

ORIGINAL ARTICLE

Practical dietary management of protein energy malnutrition in young children with cow's milk protein allergy

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Abstract

Cow's milk protein allergy (CMPA) affects between 1.9 and 4.9% of infants and young children. This food allergy requires the complete elimination of cow's milk and its derivatives, impacting on nutritional status. The risk of having protein energy malnutrition (PEM) in children with CMPA has been well documented. In 2007, the World Health Organisation published guidelines on the dietary management of PEM, which has impacted on the recommendations and composition on specialist feeds for many chronic diseases, but not on CMPA. The main change in management of the child with PEM is the protein energy ratio and energy requirements. The ideal protein energy ratio lies between 8.9 and 11.5%, which would ensure a deposition of about 70% lean and 30% fat mass. In addition, for optimal catch-up growth between 5 and 10 g/kg/day, energy requirements should be between 105 and 126 kcal/kg/day. Although most current hypoallergenic formulas fall well within the recommendation for protein, there is a problem in achieving energy requirements. As a result, modular additions are often made, disturbing the protein energy ratio or feeds are concentrated, which impacts on osmolality. We therefore aimed to review current guidelines on PEM and how these can be applied in the management of the malnourished child with CMPA.

Cow's milk protein allergy (CMPA) affects between 1.9 and 4.9% of infants and young children, of which 50–60% present with gastrointestinal symptoms and skin symptoms, and approximately 20–30% have respiratory symptoms (1–3). This food allergy reduces the availability of foods and drinks for consumption, as cow's milk and its derivatives are required to be eliminated from the diet. However, CMPA may also increase energy requirements through inflammation (i.e. skin or gastrointestinal), disrupted sleep, as well as reduce the absorption of major nutrients (i.e. CMPA-induced enteropathy) (4). The risk of having a poor nutritional status whilst following a cow's milk-free diet has been well documented over the years (5, 6). Although some research has been performed on the cow's milk elimination diet and hypoallergenic formulas itself (7, 8), limited guidance exists on the dietary management of children with CMPA who have a poor nutritional status. Dietary management is challenging because of the nutritional impact of following the elimination

diet and its comorbidities such as food aversion and refusal, which are commonly seen in children that have cow's milk-associated food allergies (9, 10).

Protein energy malnutrition (PEM) has been identified as the single largest risk factor to health worldwide, causing 3.7 million deaths in children (11). This led to the publication of many guidelines, including the World Health Organisation (WHO) guidelines on the dietary management of both acute and chronic malnutrition (12–14). Children with both immediate type (IgE-mediated) and delayed type CMPA (non-IgE-mediated) are at risk of being undernourished, particularly with the delay in diagnosis often seen in clinical practice (15). In the guidelines from 2010 by the World Allergy Organisation on the 'Diagnosis and Rationale for Action against Cow's Milk Allergy (DRACMA)', it has been mentioned that particular attention has to be paid to prescribing nutritionally safe diets for children with CMPA (3). In the absence of specific guidelines for this particular group of children with

food allergies, this review article aims to assess current evidence/guidelines on PEM and how these can be applied and assist in the practical management of CMPA.

Defining protein energy malnutrition

Several terms have been used interchangeably to describe growth retardation, which include undernutrition, PEM, growth faltering and failure to thrive. Olsen et al. (16) defined protein energy malnutrition as nutritional deprivation amongst children in developing countries, whereas faltering growth/failure to thrive is a term more commonly used for affluent societies. All terms, though, refer to paediatric undernutrition as a state of nutrition in which deficiency of energy, protein and other nutrients lead to measurable adverse effects on tissue and body functions, and a clinical outcome of growth deviation (17).

Although there may be a lack of consensus in the use of terminology, there is agreement that undernutrition should be diagnosed using anthropometric measurements only (18, 19). However, worldwide 63% of countries use percentile charts, 18% Standard Deviation (S.D.) scores and 6% use percentage-of-median to identify cases of poor nutritional status. As a result, many different cut-offs/criteria are in use (16, 18). The discrepancy between different criteria can easily be demonstrated by using 'faltering growth' as example. One of the definitions for faltering growth is the fall of 2 or more centiles in weight for age (16). However, the S.D. score for this may range from 1 to 2 S.D. scores, depending on the centile charts used.

