II M.Sc FOODS AND NUTRITION

NUTRITION IN EMERGENCIES

SUBJECT CODE: DEFN 34A

UNIT-II

Nutritional problems in emergencies in vulnerable groups.

Causes of malnutrition in emergency situations.

Major deficiency diseases in emergencies.

Protein – energy malnutrition.

Specific deficiencies

The occurrence of both natural and human-made emergencies has risen in recent years resulting in large number of affected communities, refugees, and displaced persons. Drought, flood, earthquakes, and crop destruction by diseases orpests cause nature-induced famines while war and civil conflicts create man-made famines. Deliberate use of chemical, biological, radiological, and nuclear (CBRN) agents as an act of terrorism/war or accidents involving them is a threat to any society.[1] Accidental exposure of chemicals and radiation are not a rare phenomenon these days. Major emergencies often results in food shortage, impair the nutritional status of population, and causes excessive mortality in almost all agegroups. Nutrition is, therefore, a key public health concern in emergency management. Malnutrition in one or more of its various forms is a main feature during calamities. When nutritional needs of affected population or a subgroup of population are not met completely, sign of malnutrition emerge among helpless or vulnerable individuals. There are underweight children, anemic mothers, marasmic babies, vitamin deficiency diseases, i.e., blindness, scurvy, beriberi, pellagra, and other deficiency diseases are also observed.[2] Knowledge of nutritional requirements for management of emergencies is important because of the following reasons:

- i)Assessment of nutritional needs of individuals, vulnerable groups, families, and population
- ii)Monitoring of nutrient intake in these groups
- iii)Ensuring that adequate quantities of food are being procured/made available for rations, supplements, etc.

Identification of most vulnerable groups is also essential and generally these are groups with additional nutrient requirements, e.g., pregnant and lactating women, infants and young children, single adults, e.g., widows and widowers in older age group. Besides these, patients suffering from degenerative diseases like diabetes, cancer, and immunodeficiency also need special attention.

In the initial stages of disaster there is instability, acute shortage, and mass movement of people. The victims are totally dependent on aid. There are inevitable delays in evaluation, requesting for planning, receiving donations, transport, and formation of distribution system. At this stage management is generally controlled by internal government and nongovernmental organizations (NGOs). The second stage of famine (usually after six months) is a stage of establishment. The affected people are organized or they organize themselves and use newer coping strategies, i.e., starting cultivation, setting up of small home industry, and selling of labor. At this stage relief can be more targeted towards more needful persons.

Guidelines for the identification and management of malnutrition have been published by various international and NGOs. These include Médicins Sans Frontiàres, the World Health Organization, United Nations High Commissioner for Refugees, The United Nations Children's Fund, and World Food Programme.[2–4] In addition, food security, nutrition, and food aid are included in the minimum standards set by the Sphere Project. The Sphere Project was launched in 1997 by a group of humanitarian NGOs and the Red Cross and Red Crescent movement. Sphere project has developed several tools, the key tool being the handbook which is available online.[5] The issues related to CBRN have also been reviewed with highlighting role of pharmacists.[6–8] Present review briefly summarizes the nutritional requirements during emergencies with highlighting key issues of food safety during CBRN disaster.

Information Required for Management of Emergencies

Management or intervention needs accurate information about actual situation and includes many non nutritional components in the programs, even though food is the most compelling basic necessity. The factors which need to be considered are as follows:

1. Population size, geographic dispersal of population, map of affected area including location of camps, etc
2. Age groups
3. Current nutritional status
4. Nutritional deficiencies and endemic diseases
5. Purchasing power and coping mechanisms and market prices
6. Access to potable water
7. Fuel supply
8. Assess to food, seeds, tools, etc
9. Seasonality and forecast system
10. Cultural beliefs, taboos
11. Threats to security, political, and military situations
12. Underlying causes of the crisis

In major emergencies, most urgently needed action is to prevent death and illness caused by malnutrition. Basic energy and protein requirements are primary concern, but micronutrient needs must also be met if blindness, disability, and deaths are to be avoided.

Nutrient Requirements During Emergencies

The estimated mean daily per capita energy requirement of 2070 kcal rounded up to 2100 kcal is based on WHO technical report No 724 published in 1985 and on the following assumptions:

- The age/sex distribution of the population is characteristic of developing countries
- The mean height of adult men and women are 169 and 155 cm, respectively, which is the approximate value in sub-Saharan Africa

- The body mass index (Kg/m^2) is between 20 to 22
- Physical activity is light
- All infants are breast-fed from birth to six months, and half of the infants of 6 to 11 months are still breast-feeding and deriving half of their energy and protein requirements from breast milk.

Safe daily protein intake from an average mixed diet of cereals, pulses, and vegetables is estimated to be 46 g.

Micronutrient and other specific nutrient requirement

The recommended average daily per capita intake of various specific nutrients for typical population requiring emergency food aid in developing countries is given in Table 1.

