kcal)	12 (0.6)	16 (0.8)	0.0014
Carbohydrates (%kcal)	47 (14.6)	42 (16.3)	0.0111
Fat (%kcal)	42 (14.9)	45 (19.9)	0.2097





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How to Support Gut Microbiome for Patients Receiving Nutrition Support?

- Feed the gut
- Deliver optimal "bug food" to the gut
- Supplementation?
  - Fiber
  - Prebiotics
  - Probiotics
  - Synbiotics

Efficacy Studies Needed



istockphoto.com

Cresci G. Forty-fifth ASPEN Presidential Address: Medical nutrition therapy, is it time to get personal? *J Parenter Enteral Nutr.* 2023;47:334-341.

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Thank you!

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Saturday, April 22, 2023
ASPEN Nutrition Science and Practice Conference

BLENDERIZED TUBE FEEDING: LATEST EVIDENCE AND CLINICAL APPLICATIONS

Katherine Bennett RD MPH
CHOC Children's Hospital of Orange County
Orange, California

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Speaker Disclosure

Consultant:

Abbott Nutrition

Nestlé Health Science

Nutricia North America

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Objectives

- Review real world evidence (RWE) on blenderized tube feeding presented at NASPGHAN 2022 and ASPEN 2023.
- Review new research on food-based tube feeding formulas.
- Discuss practical applications of food-based formula research for children on long term tube feedings.

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BLENDERIZED TUBE FEEDING





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Real World Evidence (RWE)



Information on health care derived from multiple sources outside typical clinical research settings:

Electronic health records (EHRs)

Claims and billing data

Product and disease registries

Data from personal devices and health applications

International Society for Pharmacoeconomics and Outcomes Research (ISPOR) defines Real World Data as:

"Data used for decision making that are not collected in conventional randomized controlled trials (RCTs)"

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Real Food vs. Plant-Based Standard and Other Formulas: GI Tolerance, Healthcare Use, and Cost[1,2,3,4]

- Retrospective observational studies
- Adult and pediatric patients in post-acute care
- Data from Decision Resources Group Real World Evidence Data Repository
- Prescribed food-based or other formula
- Aim: describe patient characteristics, concomitant medications use, GI intolerance, healthcare resource utilization, and cost of care



1. Desai A et al. Clinical Benefits of Real Food Tube Feeding Formulas Compared to Standard Tube Feeding Formulas in Post-Acute Care Pediatric Patients. *J Pediatr Gastroenterol Nutr.* 2022;75(S1):S293.
2. Desai A et al. Health Economic Benefits of Real Food Tube Feeding Formulas Compared to Standard Tube Feeding Formulas in Post-Acute Adult Patients. Presented at 44th ESPEN Congress on Clinical Nutrition and Metabolism, September 4, 2022, Vienna, Austria.
3. Henrikson A et al. Clinical Benefits of Real Food Tube Feeding Formulas Compared to Plant-Based Standard Tube Feeding Formulas in Post-Acute Adult Patients. *J Parenter Enteral Nutr.* 2023;47(S2):S102.
4. Desai A et al. Health Economic Benefits of Real Food Tube Feeding Formulas Compared to Standard Tube Feeding Formulas in Post-Acute Pediatric Patients. *J Pediatr Gastroenterol Nutr.* 2022;75(S1):S292.

*Desai A and Henrikson A are employees of Nestlé Health Science.

Nestlé-initiated and funded study

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Real-Food Formula vs Plant-Based Standard Formula: GI Tolerance

Adult[1]

Table 2. Patients Experiencing GI Intolerance Symptoms at 84-days Post Index

	CBTF N=124, n (%)	STD-TF N=324, n (%)	p-value†
Any intolerance symptoms	36 (29%)	158 (49%)	< 0.001
2 Intolerance symptoms	9 (25%)	46 (29%)	0.045
3+ Intolerance symptoms	3 (8%)	39 (25%)	0.002
Nausea & vomiting	11 (9%)	76 (23%)	< 0.001
Abdominal pain	10 (8%)	76 (23%)	< 0.001
Diarrhea	2 (2%)	33 (10%)	0.002
Flatulence	2 (2%)	21 (6%)	0.037

Abbreviations: CBTF, commercial blenderized tube feeding formula; STD-TF, plant-based standard tube feeding formula
†chi-square test, alpha=0.05 level of significance

Pediatric[2]

	CBTF N=469, n (%)	STD-TF N=595, n (%)	p-value†
Any intolerance symptoms	118 (25%)	292 (49%)	<0.001
Intolerance symptoms			
Constipation	68 (14%)	190 (32%)	<0.001
Nausea & vomiting	47 (10%)	129 (22%)	<0.001
Abdominal pain	9 (2%)	51 (9%)	<0.001
Diarrhea	13 (3%)	57 (10%)	<0.001
Flatulence	9 (2%)	31 (5%)	0.005
Abdominal distention	8 (2%)	28 (5%)	0.007
≥3 intolerance symptoms	11 (9%)	58 (20%)	<0.001

Abbreviations: CBTF, commercial blenderized tube feeding formula; STD-TF, standard tube feeding formula
†chi-square test, alpha=0.05 level of significance

1. Henrikson A, et al. Clinical Benefits of Real Food Tube Feeding Formulas Compared to Plant-Based Standard Tube Feeding Formulas in Post-Acute Adult Patients. *J Parenter Enteral Nutr.* 2023;47(S2):S102.
2. Desai A et al. Clinical Benefits of Real Food Tube Feeding Formulas Compared to Standard Tube Feeding Formulas in Post-Acute Care Pediatric Patients. *J Pediatr Gastroenterol Nutr.* 2022;75(S1):S293.

*Henrikson A and Desai A are employees of Nestlé Health Science.