The lack of consistent terminology and criteria for diagnosis creates problems in both identification and management of undernutrition. For the purpose of this review article, the term 'PEM' will be used as defined by the WHO (Table 1) (20).

Prevalence of malnutrition in children with CMPA

Although most publications describe malnutrition as a common occurrence in children following a cow's milk-free diet,

there is little published prevalence data on malnutrition in this population. Isolauri et al. (5) showed in 1998 that the relative length and weight of children with CMPA decreased compared to the control group. The fall in relative length coincided with the onset of the symptoms suggestive of CMPA and the start of the elimination diet. Of particular concern was that no significant catch-up length growth was seen by 24 months of infants with early onset of CPMA, despite following the correct dietary treatment, that is cow's milk elimination diet, in that study. The same study also showed that the relative weight of children with CMPA continued to fall compared with that in the non-allergic control group (5). Several case reports of severe PEM with food allergy, especially when cow's milk is excluded exist in the literature, including cases of kwashiorkor; however, the exact level (i.e. S.D./z-score) of malnutrition is not always documented (24, 25). A recent study by Vieira et al. (26), who performed a multicentre study of gastroenterology departments, found that 15.1% of children with CMPA had a weight for age <-2 S.D., 8.7% had weight for height <-2 S.D. and 23.9% of had a height for age <-2 S.D. Laitinen and Isolauri in 2007 (27) reported that the prevalence of stunting in children on an exclusion diet ranges between 2 and 15%; however the study by Vieira et al. (26) reported an even higher prevalence of stunting, which may be related to the fact that they recruited children with more gastrointestinal symptoms. Many children with CMPA have additional food allergies, which further compromises nutritional status. In a frequently referenced study from the USA, Christie et al. (6) showed that 35% of children with more than two food allergies had a height for age below the 25th centile. A further study by Flammarion et al. (28) showed that children with food allergies including CMPA had a weight for age and height for age <-2 S.D. in 9.3 and 7.2% of cases, respectively. This is especially important in young children with CMPA, as growth velocity is particularly rapid within the first 2 yr of life, when the prevalence of this allergy is also high (29). Early growth retardation has been shown to predict longitudinal growth increasing the child's vulnerability to be short in stature later in life (30, 31) and also possibly

Table 1 Tools and cut-offs commonly used to define malnutrition (20–23)

Method		Classification	
Weight for height (WHO)(22)	Moderate malnutrition –2 to –3 S.D. score		Severe malnutrition <-3 S.D.-score (severe wasting)
Height for age (WHO)(22)	Moderate malnutrition		Severe malnutrition –2 to –3 S.D. score <-3 s.d. score (severe stunting)
Percentage of standard weight (SW) (Gomez)	Mild 75–90% SW	Moderate 60–74% SW	Severe malnutrition $<60\%$ SW*
Weight for height (WFH) (Waterlow)	Mild 80–90% WFH	Moderate 70–80% WFH	Severe malnutrition $<70\%$ WFH
Body Mass Index	Body mass index for chronological age <5 th centile		
Weight and length centile charts	Length and weight for chronological age <5 th centile (<0.4 th centile) Or Weight deceleration crossing more than two major centile lines		

leading to reduced IQ, poor arithmetic performance and altered work habits (32–34).

Dietary management

Current recommendations

In the past, the focus of dietary management of PEM was very much on achieving energy requirements. However, it is now known that although these children gained weight rapidly reaching normal weight-for-age on a high energy diet, they had deficits of functional tissue with an excess of fat tissue gain; they were relatively obese because the balance of nutrients was not corrected to allow for appropriate lean tissue to be synthesized (35–37). As such, in 2007, the WHO/FAO/UNU (13) published guidelines on the energy and protein needs for catch-up growth in young children (Table 2). According to these guidelines, the estimation of requirements for catch-up growth should be decided by the composition of the new tissue to be laid down during re-feeding. Ideally catch-up growth should compose of 73% lean and 27% fat mass (13). Based on the research published by Atwater (38), 1 g of fat would require 9 kcal/g and 1 g protein 4 kcal/g; if it is assumed that lean tissue contained 25% protein, then lean tissue would require 1 kcal/g (0.25×4 kcal). Therefore, if the catch-up growth desired involved 30% fat and 70% lean mass, then the energy cost of the catch-up would be 3.7 kcal/g $[(0.3 \times 9) + (0.7 \times 1)]$ for 1 g/kg/day catch-up growth. If the desired rate of catch-up growth is 10 g/kg/day, this would mean an additional 3.7×10 which is 37 kcal/kg/day above normal daily energy requirements.

