The treatment and management of severe protein-energy malnutrition

World Health Organization
Geneva

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Preface

This manual is designed to offer simple guidelines for the treatment of severe protein-energy malnutrition (PEM). In spite of all the progress made in this field, it appears that children presenting severe forms of PEM are still dying at a very high rate, even when they are hospitalized. This is an unacceptable situation in view of present knowledge. It is hoped that this manual, by outlining as clearly as possible the principles of treatment and making them accessible to middle-level health personnel, will make a useful contribution to the reduction of mortality and suffering among children handicapped by severe PEM.

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1. Introduction

This manual is intended to provide health personnel responsible for the care of infants and children suffering from severe protein-energy malnutrition (PEM) with guidelines for their treatment and rehabilitation. While severely malnourished children are usually cared for in hospital, the manual can of course be used in other settings.

The objective of the manual is to promote the use of the best available therapy in order (*a*) to reduce the number of deaths from severe PEM among infants and young children, and (*b*) to speed up the rate of recovery from PEM as much as possible.

Since many complications are associated with severe protein-energy malnutrition, the manual offers guidelines for the treatment of the most common ones. These include:

(1) moderate or severe dehydration;
(2) manifest or suspected infection;
(3) eye signs of severe vitamin A deficiency, e.g., dryness, softening, or clouding of the cornea;
(4) severe anaemia;
(5) hypoglycaemia;
(6) continuing or recurrent diarrhoea;
(7) skin lesions and mucous membrane lesions;
(8) marked anorexia (no desire to eat);
(9) hypothermia.

Severely malnourished children frequently present one or more of these complications.

Classification of protein-energy malnutrition

There are two basic forms of clinical protein-energy malnutrition—marasmus and kwashiorkor—and a mixed form, marasmic kwashiorkor. The leading signs for a diagnosis of marasmus are those of starvation: an "old man's face", an emaciated body that is "only skin and bones", accompanied by irritability and fretfulness. The leading signs in kwashiorkor are oedema and apathy, often accompanied by discolo-

ration of the hair and, especially if the oedema is severe, by "flaky paint" dermatosis. The child with pure kwashiorkor is not excessively emaciated. In many populations mixed forms, e.g., marasmus with oedema, are more common than pure kwashiorkor.

Conventionally, protein-energy malnutrition is also classified by the degree of underweight compared to average (western) children of the same age (see Annex 5), and the presence or absence of oedema.

Children with marasmus, marasmic kwashiorkor, and kwashiorkor all have severe PEM. The treatment and management of these three forms of severe malnutrition are the same.

2. Management of the seriously ill patient

It is important to recognize dehydration and specific infections, such as pneumonia and septicaemia, which often accompany PEM and contribute to its severity. When a child with PEM is seen for the first time, a history of his recent physical condition should be taken, and a physical examination should be made. Since dehydration is one of the most dangerous complications, it must have first priority for treatment. Restoration of diet and prevention or cure of infection, severe anaemia, hypoglycaemia, and vitamin A deficiency also have high priority. Even for very ill patients, immediate treatment of the right kind is usually life-saving in the early phase.

History and examination of the patient

History

The following points should be noted:

- Previous intake of food and fluids
- Duration and frequency of vomiting and diarrhoea
- Presence of fever, difficulty in breathing
- Urine flow and when urine was last passed
- Mental apathy and loss of appetite
- Past history of measles.

Examination

- Take the weight of the child.
- Take the temperature, using a low-recording thermometer.
- Record the pulse and respiratory rates.
- Check for signs of dehydration (see below).
- Examine ears, throat, and chest for evidence of infection.
- Note the presence of oedema and/or severe anaemia, or the two in combination.
- Note the presence of photophobia, i.e., abnormal intolerance of light (in areas where vitamin A deficiency is prevalent).

Investigations

Where facilities permit, the following investigations are helpful:

- Haemoglobin (values amounting to less than 30 g/l or Hb(Fe) of below 1.86 mmol/l or an erythrocyte volume fraction (haematocrit) of less than 10 indicate severe anaemia)
- Urine examination for pus cells
- Stool examination for presence of ova and parasites
- X-ray of the chest
- Blood-smear examination for malarial parasites (in areas where malaria is common)
- Examination of blood for sickle-cell haemoglobin (in areas where sickle-cell anaemia is common).

Assessment of dehydration

The child with PEM nearly always suffers from diarrhoea and vomiting, which result in some degree of dehydration. In mild dehydration, the child is often thirsty, restless, and irritable, without any other clinical signs; however, fluid loss of up to 5% of body weight (50 ml/kg body weight) may have already occurred. With further fluid loss (6–9% of body weight), signs of moderate dehydration appear. When the loss equals or exceeds 10% of body weight (100 ml/kg body weight or more), signs of severe dehydration appear. In severe dehydration, the child is limp, lethargic, or unconscious, with sunken eyes, dry tongue, and weak or absent radial (wrist) pulses. Urine flow is scanty or absent. Severely dehydrated children pass into shock, and are *very seriously ill.* Table 1 summarizes the symptoms of mild to moderate and of severe dehydration.

Table 1. How to assess degree of dehydration

Sign [a]	Dehydration	
	mild/moderate	severe
1. Patient's appearance	alert or restless, thirsty	limp or unconscious, too weak to drink well or to drink at all, cold skin (shock)
2. Radial pulse	present, rapid	weak or absent
3. Eyes, fontanelle	normal or slightly sunken	sunken
4. Urine flow	normal or small	none for several hours
5. Skin elasticity	normal or slightly less than normal	poor

[a] See details below.

1. *Patient's appearance.* Thirst is an important early sign of dehydration; however, infants cannot say that they are thirsty. They show their thirst by crying and being eager to drink fluid given to them. There may be no signs in early, mild dehydration, but as dehydration increases, the children grow restless and weak. Finally, they become dazed, lethargic, and then unconscious. Their bodies become limp, their hands and feet become cold, and they are near to death. This condition is called shock.

2. *Radial pulse.* Dehydration causes the pulse rate to increase and the strength of each pulse beat to be weaker. With severe dehydration, the pulse at the wrist (radial pulse) may become absent altogether, and a pulse may be felt only in the groin (femoral artery), arm (brachial artery), or neck (carotid artery). In such cases, the children are near to death.

3. *Eyes and fontanelle.* In severe dehydration, the eyes appear sunken and the anterior fontanelle (on the top of the forehead) is depressed. In mild to moderate dehydration, these signs are minimal or absent.

4. *Urine flow.* In dehydration, very little urine is passed, and in severe dehydration the child might not have passed urine for several hours.

5. *Skin elasticity.* In patients with marasmus or marasmic kwashiorkor, lack of elasticity of the skin is not necessarily a sign of dehydration and reliance should be placed on other signs. In kwashiorkor, dehydration can occur in the presence of oedema. The skin at the side

of the neck and over the abdomen are useful sites to test for elasticity. Do not test for distension in skin overlying oedematous areas.

Treatment of mild to moderate dehydration

Most patients with severe PEM and mild to moderate dehydration can be treated by *oral* or *nasogastric* administration of fluids.

Oral rehydration

(*a*) *What fluid to give*

The "oral rehydration salts" (ORS) solution is recommended. It is prepared by dissolving one packet of these special salts in 1 litre of clean drinking-water (i.e., drinking-water that has been boiled and cooled). The composition of the salts is as follows:

sodium chloride (table salt)	3.5 g
sodium bicarbonate (baking soda)	2.5 g
potassium chloride	1.5 g
glucose	20.0 g
(Sometimes 0.5 g of flavouring is added)	

A fresh ORS solution should be made up every 12–24 hours. The solution itself must not be boiled.

(*b*) *How much fluid to give*

Between 50 and 100 ml of ORS solution per kg of body weight, depending on whether the dehydration is mild or moderate, is usually enough to restore normal hydration. This amount should be given in the first 4–6 hours of treatment, in small quantities every few minutes. If the signs of dehydration are still present after 4–6 hours but the condition is improving, the same amount of ORS solution can be given again over the next 4–6 hours.

(*c*) *Assessment of the patient's condition*

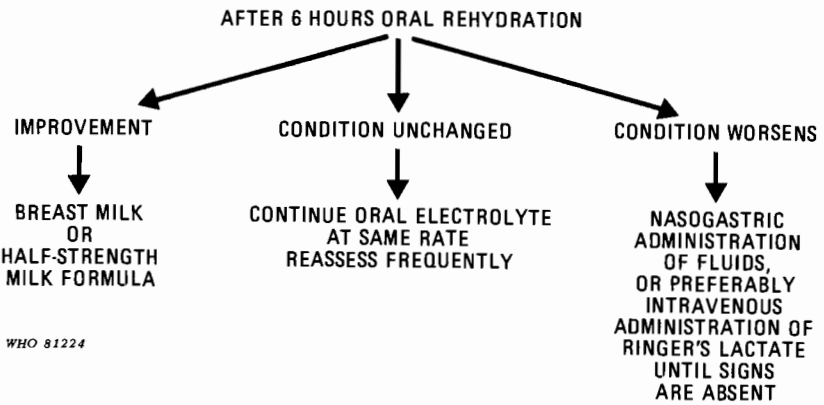
After 4–6 hours of oral rehydration, reassess the patient's condition (Fig. 1). Signs of improvement are:

- Vomiting has ceased.
- Oral feeding is tolerated.