Nestlé-initiated and funded study

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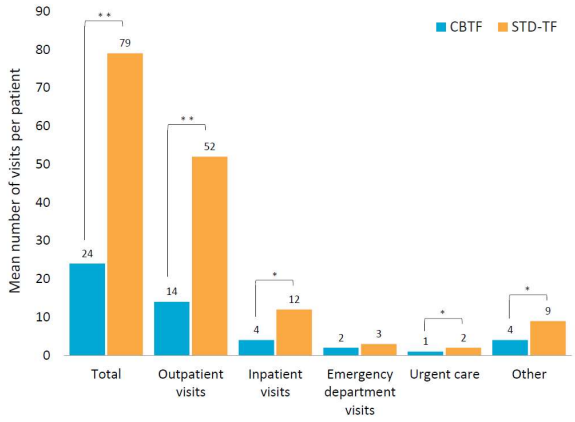
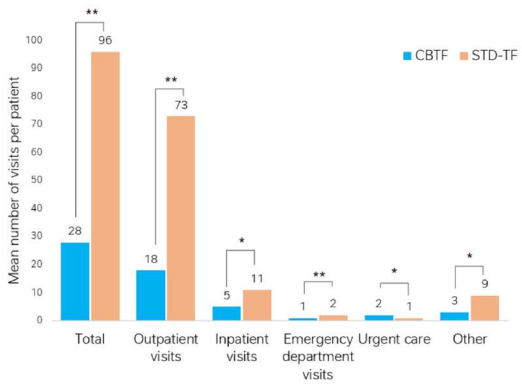
Real Food Formula vs Plant Based Standard Formula: Healthcare Resource Utilization (HCRU)

Adult[1]



Pediatric[2]



1. Desai A et al. Health Economic Benefits of Real Food Tube Feeding Formulas Compared to Standard Tube Feeding Formulas in Post-Acute Adult Patients. Presented at 44th ESPEN Congress on Clinical Nutrition and Metabolism, September 4, 2022, Vienna, Austria.
2. Desai A et al. Health Economic Benefits of Real Food Tube Feeding Formulas Compared to Standard Tube Feeding Formulas in Post-Acute Pediatric Patients. *J Pediatr Gastroenterol Nutr.* 2022;75(S1):S292.

*Desai A is an employee of Nestlé Health Science.

Nestlé-initiated and funded study

43

Healthcare Resource Utilization and Costs: Adults

Table 2. Healthcare resource utilization (HCRU) and costs pre-index and 28-, 84-, 168- days post-index to main diagnosis

HCRU	Malnutrition N=24				Digestive System N=91				Cancer N=37			
	Pre-index	Post-index			Pre-index	Post-index			Pre-index	Post-index		
		28-days	84-days	168-days		28-days	84-days	168-days		28-days	84-days	168-days
Inpatient (% visits)	100%	**8%***	**13%***	**21%***	51%	**9%***	**13%***	**16%***	68%	**16%***	**24%***	**30%***
Emergency Department (% visits)	4%	0%	0%	0%	11%	**1%***	**2%***	**3%***	11%	3%	5%	5%
Other (% visits)	13%	0%	4%	4%	9%	**2%***	3%	4%	32%	**5%***	**11%***	**14%***
Outpatient (% visits)	100%	**50%***	**63%***	**67%***	100%	**56%***	**67%***	**70%***	100%	**86%***	**89%***	**95%**
Outpatient (mean visits)	7	**1†**	**2†**	4	8	**2†**	**3†**	**5†**	20	**3†**	**5†**	**8†**
Total Visits (mean)	12	**2†**	**5†**	**7†**	20	**6†**	**7†**	**10†**	30	**7†**	**14†**	**19†**
Outpatient (mean costs, $)	$74,819	**$7,755†**	**$14,623†**	$33,278	$92,188	**$23,601†**	**$37,704†**	$62,674	$173,654	**$20,193†**	**$40,246†**	**$58,526†**
Total (mean costs, $)	$175,437	**$84,889†**	**$76,045†**	**$76,166†**	$170,327	**$44,227†**	**$71,331†**	**$92,391†**	$249,978	**$51,226†**	**$68,438†**	**$89,936†**

† t-Test; *Chi-square test (pre-index vs post-index), alpha=0.05 level of significance; Other places of service include assisted living, intermediate care, and facilities not identified on the submitted claim; Total include post-acute care visits associated with inpatient, emergency department, outpatient, urgent care and other places of service combined.

Desai A et al. Main Diagnoses in Tube-Fed Adults in the Post-Acute Care Setting: Clinical and Health Economic Benefits Associated with the Use of Commercial Blenderized Enteral Nutrition Formula. *J Parenter Enteral Nutr.* 2023;47(S2):S104.

*Desai A is an employee of Nestlé Health Science.

Nestlé-initiated and funded study

44

Healthcare Resource Utilization and Costs: Pediatrics

Table 2. Healthcare resource utilization (HCRU) and costs pre-index and 28-, 84-, 168- days post-index to main diagnosis

HCRU	Malnutrition N=231				Digestive System N=335				Cerebral Palsy N=145				Seizure N=111			
	Pre-index	Post-index			Pre-index	Post-index			Pre-index	Post-index			Pre-index	Post-index		
		28-days	84-days	168-days		28-days	84-days	168-days		28-days	84-days	168-days		28-days	84-days	168-days
Inpatient (% visits)	22%	2%*	4%*	5%*	37%	3%*	7%*	9%*	37%	2%*	4%*	5%*	49%	7%*	10%*	13%*
Emergency Department (% visits)	3%	1%	1%	1%	11%	1%*	1%*	3%*	6%	1%*	1%*	1%*	18%	3%*	4%*	5%*
Other (% visits)	4%	0%*	1%*	1%*	4%	1%*	1%*	2%	7%	1%*	1%*	1%*	11%	2%*	2%*	4%*
Outpatient (% visits)	100%	58%*	68%*	73%*	100%	59%*	69%*	75%*	100%	66%*	72%*	79%*	100%	59%*	67%*	76%*
Outpatient (mean visits)	11	2†	3†	5†	15	2†	4†	7†	17	2†	5†	7†	15	2†	4†	6†
Total Visits (mean)	20	9†	10†	17†	31	9†	12†	16†	27	6†	11†	13†	25	6†	10†	14†
Outpatient (mean costs, $)	$83,549	$14,121†	$27,901†	$41,056†	$121,557	$19,648†	$37,532†	$56,927†	$160,742	$21,941†	$45,877†	$68,273†	$113,580	$15,581†	$30,599†	$45,045†
Total (mean costs, $)	$127,839	$49,117†	$59,211†	$105,291†	$201,406	$68,802†	$90,826†	$110,618†	$220,334	$39,807†	$74,031†	$98,029†	$170,055	$42,958†	$63,757†	$89,031†

† t-Test; *Chi-square test (pre-index vs post-index), alpha=0.05 level of significance; Other places of service include assisted living, intermediate care, and facilities not identified on the submitted claim; Total include post-acute care visits associated with inpatient, emergency department, outpatient, urgent care and other places of service combined.