According to the WHO guidelines, the ideal protein energy ratio for wasted (low weight for age) children is between 8.9 and 11.5%, which would ensure a deposition of about 70% lean and 30% fat mass (Table 2). These guidelines, however, do not account for the additional needs required in children who are stunted and those with increased protein and energy turnover (i.e. increased losses, infections). In contrast, Golden et al. (12) suggested that protein intake of 11.2% of total energy should be sufficient for intense anabolism and that it

is unlikely that a higher protein requirement is needed for skeletal growth, provided that the other nutrients are all present at a sufficient density. However, Kabir et al. (39, 40) showed increased linear growth in 2–4-yr-old stunted children when increasing the protein energy from 7.5 to 15%. As both stunting and increased losses of nutrients are reported in CMPA, a higher protein energy ratio may be required in the more severe cases with PEM. However, none of the aforementioned guidelines were developed for children with CMPA, and the ideal protein energy ratio in this population still requires significant research. In the absence of this, the WHO/FAO/UNU and Golden guidelines provide a good basis for re-alimentation in children with this diagnosis (12, 13).

Vitamin and mineral deficiencies are often reported in malnourished children. It is estimated that nearly 11% of children worldwide under 5 yr of age die because of four micronutrient deficiencies, vitamin A, zinc, iron and iodine (41). In children with CMPA, calcium and vitamin D deficiencies are particularly well described (42, 43), but deranged essential fatty acid levels have also been seen (5). Christie et al. (6) found that 25% of children with food allergies achieved <67% of the Recommended Dietary Allowance for calcium, vitamin D and vitamin E, and more children with CMPA consumed less calcium than age-and-gender-specific recommendations.

Specific nutrients that are potentially needed in higher amounts for skeletal growth, according to Golden et al. (12), include sulphur, phosphorus, calcium, magnesium, vitamin D, vitamin K, vitamin C, zinc, iron and copper (12, 41). In particular, zinc has been shown to be essential in the catch up of linear growth, and Imdad et al. (44) recommend that the supplementation should be routinely be included in the management of the malnourished child. As children with malnutrition are normally consuming a diet deficient in macro- and micronutrients, multiple deficiencies are common. It would therefore be inappropriate to give only energy and protein supplementation without adequate micronutrients in an attempt to reverse wasting or stunting. In fact, optimal catch-up growth is not possible without the right balance of vitamins and minerals (12).

Table 2 Energy and protein required to achieve different rates of catch-up growth (13)

	Protein* (g/kg/day)	Energy† (kcal/kg/day)	Protein/ energy (%)
1 g/kg/day	1.02	89	4.6
2 g/kg/day	1.22	93	5.2
5 g/kg/day	1.82	105	6.9
10 g/kg/day	2.82	126	8.9
20 g/kg/day	4.82	167	11.5

*14% deposition of tissue adjusted for 70% efficiency of utilization plus the safe level of maintenance (0.82 g/kg/day).

†Maintenance energy at 85 kcal/kg + gross energy cost at 4.1 kcal/kg/day.

9.7% deposition of tissue adjusted for 70% efficiency of utilization plus the safe level of maintenance (0.82 g/kg/day).

Practical implementation

Modulating hypoallergenic formulas

Dietary management in children with malnutrition and CMPA is limited by the cow's milk protein elimination diet itself. Cow's milk and cow's milk products are high in energy, protein and selected micronutrients (i.e. calcium), and the exclusion diet leaves a nutritional void, especially in early infancy (45). Children below 2 years of age are either breast-fed or require a hypoallergenic formula. The nutritional content of breast milk cannot be adjusted, and hypoallergenic formulas are formulated to achieve nutrient requirements per 100 ml similar to breast milk, and in line with the EU Directive as well as other guidelines such as the European Society of Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) (8, 46). Other factors, including

aversive feeding (47, 48), gastric dysmotility and altered hunger and satiety (49), further increase the challenge of managing the malnourished CMPA child.