— Urine is passed.
— The mental state has improved.

When the patient is fully rehydrated (i.e., the signs of dehydration have gone), *maintenance* therapy with ORS solution should be started and continued until the diarrhoea stops.

Fig. 1. Assessment of patient's condition following oral rehydration



Nasogastric administration of fluids

Nasogastric tube feeding should be started immediately in children who vomit constantly or who cannot be fed orally. Some notes on the administration of nasogastric fluids are given in Annex 1.

The volume of fluid to be given by nasogastric tube is:
— 120 ml/kg body weight for the first 6 hours, divided into 12 portions, with one portion given every half-hour.

Maintenance therapy

If diarrhoea continues after complete rehydration has been achieved, the amount of water and salt lost by the body owing to the diarrhoea should be replaced by ORS solution—this is maintenance therapy. For mild diarrhoea, 100 ml/kg body weight per day should be adequate; for severe diarrhoea, 2–4 times this amount may be required.

The volume of ORS solution given should match as closely as possible the volume of stools passed.

If signs of dehydration reappear, rehydration therapy as described earlier should be started again.

After the first 4–6 hours of rehydration therapy and during maintenance therapy, it is important to give other fluids *in addition* to ORS solution. A breast-fed infant should be given breast milk as often as he desires it. A non-breast-fed infant should be given clean drinking-water in a volume equal to half the volume of ORS solution taken by the infant. This should be repeated at regular intervals. When full rehydration is achieved, and this should not take more than 8–12 hours, half-strength milk preparations (i.e., half the strength normally taken by the infant) can be started. For older children and adults, water should be available throughout therapy with ORS solution.

Treatment of severe dehydration

Patients with severe dehydration and patients who do not respond after oral or nasogastric fluids must be treated by intravenous fluid.

How to give intravenous fluid (see also Annex 1)

Before starting treatment with intravenous fluid, weigh the patient, record the pulse and respiratory rates, record the size of the liver, and examine the chest for basal crepitations.

What fluid to give

— Compound solution of sodium lactate (Ringer's lactate solution for injection; Hartmann's solution):

Ingredients

lactic acid	2.4 ml
sodium hydroxide	as needed (see below)
sodium chloride	6.0 g
potassium chloride	0.4 g
crystallized calcium chloride	0.4 g
distilled water	

Preparation

Mix the lactic acid with 200 ml of the distilled water and add a solution of sodium hydroxide in distilled water until a few drops of the resulting solution give an orange colour with phenol red TS. Bring to the boil and add the solution of sodium hydroxide until a few drops of the resulting solution give a permanent orange colour with phenol red TS. Dissolve the other ingredients in 700 ml of distilled water, mix the two solutions, and make up to 1000 ml with distilled water. Filter, and sterilize immediately.

How much fluid to give

To correct the dehydration, give 70 ml/kg body weight of fluid in the first 3 hours of treatment, i.e., 30 ml in the first hour of treatment, and the rest over the next 2 hours.

After the first 3 hours, continue giving Ringer's lactate only if the patient will not take ORS solution by mouth or if signs of dehydration are still present. It is important to assess the patient's condition at regular intervals and to determine the adequacy of treatment and adjust the rate of infusion as necessary. Table 2 is intended to help with this assessment. When the patient is fully rehydrated, start maintenance therapy with ORS solution by mouth as described earlier.

Table 2. How to assess intravenous therapy in severely dehydrated children

Improvement	Too much fluid infusion too fast	Too little fluid infusion too slow
Awake and alert	Respiratory rate increases	Lethargic, thirsty
Passes urine	Eyes puffy	Eyes sunken
Skin warm	Liver tender and enlarged	Pulse weak
Pulse good	Basal crepitations	Urine flow reduced or non-existent
Takes oral feeds		

With improvement, oral feeding can be started and the intravenous fluids discontinued.

If too much fluid is given, the infusion should be stopped immediately.

If too little fluid is given, check intravenous tubing and continue or restart the infusion at a faster rate. Reassess the patient's condition frequently.

When intravenous fluid cannot be given

Where intravenous therapy cannot be carried out and the severely dehydrated patient has to be transferred to another centre, the following immediate treatment may be life-saving:

— Rapid intraperitoneal infusion of 70 ml/kg body weight of half-strength Ringer's lactate solution.

Some notes on the administration of intraperitoneal fluids are given in Annex 1.

Infections

Infections are commonly associated with severe PEM. Hypothermia rather than fever may be present in the malnourished child with a severe infection. Pneumonia and septicaemia are frequently the immediate cause of death in these patients.

It is recommended that all severely malnourished infants and young children be given antibiotic therapy.

Antibiotics to use

The severely malnourished child who does not have clear-cut signs of specific infection should receive a combination of procaine benzylpenicillin and ampicillin. If ampicillin is not available, procaine benzylpenicillin should be given with either chloramphenicol or tetracycline.

When the causative agent of the infection is known or suspected, the appropriate antibiotic therapy should be used. Thus for common infections such as pneumonia, otitis media, tonsillitis, and impetigo, procaine benzylpenicillin is the drug of choice.

Treatment schedules are as follows:

Procaine benzylpenicillin (water-miscible)

Route: intramuscular
Dosage: 1–2 ml once daily for 5–10 days

Plus

Ampicillin

Route: Give orally unless there is vomiting or severe diarrhoea, in which case the intramuscular route is recommended. If the patient is receiving an intravenous infusion, the drug should be given intravenously. (Inject the drug via the intravenous tube and not into the intravenous bottle or chamber.)

Dosage: 125 mg at 6-hour intervals for 5–10 days (500 mg per day)

Or plus

Chloramphenicol

Route: Oral or intravenous
Dosage: 50 mg/kg body weight per 24 hours at 6-hour intervals for 5 days

Or plus

Tetracycline

Route: Oral or intravenous
Dosage: 25–50 mg/kg body weight orally per 24 hours at 6-hour intervals for 5 days, or 10–15 mg/kg body weight intravenously per 24 hours at 12-hour intervals for 5 days.

For the treatment of other specific infections and conditions associated with PEM, see section 4 and Annex 3.

Feeding during the first week

In patients who are not dehydrated or in whom dehydration has been corrected, oral feeding starts with small frequent feeds of dilute milk. The aim is to provide the patient with some energy and protein without provoking vomiting or diarrhoea. The strength and volume of the feeds are gradually increased and the frequency of feeding decreased over the next few days. Nursing mothers should be encouraged to continue breast-feeding small infants in order to maintain lactation. A typical feeding schedule for a severely malnourished child is given in Table 3.

Table 3. Typical feeding schedule for the severely malnourished child

Days in centre	Type of feed	No. of feeds per day
1 [a]	Oral rehydration salts (ORS)	12
2	Half-strength milk feeds	12
3	Half-strength milk feeds	8
4, 5	Full-strength milk feeds	8
6 onwards	High-energy milk feeds	6

[a] If diarrhoea, vomiting, or dehydration are not present, start half-strength milk feeds on day 1.

How many feeds to give

Malnourished patients should be fed 125 ml/kg body weight each day for the first 4 or 5 days.

As the child's appetite increases on days 6, 7, and 8, oral feeds are increased in amount to 150 ml/kg body weight per day, and are given every 4 hours (6 feeds per 24 hours).

How often to feed

For the first 2 days malnourished children should be fed every 2 hours, or 12 times a day. This frequency of feeding reduces the risk of the patient's developing hypothermia and hypoglycaemia. Severe vomiting and diarrhoea are less likely to occur.

When the patient is feeding satisfactorily, feeds should be given every 3 hours for the next 2 or 3 days, and then at 4-hourly intervals.

What feeds to give

From the first or second day, the malnourished child should be fed a dilute milk feed, such as half-strength milk, for a day or two. When the patient accepts this well, a full-strength milk feed can be given on days 4 and 5. Towards the end of the week, when feeding is satisfactory, a high-energy milk feed is started.

When a patient does not tolerate a change in formula or an increase in the size of the feed, it is best to return to a more dilute feed and/or to reduce the size of the feed.

A small percentage of malnourished children cannot tolerate milk feeds because of the lactose content. This lactose intolerance results in the development of copious, frothy, and watery stools. In such patients, the stool should be examined (see pages 28–29) and where lactose intolerance is indicated, preparations made with K-MIX2 or yogurt should be given (see below).

How to prepare milk feeds

Either fluid milk (cow's, goat's, buffalo's, camel's or ewe's and canned evaporated milk) or milk powder (skimmed or full-cream powder) can be used to prepare milk feeds.

(*a*) *Cow's milk*

About 1 litre of full-strength milk feed is prepared by adding 50 g (10 teaspoons) of sugar to 1000 ml undiluted milk.

