

# Optimizing Enteral Nutrition in Pediatric and Adult Patients with Fat Malabsorption

## Introduction

Fat malabsorption related to certain diseases and conditions will decrease enteral macronutrient utilization and fat-soluble vitamin absorption, potentially leading to malnutrition. In children, it can impair growth and development. Managing this issue will help optimize enteral nutrition (EN) therapy and minimize the consequences of fat malabsorption. This practice tool discusses fat malabsorption and how to optimize EN use in patients with gastrointestinal (GI) diseases.

## What is Fat Malabsorption?

Fat malabsorption occurs when fat in the diet is not fully digested and absorbed in the gastrointestinal tract. This can result in fatty stools (steatorrhea) which are often greasy, liquid, and foul-smelling. Additional symptoms may include abdominal bloating and gas.

## What Diseases are Associated with Fat Malabsorption?

Many GI diseases are associated with some fat malabsorption. These include but are not limited to:<sup>1</sup>

- Zollinger-Ellison syndrome
- Crohn's disease (an inflammatory bowel disease)
- Ulcerative colitis (an inflammatory bowel disease)
- Celiac disease
- Small bowel or gastric resection
- Short bowel syndrome (SBS)
- Liver disease
- Cholestasis
- Small intestinal bacterial overgrowth (SIBO)
- Exocrine pancreatic insufficiency (EPI)
  - » Chronic pancreatitis
  - » Pancreatic resection
  - » Cystic fibrosis
  - » Pancreatic cancer (obstruction and loss of functional pancreatic tissue)

## Why Use Enteral Nutrition?

Enteral nutrition allows for the delivery of nutrients to those who cannot maintain adequate nutrition by oral intake alone. EN is indicated in patients with GI diseases — including but not limited to inflammatory bowel diseases, chronic liver disease, and EPI — when the patient is at risk or has emerging malnutrition due to inadequate oral intake.<sup>2</sup> EN may be provided continuously or cyclically. A cyclic infusion allows patients to receive supplemental calories in addition to their oral diet.<sup>3,4</sup>

## Why is EN Challenging With Fat Malabsorptive Conditions?

Most enteral formulas contain fat which provides a source of energy and allows absorption of fat-soluble vitamins. Fat usually requires significant digestive processes to allow for absorption and may cause symptoms of fat malabsorption when not absorbed properly. Patients with EPI are often prescribed pancreatic enzyme replacement therapy (PERT) which comes in capsules that cannot be chewed. For infants and younger children who cannot swallow capsules, the enteric-coated beads inside can be mixed with strained food. For those on EN who cannot take PERT orally, the PERT can be given via the feeding tube but mixing it with the formula can lead to tube occlusion and inconsistent enzyme delivery.<sup>3</sup> Patients with SBS have fat malabsorption due to decreased intestinal surface area for nutrient absorption and changes in digestive fluids such as bile insufficiency. EN is often used with parenteral nutrition (PN) in patients with SBS to increase gut adaptation and decrease PN use. In addition, use of isotonic polymeric formulas are recommended but some patients may need semi-elemental formulas that usually contain less fat.<sup>5</sup>

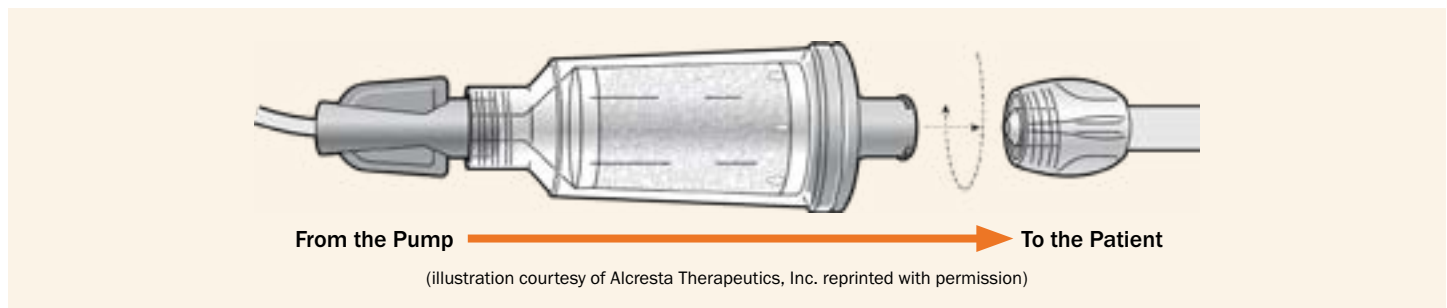
## Managing Fat Malabsorption in EN

Managing fat malabsorption with EN is important to ensure patients are receiving adequate nutrition and caloric value from the enteral formulas. To manage symptoms of fat malabsorption, consider the following actions:

- Modify EN administration methods, including feeding rate or frequency such as infusing EN continuously rather than by bolus.
- Add fiber to slow transit time.
- Change enteral formulas to a semi-elemental diet.
- Provide fat-soluble vitamins and/or other nutrient supplements.
- Use in-line digestive enzyme cartridges.

