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Refeeding Practices of Malnourished Children

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REFEEDING PRACTICES OF MALNOURISHED CHILDREN

by

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Abstract: Refeeding Practices of Malnourished Children:

Over 200 million children in developing countries under the age of five are malnourished. Malnutrition contributes to more than half of the nearly 12 million under-five deaths in developing countries each year. The World Health Organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions." Because of the high demand for energy and essential nutrients, infants and children are at a particular risk for under-nutrition. Malnutrition is a condition that needs to be taken seriously and with proper treatment can save the lives of many children. The management and treatment is usually divided into the following three phases: initial treatment, rehabilitation, and follow-up. During the initial treatment life threatening problems are identified and treated, specific deficiencies are corrected, metabolic abnormalities are reversed, and feeding is begun. During the rehabilitation phase of treatment, intensive feeding is given to recover most of the lost weight, emotional and physical stimulation are increased, the mother or caregiver is trained to continue care at home, and preparations are made for discharge. The follow-up phase is after discharge and is where the child and its family are followed to prevent relapse and assure the continued development of the child. Malnutrition for the most part is a silent and invisible emergency. People need to be aware of such cases and get these children the help that they need.

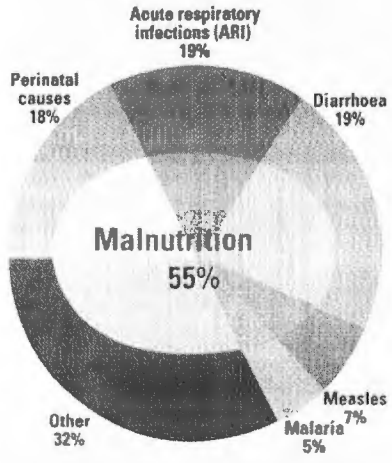
Refeeding Practices of Malnourished Children

Good, sound nutrition can change children's lives, improve their physical and mental development, protect their health, and lay a firm foundation for future productivity. In United Nations International Children's Emergency Fund (UNICEF), *The State of the World's Children – 1998*, it states that over 200 million children in developing countries under the age of five are malnourished. Malnutrition contributes to more than half of the nearly 12 million under-five deaths in developing countries each year. This human suffering and waste happen because of illness, much of which is preventable. This problem isn't just facing those individuals in third world countries. In the United States, researchers estimate that over 13 million children, more than one in every four under the age of 12, have a difficult time getting all the food they need. This is a problem that is often at its worst during the last week of the month when families' social benefits (food stamps/WIC) or wages run out. Over 20 percent of children in the United States live in poverty; more than double the rate of most other industrialized countries (1). So what can be done to help these children who have been affected by such a disease? Throughout this paper the following points will be discussed: what is malnutrition, who it is affecting, and the treatment options that exist.

The World Health Organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions" (2). Malnutrition decreases cardiac output, blood pressure, oxygen consumption, TLC, T cells, and glomerular filtration rate and increases infection rate, fatty infiltration, energy, emphysema, pneumonia, anemia, GI tract atrophy, bacterial overgrowth, and hepatic mass losses (3). Although many still

refer to growth failure as protein-energy malnutrition (PEM), it is now recognized that poor growth in children results not only from a deficiency of protein and energy but also from an inadequate intake of vital minerals (such as iron, zinc and iodine) and vitamins (such as vitamin A), and often essential fatty acids. WHO estimates that malnutrition was associated with over half of all child deaths that occurred in developing countries in 1995. Other causes of death are as shown below in Figure 1 (1).

Figure 1:

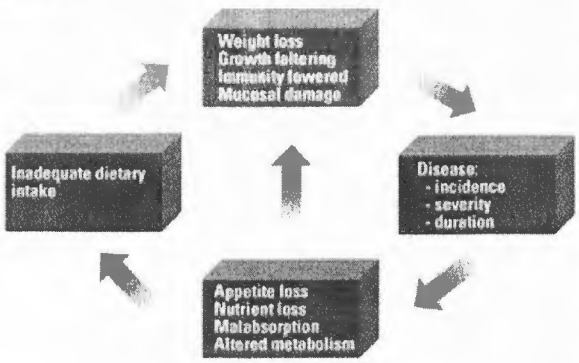


Clinically, PEM has three forms: dry, wet, and a combination of the two. Each of the three forms can be graded as mild, moderate, or severe. Grade is determined by calculating weight as a percentage of expected weight for length using international standards (normal, 90-110%, mild PEM, 85-90%, moderate, 75-85%, and severe, <75%) (4) For adolescents (10-18 years old) BMI-for-age (<5th percentile) is the best indicator of severe malnutrition (5).

