

Feeding children with gastrointestinal impairment

Children with gastrointestinal impairments, including those with neurological diseases, congenital heart disease, short bowel syndrome, neuromuscular disorders, and cancer, often face significant nutritional challenges.

Addressing these challenges requires careful consideration of nutritional strategies and enteral formula selection to ensure optimal health outcomes for these vulnerable patient populations.

Chairman - Prof. Claudio Romano

Nutritional Management of Patients with Gastrointestinal Impairment: Considerations on Choice of Enteral Feed & Importance of Fibers



Prof. Claudio Romano
Head of Pediatric Gastroenterology and Cystic Fibrosis Unit, University of Messina, Italy

Enteral nutrition (EN) and specialised strategies for various conditions improve outcomes, with advances in enteral formulas offering additional benefits.

Neurological impairment and congenital heart disease

For children with neurological impairments, oral nutrition should be recommended whenever possible, as well as postural correction, therapeutic interventions and speech therapy.

When oral feeding is not possible and the total feeding time exceeds 3 hours, EN is preferred, often combining nighttime feedings with daytime bolus feedings. For long-term EN (>3 months) a gastrostomy is considered.

Early tube feeding has been shown to improve nutritional status and reduce gastrointestinal complications in this population.¹

In children with congenital heart disease, ensuring adequate caloric intake (90-110 kcal/kg/day) and protein (≥ 1.5 g/kg) intake is critical. Nasogastric tubes and whey-based formulas are recommended to treat symptoms associated with gastroesophageal reflux disease and motility disorders.²

Neuromuscular disorders and biliary atresia

Tube feeding is recommended in children with neuromuscular diseases, particularly spinal muscular

atrophy types 1 and 2.³ Although no specific diet or formula is specified, whey-based formulas have been used successfully to treat symptoms associated with gastroesophageal reflux, constipation and delayed gastric emptying.

Children with biliary atresia often suffer from malnutrition. A French study⁴ showed significant improvements in weight, length and height using an elemental formula and highlighted the role of EN in optimizing outcomes up to liver transplantation.

Short bowel syndrome and cancer

For children with short bowel syndrome, treatment includes two phases. Initially, total parenteral nutrition and separate infusions are used to replenish excessive losses and control electrolytes.

In the second stage, EN is introduced, preferably using whey-based formulas to optimise absorption, reduce the need for parenteral calorie requirements, and reduce the risk of parenteral nutrition-related liver disease.

For children with cancer, EN is essential to prevent and support malnutrition and promote growth in-line

with genetic targets. The prevalence of malnutrition in this population ranges from 5 to 48%, highlighting the importance of nutritional support from diagnosis through long-term survival.⁵

Advances in enteral formula selection

The choice of enteral supplements include the use of semi-elemental supplements, fibre-fortified supplements, and real food supplements. Whey peptide-based formulas have been shown to be effective in improving symptoms of feed intolerance,⁶

promoting weight gain and reducing gastrointestinal distress⁷ in various populations, including critically ill children.⁸ Fibre-enriched formulas have been linked to improved intestinal motility, colon health and microbiota modulation.⁹ Formulas containing partially hydrolyzed guar gum (PHGG) have shown improvement in stool consistency within 1-7 days of initiation.¹⁰ Real food formulas are becoming increasingly common in clinical practice; current findings are provided by Dr. Graeme O'Connor.

Effective Approaches to Improve Tolerance to Feed in Children with Gastrointestinal Impairment

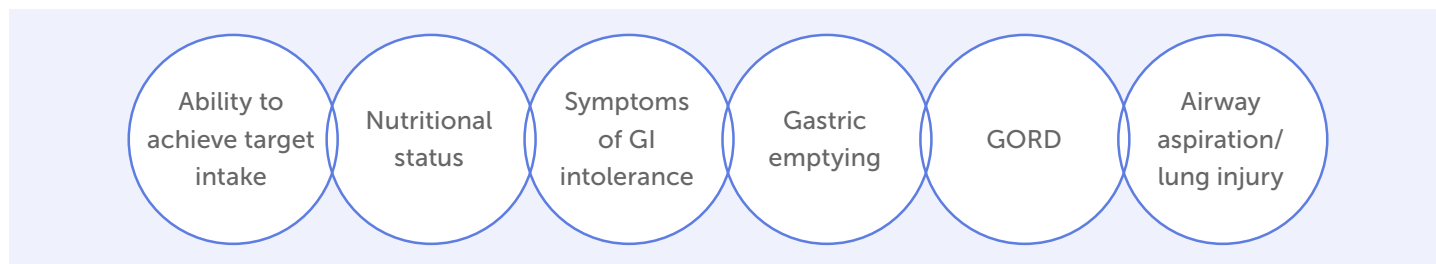


Prof. Antonella Diamanti
Gastroenterology and Nutritional Rehabilitation Unit Istituto di Ricovero e Cura a Carattere Scientifico, Bambino Gesù Children's Hospital, Rome, Italy