Henrikson A et al. Chronic Conditions in Children Receiving Commercially Blenderized Tube Feeding Formula in the Post-Acute Care Setting: Real World Evidence of Clinical and Health Economic Outcomes. *J Parenter Enteral Nutr.* 2023;47(S2):S218.
*Henrikson A is an employee of Nestlé Health Science.

Nestlé-initiated and funded study

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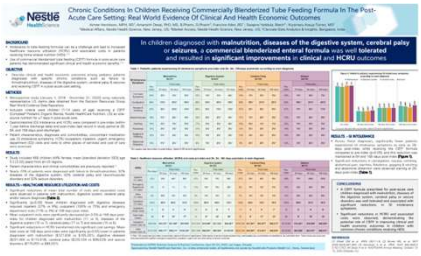
Main Diagnoses in Tube-Fed Adults in the Post-Acute Care Setting: Clinical and Health Economic Benefits Associated with the Use of Commercial Blenderized Enteral Nutrition Formula

(Poster #27)



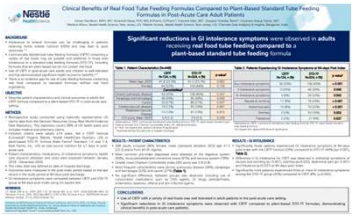
Chronic Conditions in Children Receiving Commercially Blenderized Tube Feeding Formula in the Post-Acute Care Setting: Real World Evidence of Clinical and Health Economic Outcomes

(Poster #120)



Clinical Benefits of Real Food Tube Feeding Formulas Compared to Plant-Based Standard Tube Feeding Formulas in Post-Acute Adult Patients

(Poster #26)



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NEW RESEARCH

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BTF: A Review of Benefits & Complications

Aim: Review the literature to advance knowledge on whether BTF results in beneficial clinical outcomes in young people compared to commercial formula

Inclusion criteria: English language, children, original research from RCT, interventional and observational, cohort studies, examination of BTF outcomes vs commercial formula

Evaluated GI symptoms, medication use, growth and complications/adverse events

McCormack S et al. Blended diet for enteral tube feeding in young people: A systematic review of benefits and complications. *J Hum Nutr Diet.* 2023;1-16.



48

BTF: A Review of Benefits & Complications

7 eligible studies

- 267 participants (56% male)
- Age range 9 to 26 years
- Neurological, cardiac, genetic diagnoses

BTF is associated with:

- Improved GI symptoms
- Decreased medication use
- Adequate growth trend

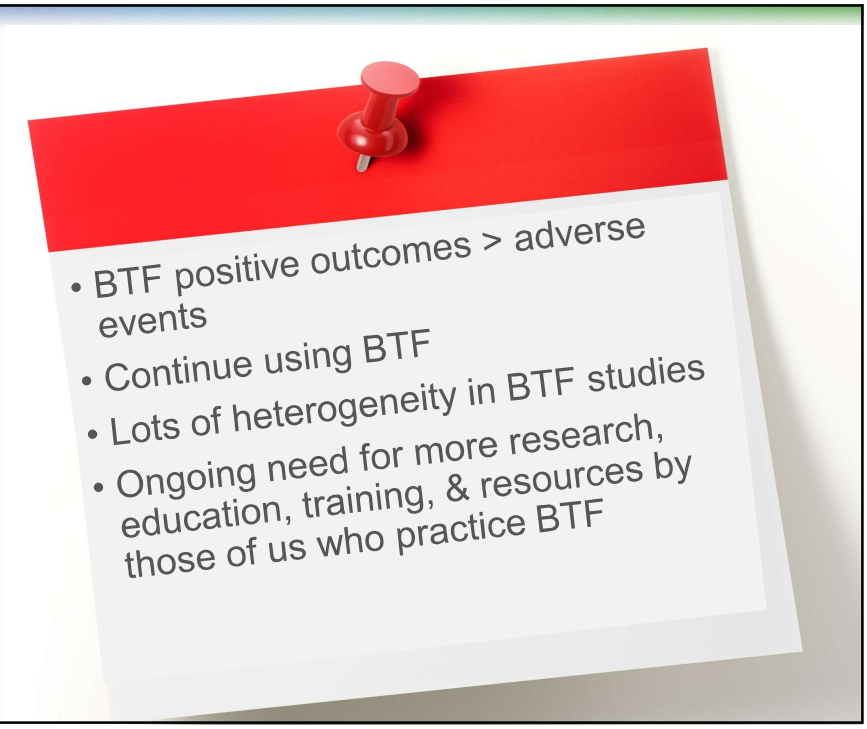
Few reports of adverse effects



McCormack S, Patel K, Smith C. Blended diet for enteral tube feeding in young people: A systematic review of benefits and complications. *J Hum Nutr Diet*. 2023; 1-16.