Because of the high demand for energy and essential nutrients, infants and children are at a particular risk for under-nutrition. In adolescence, nutritional requirements increase because the growth rate increases (4). In one study it was shown that 1.3-17.4% of hospitalized children were found to have severe or mild PEM (3). Under-nutrition can result from inadequate intake, malabsorption, and abnormal systematic loss of nutrients due to diarrhea, hemorrhage, renal failure, infection, or excessive sweating(4). Inadequate dietary intake and infection is a vicious cycle that accounts for much of the high morbidity and mortality seen in developing countries.

When children don't eat enough, their immune system defenses are lowered, resulting in greater incidence, severity and duration of disease. Disease speeds nutrient loss and suppresses appetite, so sick children tend not to eat as they should and the cycle continues. See Figure 2. (1) Severe malnutrition is both a medical and a social disorder. That is, the medical problems of the child result, in part, from social problems of the home in which the child lives. Successful management of the severely malnourished child requires both medical and social problems be recognized and corrected (6).

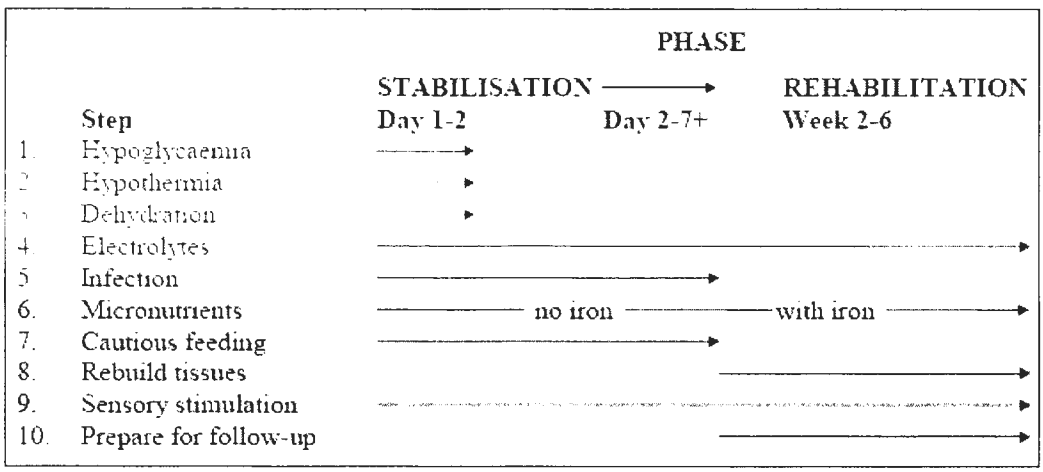
Figure 2:



The statistics and list above show what serious consequences malnutrition can lead to. This is a condition that needs to be taken seriously and with proper treatment can save the lives of many children. Successful management of severely-malnourished children requires prompt diagnosis and immediate consideration of medical, nutritional and social problems. Some 1.5 million children die every year because they are inappropriately fed and 35% of infants worldwide are exclusively breastfed for the first four months of life. This has led to the consensus on the need for exclusive breastfeeding and ways to achieve it (7). Breastfeeding may aid in decreasing the risk for incidence of under-nutrition, but what needs to be done for those infants that are already severely malnourished? According to the WHO/UNICEF strategy of Integrated Management of Childhood Illness (IMCI) the following steps are aimed at improving treatment and reducing mortality in these conditions. The management is usually divided into the following three phases: initial treatment, rehabilitation, and

follow-up. During the initial treatment life threatening problems are identified and treated, specific deficiencies are corrected, metabolic abnormalities are reversed, and feeding is begun. During the rehabilitation phase of treatment, intensive feeding is given to recover most of the lost weight, emotional and physical stimulation are increased, the mother or caregiver is trained to continue care at home, and preparations are made for discharge. The follow-up phase is after discharge and is where the child and its family are followed to prevent relapse and assure the continued development of the child. A standard time frame for the management of a child with severe malnutrition is shown in Figure 3 (6).

Figure 3:



During the initial treatment phase, severely malnourished children are seriously ill and therefore, life threatening problems such as severe infections including septic shock and severe dehydration, hypoglycemia and hypothermia must be identified and treated promptly (5). Outlined below are the steps to treat individuals that are malnourished.

Step 1- Hypoglycemia:

Most all malnourished children are at a high risk for developing hypoglycemia (blood glucose <54 mg/dL), which is often a frequent cause of death during the first few

days of treatment (6). If unable to test blood glucose levels of these children, assume all are hypoglycemic and treat accordingly. Treatment should be given immediately by giving 50 ml bolus of a 10% sucrose or glucose solution (1 rounded teaspoon of sugar in 3.5 tablespoons water). Feeding should continue every 30 minutes for 2 hours. Children should also be given feeds through the night (8).