Patients with medical complexity often require EN, but both underlying diseases and EN can lead to gastrointestinal intolerance. Recently, a more natural approach to EN has been considered to improve gastrointestinal tolerance in these patients.

A review of the literature published in the last 20 years was performed, excluding studies on premature infants and including reports from PICU (representative model of GI EN intolerance), including the studies performed by Prof. Diamanti's team, in which she compared the efficacy of bolus vs. continuous feeding and enteral nutrition (EN) alone vs EN+Nissen Fundoplication (NF) surgery for improvement of gastrointestinal EN intolerance and their benefits in clinical practice, with a focus on the outcomes indicated below. (Figure 1)

Figure 1. Outcomes



Bolus feeding vs. continuous feeding

Bolus feeding is considered more physiological than continuous feeding due to the more natural release of gastrointestinal hormones and its effectiveness in promoting muscle protein synthesis.¹¹ A literature review comparing the efficacy of bolus vs. continuous feeding in improving gastrointestinal intolerance found mixed results. While some studies reported better outcomes with bolus feeding in terms of achieving target intake and cost-saving,¹² others found similar or better results with continuous feeding.

However, from a practical standpoint, bolus feeding is considered more reliable for home enteral nutrition,¹³ and new equipment has been developed to reduce preparation time and maintain microbiological safety.¹⁴

Figure 2. New cap-based bolus feeding system securely fixed onto collapsible semi-rigid bottles directly connectable to ENFit feeding tube



EN alone vs. EN with Nissen fundoplication

Nissen fundoplication (NF) is a surgical procedure that alters the morphology of the upper gastrointestinal tract to prevent gastric content from entering the oesophagus. When comparing EN alone to EN combined with NF, most studies found no significant differences in terms of achieving target intake, nutritional status, symptoms of gastrointestinal intolerance and airway aspiration or lung injury. However, some studies found that EN alone may be better in terms of reducing the probability of future surgery and major complications.¹⁵

Figure 3. Proportion of patients with no further procedure

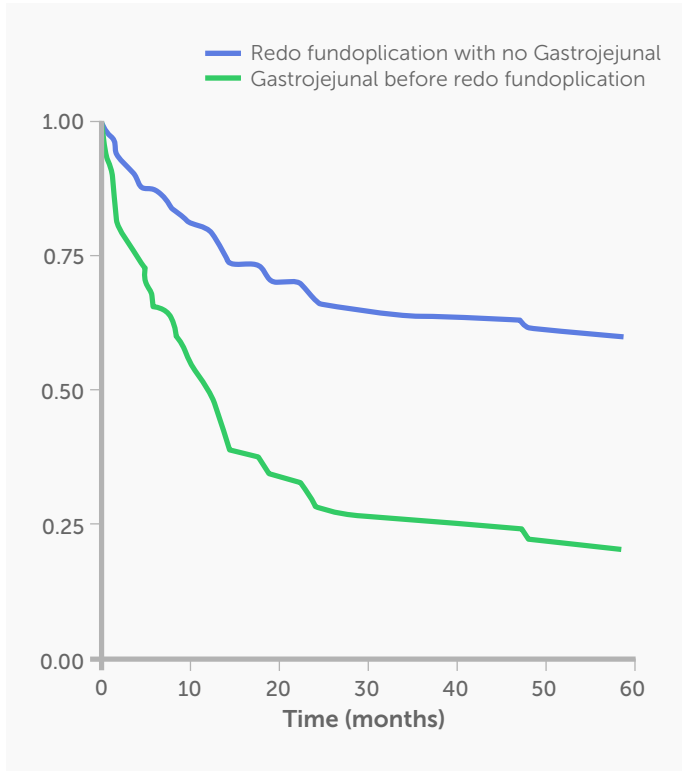
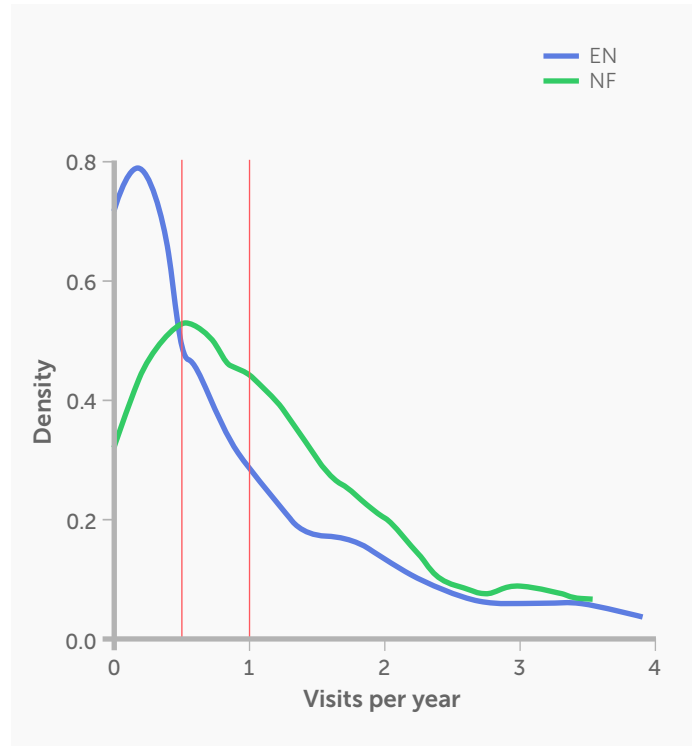