(Goat's, buffalo's, or ewe's milk can be used instead of cow's milk. For feeds based on buffalo's milk, 500 ml of milk should be used with 500 ml of clean (boiled and cooled) water and 50 g of sugar, since buffalo's milk is rich in fat.)

(*b*) *Evaporated milk*

500 ml of evaporated milk is mixed with 500 ml of water and 50 g of sugar added to prepare about 1 litre of full-strength milk.

(*c*) *Full-cream milk powder*

Add 150 g of milk powder—i.e., 30 teaspoons or 30 level scoops (as supplied with the tin)—and 50 g of sugar to 1000 ml of water to prepare approximately 1 litre of full-strength milk.

(*d*) *Skimmed milk powder*

Mix 75 g (15 teaspoons) of skimmed milk powder with 30 g (35 ml) of vegetable oil (6 teaspoons) and 50 g of sugar (10 teaspoons) to a smooth paste. Gradually add 1000 ml of water, stirring briskly. If the oil separates out on standing, whisk the milk well before feeding.

To prepare half-strength milk feeds, add 1 litre of water to 1 litre of full-strength milk feed made as above.

Full-strength milk feeds provide 0.33 MJ (80 $kcal_{th}$) per 100 ml of formula.

Half-strength feeds provide 0.165 MJ (40 $kcal_{th}$) per 100 ml of formula.

Yogurt preparation

Mix 50 g (10 teaspoons) of sugar into 1000 ml of yogurt to make approximately 1 litre of full-strength feed.

K-MIX2 formula

K-MIX2 is a food mixture produced for and distributed by UNICEF for the initiation of treatment of severe protein-energy malnutrition. Its composition is as follows:

calcium caseinate	3 parts by weight
skimmed milk powder	5 parts by weight
sucrose	10 parts by weight
retinol palmitate	2.75 mg (5000 IU vitamin A) per 100 g dry mixture

Mix 100 g of K-MIX2 with 50 g (58 ml) of vegetable oil to a smooth paste; gradually add 1 litre of water, stirring well. If the vegetable oil separates on standing, stir milk briskly before feeding.

3. Nutritional rehabilitation after the early phase

Introduction

After treating the initial life-threatening conditions, such as severe dehydration and infection, the next step is to correct as rapidly as possible the weight deficit that always occurs in severe PEM. Growth is normally a slow process, but during recovery from severe PEM it is possible to achieve very rapid rates of weight gain. This is called "catch-up growth".

Correction of the weight deficit is a very important aspect of the treatment of malnutrition. The formation of new tissue requires protein, but large quantities of protein are not necessary. It is the energy intake that chiefly determines the rate of "catch-up growth".

It is not enough simply to feed a standard infant milk formula. For really effective treatment a *high-energy feed* must be given.

The importance of special dietary management during this period must be stressed. The formula must be carefully mixed and given in the required amounts based on the patient's weight. The amount of formula taken should be recorded after each feed.

It is not uncommon to find, during the first week or so of high-energy feeding, that malnourished patients fail to gain weight despite an adequate intake. This is no cause for alarm and is due to changing body composition. However, in areas where tuberculosis is common, this infection should be suspected and the patient treated as described in Annex 3.

Setting for nutritional rehabilitation

It is neither necessary nor desirable for a patient to remain in a treatment centre or hospital until nutritional rehabilitation is achieved.

In many parts of the world, children recovering from malnutrition are transferred from a treatment centre or hospital to a nutritional rehabilitation centre or equivalent facility. At such centres a child should continue to receive the appropriate high-energy diet until rehabilitation is complete.

The advantages of such rehabilitation centres are:

1. The mother or the person taking care of the child can learn appropriate child-feeding methods and child-rearing practices, as well as simple measures of hygiene, by demonstration and practice. Parents can also learn about child spacing and family planning.

2. Children can receive appropriate immunization.

3. Rehabilitation centres are less expensive to run than treatment centres or hospitals.

4. In such an environment, loving care and affection, along with mental stimulation through play, can easily be provided. These are essential in the treatment of the malnourished child, but they are too often neglected in treatment centres.

When should patients be transferred to a nutritional rehabilitation centre?

It is wise to provide close supervision for the child recovering from malnutrition until he shows satisfactory progress. The child is ready to be transferred to a nutritional rehabilitation centre when:

(1) his mental state has improved as shown by his ability to smile and respond to stimuli, his awareness, and his interest in his surroundings;

(2) he is once again able to engage in such physical activities as sitting, crawling, standing up, or walking, depending on his age;

(3) his temperature is normal;

(4) he has no vomiting or diarrhoea;

(5) he has almost or completely lost his oedema, or, if no oedema was present initially, he begins to gain weight.

High-energy milk feeds and diets

High-energy milk feeds and diets are usually based on milk, sugar, and oil, but some also contain cereals. Several high-energy preparations

Table 4. How to prepare about 1 litre of high-energy feed

Ingredients				Energy or protein provided			
	Milk or milk preparation (g)	Oil (g)	Sugar (g)	Approximate total energy	Approximate energy per 100 ml	Protein g/l	Protein g/100 ml
Cow's/goat's milk	900	55	70	5.6 MJ [a]	0.56 MJ [b]	0.030	3.0
• Buffalo's/ewe's milk	800	30	65	5.6 MJ [a]	0.56 MJ [b]	0.030	3.0
• Skimmed milk powder [c]	90	85	65	5.6 MJ [a]	0.56 MJ [b]	0.032	3.2
• Full-cream milk powder [c]	120	55	65	5.7 MJ [d]	0.57 MJ [e]	0.030	3.0
• Evaporated milk	450	50	70	5.7 MJ [d]	0.57 MJ [e]	0.031	3.1
• K-MIX2 [c]	120	85	35	5.7 MJ [d]	0.57 MJ [e]	0.030	3.0
Yogurt [f]	900	65	70	5.7 MJ [d]	0.57 MJ [e]	0.030	3.0

• After mixing with oil and sugar, make up to 1000 ml with water.
[a] Approximately 1350 $kcal_{th}$.
[b] Approximately 135 $kcal_{th}$ per 100 ml.
[c] Unreconstituted.
[d] Approximately 1360 $kcal_{th}$.
[e] Approximately 136 $kcal_{th}$ per 100 ml.
[f] Energy value of milk with half the carbohydrates.

have been successfully used in the nutritional rehabilitation of malnourished children. The quantities of milk, oil, and sugar required to prepare some of these feeds are shown in Table 4. How to prepare such feeds by measuring out the ingredients by volume, or with cups and tablespoons, is shown in Annex 2.

The oil provides additional energy which is essential for "catch-up" growth. Most vegetable oils can be used.

For preparations containing milk powder (e.g., skimmed milk powder or full-cream milk powder), mix the milk powder, sugar, and oil to a smooth paste, then add to the paste small quantities of warm but not hot water that has been previously boiled and mix thoroughly with a rotary egg-beater. Where an electric blender is available, all the measured ingredients should be placed in a container and blended at high speed for a few minutes. For preparations that contain fluid milk (e.g., cow's or goat's milk or evaporated milk), it is best to use an electric blender, though a rotary egg-beater may always be used. The blender or beater must be scrupulously cleaned after use.

Where refrigeration is available, enough for several feeds (enough for 12 or even 24 hours) may be prepared in advance and stored. If oil separates after refrigeration (coconut oil, especially, causes this problem and may solidify and adhere to the sides of the container), simply stir the oil vigorously or blend it again.

If refrigeration is not available, the preparation must be made up freshly every 6–12 hours in order to prevent spoiling. The oil may still separate when left standing, so that stirring or blending may again be necessary.

If the feed is carefully prepared and well covered, no further sterilization is necessary; just stir and measure out the correct volume of feed.

If an electric blender is not available, the addition of cereal flour (any locally available and acceptable cereal flour, such as wheat, rice, millet, or oatmeal flour) to the milk preparation will prevent the oil from rising to the top of the prepared feed. An example of such a mixture is given below:

Cow's milk	1000 ml			1000 ml		4 cups
Sugar	50 g			60 ml		4 tablespoons
Cereal flour	50 g	*or*		110 ml	*or*	7 tablespoons
Vegetable oil	30 g			35 ml		4 tablespoons

Mix the sugar, flour, and some milk to the consistency of a smooth paste. Stir in the rest of the milk, and heat over a low flame, stirring constantly. Boil for 2 or 3 minutes to cook the flour, remove from heat, and stir in the oil. There are 0.56 MJ (135 $kcal_{th}$) and 3 g of milk protein in every 100 ml of this mixture.

Feeding schedule

When the child has been taking oral feeds well, he is ready to be placed on the *high-energy feeding regime.* Thus, on the 6th or 7th day he should be offered 150 ml of high-energy feed (described above) per kg of body weight per day. The higher the energy intake, the faster will be his rate of recovery.

The calculated amount of high-energy milk feed is given, ideally, over 24 hours, in 6 feedings at 4-hour intervals. If it is not possible to feed the child every 4 hours, then the total amount of formula for the 24 hours should be given in 5 feeds.