49

Clinician Take-Away



50

Food-Based Formula & Feeding Pumps

Retrospective chart review of food-based formula via feeding pump over 12 months

5 case reports with poor weight gain on food-based formula using feeding pump

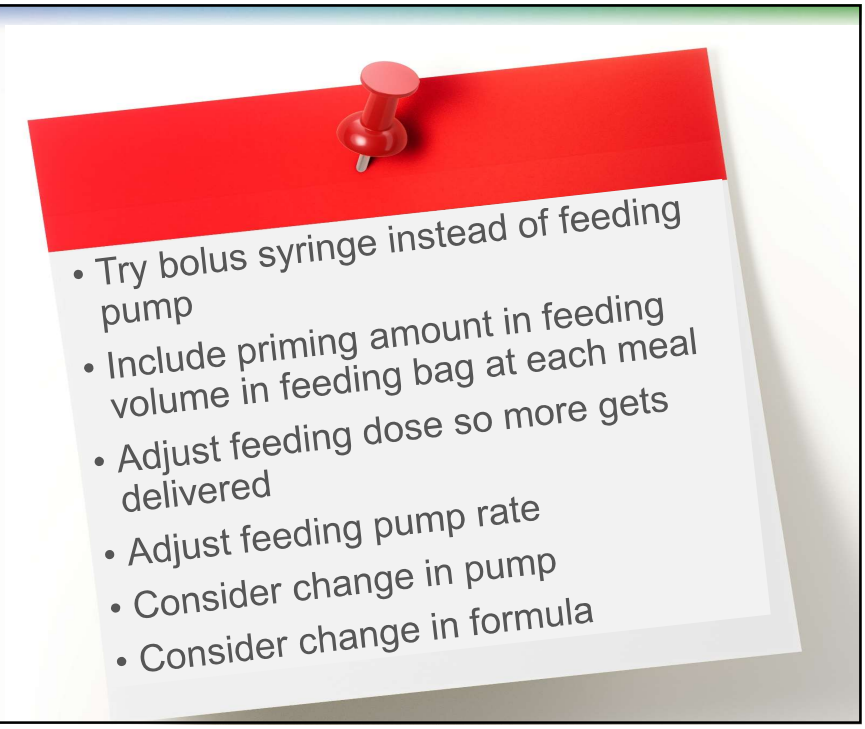
Authors make recommendations to mitigate growth issues and improve food based formula feeding



David J, Huston P, Manville K et al. Unexpected Poor Growth in Pediatric Patients on Food-based Enteral Therapy: Case Series and Suggested Practice Changes. *J Pediatr Gasteroenterol Nutr.* 2021;73(5):599-603.

51

Clinician Take-Away



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Improved Tolerance on Food Based Formulas

National multicenter retrospective study

Aim: evaluate clinical experience of changing from standard enteral formula to food-based formula in pediatric acute care and community setting

Data: anthropometrics, gastrointestinal outcomes, feeding tolerance, stooling patterns, and caregiver comments



O'Connor G et al. Monitor gastrointestinal tolerance in children who have switched to an "enteral formula with food-derived ingredients": A national, multicenter retrospective chart review (RICIMIX study). *Nutr Clin Prac.* 2022;37:929-934.

53

Improved Tolerance on Food-Based Formulas

TABLE 3 Reported change in gastrointeninal symptoms after switching to an enteral formula with food ingredients

Gastrointestinal intolerance symptom	Reported number of patients with symptom, *N*	Post switch number of children who reported an improvement in symptoms, *n* (%)	Other, *n* (%)
Retching	18	17 (95)	1 (5) no change
Vomiting	13	11(85)	1 (5) reduction in stoma output 1 (5) vomiting worsened 1 (5) no change
Flatulence	8	6 (75)	2 (25) no change
Loose stools	11	10 (90)	1 (10) no change
Constipation	11	10 (90)	1 (10) no change

O'Connor G et al. Monitor gastrointestinal tolerance in children who have switched to an "enteral formula with food-derived ingredients": A national, multicenter retrospective chart review (RICIMIX study). *Nutr Clin Prac.* 2022;37:929-934

54

Clinician Take-Away

- Food-based formulas offer similar benefits to home BTF
- Provide convenience for all
- Still need monitoring

55

Short Bowel Syndrome and Food-Based Formula

Retrospective chart review (n= 55)

Aim: evaluate symptoms and weight changes in pediatric SBS patients transitioned from standard, elemental or partially hydrolyzed commercial formula to blenderized feedings

NEC most common etiology of SBS

Mean remaining bowel length = 59cm

72% were on food-based formulas at some time during study

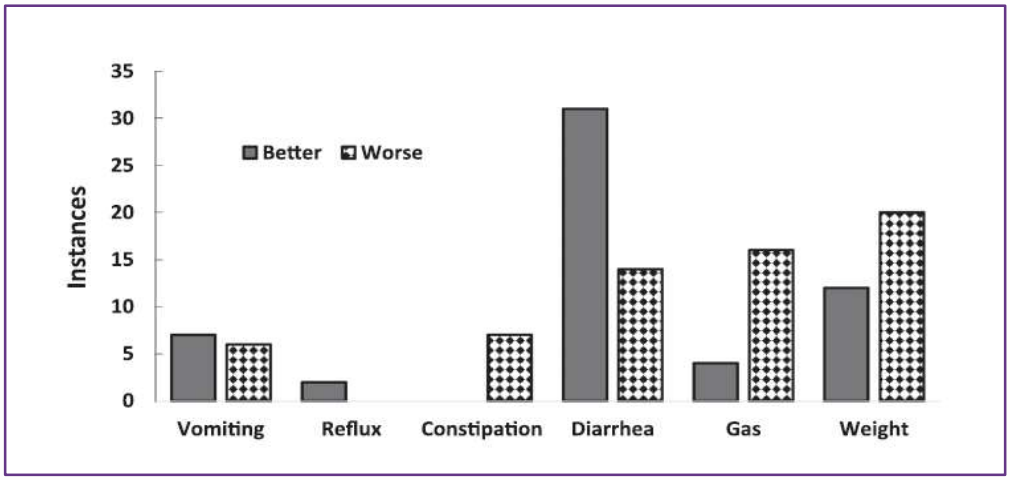


Zong W et al. Blenderized enteral nutrition in pediatric short gut syndrome: Tolerance and clinical outcomes. *Nutr Clin Pract.* 2022;37(4):913-920.

56

Short Bowel Syndrome and Food-Based Formula

FIGURE 1 Symptoms and signs on commercial blends.