Step 2- Hypothermia:

Many of these malnourished infants are highly susceptible to hypothermia. If their rectal temperature is below 95.9 degrees F, the child should be warmed. The "kangaroo technique" is frequently used by placing the child on the mother's bare chest or abdomen, or the child is clothed well and then covered with a warmed blanket (6). A continuous monitoring of rectal temperature on the child needs to be done every two hours until it rises to the proper temperature. The child must be kept covered at all times, especially at night (8).

Step 3- Dehydration:

It is difficult to estimate dehydration status in severely malnourished children using clinical signs alone. Some of the signs include the following: a history of diarrhea, especially if it's watery, small mucoid stools, and thirst. The child drinking eagerly is also another sign of "some" dehydration. Sunken eyes, a weak or absent radial pulse, cold hands and feet, and decreased urine flow are also indications of dehydration (6).

To treat dehydration, in most cases it is recommended to re-hydrate orally. IV infusion can result in over-hydration and a flooding of circulation and overloading of the heart. Severely malnourished children are usually deficient in potassium and have high levels of sodium, so WHO recommends giving the child the oral hydration salts (ORS)

solution, ReSoMal, that is made specifically for severely malnourished children and is available commercially for use. It contains small amounts of sodium and large amounts of potassium. Magnesium, copper, and zinc have also been added to correct deficiencies in these minerals (5). Figure 4 shows the composition of the ORS for severely malnourished children (ReSoMal).

Figure 4:

Component	Concentration (mmol/l)
Glucose	125
Sodium	45
Potassium	40
Chloride	70
Citrate	7
Magnesium	3
Zinc	0.3
Copper	0.045
[illegible]	300

This solution should be given to a child who can drink by giving the required amount of sips or by spoon every few minutes. If the child is too weak to do this, the solution should be given nasogastric at the same rate. The only time an IV infusion should be used is in a severely malnourished child where a circulatory collapse has occurred because of dehydration or septic shock (6). During treatment, rapid respirations and pulse rate should slow and the child will begin to pass urine. The child's pulse rate, respiratory rate, urine frequency, and stool/vomit frequency should be monitored until the child becomes stable (8).

Step 4- Electrolyte Imbalances:

Severely malnourished children have excess body sodium even though plasma sodium may be low. Deficiencies of potassium and magnesium are also present which may take up to two weeks to correct. Edema is often due to these imbalances. Extra potassium and magnesium may be given by preparing it in a liquid form and added directly to the child's feeds during preparation (8).

Step 5- Infection:

Most severely malnourished children have bacterial infections when first admitted. Many have several infections resulting from different organisms. Infection of the lower respiratory tract is especially common. In many of these children infection is hard to detect because the child may just be apathetic and drowsy (6). Because of the difficulty of assessment of infection, all admissions should be given routinely a broad spectrum of antibiotics and a measles vaccine. The measles vaccine should be given so other children will not catch the disease. When the specific infection has been identified, then the specific antibiotic needed may be given.

Step 6- Micronutrient Deficiencies:

Vitamin A deficiency: These children are at a very high risk of developing blindness due to vitamin A deficiency. Because of this, a large dose of vitamin A (if aged >1 year give 200,000 IU) should be given to all malnourished children when they first are admitted to the hospital. Oral treatment is recommended (6).

Other vitamin deficiencies: All severely malnourished children have vitamin and mineral deficiencies. Although anemia is common, iron should not be given initially but delayed until the child is back to a normal appetite and has started to gain weight. The following should also be given to such children: Multi-vitamin supplement, 1 mg/d Folic Acid, 2 mg/kg/d Zinc, 0.2 mg/kg/d Copper, and 3 mg/kg/d of Iron once the child has started to gain weight. Many of these children are also deficient in riboflavin, ascorbic acid, thiamine, and the fat soluble vitamins (8).

Step 7- Initiate Refeeding:

During the stabilization phases, caution must be taken in refeeding due to the child's fragile physiological state and reduced homeostatic capacity. Feeding should be started as soon as possible after admission and should be designed to provide just sufficient energy and protein to maintain basic physiological processes (8). Because these children have so many health related problems, they are unable to tolerate the usual amounts of dietary protein, fat, and sodium. So these children should begin on a diet that is low in these nutrients and higher in carbohydrates. Daily nutrient requirements of malnourished children are given in Appendix 1 (6).

There have been two formulas that have been developed for the use in severely malnourished children. The first is the special formula diet called F-75. It is to be used in the initial phase of the treatment. It is milk based and is to be given frequently in small amounts to avoid overloading the intestine, liver, and kidneys. F-75 provides 75kcal/100ml and 0.9g of protein per 100ml. Initially, F-75 should be given in a volume of about 130 ml/kg of birth weight per day. It should be offered either orally or nasogastric depending on the condition of the child (5). The second formula, F-100 is used during the rehabilitation phase of treatment, after the appetite of the child has returned. F-100 provides 100kcal/100ml and 2.9g protein per 100ml. The transition to the F-100 formula should be gradual to avoid the risk of heart failure. Both of these formulas can easily be made with basic ingredients including dried skimmed milk, sugar, cereal flour, oil, and mineral and vitamin mix. They are also available as powder formulas that can be mixed with water (6).