From the third week onwards, traditional foods should be progressively introduced into the diet of the child, gradually replacing the high-energy feed. This should ensure a smooth transition to normal eating.

When older children are recovering from malnutrition, an entirely liquid diet is inappropriate and expensive. A mixed diet of high-energy foods with added oil should be given. Parents, or whoever takes care of the child, should be instructed to buy such foods and be taught how to prepare them at home.

Assessment of progress in rehabilitation

The best method of assessing a child's progress is by frequent measurements of body weight. During catch-up growth, it should be possible to achieve weight gains of 70 g/kg body weight per week. Because of stunted body length, especially in the case of marasmic children, patients should be considered clinically recovered when they have reached a normal weight for their length (see Annex 4), rather than for their age (Annex 5).

With high-energy feeding, most malnourished children recover after 4–6 weeks.

Mineral and vitamin supplements

Potassium supplements

Most children with severe PEM are deficient in potassium. It is therefore recommended that oral potassium supplements be given routinely. A convenient stock solution can be made by adding 7.5 g of potassium chloride to 100 ml of water, previously boiled. This solution contains 1 mmol of potassium to 1 ml of solution.

Four millilitres of the stock solution per kg of body weight per day for 2 weeks are sufficient to replenish body potassium stores. Potassium supplements can be started once the patient is receiving oral feeds. The solution should be given in divided doses with the feeds.

Iron and folic acid supplements

Nearly all seriously malnourished children suffer from anaemia due to iron deficiency and, sometimes, folate deficiency. Therefore both iron and folic acid supplements should be given routinely to all malnourished children.

The recommended dose of iron is 60 mg of elemental iron daily in 2 divided doses, given for 3 months. Iron supplements should be given between meals.

The recommended dose of folic acid is 100 µg per day. Folic acid supplements should be given throughout recovery (at least for 2 months).

UNICEF tablets containing 30 mg elemental iron and 100 µg folic acid are recommended for routine use. One tablet should be given twice a day.

Vitamin A

In certain areas, vitamin A deficiency is commonly associated with severe PEM, and children in these areas are at serious risk of becoming blind. The diagnosis and treatment of vitamin A deficiency are dealt with on page 26. *Administration of vitamin A according to the same schedule should be done as a preventive measure in all regions where vitamin A deficiency is known to exist, even in the absence of any signs of xerophthalmia.*

Vitamin K

If purpura—a skin condition characterized by pinpoint-sized, non-raised, purplish-red spots—is present, it may be associated with prothrombin deficiency. In the absence of facilities for the estimation of prothrombin time, 10 mg of vitamin K should be given, by intramuscular injection.

Other vitamin supplements

Malnourished children are likely also to be deficient in other vitamins, e.g., B complex, C, and D. Throughout rehabilitation, these are best supplied by multivitamin tablets or drops, in the manufacturer's recommended dosages providing for daily requirements.

4. Associated conditions and their management

Malaria

In areas where malaria occurs, all severely malnourished children should be treated for the disease. Confirmation of the diagnosis should be obtained, and a determination of the *Plasmodium* species involved should be made wherever this is possible.

Treatment

(*a*) Infections with chloroquine-sensitive *Plasmodium falciparum*, and vivax, ovale, and quartan malaria:

(i) For patients under 1 year of age:
day 1 — a first dose of 50 mg chloroquine
— 6 hours later, 25 mg chloroquine
days 2 and 3 — a single dose of 25 mg chloroquine.

(ii) For patients aged 1–4 years:
day 1 — a first dose of 100 mg chloroquine
— 6 hours later, 50 mg chloroquine
days 2 and 3 — a single dose of 50 mg chloroquine.

(*b*) Infections with *P. falciparum* in areas with chloroquine resistance:

(i) For patients under 1 year of age:
— a single dose of 125 mg sulfadoxine + 6.25 mg pyrimethamine (Fansidar) together with 5 mg folic acid.

(ii) For patients aged 1–4 years:
— a single dose of 250 mg sulfadoxine + 12.5 mg pyrimethamine (Fansidar) together with 10 mg folic acid.

Vitamin A deficiency

Treatment [1]

As mentioned earlier, vitamin A deficiency is frequently associated with PEM. In the areas concerned, severely malnourished children may be at high risk of developing blindness due to vitamin A deficiency. Common early symptoms of vitamin A deficiency are photophobia (abnormal intolerance of light) and night-blindness. Signs of severe deficiency are corneal haziness, corneal ulceration, and keratomalacia (softening of the cornea). All children presenting these signs *and,* more generally, all children presenting a severe form of protein-energy malnutrition and living in regions where vitamin A deficiency is known to exist, even without any sign of xerophthalmia, should receive the following treatment immediately. Treatment by intramuscular injection is preferred, at least at the beginning, because of the severe diarrhoea and vomiting that may be present.

Infants under 12 months of age

27.5 mg retinol palmitate (50 000 IU water-miscible vitamin A) intramuscularly in a single injection. If not available, give 55 mg retinol palmitate (100 000 IU vitamin A) orally.

Children over 12 months of age

55 mg retinol palmitate (100 000 IU water-miscible vitamin A) in a single intramuscular injection. If not available, give 110 mg retinol palmitate (200 000 IU vitamin A) orally.

The same oral dosage should be administered on the second day. Treatment can then be continued with a daily oral multivitamin tablet or liquid, to provide 1.65 or 2.75 mg retinol palmitate (3000 or 5000 IU vitamin A) per day. On concluding treatment, give a protective dose of

[1] The International Unit for vitamin A was discontinued in 1954, but its use persists, particularly in the labelling of capsules and injectable preparations. Dosages in IU have therefore been given in parentheses for the convenience of persons using such preparations.

55 mg retinol palmitate (100 000 IU vitamin A) by mouth, if the child is under 1 year old, and 110 mg retinol palmitate (200 000 IU) if the child is over 1 year old.

In cases of *corneal ulceration:*

(1) treat as above with injection of water-miscible vitamin A;

(2) instil tetracycline (1%) eye drops three times a day. Continue until the ulceration heals.

Severe anaemia

Severe anaemia is defined as an erythrocyte volume fraction (haematocrit) of less than 10, or a haemoglobin(Fe) concentration of less than 1.86 mmol/l (30 g/l).

Severely anaemic patients with congestive heart failure should be given a blood transfusion and a diuretic.

Treatment

Children with severe anaemia and congestive heart failure:

- 1 mg furosemide per kg body weight intravenously
- 10 ml fresh whole blood per kg body weight given intravenously over 3 hours

OR

if the necessary facilities are available, 10 ml red cell concentrate per kg body weight, transfused slowly over 3 hours

- commencement of treatment with iron and folic acid supplements.

Malnourished children may also present with sickle-cell anaemia and may have very low haemoglobin levels. Such children should not receive blood transfusion unless there are clear signs of impaired cardiovascular function. Hidden infection, e.g., osteomyelitis, is often associated with sickle-cell anaemia and should be excluded in patients with this disease. The association of sickle-cell anaemia can slow down the recovery process and minimize the weight gained.

Hypoglycaemia

Malnourished children are more prone to develop hypoglycaemia (low blood glucose) than normal children. It occurs when the children

have not been fed for 4–6 hours. The best means of prevention is to give them small frequent feeds throughout the day and night.

Hypoglycaemia may produce various symptoms—low body temperature is a frequent accompaniment. Lethargy, unresponsiveness, limpness, rigidity, twitching, or convulsions may occur, Untreated hypoglycaemia causes death. If hypoglycaemia is suspected, it should be treated immediately.

Treatment

In mild cases in which the patient is quite conscious, giving an oral feed of a milk preparation or glucose water may suffice. If the infant has convulsions or is unconscious, glucose should be given intravenously. The procedure is as follows:

(*a*) 1 ml of sterile 50% dextrose solution per kg of body weight is given intravenously;

(*b*) if the dose of glucose cannot be administered intravenously, it should be given by a nasogastric tube to the stomach;

(*c*) when the child regains consciousness, an oral feed of a milk preparation or of glucose water is given immediately and followed by frequent oral feeds.

Continuing or recurrent diarrhoea

Treatment

Diarrhoea is more common in malnourished children than in others and can be more severe and prolonged in them. The episodes are frequently of infectious origin and can be treated accordingly. In mild diarrhoeas (4–5 stools per day), milk feeding need not be stopped provided the child's hydration and urine output are satisfactory.

If diarrhoea worsens on the introduction of milk feeds, it is wise to return to giving electrolyte fluids (oral rehydration salts) as described on page 11.

In children in whom diarrhoea is constantly associated with milk feeding, lactose intolerance may be suspected. The following tests for detecting reducing substances in the stool have been found useful in such cases:

1. Collect a sample of stool on a plastic sheet or bag. Mix 1 volume (1–2 g) of stool with 2 volumes of water. Add one Clinitest tablet and

observe any change in colour (green: test negative; yellow or brick red: test positive.

OR

2. Add 8 drops of liquid stools to 5 ml of Benedict's reagent, boil and cool. Observe the colour change (green: less than 0.25% reducing substance, test negative; yellow: 0.50% reducing substance, test positive; brick red: over 1.0% reducing substance, test positive).