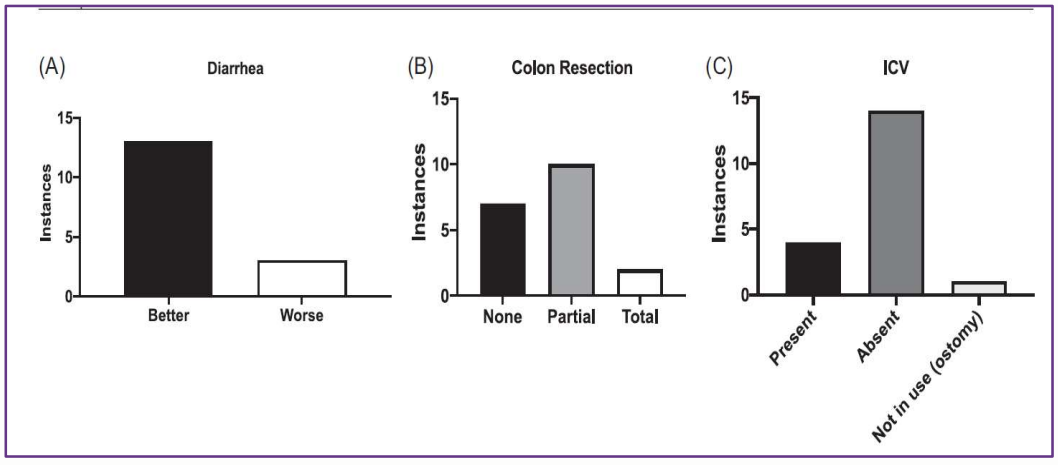


Zong W et al. Blenderized enteral nutrition in pediatric short gut syndrome: Tolerance and clinical outcomes. *Nutr Clin Pract.* 2022;37(4):913-920.

57

Short Bowel Syndrome and Food-Based Formula

FIGURE 3 Commercial blend and anatomy in weight loss subgroup



Zong W et al. Blenderized enteral nutrition in pediatric short gut syndrome: Tolerance and clinical outcomes. *Nutr Clin Pract.* 2022;37(4):913-920.

58

Clinician Take-Away

- Food-based formulas are options for children with SBS
- Anatomy has a lot to do with tolerance
- Evaluate real food-based formula ingredients including fiber type & amount in food-based formulas

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ASPEN Clinical Recommendations for Blenderized Tube Feeding 2023

J Pediatr Gastroenterol Nutr. 2023 Jan 1;76(1):109-117. doi: 10.1097/MPG.0000000000003601. Epub 2022 Sep 2.

The Use of Blended Diets in Children With Enteral Feeding Tubes: A Joint Position Paper of the ESPGHAN Committees of Allied Health Professionals and Nutrition

Jutta Köglmeier [1], Ines Assecaira [2], Elena Banci [3], Barbara De Koning [4], Nadja Haiden [5], Flavia Indrio [6], Wendy Kastelijn [7] [8], Denise Kennedy [9], Veronica Luque [10], Lorenzo Norsa [11], Elvira Verduci [12], Analou Sugar [13]

BMJ Open. 2019 Oct 9;9(10):e033831. doi: 10.1136/bmjopen-2019-033831.

'Your Tube': the role of different diets in children who are gastrostomy fed: protocol for a mixed methods exploratory sequential study

Johanna Taylor [1], Mark O'Neill [2], Jane Maddison [3], Gerry Richardson [4], Catherine Hewitt [5], Karen Horridge [6], Janet Cade [7], Alison McCarter [8], Bryony Beresford [3], Lorna Katharine Fraser [9]

60

Thank you!

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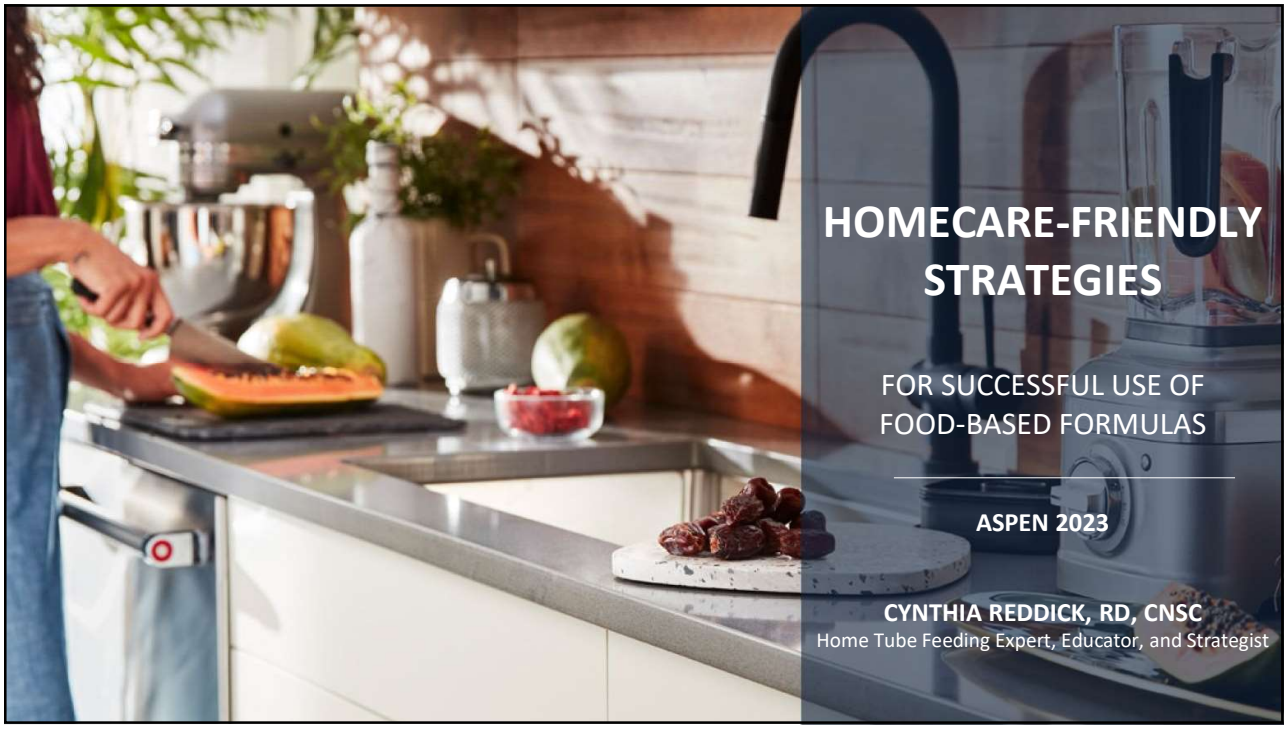