Figure 4. The expanechnikov kernel density of annual outpatient visits for GI symptoms in the EN group and NF group



Moreover, it was reported that there were increased outpatient consultations for GI problems in patients who had undergone NF. Overall analysis indicates that NF may not improve the clinical aspect and related costs in children with neurological diseases compared to EN.

New Advances in Using Food-based Formulas for Paediatric EN



Dr. Graeme O'Connor
Great Ormond Street Children's Hospital, University College London and Institute of Child Health, UK

Food-based formulas are gaining popularity in paediatric EN due to their potential benefits in improving gastrointestinal (GI) symptoms and gut microbiome.

Figure 5. What's the difference?

Food Based Formula	Homemade Blended Diet	Commercial Blended Diet
<ul style="list-style-type: none"> Commercial product Ready to Hang Formula 14-30% Rehydrated Food Nutritionally Complete Soluble/insoluble fibre 	<ul style="list-style-type: none"> 100% Homemade Blended real food Family foods Added milk/ milk alternative Nutrient content variable 	<ul style="list-style-type: none"> 100% real food Ready to feed Often marketed as organic Heat processed: shelf-life

Homemade blended diets and commercial blended formulas

Studies comparing standard formulas to homemade blended diets or commercial blended formulas have shown positive outcomes, particularly in reducing upper and lower GI symptoms. Two studies also found improvements in gut microbiome diversity.

However, blended diets have limitations in the acute clinical setting, such as difficulty in administering through nasal gastric tubes, microbial contamination risk¹⁶ and contraindications for immunocompromised patients and post-pyloric feeding.

Evidence supporting food-based formulas

Several studies from North America, Italy and the United Kingdom have demonstrated the benefits of food-based formulas in various patient populations:

1. Patients with intestinal failure¹⁷ and short bowel syndrome¹⁸ showed improved tolerance and stool patterns.
2. Children with neurological impairment experienced reduced GI symptoms, particularly constipation and loose stools.¹⁹
3. A case study of a child with oesophageal atresia, complex cardiomyopathy and short bowel syndrome showed resolved diarrhoea and improved growth after transitioning to a food-based formula.²⁰
4. A pilot study on spinal muscular atrophy patients using food-based formulas showed promising results.²¹