In children in whom lactose intolerance is diagnosed, the diet should be changed to a formula based on K-MIX2 or yogurt (see page 19).

Medicines that should not be used to treat diarrhoea

A number of medicines that are of no value or even dangerous have often been given to treat diarrhoea; money and time are wasted on their use. These medicines include:

- neomycin and streptomycin (harmful to the intestine and may cause malabsorption)
- purgatives (diarrhoea and dehydration worsen)
- tincture of opium, paregoric, or atropine (dangerous to children, and to patients with dysentery)
- cardiotonics such as epinephrine or nikethamide (shock must be corrected by intravenous fluids, not by these drugs)
- steroids (expensive, dangerous)
- oxygen (expensive, unnecessary)
- charcoal, bismuth, and kaolin (of no value, they interfere with antibiotics)
- diphenoxylate (dangerous in small children)
- metoclopramide (can cause extrapyramidal neurological complications).

Specific dermatosis of kwashiorkor

This type of dermatosis is characterized by hypo- or hyperpigmentation, desquamation (shedding of skin in scales or sheets), and ulceration of the perineum (the region between the thighs from the genitalia to the anus), groin, limbs, and armpits. There may be widespread exudative (secreting liquid) skin lesions which often become secondarily infected. Ulceration may resemble severe burns.

Treatment

Spontaneous resolution can be expected with improved nutrition. Atrophy of the skin in the perineal region leads to severe napkin dermatitis, especially if the child has diarrhoea. Leaving the perineum exposed, dry, and clean will often result in rapid healing. Sometimes the application of a barrier substance such as zinc and castor oil ointment is useful.

The application of paraffin gauze dressing (*tulle gras*) to raw areas will help to relieve the pain. Soaking the affected areas in a dilute solution of potassium permanganate 1% for 10–15 minutes daily has been found useful. It is probably best to avoid the use of systemic antibiotics, unless other indications for their use are present, since they may encourage the emergence of resistant organisms such as *Pseudomonas* and *Proteus*.

Other infections and infestations that are occasionally associated with severe PEM are dealt with in Annex 3.

5. Failure to respond to treatment

Sometimes children fail to respond to treatment and do not gain weight satisfactorily. Others may show a weight gain to begin with, but fail to maintain the improvement. In these cases the following points should be checked.

Feeding problems

(*a*) The feed is not being made up properly, so that the child is not receiving a high-energy diet. Check with pages 21–23.

(*b*) The child is not receiving enough feed:

(i) As the child grows, his food needs become greater, so he must be fed more.

(ii) The child is getting too few feeds. In order to get enough energy the child needs regular feeds *night and day*.

(*c*) The child refuses feeds. Lack of appetite is common in the malnourished child on admission to hospital. This can be overcome by spoon-feeding at frequent intervals or by gastric intubation during the first 2 or 3 days of treatment. If later on in recovery the child still has

no desire to eat, then some undiagnosed associated condition (see below) is probably present.

Undiagnosed associated conditions

An infection, such as tuberculosis, otitis media, tonsillitis, or urinary infection, may remain undiagnosed and hinder recovery. Sickle-cell anaemia, congenital heart disease, or a renal disease are other possible causes of poor recovery.

Psychological causes

Sometimes, though rarely, a child may fail to respond to treatment because of emotional deprivation or homesickness. If given due affection and attention, the child should start to eat and grow once again.

6. Guidelines to the nursing care of malnourished children

- The seriously ill malnourished child should be handled gently and disturbed as little as possible.
- He should be kept clean, dry, and warm. Vomiting and diarrhoea are common in such children, and they should not be left in soiled clothes or lying on soiled sheets.
- The tendency for malnourished children, especially marasmic patients, to become hypothermic is aggravated by cool surroundings, and it is more common at night when sleep and inactivity reduce heat output. Special care should be taken at night to ensure that the children are warm, even though the air temperature may seem uncomfortably high to the nursing staff. Frequent feeding and maternal warmth will also help to prevent the development of hypothermia.
- Malnourished children, especially those with extensive skin lesions, are also susceptible to heat and may become feverish if exposed to high temperatures. The most satisfactory temperature range in which to nurse the malnourished child is around 25 °C.

- Much care and patience are required to feed the ailing malnourished child, who is weak and has a poor appetite.
- Nurses and other attending staff should always use malnourished children's given names and talk to them even though they may not respond initially.

7. Treatment of mental and psychological impairment in severe protein-energy malnutrition

Malnourished children show impaired mental and psychological development. Treatment of this aspect of PEM is as important as treatment of the physical side of the illness.

While the malnourished child is being cared for in a treatment or nutritional rehabilitation centre, he should be given love and affection by parents and attending staff. He should be mentally stimulated by means of games, toys, and books appropriate to his age and home background.

Parents should be shown how to teach their children by playing with and talking to them. The use of toys, books, and other play materials to teach concepts of size, colour, shape, and quantity should be demonstrated to the parents.

8. When to discharge patients

A child can be considered fully recovered and ready for discharge when he reaches the normal weight for his height or (in the case of infants) his length (see Annex 4). This means that height or length should be measured every month.

Where it is not possible for the child to remain at the rehabilitation centre until he attains the appropriate weight for his height, he can be sent home when his appetite is good, when he has lost oedema and/or is gaining weight rapidly, and when his mother or attendant understands the importance of continuing the high-energy diet at home until full recovery has taken place.

9. Follow-up of children after discharge

Regular follow-up of children who have recovered from severe PEM is strongly recommended, since this:

(*a*) reduces the risk of the child again getting PEM, to which he has already been shown to be vulnerable;

(*b*) allows completion of immunization schedules;

(*c*) provides an opportunity for continuing education on child-feeding and child-rearing practices, family planning, and personal hygiene.

Every child admitted for treatment of severe PEM should be followed up regularly until $2\frac{1}{2}$ years of age or, in the case of older children, for a minimum period of one year.

Adequate follow-up should be instituted by:

(*a*) reporting the child's admission with PEM to the health authority of the district or place where the child resides;

(*b*) arranging, on the child's discharge from the treatment centre, an early appointment for the mother and child at the child health clinic, special nutrition clinic, hospital outpatient department, or equivalent facility in their district or area.

Efficient follow-up activities require coordination between the curative and preventive services and constitute a key preventive measure against PEM.

Annex 1

Administration of fluids

It is important to note that techniques 2, 3, and 4 described below should be attempted only by workers who have received appropriate training.

1. Oral rehydration salts (ORS) solution by mouth

Put the fluid into a container from which the patient can drink comfortably. Infants and young children may be given fluids with a cup and spoon or may drink directly from a cup. Assess how much fluid the cup or glass holds so that you can easily tell how much the patient has drunk from the number of cupfuls or glassfuls given. Most cups contain between 180 ml and 240 ml.

When a mother is allowed to give rehydrating fluids to her infant, she learns how she may use the same fluid at home. In general, for rehydration children may be given 50—100 ml/kg body weight over 4—6 hours.

2. Oral rehydration fluid by nasogastric tube

A plastic or rubber nasogastric tube with an internal diameter of 2 mm or 2.7 mm (French gauge 6 or 8) is used; it can be used again after cleaning and sterilization. The length of tube needed to reach the inside of the stomach is approximately the length needed to pass from the tip of the nose, over one ear, and down to the lower edge of the sternum. An additional 20 cm (8 inches) or so is needed outside the nose so that the tube may be fixed to the face with adhesive plaster. In the case of babies, some gentle method of preventing them from pulling out the tube should be used.

The moistened tube is passed through the nose, down the back of the throat, and into the oesophagus. Passage into the oesophagus is

easiest while the patient is swallowing. Be certain that the tube is in the stomach and not in the lungs or coiled in the mouth. As the patient is conscious, he will certainly cough if the tube tries to enter the lungs. Examine the mouth with a torch and tongue-depressor to be certain the tube is not coiled there, and place a stethoscope or your ear over the stomach and push 10–20 ml of air through the tube with a syringe. If the tube is in the stomach, the air can easily be heard entering the stomach. The required amount of fluid can be introduced by a 20- or 50-ml syringe at the start, and later on a plastic or rubber drip set may be attached to the tube. Fluids may be contained in any type of clean bottle or flask of known volume which can be easily attached to the drip set. Old intravenous fluid bottles are suitable.

3. Intravenous fluids

Fluids may be given into any convenient vein. The bottles, fluids, needles, and tubing used must be sterile. The most useful veins are where the arms fold in front of the elbow, on the back of the hands, on the front of the inside of the ankle, in the side of the neck, and (for infants) on the side of the scalp. It is extremely important to learn, practise, and become skilled in starting infusions into these veins. It should not be necessary to make a vein incision. In some cases of severe dehydration, it may be necessary to start infusions in two veins at once so that the life-saving fluid goes in quickly. Once the danger is over, one infusion is then removed.

4. Intraperitoneal fluids

Examine the child's abdomen carefully so as to avoid putting the needle into an enlarged liver, spleen, or bladder. It is very important that everything used should be sterile, including the fluid.