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Speaker Disclosure

Speaker's Bureau:
Nestlé Health Science

General Consulting:
Abbott Nutrition
Functional Formularies
Kate Farms
U-Deliver Medical

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Objectives

- Differentiate between whole food formula categories.
- Review the use of whole food formulas in the home setting.
- Understand the innovations in administration methods for clinicians, patients, and caregivers.
- Learn from John's Story.

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		Food-based formulas		Plant-based; no food ingredients	
B4149	Blenderized whole food or food ingredients	✓	Plant based; meat-based options; fruit and vegetable ingredients; organic and non-organic options		
B4153	Hydrolyzed/peptide Adult	✓	Hydrolyzed pea protein and whole food ingredients; organic and non-organic options	✓	Hydrolyzed pea protein; organic
B4154	Disease specific/diabetes	✓	Soy protein and pureed fruit and vegetable ingredients; non-organic	✓	Intact pea protein; organic
B4161	Hydrolyzed/peptide Pediatric	✓	Hydrolyzed pea protein and fruit and vegetable ingredients; organic and non-organic options	✓	Hydrolyzed pea protein; organic
B4150	Intact nutrients "standard formula" Adult			✓	Intact pea protein; organic and non-organic options
B4160	Intact nutrients "standard formula" Pediatric			✓	Intact pea protein; organic and non-organic options

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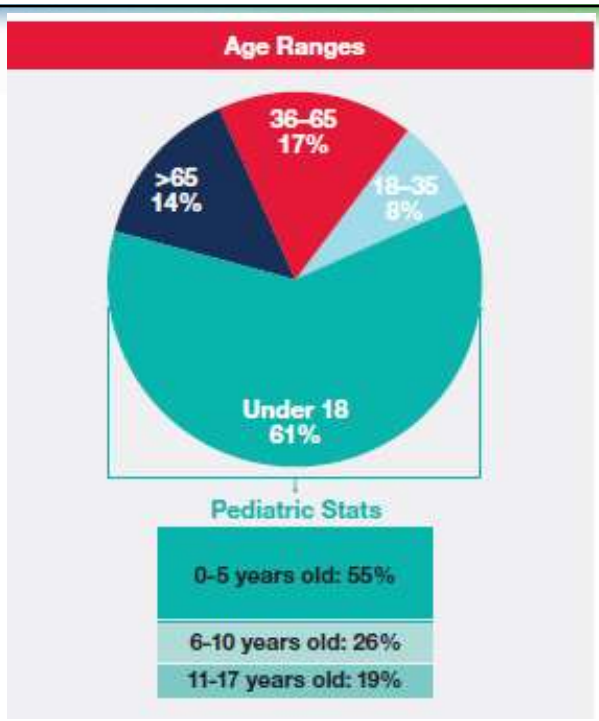
Lessons Learned
from patients in the HEN setting

Reported % of Intake	Pediatric	Adult
<25%	6%	13%
25-50%	11%	18%
>50%	83%	69%
% total daily intake	71%	56%

Epp L, Lammert L, Vallumsetla N, Hurt RT, Mundi MS. Use of Blenderized Tube Feeding in Adult and Pediatric Home Enteral Nutrition Patients. *Nutr Clin Pract*. 2017;32:201-205.

66

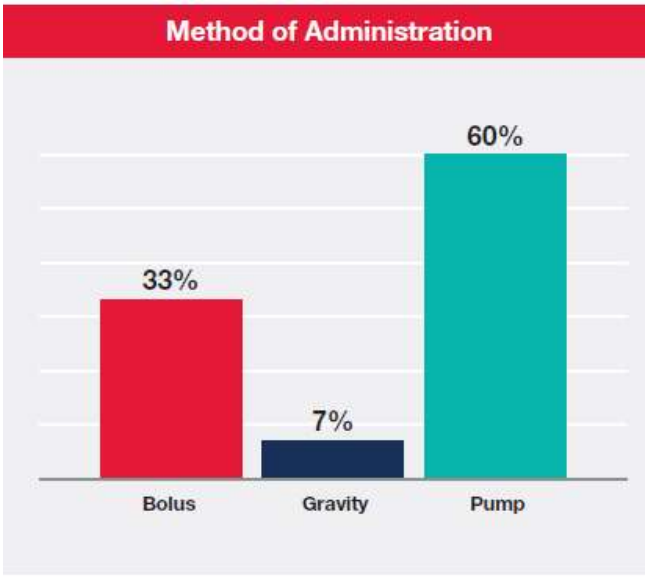
Lessons Learned
from prescribed use of whole food formulas at home



Reddick C. Characteristics of Enteral Patients Prescribed Commercially Prepared Blenderized Tube Feeding in the Home Setting. Poster Presented at ASPEN Nutrition Science and Practice Conference. March 2019. Phoenix, AZ.

67

Lessons Learned
from prescribed use of whole food formulas at home



Reddick C. Characteristics of Enteral Patients Prescribed Commercially Prepared Blenderized Tube Feeding in the Home Setting. Poster Presented at ASPEN Nutrition Science and Practice Conference. March 2019. Phoenix, AZ.

