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# The new concept of stepped diet therapy of acute enteric infections in children

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**Abstract:** The article describes the main principles of stepped diet therapy of acute intestinal infections in children developed on the basis of nutritive support staging, depending on patients' age, stage and severity of disease. Significance of functional food products for diet therapy tactics in patients with mild and moderately severe forms of infection is demonstrated.

**Keywords:** Acute Intestinal Infections, Stepped Diet Therapy

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## 1. Introduction

Acute intestinal infections are still among the most common infectious diseases in children, especially infants. Nutrition disorders in children with acute intestinal infections develop in the early stages of the disease and are related to both the course of the infection and metabolic changes caused by the disease.

Children with acute intestinal infections develop a regular urgent adaptation reaction. It includes activation of all the protective and homeostatic mechanisms of the body, functional and plastic reserve deficiency, stereotypic metabolic response regardless of the disease etiology, significant functional changes of many organs and organ systems, and changes in the body's metabolic processes [1].

The fast exhaustion of glycogen reserves within the first 24 hours of the disease, followed by the stimulation of gluconeogenesis pathway, is a characteristic feature of metabolic disorders in pediatric intestinal infections. It involves promotion of structural proteins catabolism, increase in ketone bodies levels and activation of lipid peroxidation, which worsens the intoxication syndrome in this group of patients. The distinctive feature of the metabolic response in this case is the lack of the effect from exogenous glucose introduction on the gluconeogenesis and, therefore, on muscle catabolism [2].

Enteral nutrition is a necessary component in management of such patients, even those with severe forms

of acute intestinal infections, since nutrients affect the nutritive status of a sick child and the state of immunobiological reactivity, produce an enteroprotective effect, and help to maintain enteric flora and all the organ systems functions. Wrong dieting causes decrease in the adaptation potential and the immunological functions of the body.

Despite the marked derangements of nutritive status that are characteristic for the pediatric acute intestinal infections, anorexia, vomiting and diarrhea, 80-90% of dietary carbohydrates, 70% of lipids, and 75% of proteins are absorbed in the intestine [3]. However, the specifics of the infection course, the adaptation reactions, and nutritive status in acute pediatric intestinal infections require a pediatrician to use a special approach to the dietary management, taking into consideration patient's age, disease type and duration.

The basic principles of the dietary management of infectious diseases (in particular, in the acute intestinal diseases) were developed by M.I.Pevzner back in 1927 [4].

It is widely accepted in present that continuation of enteral nutrition in acute pediatric intestinal infections is obligatory and it has been proved that tea and water fasting and starvation diets significantly weaken body's protective potential and suppress reparative processes in the intestine [3, 5].

There are detailed publications on problems of dietotherapy in the acute intestinal infections of infants.

The role of breast feeding and adapted nutrition (in children on artificial feeding) has been demonstrated [3, 6-8, 22].

There is a considerable number of publications on the role of functional nutrition products and probiotic-containing nutrition formulas for infants both in acute period of the disease and during rehabilitation after the acute intestinal infections [9-13].

Based on the study of lactase insufficiency with clinical and laboratory assessments in children younger than 3 years of age with acute intestinal infections, the lactase insufficiency symptoms are present in 91.4%. Therefore, addressing this issue plays an important role in dietotherapy of pediatric intestinal infections [15-18].

Problems of the intestinal infections dietotherapy in children older than 1 year of age are less covered in the literature [20, 21]. The role of enteral feeding with specialized clinical nutrition products has been demonstrated in severe acute intestinal infections [16, 19].

However, novel clinical dietology approaches in pediatrics describe nutrition assessments of certain groups of patients with acute intestinal infections; at present, one of current issues is the creation of the unified dietary management system for this disorder that would take into consideration patient's age, severity of metabolic disorders, and disease stage and form.

## 2. Principles of Stepped Diet Therapy

We have developed the system of stepped diet therapy implying staged organization of the nutritional support depending on the age and disease stage and severity.

The common requirement for all groups of patients is timeliness of initiation of the diet therapy, which should be initiated on the first day of the disease and last until normalization of the metabolic status and achievement of positive changes in child's condition. At the same time, nutrition should be adequate for each stage and balanced in regard to macro- and micronutrient content.

The stepped diet therapy regimen includes three main stages; for each of them a certain stage of the dietotherapy is pathogenetically substantiated.

Each of the diet therapy stages is determined on the basis of clinical presentation, morphological and functional changes caused by the infection, as well as of the disease severity and child's age.

## 3. The First Stage of Stepped Diet Therapy

The first stage of stepped diet therapy organization corresponds to the acute stage of the disease, the second stage to the "repair" period, and the third one to the convalescence period.

The acute period of the disease corresponds to the first organization stage of the stepped diet therapy. The distinctive feature of this period is the presence of marked

clinical symptoms, nutritive status imbalance, significant morphological and functional changes in the body caused by a damaging factor (acute intestinal infection agent). The diet therapy at this stage should provide optimal balance of nutrients (in particular, with regard to the amount of dietary proteins, since additional protein intake (despite intensive catabolic processes during the acute stage of the disease) brings no advantages, but rather leads to increased metabolic load), provide adequate metabolic support and enterosorption (rice water and pectin-containing products used to be commonly prescribed).

According to the proposed scheme of the stepped diet therapy for infants (children younger than 1 year of age) on artificial feeding (scheme 1), different types of nutritional support are recommended during the first stage, depending on the disease severity.

For example, patients with the severe disease should be administered with specialized enteral formulation derived from highly hydrolyzed lactalbumin (e.g. Alfare) that have proven their efficacy in a variety of clinical trials [3, 22, 23]. Such feeding should be continued until the restoration of the basic homeostatic parameters and alleviation of the intestinal infection signs and symptoms (cessation of vomiting and anorexia, decrease in defecation frequency and improvement of stool characteristics).