In infants with CMPA, 34–45% of energy and 35–47% of protein come from hypoallergenic formulas (5). Whilst 91% of the children with CMPA who consumed their hypoallergenic formula (in sufficient volumes) met the recommended intake for nutrients, it is not surprising that the most widespread dietary interventions for malnourished children with CMPA include the manipulations of the hypoallergenic feed to achieve requirements (6).

Common practice includes modular additions to feeds of either fat: carbohydrate blends, long-chain and medium-chain fatty acid or carbohydrates alone. Increasing the concentration of the hypoallergenic formula from the normal concentration (12–14%) up to a 20% concentration (20 g powder mixed in 100 ml water) is also a common practice. 'Food solutions' for the weaned infant are often used, which include the addition of fat or hypoallergenic milk formula powder to food, increasing protein intake in the weaning diet (i.e. chicken, fish, turkey, red meat and pulses) and product-specific recipes for hypoallergenic formulas. The impact of such feed/food interventions is seldom considered, however may impact significantly on the tolerance of the feed, and also the rate of catch-up growth and percentage of lean vs. fat mass. It is known from studies comparing whole-protein energy-dense infant feeds to energy-supplemented feeds, that the energy provided from protein is reduced, often to as little as 6% in the energy-supplemented feeds (50). This protein/energy ratio is below that recommended by the EU Directive for standard infant formulas (minimum 8% protein energy) (8). Additionally, when carbohydrate modules are added to

feeds, they can affect the osmolality significantly, which has additional negative effects in terms of tolerance, especially in those infants with CMPA with a gastrointestinal symptoms. These aspects should be considered when supplementing feeds for young children with CMPA, as it may lead to inappropriate catch-up growth (higher percentage fat and lower percentage lean muscle mass), may also reduce volume consumption because of delayed gastric emptying and higher likelihood of osmotic diarrhoea (51). This is not a desirable effect in children with CMPA that are already struggling to achieve optimal volumes of hypoallergenic feeds.

Increasing the concentration of a formula maintains the percentage energy derived from protein, however, increases the osmolality, the potential renal solute load (upper limit according to the Food and Drug Administration = 277 mOsm/l) and alters the palatability of the hypoallergenic formula (52). The osmolality of hypoallergenic formulas is mainly determined by the fact that the protein content is exclusively in the form of low molecular weight peptides and free amino acids. Hydrolysed and amino acid formulas therefore have an increased osmolality when compared to regular infant formulas. A study by Pereira-da-Silva et al. (53) investigated the impact of feed concentration (12, 14 and 16 g/100 ml) with modular additions (10% and 20% carbohydrate/fat mixture, respectively) on the osmolality of semi-elemental and elemental formulas and found that when the concentration reached 16 g/100 ml, it yielded an osmolality of 381 mOsm/kg (elemental formula), and this increased well above 400 mOsm/kg for both elemental and semi-elemental formula with a 20% modular addition. One needs to take into account that the authors of this study did not assess the osmolality of a 20 g/100 ml concentration, which is

Table 3 Examples of fortified and concentrated formulas (calculation aimed to achieve ≈ 1 kcal/ml, which is similar to energy-dense formulas available for non-allergic infants with poor growth)

Per 100 ml	Pepti 1 (Aptamil)	Pepti with Modular Addition	Nutramigen L.p.11 (Mead Johnson)	Nutramigen L.p.11 with Modular Addition	Neocate LCP (Nutricia)	Neocate LCP with Modular Addition
Extensively hydrolysed hypoallergenic formula and amino acid formula with the addition of a fat/carbohydrate blend (6 g/100 ml) to achieve ≈ 100 kcal/100 ml						
Energy (kcal)	67	97	68	98	70	99
Protein (g)	1.6	1.6	1.9	1.9	1.9	1.9
% Protein	9.6	6.6	11.1	7.7	10.8	7.6
Fat (g)	3.5	4.8	3.4	4.7	3.4	4.7
Osmolality	280	Not measured	280	Not measured	360	Not measured
Per 100 ml	Pepti 1	20 g concentrated Pepti	Nutramigen	20 g concentrated Nutramigen	Neocate	20 g Neocate concentration
Extensively hydrolysed hypoallergenic formula (Nutramigen1, Mead Johnson) and amino acid formula (Neocate LCP, Nutricia) concentrated to a 20 g concentration						
Energy (kcal)	67	98.6	68	100	70	95
Protein	1.6	2.32	1.9	2.8	1.95	2.6
% Protein	9.6	9.5	11.1	11.1	11.1	11.1
Osmolality*	280	446	280	424	360	455
PRSL†	139	207	179	264	158	219

*Osmolality measured in Great Ormond Street Hospital for Children, using electronic scales (0.1 g accurate).