The bottle of sterile fluid is attached to a sterile set just as for giving an intravenous infusion. Warm the fluid to body temperature. Clean the skin with iodine or alcohol. Push an 18-gauge (1.2-mm) needle through the skin just below the umbilicus. Then open the clamp on the tubing of the set and push the needle straight (vertically) into the peritoneal cavity. You can tell the needle is in the cavity because the fluid will flow in a steady stream rather than drop by drop. Fluid should be allowed to flow as fast as possible. The full amount (70 ml/kg body weight) can usually be given in 10–20 minutes. The needle can be either held by an assistant during this time or fixed carefully in position with adhesive plaster. When the infusion is completed, the needle is removed and a small gauze bandage placed over the hole.

Annex 2

How to prepare high-energy feeds

1. Measured by volume

The ingredients may be measured out by volume, as given in the following table.

	Milk or milk preparation (ml or cm^3)	Oil (ml or cm^3)	Sugar (ml or cm^3)	Approximate energy
Cow's milk/goat's milk	900	60	80	5.7 MJ [a]
Buffalo's milk/ewe's milk	800	35	75	5.6 MJ [b]
Skimmed milk powder [c]	180	95	75	5.6 MJ [b]
Full-cream milk powder [c]	270	60	75	5.7 MJ [a]
Evaporated milk	430	55	80	5.7 MJ [a]
K-MIX2 [c]	130	95	40	5.7 MJ [a]
Yogurt [d]	900	70	80	5.7 MJ [a]

[a] Approximately 1360 $kcal_{th}$.
[b] Approximately 1350 $kcal_{th}$.
[c] Unreconstituted.
[d] Energy value of milk with half the carbohydrates.

2. Measured in cups and level tablespoons

	Milk or milk preparation	Oil (tbsp [a])	Sugar (tbsp [a])	Approximate energy
Cow's milk/goat's milk	3⅗ cups [b]	5	7	5.7 MJ [c]
Buffalo's milk/ewe's milk	3⅕ cups [b]	3	6	5.7 MJ [c]
Skimmed milk powder [d]	13 tbsp [a]	8	7	5.7 MJ [c]
Full-cream milk powder [d]	15 tbsp [a]	5	7	5.6 MJ [e]
Evaporated milk	1¾ cups [b]	5	6	5.7 MJ [c]
K-MIX2 [d]	10 tbsp [a]	8	4	5.7 MJ [c]
Yogurt [f]	3⅗ cups [b]	6	7	5.7 MJ [c]

[a] One tablespoon = 15 ml, or 12.5 g (sugar).
[b] One cup = 250 ml, or 208 g (sugar).
[c] Approximately 1360 $kcal_{th}$.
[d] Unreconstituted.
[e] Approximately 1350 $kcal_{th}$.
[f] Energy value of milk with half the carbohydrates.

The composition of the various preparations in terms of oil and sugar are not strictly comparable to those indicated in Table 4, page 21, but their energy value is similar.

Annex 3

Infections and infestations associated with severe protein-energy malnutrition in children

Urinary tract infection

In certain areas, urinary tract infections are frequently associated with severe PEM. When such an association is suspected, a fresh sample of urine should be examined microscopically for leukocytes. If there are 10 or more leukocytes per microscope field (power: ×40), then treat for urinary infection as follows:

- ampicillin, 125 mg orally, 6-hourly for 2 weeks
- sulfadimidine, 150 mg/kg body weight daily, orally in 4 divided doses, for 2 weeks.

Skin lesions

There are several skin affections associated with PEM. The specific dermatosis of kwashiorkor was described on page 29, and treatment of purpura was described on page 25. Other associated skin lesions are pyodermas of all kinds, scabies, and mucocutaneous thrush.

Pyodermas

In malnourished children, bacterial infection of the skin is almost inevitable. Infection takes the form of pustules, impetigo (skin inflammation), chronically infected fissures (especially behind the ears), and indolent ulcers. The following measures have been found helpful in the acute stage:

1. Drainage of abscesses.

2. Skin-cleansing with soap and water, or iodine, or chlorhexidine, all of which are active against staphylococci.

3. Scalp-cleansing with soap and water, if impetigo of the scalp is present, followed by application of neomycin + bacitracin ointment 2–3 times daily until 2 days after skin is clear.

4. Removal of slough and crust from chronic lesions with clean warm water or, if available, warm normal saline solution (9%).

5. Topical application of neomycin + bacitracin ointment to infected fissures 2–3 times daily until healed.

6. Systemic antibiotics—usually penicillin—if there is extensive impetigo, lymphangitis, cellulitis, or widespread desquamation (scaling off of skin) with formation of bullae (blister-like bumps).

Scabies

Scabies is common in malnourished children. It is caused by a mite which bores beneath the skin and causes intense itching. It should be treated as follows:

1. Daily application of benzyl benzoate (12.5%) to the affected areas for 2 days. It may be necessary to repeat this course of treatment. Treat the mother or attendant at the same time, if she is also affected.

2. Gamma benzene hexachloride cream (1%) is very useful when the skin is broken and easily irritated by benzyl benzoate. Gamma benzene hexachloride cream is applied to the affected areas daily for 2 days.

3. When the lesions are secondarily infected, the infection should first be treated with procaine benzylpenicillin, 1–2 ml/day, intramuscularly for 7–8 days, before applying scabicidal emulsions or creams.

Thrush

Mucocutaneous thrush is seen in severely malnourished infants and commonly presents as whitish plaques in the mouth or as a rash in the napkin area. It can be treated as follows:

(*a*) oral thrush: nystatin oral suspension, 100 000 International Units (IU) 4-hourly, *or* 1% gentian violet, aqueous, 4-hourly;

(*b*) cutaneous thrush: nystatin oral suspension, 100 000 IU 4-hourly, and nystatin cream applied locally twice a day.

Tuberculosis

In many parts of the world, tuberculosis is frequently associated with severe PEM. Bacteriological examinations, chest X-ray, and the Mantoux test may not be helpful in establishing the diagnosis of tuberculosis in a severely malnourished child.

If tuberculosis is suspected in the malnourished child, prophylaxis should be started without awaiting confirmation of the diagnosis. Where tuberculosis is common, any malnourished child who fails to show a satisfactory gain in weight despite an adequate dietary intake should be suspected of having tuberculosis, and prophylaxis with isoniazid (INH), 15 mg/kg body weight daily, should be started.

If tuberculosis is confirmed, treatment should immediately be undertaken as follows:

- streptomycin, 20 mg/kg body weight/day intramuscularly, for 6–12 weeks;

plus

- isoniazid, 15 mg/kg body weight orally, once a day for 1 year;

plus

- thioacetazone, 5 mg/kg body weight orally, once a day for 1 year. This preparation is not marketed alone, but usually in a tablet containing 100 mg isoniazid/50 mg thioacetazone. For a child weighing 10 kg, the daily prescription of isoniazid and thioacetazone would therefore be 1 tablet of isoniazid (100 mg)/thioacetazone (50 mg) plus 1 tablet of isoniazid (50 mg) alone.

Intestinal infections

The common parasitic infections found in this age group are giardiasis, trichuriasis, and ascariasis. Children may have more than one such infection. Ancylostomiasis and strongyloidiasis are common in young children in some areas. Treatment should not be initiated before the child has sufficiently recovered from PEM and eats satisfactorily.

Giardiasis (infection with *Giardia lamblia*)

This is often associated with mild to moderate chronic diarrhoea and slow weight gain in malnourished children who are getting the recovery diet. Treatment is as follows:

(*a*) Metronidazole suspension, 15 mg/kg body weight/day orally, in 2 doses daily for 5 days. Tinidazole and ornidazole are equally effective.

(*b*) If the drugs mentioned above under (*a*) are unavailable, furazolidone suspension, 5 mg/kg body weight/day orally, in 3–4 doses daily for 7 days.

Trichuriasis (infection with *Trichuris trichiura,* whipworm)

Heavily infested patients typically have anaemia, bloody mucous diarrhoea, and occasionally prolapse of the rectum. Weight loss and anorexia are common. Treatment is as follows:

(*a*) Mebendazole suspension, 100 mg orally, twice a day for 3 days.

(*b*) If mebendazole is unavailable, tiabendazole, 25 mg/kg body weight orally, twice a day for 10 days. Mebendazole is, however, the drug of choice for severely malnourished children who suffer from vomiting and diarrhoea.

Ascariasis (infection with *Ascaris lumbricoides,* roundworm)

This infection is treated as follows:

(*a*) Piperazine citrate suspension, 75 mg/kg body weight/day orally, for 2 consecutive days.

(*b*) If piperazine citrate is not available, pyrantel suspension in a single dose of 10 mg/kg orally.

Trichuriasis and ascariasis together

Treat with mebendazole as for trichuriasis alone, 100 mg orally, twice a day for 3 days.

Ancylostomiasis (infections with *Ancylostoma* or *Necator,* hookworm)

(*a*) Mebendazole suspension, 100 mg orally, twice a day for 3 days,

or

(*b*) Pyrantel suspension, 10 mg/kg body weight/day orally, for 3 days.