When first admitted to the hospital, these children are weak and have poor appetites. They may need lots of patience and encouragement to complete the required feedings. Most of the children can be fed from a cup and spoon, but bottles should never be used because if the child is extremely weak, a dropper or syringe may be used. If this still isn't resulting in a sufficient intake, some children may need to be fed using a nasogastric tube. This should be as limited as possible and should get back to oral feeding as soon as possible (6). The duration of this initial treatment usually lasts 2-7 days but depends largely on the severity of the child's malnutrition and underlying diseases of the child (5).

Health professionals who are working with these children need to be aware of certain cases when administration of nutrition is very aggressive because the complication of refeeding syndrome may result (9). Refeeding syndrome is defined as a severe shift in fluid and electrolyte levels from extra cellular to intracellular spaces. This can lead to cardiovascular, neurologic, and hematologic complications and leads to increased risk of morbidity and mortality (10). Abnormal metabolism also results, with a shift from body fat to CHO as a substrate. Insulin is excreted excessively, and glucagon decreases with reduced gluconeogenesis, glycogenolysis, and fatty acid mobilization. Glucose is taken up rapidly into the cells, and phosphorus is driven inside the cells (3).

Step 8- Catch-up Growth & Rebuilding:

The child is ready to begin the rehabilitation phase once they have begun to gain weight and have a steady appetite. The child will also have their infections under control, their liver is able to metabolize the diet, and other metabolic abnormalities are improving. The approach taken here is enthusiastic and everyone should be hopeful of very high

intakes and rapid weight gain of >10 g/kg/d (6). Progress here is assessed by the rate of weight gain. The child should be weighed each morning before being fed. Their weight should be plotted, and after each week weight gain should be calculated and recorded as g/kg/d (8).

Step 9- Emotional Support:

Severely malnourished children have gone through a lot of stress and often have delayed mental and behavioral development. If these conditions are not treated they can become serious long-term problems including permanent mental retardation and emotional impairment. The mother or caregiver should provide the child with the following: tender loving care, a cheerful stimulating environment, structured play therapy for 15-30 min/d, physical activity as soon as well enough, and maternal involvement when possible such as comforting, feeding, bathing, and playing (8). Toys should also be available for the child. Malnourished children also need interaction with other children during their rehabilitation (6).

Step 10- Follow-up and Recovery:

Discharge may be considered when the child has reached 1 SD (90%) of the median NCHS/WHO reference values for weight-for-height. The child is still likely to have a low weight-for-age because of stunting (8). Food feeding practices should be continued at home so the mother/caregiver must be trained in proper feeding and cooking methods. There is a very high risk of relapse right after discharge so the child should be seen after 1 week, 2 weeks, 1 month, 3 months, and 6 months. If the child continues to have frequent problems the child should remain under supervision longer (6).

Mortality from severe malnutrition is still unacceptably high. It is believed that a major factor for this continuing high mortality is too late of referral and faulty case-management. Malnutrition for the most part is a silent and invisible emergency. An increase of awareness needs to be pushed. People need to be aware of such cases and get these children the help that they need. We need to realize that children all over the world, no matter their situation have the right to good nutrition.

Appendix 1:

Desirable daily nutrient intake during initial phase of treatment

Nutrient	Amount per kg of body weight
Water	120–140 ml
Energy	100 $kcal_h$ (420 kJ)
Protein	1–2 g
Electrolytes:	
Sodium	1.0 mmol (23 mg)*
Potassium	4.0 mmol (160 mg)
Magnesium	0.8 mmol (10 mg)
Phosphorus	2.0 mmol (60 mg)
Calcium	2.0 mmol (80 mg)
Trace minerals:	
Zinc	30 µmol (2.0 mg)
Copper	4.5 µmol (0.3 mg)
Selenium	60 nmol (4.7 µg)
Iodine	0.1 µmol (12 µg)
Water-soluble vitamins:	
Thiamine (vitamin B_1)	70 µg
Riboflavin (vitamin B_2)	0.2 mg
Nicotinic acid	1 mg
Pyridoxine (vitamin B_6)	70 µg
Cyanocobalamin (vitamin B_{12})	0.1 mg
Folic acid	0.1 mg
Ascorbic acid (vitamin C)	10 µg
Pantothenic acid (vitamin B_5)	0.3 mg
Biotin	10 µg
Fat-soluble vitamins:	
Retinol (vitamin A)	0.15 mg
Calciferol (vitamin D)	3 µg
α-Tocopherol (vitamin E)	2.2 mg
Vitamin K	4 µg

* Value refers to the *maximum* recommended daily intake.

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