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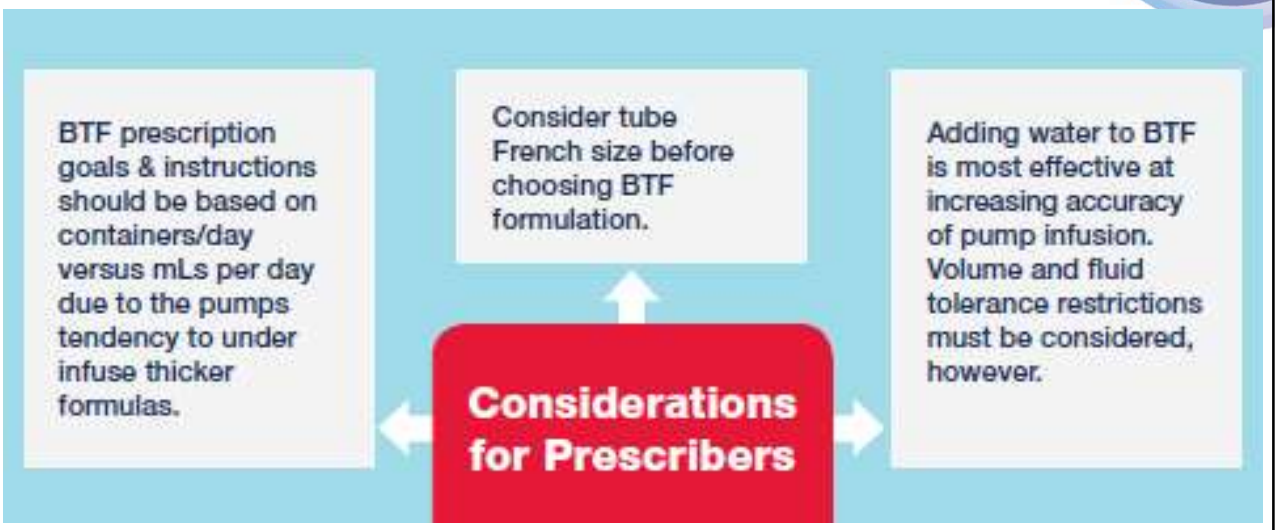
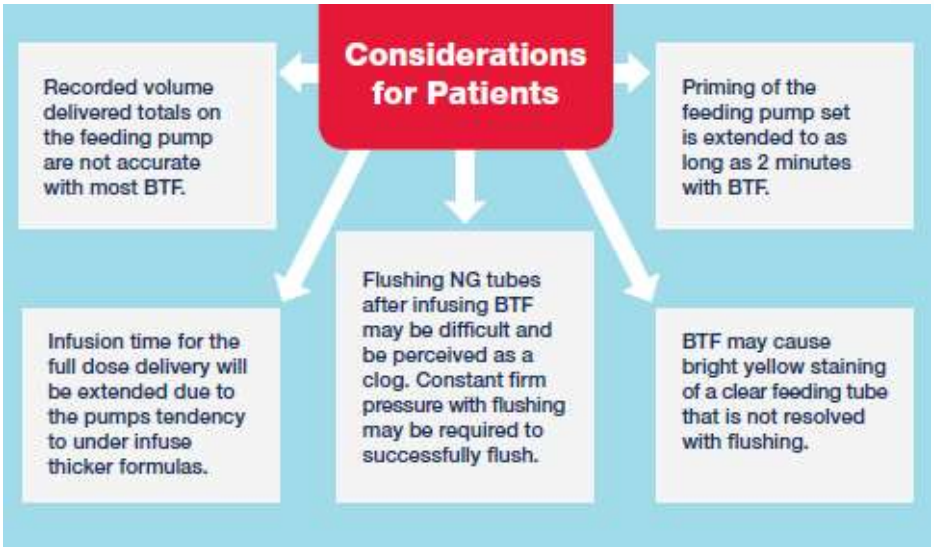
Practical Recommendations
for whole food formula use at home



Reddick C, Flaherty J. *Considerations When Using Commercially Prepared Blenderized Tube Feeding Via an Enteral Feeding Pump in the Home Care Setting.* Poster Presented at ASPEN Nutrition Science and Practice Conference. January 2018. Las Vegas, NV.

69

Practical Recommendations
for whole food formula use at home



Reddick C, Flaherty J. Considerations When Using Commercially Prepared Blenderized Tube Feeding Via an Enteral Feeding Pump in the Home Care Setting. Poster Presented at ASPEN Nutrition Science and Practice Conference. January 2018. Las Vegas, NV.

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FEEDING METHOD OPTIONS AND INNOVATIONS

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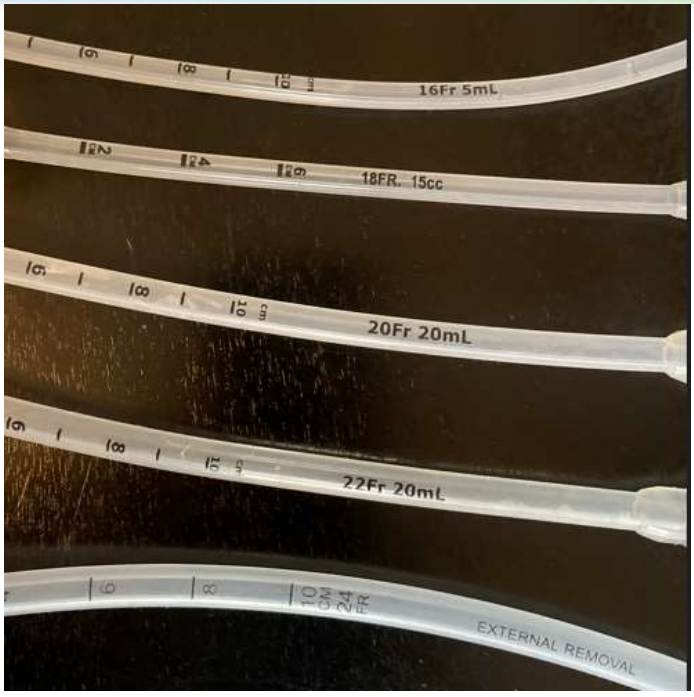
Standard Gastric Tube
French size comparison



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Options Available for syringe feeding