When hookworm and roundworm (*Ascaris*) are both present, the treatment with mebendazole or pyrantel should be given.

Strongyloidiasis (infection with *Strongyloides stercoralis,* threadworm)

Infection with *Strongyloides* occurs in the older child with severe PEM. Hyperinfection with *Strongyloides* is a serious complication. Treatment is as follows:

Tiabendazole suspension, 25 mg/kg body weight, in a single dose daily for 3 days.

Annex 4

Weight for supine length: reference values [a]

Supine length (cm)	BOYS		GIRLS	
	Median weight −2 SD (kg)	Median weight (kg)	Median weight −2 SD (kg)	Median weight (kg)
49.0	2.5	3.2	2.6	3.3
49.5	2.5	3.2	2.6	3.3
50.0	2.5	3.3	2.6	3.4
50.5	2.6	3.4	2.7	3.5
51.0	2.6	3.5	2.7	3.5
51.5	2.7	3.6	2.8	3.6
52.0	2.8	3.7	2.8	3.7
52.5	2.8	3.8	2.9	3.8
53.0	2.9	3.9	3.0	3.9
53.5	3.0	4.0	3.1	4.0
54.0	3.1	4.1	3.1	4.1
54.5	3.2	4.2	3.2	4.2
55.0	3.3	4.3	3.3	4.3
55.5	3.3	4.5	3.4	4.4
56.0	3.4	4.6	3.5	4.5
56.5	3.6	4.7	3.6	4.6
57.0	3.7	4.8	3.7	4.8
57.5	3.8	5.0	3.8	4.9
58.0	3.9	5.1	3.9	5.0
58.5	4.0	5.2	4.0	5.1
59.0	4.1	5.4	4.1	5.3
59.5	4.2	5.5	4.2	5.4
60.0	4.4	5.7	4.3	5.5
60.5	4.5	5.8	4.4	5.7
61.0	4.6	5.9	4.6	5.8
61.5	4.8	6.1	4.7	6.0
62.0	4.9	6.2	4.8	6.1
62.5	5.0	6.4	4.9	6.2
63.0	5.2	6.5	5.0	6.4
63.5	5.3	6.7	5.2	6.5
64.0	5.4	6.8	5.3	6.7
64.5	5.6	7.0	5.4	6.8
65.0	5.7	7.1	5.5	7.0
65.5	5.8	7.3	5.7	7.1
66.0	6.0	7.4	5.8	7.3
66.5	6.1	7.6	5.9	7.4
67.0	6.2	7.7	6.0	7.5
67.5	6.4	7.8	6.2	7.7
68.0	6.5	8.0	6.3	7.8
68.5	6.6	8.1	6.4	8.0
69.0	6.8	8.3	6.5	8.1
69.5	6.9	8.4	6.7	8.2
70.0	7.0	8.5	6.8	8.4

Weight for supine length: reference values *(continued)*

Supine length (cm)	BOYS		GIRLS	
	Median weight −2 SD (kg)	Median weight (kg)	Median weight −2 SD (kg)	Median weight (kg)
70.5	7.2	8.7	6.9	8.5
71.0	7.3	8.8	7.0	8.6
71.5	7.4	8.9	7.1	8.8
72.0	7.5	9.1	7.2	8.9
72.5	7.7	9.2	7.4	9.0
73.0	7.8	9.3	7.5	9.1
73.5	7.9	9.5	7.6	9.3
74.0	8.0	9.6	7.7	9.4
74.5	8.1	9.7	7.8	9.5
75.0	8.2	9.8	7.9	9.6
75.5	8.3	9.9	8.0	9.7
76.0	8.4	10.0	8.1	9.8
76.5	8.5	10.2	8.2	9.9
77.0	8.6	10.3	8.3	10.0
77.5	8.7	10.4	8.4	10.1
78.0	8.8	10.5	8.5	10.2
78.5	8.9	10.6	8.6	10.3
79.0	9.0	10.7	8.7	10.4
79.5	9.1	10.8	8.7	10.5
80.0	9.2	10.9	8.8	10.6
80.5	9.3	11.0	8.9	10.7
81.0	9.4	11.1	9.0	10.8
81.5	9.5	11.2	9.1	10.9
82.0	9.6	11.3	9.2	11.0
82.5	9.6	11.4	9.3	11.1
83.0	9.7	11.5	9.4	11.2
83.5	9.8	11.6	9.5	11.3
84.0	9.9	11.7	9.6	11.4
84.5	10.0	11.8	9.6	11.5
85.0	10.1	11.9	9.7	11.6
85.5	10.2	12.0	9.8	11.7
86.0	10.3	12.1	9.9	11.8
86.5	10.4	12.2	10.0	11.8
87.0	10.5	12.3	10.1	11.9
87.5	10.5	12.4	10.2	12.0
88.0	10.6	12.5	10.3	12.2
88.5	10.7	12.7	10.4	12.3
89.0	10.8	12.8	10.5	12.4
89.5	10.9	12.9	10.6	12.5
90.0	11.0	13.0	10.7	12.6
90.5	11.1	13.1	10.8	12.7
91.0	11.2	13.2	10.9	12.8
91.5	11.3	13.3	11.0	12.9
92.0	11.4	13.4	11.1	13.0
92.5	11.5	13.5	11.2	13.1
93.0	11.6	13.7	11.3	13.3
93.5	11.7	13.8	11.4	13.4

Weight for supine length: reference values *(continued)*

Supine length (cm)	BOYS		GIRLS	
	Median weight −2 SD (kg)	Median weight (kg)	Median weight −2 SD (kg)	Median weight (kg)
94.0	11.9	13.9	11.5	13.5
94.5	12.0	14.0	11.6	13.6
95.0	12.1	14.1	11.8	13.8
95.5	12.2	14.3	11.9	13.9
96.0	12.3	14.4	12.0	14.0
96.5	12.4	14.5	12.1	14.2
97.0	12.5	14.7	12.2	14.3
97.5	12.7	14.8	12.4	14.4
98.0	12.8	14.9	12.5	14.6
98.5	12.9	15.1	12.6	14.7
99.0	13.0	15.2	12.8	14.9
99.5	13.1	15.4	12.9	15.0
100.0	13.3	15.5	13.1	15.2
100.5	13.4	15.7	13.2	15.3
101.0	13.5	15.8	13.3	15.5
101.5	13.6	16.0		
102.0	13.8	16.1		
102.5	13.9	16.3		
103.0	14.0	16.5		

[a] The values in the table are derived from data of the National Center for Health Statistics, USA. The left-hand column gives the supine length in cm. Children are usually measured lying down until about 48 months of age and standing upright thereafter; when they are measured standing, 1 cm should be added to the measured value to obtain the appropriate reference weight in this table. The first column under "Boys" or "Girls" shows the median weight for each length minus 2 standard deviations (−2 SD); the weight of children with non-oedematous protein-energy malnutrition is usually below this threshold level. The second column under "Boys" or "Girls" gives the median weight for each length.

Annex 5

A. Weight for age: reference values [a]

Years	Months	BOYS				GIRLS			
		Median weight (kg)	Median weight −2 SD (kg)	Median weight −3 SD (kg)	Median weight −4 SD (kg)	Median weight (kg)	Median weight −2 SD (kg)	Median weight −3 SD (kg)	Median weight −4 SD (kg)
	0	3.3	2.5	2.0	1.6	3.2	2.2	1.7	1.2
	1	4.3	2.9	2.2	1.6	4.0	2.8	2.2	1.6
	2	5.2	3.5	2.6	1.8	4.7	3.3	2.7	2.0
	3	6.0	4.1	3.1	2.2	5.4	3.9	3.2	2.4
	4	6.7	4.7	3.7	2.7	6.0	4.5	3.7	2.9
	5	7.3	5.3	4.3	3.3	6.7	5.0	4.1	3.3
	6	7.8	5.9	4.9	3.9	7.2	5.5	4.6	3.7
	7	8.3	6.4	5.4	4.5	7.7	5.9	5.0	4.1
	8	8.8	6.9	5.9	4.9	8.2	6.3	5.3	4.4
	9	9.2	7.2	6.3	5.3	8.6	6.6	5.7	4.7
	10	9.5	7.6	6.6	5.6	8.9	6.9	5.9	4.9
	11	9.9	7.9	6.9	5.9	9.2	7.2	6.2	5.1
	12	10.2	8.1	7.1	6.1	9.5	7.4	6.4	5.3
	13	10.4	8.3	7.3	6.3	9.8	7.6	6.6	5.5
	14	10.7	8.5	7.5	6.4	10.0	7.8	6.7	5.6
	15	10.9	8.7	7.6	6.5	10.2	8.0	6.9	5.8
	16	11.1	8.8	7.7	6.6	10.4	8.2	7.0	5.9
	17	11.3	9.0	7.8	6.7	10.6	8.3	7.2	6.0
	18	11.5	9.1	7.9	6.8	10.8	8.5	7.3	6.1
	19	11.7	9.2	8.0	6.8	11.0	8.6	7.5	6.3
	20	11.8	9.4	8.1	6.9	11.2	8.8	7.6	6.4
	21	12.0	9.5	8.3	7.0	11.4	9.0	7.8	6.5
	22	12.2	9.7	8.4	7.1	11.5	9.1	7.9	6.7
	23	12.4	9.8	8.5	7.2	11.7	9.3	8.1	6.8
	24	12.6	9.9	8.6	7.3	11.9	9.4	8.2	7.0
2	1	12.5	10.2	9.0	7.8	12.0	9.6	8.4	7.2
2	2	12.7	10.3	9.1	7.9	12.2	9.8	8.5	7.3
2	3	12.9	10.4	9.1	7.9	12.4	9.9	8.7	7.4
2	4	13.1	10.5	9.2	7.9	12.6	10.1	8.8	7.5
2	5	13.3	10.6	9.3	7.9	12.8	10.2	8.9	7.6
2	6	13.5	10.7	9.4	8.0	13.0	10.3	9.0	7.7
2	7	13.7	10.9	9.4	8.0	13.2	10.5	9.1	7.8
2	8	13.9	11.0	9.5	8.0	13.4	10.6	9.2	7.9
2	9	14.1	11.1	9.6	8.1	13.6	10.8	9.4	7.9
2	10	14.3	11.2	9.7	8.1	13.8	10.9	9.5	8.0
2	11	14.4	11.3	9.7	8.2	13.9	11.0	9.6	8.1
3	0	14.6	11.4	9.8	8.2	14.1	11.2	9.7	8.2
3	1	14.8	11.5	9.9	8.3	14.3	11.3	9.8	8.3
3	2	15.0	11.7	10.0	8.3	14.4	11.4	9.9	8.4
3	3	15.2	11.8	10.1	8.4	14.6	11.5	10.0	8.5