†Potential Renal Solute Load (PRSL) as described by Ziegler et al. (51).

commonly used in practice. We have measured the osmolality of a whey, casein hydrolysate and an amino acid formula at this concentration and found that they were all above 400 mOsm/kg (Table 3). The hazards of scoop measurements have also been well described by Jeffs who found great variation in how mothers use the scoops of infant formulas (54). Inaccurate scoop measurements in the home setting can therefore add to the concerns of both increased osmolality and renal solute load.

No specific guidance on tolerance of osmolality has been published for the CMPA child, but the Committee on Nutrition of the American Academy of Pediatrics has recommended infant formulas with concentrations no > 400 mOsm/kg and enteral feeds according to ESPGHAN at no greater than 350 mOsm/kg (53, 55). However, it may be that the tolerance of hypoallergenic formulas in children with cow's milk protein induced enteropathy and gastro-oesophageal reflux

maybe somewhat lower than the aforementioned safe levels. Many hypoallergenic formulas are also high in long-chain fatty acids, which also have a significant effect on gastric emptying (56). It is therefore important to monitor any increase in concentration/modular additions as this can lead to reduced volume consumption, diarrhoea, vomiting and feed refusal.

Hypoallergenic formulas are known for their poor palatability, which in general is not a problem for the taste naïve child below 6 months of age, but introduction after this age can be more challenging, in addition to its potential impact on future taste preferences (57, 58). Increasing the concentration of formulas intensifies this bitter taste and may lead to refusal of a previously consumed hypoallergenic formula. The nutritional intervention should therefore be considered carefully, depending on the type of CMPA (IgE, non-IgE or combined), the type of symptoms, as gastrointestinal

Table 4 Practical suggestions

Intervention	Consideration	Practical Solution
Modular Additions*	Reduction in energy % from protein Osmolality of feed Risk of getting additions wrong Additions add to labour of mixing feed	Limit additions to 3 g of carbohydrate/fat blend or 15 kcal/100 ml (keep protein/energy ratio) Ensure that parents have the correct measuring devices to make additions as easy as possible Provide parents with written advice on additions Possibly not a good solution where parents are overwhelmed by diagnosis Suitable whilst consuming hypoallergenic formula
Concentration of feeds*	Increase in osmolality Increase in renal osmotic load Affects taste of feed Risk of getting it wrong is high	Try not to increase feed concentration more than ≈ 16 g/100 ml Ensure that child consumes sufficient other liquids before recommending an increase in concentration Slowly increase the concentration so that the child can get used to the altered taste Parents require very specific advice on how to mix formula. May not be a good solution for parents that are overwhelmed by other factors Suitable whilst consuming hypoallergenic formula
Addition of hypoallergenic formula powder to food	Alters taste Limited fluid may increase renal solute load Additional labour for the parents	Increase the amount slowly Ensure that the child consumes sufficient other liquids If parents are already overwhelmed by other factors, not a good method. Can reach similar energy density with the addition of energy-dense milk-free foods
Addition of energy and protein to food	Can alter the taste of food Can create extra work for parents Difficult to calculate protein energy ratio of food	Ensure that foods that are added are part of the child's diet and that these are added slowly. (i.e. olive oil can have a strong taste and may be rejected by a child) Add foods that are already used in the household and do not create extra work It is not practical for parents to weigh food and for exact calculations of food intake to take place regularly. Ensure that additions are made in proportion.
Recipes using hypoallergenic formula	Palatability of cooked foods Can the parents cook	Parents often assess taste according to their own preferences. In many instances the allergic child would not know how that recipe would taste with a cow's milk product. Highlight this to the parents Not useful suggestions if parents cannot cook

*It is not suggested to concentrate feeds and make modular additions, as this would increase osmolality significantly and may lead to diarrhoea and vomiting. Where there is no option, table 4 provides guidance on safe suggestions and additions.

involvement may impact on the tolerance, the level of malnutrition and concomitant factors like food aversive behaviour. Once this has been established, parents should be provided with practical dietary advice that is achievable and will lead to optimal catch-up growth (Table 4).