Real world evidence study findings

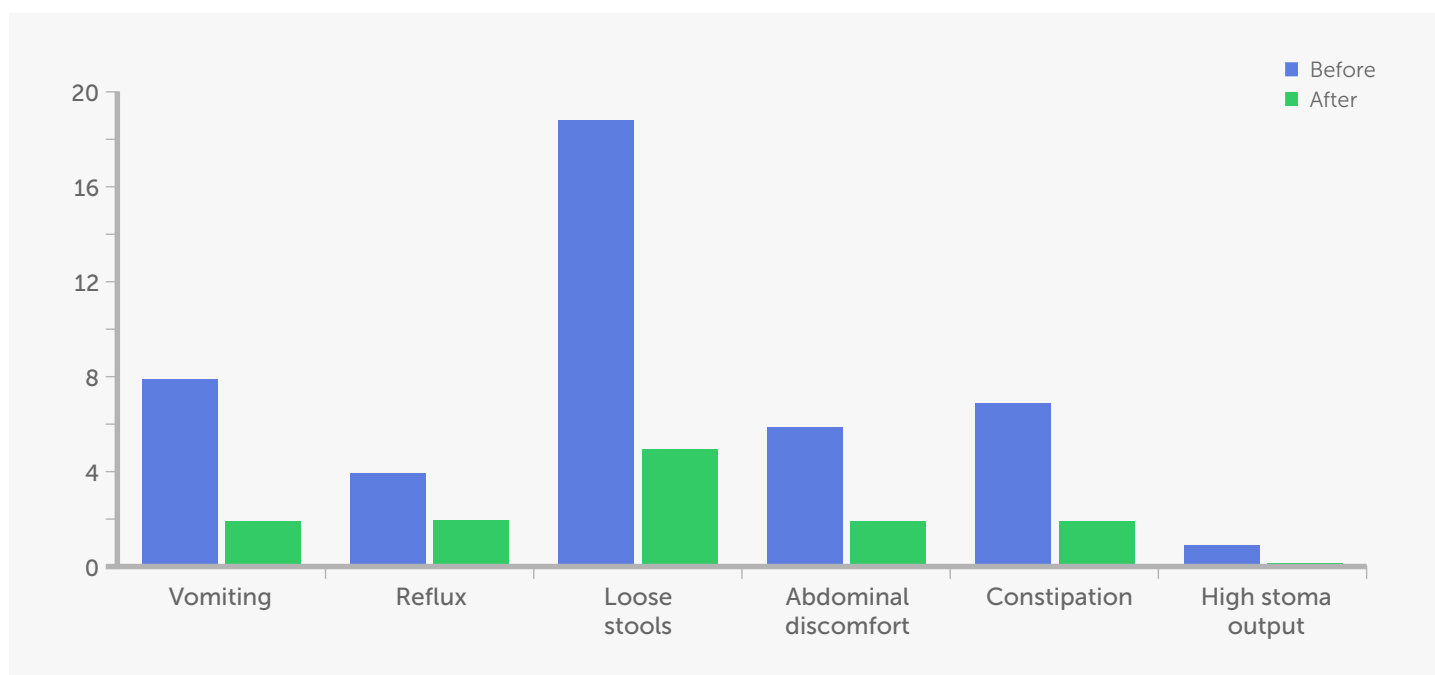
A national multi-center study in the UK, involving 43 children (43% with neurological impairments), demonstrated significant improvements in all GI symptom categories when switching from standard to food-based formulas. 81% of dietitians reported improvements, with 90% of children experiencing reduced or discontinued constipation medication.²² Another prospective study in intensive care patients (aged 1-16) with sepsis and diarrhoea showed improved stool frequency and consistency within one week of using a food-based formula, while maintaining stable levels of propionate and butyrate in faecal short-chain fatty acids.²³

A new single-center retrospective study in the UK,²⁴ analysing data from 70 patients, revealed that dietitians are using food-based formulas in younger age groups and various conditions, including neurological, oncological, cardiological, metabolic and endocrine disorders. The presence of GI symptoms was the most common reason for initiating a food-based formula (58 out of 70 children), even in those already on amino acid or hydrolysed formulas (nearly 50% of participants).

The study found that food-based formulas were well tolerated when administered post-jejurally, both continuously and via bolus feeding.

The study results highlight the improvements in GI symptoms before and after food based formula was introduced. The most significant improvement was observed in the reduction of loose stools, a common symptom among children in acute clinical settings, particularly those experiencing antibiotic-related diarrhoea..

Figure 6. Gastro symptoms before and after formula changed to food-based formula (N=58)



Quotes



“In this retrospective study with children with neurological impairment and progressive or non-progressive neurological disease, we have demonstrated that early tube feeding improves nutritional status and reduces GI complications and GI symptoms.”

Prof. Claudio Romano



“From a clinical point of view, a more natural way to manage enteral nutrition is as efficient as the commonly used less natural way to manage enteral nutrition.”

Prof. Antonella Diamanti



“This is a real change of practice for us in our specialised hospital because we're using a food-based formula to correct GI symptoms that are occurring in other formulas.”

Dr. Graeme O'Connor

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