A. Weight for age: reference values [a] *(continued)*

Years	Months	BOYS				GIRLS			
		Median weight (kg)	Median weight −2 SD (kg)	Median weight −3 SD (kg)	Median weight −4 SD (kg)	Median weight (kg)	Median weight −2 SD (kg)	Median weight −3 SD (kg)	Median weight −4 SD (kg)
3	4	15.3	11.9	10.2	8.5	14.8	11.6	10.1	8.5
3	5	15.5	12.0	10.3	8.5	14.9	11.8	10.2	8.6
3	6	15.7	12.1	10.4	8.6	15.1	11.9	10.3	8.7
3	7	15.8	12.3	10.5	8.7	15.2	12.0	10.4	8.8
3	8	16.0	12.4	10.6	8.8	15.4	12.1	10.5	8.9
3	9	16.2	12.5	10.7	8.8	15.5	12.2	10.6	8.9
3	10	16.4	12.6	10.8	8.9	15.7	12.3	10.7	9.0
3	11	16.5	12.8	10.9	9.0	15.8	12.4	10.8	9.1
4	0	16.7	12.9	11.0	9.1	16.0	12.6	10.9	9.2
4	1	16.9	13.0	11.1	9.2	16.1	12.7	10.9	9.2
4	2	17.0	13.1	11.2	9.3	16.2	12.8	11.0	9.3
4	3	17.2	13.3	11.3	9.4	16.4	12.9	11.1	9.4
4	4	17.4	13.4	11.4	9.4	16.5	13.0	11.2	9.4
4	5	17.5	13.5	11.5	9.5	16.7	13.1	11.3	9.5
4	6	17.7	13.7	11.6	9.6	16.8	13.2	11.4	9.6
4	7	17.9	13.8	11.8	9.7	17.0	13.3	11.5	9.6
4	8	18.0	13.9	11.9	9.8	17.1	13.4	11.5	9.7
4	9	18.2	14.0	12.0	9.9	17.2	13.5	11.6	9.8
4	10	18.3	14.2	12.1	10.0	17.4	13.6	11.7	9.8
4	11	18.5	14.3	12.2	10.1	17.5	13.7	11.8	9.9
5	0	18.7	14.4	12.3	10.2	17.7	13.8	11.9	9.9

[a] The values in Annex 5 are derived from data of the National Center for Health Statistics, USA. For the convenience of persons accustomed to using the Gomez classification of protein-energy malnutrition, weight-for-age values have been given in Table A to minus 4 standard deviations; the − 4SD values correspond approximately to third-degree malnutrition in the Gomez classification.

B. Height for age: reference values

		BOYS			GIRLS		
Years	Months	Median height (cm)	Median height −2 SD (cm)	Median height −3 SD (cm)	Median height (cm)	Median height −2 SD (cm)	Median height −3 SD (cm)
Measured supine	0	50.5	45.9	43.4	49.9	45.5	42.1
	1	54.6	49.7	47.1	53.5	49.0	45.9
	2	58.1	52.9	50.4	56.8	52.0	49.1
	3	61.1	55.8	53.3	59.5	54.6	51.9
	4	63.7	58.3	55.8	62.0	56.9	54.3
	5	65.9	60.5	58.0	64.1	58.9	56.4
	6	67.8	62.4	60.0	65.9	60.6	58.2
	7	69.5	64.1	61.7	67.6	62.2	59.8
	8	71.0	65.7	63.2	69.1	63.7	61.2
	9	72.3	67.0	64.7	70.4	65.0	62.5
	10	73.6	68.3	66.0	71.8	66.2	63.7
	11	74.9	69.6	67.2	73.1	67.5	64.9
	12	76.1	70.7	68.3	74.3	68.6	66.0
	13	77.2	71.8	69.3	75.5	69.8	67.1
	14	78.3	72.8	70.3	76.7	70.8	68.1
	15	79.4	73.7	71.2	77.8	71.9	69.1
	16	80.4	74.6	72.1	78.9	72.9	70.1
	17	81.4	75.5	72.9	79.9	73.8	71.0
	18	82.4	76.3	73.7	80.9	74.8	71.9
	19	83.3	77.1	74.5	81.9	75.7	72.8
	20	84.2	77.9	75.2	82.9	76.6	73.6
	21	85.1	78.7	75.9	83.8	77.4	74.4
	22	86.0	79.4	76.6	84.7	78.3	75.2
	23	86.8	80.2	77.4	85.6	79.1	76.0
	24	87.6	80.9	78.1	86.5	79.9	76.8
2	1	86.4	79.9	76.7	85.3	78.8	75.4
2	2	87.2	80.6	77.3	86.2	79.6	76.2
2	3	88.1	81.3	78.0	87.0	80.3	76.9
2	4	88.9	82.0	78.6	87.9	81.0	77.6
2	5	89.6	82.7	79.2	88.7	81.8	78.4
2	6	90.4	83.4	79.9	89.5	82.5	79.0
2	7	91.2	84.1	80.5	90.3	83.1	79.7
2	8	92.0	84.7	81.5	91.0	83.8	80.3
2	9	92.7	85.4	81.7	91.8	84.5	81.0
2	10	93.5	86.0	82.3	92.5	85.2	81.6
2	11	94.2	86.7	82.9	93.2	85.8	82.1
3	0	94.9	87.3	83.5	94.0	86.5	82.8
3	1	95.6	87.9	84.7	94.6	87.1	83.4
3	2	96.3	88.6	85.2	95.3	87.7	84.0
3	3	97.0	89.2	85.6	96.0	88.4	84.6
3	4	97.7	89.8	86.1	96.6	89.0	85.2
3	5	98.4	90.4	86.6	97.3	89.6	85.8
3	6	99.1	91.0	87.0	97.9	90.2	86.3
3	7	99.7	91.6	87.5	98.6	90.7	86.9
3	8	100.4	92.1	88.0	99.2	91.3	87.4

B. Height for age: reference values *(continued)*

Years	Months	BOYS			GIRLS		
		Median height (cm)	Median height −2 SD (cm)	Median height −3 SD (cm)	Median height (cm)	Median height −2 SD (cm)	Median height −3 SD (cm)
3	9	101.0	92.7	88.4	99.0	91.9	88.0
3	10	101.7	93.3	88.9	100.4	92.4	88.5
3	11	102.3	93.9	89.3	101.0	93.0	89.0
4	0	102.9	94.4	89.8	101.6	93.5	89.5
4	1	103.6	95.0	90.3	102.2	94.1	90.0
4	2	104.2	95.5	90.7	102.7	94.6	90.5
4	3	104.8	96.1	91.2	103.3	95.1	91.0
4	4	105.4	96.6	91.6	103.9	95.6	91.5
4	5	106.0	97.1	92.1	104.5	96.1	92.0
4	6	106.6	97.7	92.5	105.0	96.7	92.4
4	7	107.1	98.2	93.0	105.6	97.1	92.9
4	8	107.7	98.7	93.4	106.2	97.6	93.3
4	9	108.3	99.2	93.9	106.7	98.1	93.8
4	10	108.8	99.7	94.4	107.3	98.6	94.2
4	11	109.4	100.2	94.8	107.8	99.1	94.7
5	0	109.9	100.7	95.3	108.4	99.5	95.1

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