## Use of Inline Lipase Cartridge for EN

An inline digestive lipase cartridge (RELIZORB, Alcresta Therapeutics, Inc.) was introduced in 2015 and is approved for use in pediatric patients (ages 2 years and above) and adult patients to hydrolyze fats in enteral formula. This is for inline use with enteral feeding only (Figure below). When formula transverses the cartridge, the triglycerides in the formula are hydrolyzed to free fatty acids and monoglycerides prior to ingestion by the lipase in the cartridge.<sup>6,7</sup> The lipase itself remains in the cartridge and is not ingested by the patient, even over hours-long feedings.



This inline cartridge has been shown to break down fats in enteral tube feeding formulas, including long-chain polyunsaturated fatty acids (LCPUFAs) such as docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), and arachidonic acid (AA), which are critical for growth and development, yet very difficult to break down.<sup>8</sup>

See [www.relizorb.com/pdf/Compatible-Formulas-and-Pumps.pdf](http://www.relizorb.com/pdf/Compatible-Formulas-and-Pumps.pdf) for the list of evaluated compatible formulas and pumps. Medications should not be administered through this cartridge. The device is available with ENFit connectors and is compatible with all EN supplies. This device has been trialed and found safe, convenient, and effective in prospective studies of patients with CF<sup>6,8</sup> and is currently undergoing trials in children with short bowel syndrome to study if these PN dependent patients can decrease the use of PN and increase EN.<sup>9</sup>

### References

1. Zavarox T, Belletieri C. Malabsorption syndromes. *StatPearls*. 2023. <https://www.ncbi.nlm.nih.gov/books/NBK553106/>
2. Bechtold ML, Brown PM, Escuro A, et al. When is enteral nutrition indicated? *JPEN J Parenter Enteral Nutr*. 2022;46:1470-1496.
3. Sankararaman S, Schindler T, Sferra TJ. Management of exocrine pancreatic insufficiency in children. *Nutr Clin Pract*. 2019 Oct;34 Suppl 1:S27-S42.
4. Schwarzenberg SJ, Hempstead SE, McDonald CM, et al. Enteral tube feeding for individuals with cystic fibrosis: Cystic Fibrosis Foundation evidence-informed guidelines. *J Cyst Fibros*. 2016;15(6):724-735.
5. Limketkai BN, Hurt RT, Palmer LB. Short bowel syndrome. In Mueller CM (ed.) *The ASPEN Adult Nutrition Support Core Curriculum*. Silver Spring, MD, ASPEN. 2017
6. Stevens J, Wyatt C, Brown P, Patel D, Grujic D, Freedman SD. Absorption and safety with sustained use of RELIZORB evaluation (ASSURE) study in patients with cystic fibrosis receiving enteral feeding. *J Pediatr Gastroenterol Nutr*. 2018 Oct;67(4):527-532.
7. Giguere-rich C, Mathew A, Reid E, Autore K. Use of an in-line digestive cartridge with enteral nutrition improves the weight trajectory of 2 children with cystic fibrosis complicated by another medical diagnosis. *Nutr Clin Pract*. 2018;33(2):286-294.
8. Freedman S, Orenstein D, Black P, Brown P, McCoy K, Stevens J, Grujic D, Clayton R.J. Increased fat absorption from enteral formula through an in-line digestive cartridge in patients with cystic fibrosis. *Pediatr Gastroenterol Nutr*. 2017 Jul;65(1):97-101.
9. Tsikis ST, Fligor SC, Mitchell PD, Hirsch TI, Carbeau S, First E, Loring G, Rudie C, Freedman SD, Martin CR, Gura KM, Puder M. Fat digestion using RELIZORB in children with short bowel syndrome who are dependent on parenteral nutrition: Protocol for a 90-day, phase 3, open labeled study. *PLoS One*. 2023 Mar 1;18(3):e0282248.

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