In our rapidly shrinking world, illnesses that have not been of great concern in the United States have become topics of increased interest. International travelers, missionary and other groups that seek to assist people in need, and international migrations have necessitated the acquisition of knowledge about conditions that are not a major health problem for those living in more affluent societies. It must be emphasized that although rare in developed countries, those illnesses could and do occasionally occur in the United States, most commonly among hospitalized patients.

Protein-energy malnutrition (PEM) can be a life-threatening situation, because it can lead to an immune deficiency that increases susceptibility to infections. It appears that cell-mediated immunity is the most severely affected (Parent, Chevalier, Yulles, et al., 1994). Severe malnutrition in infants and young children is associated with insufficient food availability, inadequate knowledge regarding nutrition, or poor hygiene. The two major types of protein-energy malnutrition are Marasmus and Kwashiorkor.

Marasmus is the result of caloric deprivation. It is characterized by decreased anthropometric measurements and is usually well tolerated in the absence of stress, unless it is severe. Failure to gain weight may result in emaciation and loss of skin turgor. General body functions decrease as indicated by a subnormal temperature, decreased pulse and metabolic rate, and constipation. Starvation diarrhea (frequent small stools containing mucus) may be present.

Kwashiorkor is the name given to the syndrome of severe protein malnutrition. Kwashiorkor is an African term that refers to a child from 4 months to 5 years of age who is no longer being breastfed. It was first described in Ghana in 1933 by Williams (Marsden, 1990). As might be expected, the height and weight of these children fall well below the curves for other children of the same age. Even with treatment these children never can "catch up" to their age mates.

Signs and symptoms associated with the syndrome result from a lack of nutritional protein coupled with an excess of carbohydrates. Young children must maintain a positive nitrogen balance in contrast to adults, who require a nitrogen equilibrium. To meet nitrogen requirements adequate amounts of the essential amino acids are required. An adequate caloric intake in the form of carbohydrates or fats helps to minimize protein requirements (Behrman, Kliegman, Nelson, and Vaughan, 1992). Protein helps in the maintenance of serum albumin, the formation of globin for heme, the preservation of the structure and integrity of cells, and the production of enzymes and hormones. Serum protein levels may decrease because of an inadequate quantity or quality of protein foods, an impaired protein absorption as in severe diarrhea, or abnormal protein losses as in proteinuria (nephrosis), burns, hemorrhage, and infections. It might also be caused by a decrease in protein synthesis as indicated in...
chronic liver disease. Unfortunately, Kwashiorkor may be underdiagnosed because it is primarily associated with third-world countries.

Early signs of protein deficiency are nonspecific and include lethargy, apathy, or irritability. Affected children are increasingly susceptible to infections, and diseases such as measles can be fatal. In most third-world countries, extensive laboratory analysis is not performed or may not be available. Common laboratory findings include the following. Early in the process ketonuria can be found. Amino acid levels in plasma may be low. Blood glucose levels are low, as are potassium and magnesium levels. Anemia may be normocytic, microcytic, or macrocytic.

Other signs of the illness that are easily detectable include a desquamative dermatoses, hypopigmentation, alopecia, and mucous membrane changes. The alopecia that occurs exhibits a particular appearance which is referred to as a positive "flag sign." This condition is best described as an area on the scalp having the appearance of stripes with alternating rows of hair and no hair. The hair itself is hypopigmented, dull, dry, and brittle. A reddish color change of the hair, hypochromatricia, also occurs. In some cases the hair may have a gray appearance.

Hypopigmentation of the skin is generalized and easily detectable in dark-skinned children. It usually begins circumorally and in a peribital location (Albers, Brozena, and Fenske, 1993). Vitiligo may occur in spots throughout the body, but as the disease progresses, hyperpigmented plaques with a waxy texture appear. 

These may be referred to as "enamel paint" lesions, and they give a mosaic pattern to the skin. They may be found on the elbows, knees, and intertriginous sites (Albers, Brozena, and Fenske, 1993). In severe cases extensive desquamation, which has been described as "crazy pavement" or "flaky paint," occurs (McLaren, 1987).

An examination of the mouth of a child with Kwashiorkor reveals atrophy of the tongue papillae, giving a smooth shiny appearance to the tongue. Other erosions of the nose and throat may also be present. An enlarged liver may be found at any point in the progression of the syndrome. Other signs include anorexia and loss of muscle tone. Edema occurs early in the process and is believed to be caused by added stress such as infection. The edema may actually cause the child to look better nourished than the child is; that is, the face and limbs may not appear wasted. However, edema is present in internal organs before it is recognized in the face or limbs (Behrman, Kliegman, Nelson, and Vaughan, 1992).

Diarrhea always poses a major threat to children with PEM. Terminal diarrhea is believed to be due in large part to malnutrition of the intestinal epithelium. Because of this factor, oral refeeding in the first few days of intervention may actually result in a worsening of the diarrhea and result in death. In severe cases the intestine cannot handle the added nutrients, because the epithelium does not have enough energy to control absorption effectively (Roediger, 1986). Antibiotics are not effective as a treatment, because they prevent effective bacterial fermentation. Refeeding routines should include glutenine for the small intestine and macromolecules such as complex polysaccharides and dietary fiber for the colon. It takes 5 to 7 days in the treatment regimen for the intestinal mucosa to resume functional ability. Roediger (1986) recommends a refeeding diet with a moderately high content of dietary fiber, complex polysaccharides, and peptides rich in glutamine. The diet should have smaller amounts of medium-chain fatty acids (milk fats) and glucose than those usually found in refeeding diets.

Parent et al. (1994) investigated the relationship of thymic dysfunction to depressed cell-mediated immunity in PEM. The thymus is the site of T-cell differentiation and maturation. A high degree of T-lymphocyte immaturity was found in the children studied. This physiological occurrence is important because the total lymphocyte count provides a measure of the degree of immunosuppression resulting from malnutrition. Immunosuppression increases the child's susceptibility to infections.

The best intervention for protein energy malnutrition is obviously nutrition and education. For mild or moderate cases hydration fluids are given orally or via a nasogastric tube. Intravenous fluids are administered in severe cases. Oral feedings resume with small frequent amounts of dilute milk, which is gradually increased over a 5-day period; weight loss may continue for a few days as edema resolves.

Various cardiac abnormalities have been associated with Kwashiorkor, including low cardiac output and cardiac failure (Bergman, Homan, Moor, and Schulz, 1988). Kwashiorkor appears to be associated with a decreased myocardial mass that may prevent the ventricles from responding to increases in ventricular preload.

Marsden (1990) reported experiences with Kwashiorkor in Brazil. In one case a child was found to be eating only farina because her mother could not afford meat or beans. Farina is a staple food in Brazil, and unfortunately it is rich only in carbohydrates, thus leading to a status of protein deficiency. This imbalance occurs during a period of maximum growth for children. As the deficiency progresses, interventions focus on the treatment of acute problems including diarrhea, infections, or both. It is very unfortunate that in severe cases children who
survive may have permanent extensive physical and mental retardation.

Kwashiorkor is a preventable nutritional deficit that has an associated mortality and morbidity that can be high without adequate treatment. Health care providers should have an awareness of protein-energy malnutrition and should, as always, perform complete nutritional and physical examinations.

REFERENCES