For children below one year of age on artificial feeding with moderate acute intestinal infections, sour-milk formulas intended for this age group are recommended according to the scheme of the step-diet [3, 16, 22]. If lactase insufficiency develops, low lactose or lactose-free formulations for the corresponding age are recommended; they have proven benefits in coping with this condition in children below one year of age with acute intestinal infections over the other methods of nutritional support [3, 4].

If a patient develops a mild form of the disease, then, at this stage, the probiotic-containing functional nutrition products intended for children below one year of age should be the major constituent of the diet. Therapeutic effects of probiotics containing in food are related to maintenance of colonization resistance, first of all, in the biotope of the intestinal mucosa, via the immunomodulating effects as well as their impact on metabolic, disintoxication and other processes [24].

On the first stage of the stepped diet therapy for children over 1 year of age, the choice of nutrition management tactics also depends on the disease severity (scheme 2).

Therapeutic enteral nutrition products (for instance, Clinutren Junior) have proved their efficacy in clinical trials of nutrition support in severe acute intestinal infections [16, 19]. A clinical nutrition product used for dietotherapy of patients with severe intestinal infections should meet needs of the growing child's organism, as well as not to increase osmolality of the intestinal contents (as the intestinal mucosal barrier is damaged), have optimal protein content (increased portion of serum proteins) and should not contain lactose. These enteral feeding products

were widely used previously in patients with severe inflammatory intestinal diseases (nonspecific ulcerative colitis, Crohn's disease) and in surgical interventions. At present, recent clinical trials results permit to expand the scope of their application in the dietotherapy and prescribe these products in severe acute intestinal infections [19].

For children over 1 year of age with moderate acute intestinal infections, most authors recommended to exclude unprocessed milk from diet and to prescribe sour-milk formulas products as a dietotherapy [3]. Favorable properties of these products in acute intestinal infections are explained by a number of factors; in particular, presence of lactic acid adds marked bactericidal properties to the product due to suppression of growth of pathogenic microflora and potentiation of normal flora growth. Besides, it has been proved that cultured milk products positively affect intestinal microbiocenosis, secretory function of digestive glands, and intestinal peristalsis. They also have immunomodulating properties [23].

Use of milk-free cooked cereals with probiotics and synbiotics is one of important components of stepped diet therapy in this category of patients. The clinical studies results have demonstrated that use of these products contributes to a faster relief of major signs and symptoms of intestinal dysfunction and to the recovery of intestinal microbiocenosis [21].

For older patients with mild acute intestinal infections (as for the infants), functional nutrition products with probiotics are recommended at the first stage, according to the proposed stepped diet therapy scheme (scheme 2).

## 4. The Second Stage of Stepped Diet Therapy

The second stage ("repair" period) is characterized by the alleviation of resolution of the major signs and symptoms of an acute intestinal infection. The patient's condition is being improved, the child becomes more active, an appetite is increasing (in some patients it may become excessive), which is interpreted by many parents as a signal to intensify feeding. However, morphological and/or functional changes in the patient's organism are still present, and, therefore, the dietotherapy should be continued during this period. This period also has prognostic implications, since failure to follow the diet may lead to development of gastroenterological disorders (pancreas, bile ducts, and other organs). The diet therapy at this stage should account for intestinal repair processes, allow for gradual pancreatic and biliary functions restoration, as well as recovery of gastrointestinal microbiocenosis.

According to the stepped diet therapy scheme, the nutritional support regimen is prescribed on the individual basis (depending on the course of the acute stage of the disease) during the repair period. For this purpose, we should move to a lower step from the one applied during the first dietotherapy stage in the scheme. For example, in

patients with severe forms of acute intestinal infections, cultured milk products, lactose-free and low lactose products are indicated during the repair period, according to patient's age. For patients below 1 year of age recovering from mild and moderate acute intestinal infections, nutrition formulas with probiotics are recommended during the second stage of the dietotherapy; probiotic products should be given to the older children (schemes 1 and 2).

## 5. The Third Stage of Stepped Diet Therapy

The third stage is the convalescence period. The basic approach to diet therapy of acute intestinal infections in children at this stage is gradual extension of the diet according to child's age. Use of probiotic food products is encouraged to recover and sustain gastrointestinal function and microbiocenosis.

## 6. Conclusion

Thus, the abovementioned scheme of the stepped diet therapy permits a clinical practitioner to unify the approach to the nutritional support of pediatric patients with acute intestinal infections, taking into consideration their age as well as disease severity and stage.

**Scheme 1.** The stepped diet therapy for infants on artificial feeding with acute intestinal infections.

<b>Severe</b>	Protein hydrolysate formulas		
	Sour-milk formulas,	Sour-milk formulas,	
<b>Moderate</b>	lactase-free and low lactose nutrition formulas	lactase-free and low lactose nutrition formulas	
	Formulas with probiotics	Formulas with probiotics	Formulas with probiotics
<b>Mild</b>			
	<b>Acute period</b>	<b>Repair period</b>	<b>Reconvalescence period</b>

**Scheme 2.** The stepped diet therapy for children over one year of age on artificial feeding with acute intestinal infections

<b>Severe</b>	Enteral formulas		
	Sour-milk formulas,	Sour-milk formulas,	
<b>Moderate</b>	lactase-free and low lactose nutrition formulas	lactase-free and low lactose nutrition formulas	
	Functional nutrition products	Functional nutrition products	Functional nutrition products
<b>Mild</b>			
	<b>Acute period</b>	<b>Repair period</b>	<b>Reconvalescence period</b>

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