O-ring vs standard
stopper-style syringe

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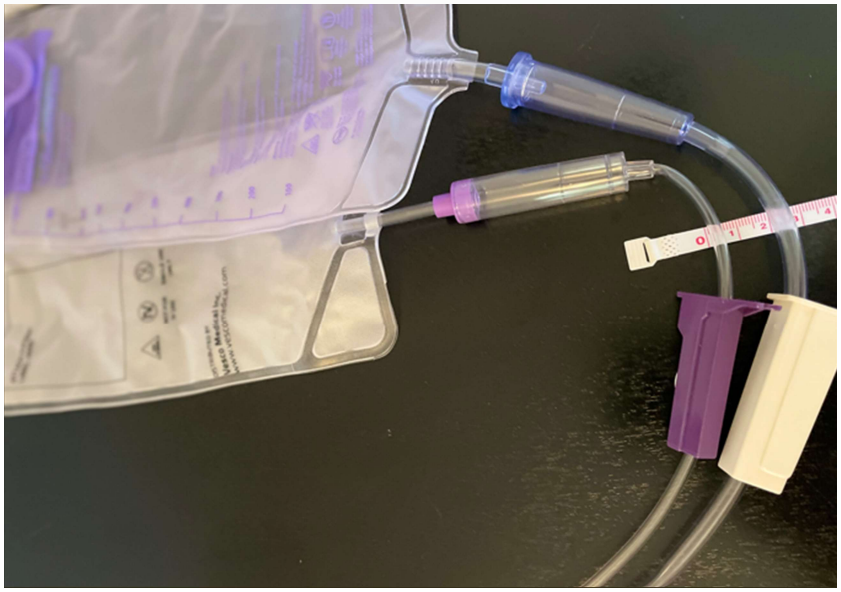
Options Available for gravity feeding

Small
vs.
large
bore gravity bag



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Innovations Available
for administering whole food formulas at home



Bolee® Bag + Bolink® large cap



Bolink® small cap

- Indicated for gastric feeding
- Administered as a bolus
- Available via DME/Home infusion and online retail
- B4036 or S9341 – Enteral feeding kit gravity
- Portable
- Reusable
- ENFit connection



Image Source: U Deliver Medical. https://www.udelivermedical.com/
Bolee® and BoLink® are registered trademarks of U Deliver Medical, LLC.

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Options Available
for use of whole food formulas at home

	Type of Nutrition	Pros	Cons
Option 1	100% Commercial Tube Feeding (TF)	Easy, nutritionally complete, ready to feed. Easy to travel with and allows for non-refrigerated storage of unopened cans. Typically supplied by a home tube feeding provider; insurance coverage may be available.	Will not be using whole food from home or from a commercially prepared product. Body has to adjust to a diet different from table food. If not covered by insurance, commercial TF can be expensive.
Option 2	Commercial TF + Commercial Blenderized Tube Feeding (BTF)	Combines ease of a ready-to-feed formula with ready-to-feed blenderized whole food formula. Easy to travel with and allows for non-refrigerated storage of unopened containers.	Commercial BTF may not be covered by insurance or available from your home tube feeding provider, which could increase out-of-pocket expenses. If not covered by insurance, commercial TF can be expensive.
Option 3	Commercial BTF + Homemade BTF	Combines ease of a ready-to-feed blenderized whole food formula with homemade BTF to save time and energy. Provides flexibility on how much and how often homemade BTF needs to be prepared and provided.	Commercial BTF may not be covered by insurance or available from your home tube feeding provider, which could increase out-of-pocket expenses. Homemade BTF requires more time and energy for preparation and also requires careful nutrition calculations and food safety considerations. Homemade BTF is not reimbursed or covered by insurance. It may not be appropriate for pump infusion and limited to bolus or gravity feeding methods.
Option 4	100% Homemade BTF	Uses whole food that the patient likes and may typically eat (although he or she isn't tasting, the smell may improve desire to "eat") and allows him or her to participate in the act of preparing meals. The patient may "eat" what the rest of the family is eating, allowing him or her to feel more included in family meal times.	There is no reimbursement or coverage of home BTF by insurance. Food preparation and storage may be time consuming, and requires careful nutrition calculations and food safety considerations. May not be appropriate for pump infusion and limited to bolus or gravity feeding methods.

10 — LifelineLetter • (518) 262-5079 *September/October 2017*

Use of whole food through a feeding tube is **not an "all or nothing" proposition**

Ireton-Jones C, Martin K, Emch V, Reddick C, Epp L, Carr V. *Dietitians Offer Sample Recipes and Helpful Hints for Blenderized Tube Feeding.* The Oley Foundation *LifelineLetter.* September/October 2017. https://cdn.ymaws.com/oley.org/resource/resmgr/2017_solll_images/2017_solll.pdf. Accessed 3/19/2023

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JOHN'S STORY AND MY EXPERIENCE THINKING OUTSIDE THE BOX (AND THE TUBE)

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John's story

BEFORE INTERVENTION

- Malnourished
- Not gaining weight
- Needed extra non-protein calories
- **Wanted to blend his own formula and use it as a supplement to his 2.0 kcal/mL formula**



18.9 BMI 139.4 lbs 4.14.15

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John's story



Weight Gain Journey											
Date (2015)	4/5	4/14	4/23	5/2	5/6	5/17	5/29	6/6	6/17	6/30	7/9
Weight (lbs)	135.0	139.4	142.4	144.2	147.0	148.6	153.0	153.4	160.3	161.7	163.4
BMI	18.3	18.9	19.3	19.6	20.0	20.2	20.8	20.8	21.8	22.0	22.2



18.9 BMI 139.4 lbs 4.14.15



20.2 BMI 148.6 lbs 5.17.15



22.2 BMI 163.4 lbs 7.9.15

AFTER INTERVENTION

- Gained weight
- Took an active and interested role in his home tube feeding journey
- Tapped into his creativity in the kitchen
- Cooked and blended in large batches
- 10 cubes a day!

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Questions?

ACCESS NUTRITION RESOURCES at:

NestleMedicalHub.com

Visit MyCE at
NestleMedicalHub.com/myce
Offering CE to dietitians and registered nurses

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