Further factors that will influence the success of dietary implementation include number of other children in the family (i.e. time parents can spend on feeding child with CMPA), educational level, cooking skills, parental status (i.e. single parent) and financial means. It is important to consider the consequences of the feeding plan, which can add to the existing anxiety for families coping with a child with food allergies, and may lead to the development of feeding difficulties, which further complicates the dietary management (59).

Complementary food

It is important that the introduction of complementary foods is not delayed beyond 6 months of age in any infant with CMPA, more so in the malnourished allergic child (60). In addition, other allergens (i.e. wheat, egg, fish, nuts), the child is not be allergic to, should not be avoided, as this does not prevent the development of further allergies, and these foods contribute significantly to both energy and protein (61). For the child that has already been weaned appropriately, enriching foods with hypoallergenic formula, introducing milk-free energy-dense food alternatives and using the hypoallergenic formulas to cook sauces/make desserts and bake may assist in achieving the goal energy and protein intake. However, one should also consider the possible impact on taste when hypoallergenic formulas are added to foods.

Vitamins and minerals

Vitamin and mineral supplementation should be born in mind in this population. If the consumption of hypoallergenic formula is between 500 and 600 ml/day (Table 5), clinicians should calculate the amount of vitamin D and calcium provided by the diet of the child and supplement accordingly, and if formula consumption is <500 ml/day, a multivitamin (including Vitamin D) and calcium are indicated.

Monitoring the malnourished child with CMPA is extremely important. Weight, length/height and head circumference (<2 yr) should be repeated at every visit. The

Table 5 Calcium and Vitamin D content of hypoallergenic formulas suitable for children <1 yr of age

Name of Hypoallergenic Formula	Calcium/ 100 ml (mg)	Vit D/ 100 ml (µg)
Nutramigen Lipil 1 (Mead Johnson)	77	1
Nutramigen Lipil 2 (Mead Johnson)	94	1.1
Pregestimil Lipil (Mead Johnson)	78	1.25
Pepti 1 (Aptamil)	47	1.3
Pepti 2 (Aptamil)	63	1.4
Pepti Junior (Cow and Gate)	54	1.3
Althera (Nestle)	41	1.0
Alfare (Nestle)	54	1.1
Neocate LCP (Nutricia)	68.5	1.2
Nutramigen AA (Mead Johnson)	64	0.85

frequency depends on the severity of malnutrition, and the feeding regime is suggested.

Continuing poor growth

In some cases, weight and height/length growth may continue to be below the catch-up growth rate suggested by the WHO/FAO/UNU. This may be related to not achieving energy and protein requirements orally because of food refusal, poor gastric compliance and vomiting, but can also be associated with chronic inflammation (62). It is therefore important to establish firstly the dietary reasons for not achieving optimal catch-up growth, which may require the consideration of enteral feeding (nasogastric or gastrostomy), but then also to ensure that these children are assessed medically as to whether further medical investigations and interventions are required (Box 1).

Summary of process

Step 1: Ascertain level of malnutrition by weight, length/height and head circumference measurement.

Step 2: Decide on rate of catch-up growth required (based on the weight for height or S.D. scores.) and feasibility of this, depending on the individual patients' current dietary intake and allergen restrictions.

Aim for between 8.9 and 11.5% of energy to be provided by protein and consider increasing this, depending on the level of stunting.

Step 3: Plan how to achieve protein and energy requirements taking the protein energy ratio into account.

- choose correct hypoallergenic formula
- decide whether additions or adjusted concentration is appropriate
- food fortification
- feeding strategies

Consider vitamin and/or mineral supplementation.

Step 4: Monitor patient and adjust diet plan accordingly.

Conclusion

Malnutrition commonly occurs in children with CMPA. The focus on catch-up growth has changed, as weight gain, in itself, does not indicate a return to physiological, biochemical, immunological or anatomical normality. Whilst no specific guidelines exist for the cow's milk allergic child, existing guidelines published by the WHO/FAO/UNU may be useful. Although many of the nutritional solutions presented in this article are extrapolated from research on non-allergic children, in the absence of a ready-to-feed 1 kcal/1ml palatable, hypoallergenic formula with a protein/energy ratio according to current guidelines, clinicians have no choice but to resort to other methods to achieve optimal catch-up growth.

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