Table 1

Recommended mean daily per capita nutrient intake for emergency food in developing country

Nutrient	Recommended daily intake
Vitamin A (retinol) equivalents	500 μg
Vitamin D	3.8 μg
Thiamin (Vitamin B_1)	0.9 mg
Riboflavin (Vitamin B_2)	1.4 mg
Niacin equivalents	12.0 mg
Folic acid	160 μg
Vitamin B_{12}	0.9 μg
Vitamin C	28 mg
Iodine	150 μg
Iron*	22 mg
Calcium	0.5 g

*From diet that provides iron of low or very low bioavailability

Major Nutritional Deficiency Diseases in Emergencies

Protein-energy malnutrition

Even in normal times, protein-energy malnutrition (PEM) is a problem is many developing countries most commonly affecting children between ages of six months to five years; in times of nutritional emergencies, primarily the more acute form of PEM is observed that has to be dealt with. These are characterized by rapid loss of weight and may affect larger number of older children, adolescents, and adults than usual. Infants and children suffering from severe PEM must be treated as soon as possible to avoid hunger deaths. Selective feeding program should be initiated for PEM-affected individuals and these include supplementary feeding programs (SFPs) providing extra 500 to 700 kcal/day from cooked food or by distribution of dry take-home rations (1000 – 1200 kcal/day). Breast-feeding must be encouraged. Blanket SFP should be needed only temporarily when malnutrition rates (weight for height below median –2 Standard Deviation (SD)) exceeds 15 or 10% in the presence of other aggravating factors. Targeted supplementary feeding (i.e., extra food given to selected individuals) is indicated if the malnutrition rate exceeds 10 or 5% in presence of other aggravating factors, e.g., high mortality and/or epidemic infectious diseases. Therapeutic feeding is required to reduce death rate among infants and young children. A rehabilitative diet, with high- energy foods (providing 150 – 20 kcal and 2 – 3 g of protein/kg body weight daily)should be served at frequent intervals. For first few days, there should be close medical supervision and feeding should be made at every three hours on a 24-h basis. Mothers should feed their sick children themselves. Broad spectrum antibiotics for treatment of emerging infections, immunization against measles, andnormal doses of vitamin A should be made available.

Micronutrient deficiencies

Micronutrient deficiencies are more common during calamities due to lack of diversified food items and nonavailability of fresh foods. All forms of vitamin and micronutrient deficiency diseases can be seen in affected population if preventive measures have not been taken in time. These include iron deficiency anemia, vitamin A deficiency blindness, beriberi, pellagra, edema, and goiters. There are several approaches for preventing onset of micronutrient deficiencies in emergencysituation affecting large populations, which are as follows:

- Increasing the daily ration that will allow a surplus to be sold for other purposes like procuring fruits and vegetable.
- Varying the composition of food basket such as pulses, groundnuts, fresh fruits and vegetables, and red palm oil. A better alternative is local production of fruits and vegetables in home gardens.
- Including micronutrient fortified foods in ration, e.g., cereals/pulse blends, iodized salt, vitamin A enriched skim milk or vegetable oils.
- Providing supplementation when there is likely to be a specific deficiency based on dietary assessment and overt signs and symptoms.

Assessment and surveillance of nutritional status and relief measures in emergencies

During nutritional emergency, relief foods may be scarce and may need to be provided preferentially (targeted) to the more needy people. Food relief programs should be planned and implemented on the basis of initial, rapid nutrition assessment followed by systemic surveys and continues monitoring (surveillance) of nutritional conditions. Suitable arrangements must be made for evaluating nutritional status at levels of communities (to assess extent of severity of malnutrition and micronutrient deficiencies and composition of emergency ration; to ensure that fuel and cooling utensils are available; and to monitor changes in nutritional status over a period of time) and of individuals (to screen for supplementary or therapeutic feeding programs [TFPs]).

Various simple indicators may be used such as:

1. Weight for height
2. Body mass index (weight in kg/squire of height in meters) of adults
3. Mid upper arm circumference can be used as an alternative for initial screening
4. Edema is an essential indicator when Kwashiorkor is present.

Nutritional relief program and interventions

A general feeding program is required during first stage when the affected population does not have sufficient food to meet nutritional needs. If the population is entirely dependent upon external aid, the general ration must provide for a minimum intake of 2100 kcal per person per day and more if population is already malnourished, exposed to cold, or engaged in heavy work [Table 2].Besides being nutritionally balanced, the general ration should be acceptable culturally, fit for consumption, and easily digestible for children and other affected vulnerable groups. Although nutrient needs are different for different age groups ina family, same general ration components should be provided for each person, regardless of age; families would divide ration among themselves. The general ration is normally provided dry, for cooking at home.

Table 2

Mean energy requirements and recommended adjustments for different activity levels, environmental temperatures and food losses during transport

	Developing country	Industrialized country
Mean energy requirement (kcal)	2080	2180
Adjustment for activity level		
Moderate adult male	+300	+370
Adult female	+100	+105
Whole population	+140	+180
Heavy adult male	+850	+890
Adult female	+330	+340
Whole population	+350	+460
Adjustment in kcal for mean daily temperature		
20°C	-	
15°C	+100	
10°C	+200	
5°C	+300	
0°C	+400	
Adjustment in energy requirement (kcal) for food losses in transport	-	
Country with port	+5%	
Land locked country	+10%	

Energy requirement for moderate activity are calculated as 1.78 × BMR for males and 1.64 × BMR for females, and for heavy activity as 2.10 × BMR and 1.82 × BMR for females. Source: WHO 2000, The Management of Nutrition in Major Emergencies

Because of the following reasons, distribution of cooked food should be avoided except as a short-term measure that should be stopped as soon as people have necessary arrangements to prepare their meals:

- Such program is often culturally inappropriate and may cause offence.
- Hygiene is difficult to ensure.

- Food intakes are often lower and difficult to meet needs of young children.

For distribution of cooked food, locally available fuel and local methods for making fire can be used. Individuals may be asked to collect and bring wood, cow dung, etc for fuel and if collection is difficult or there are chances of deforestation in area, kerosene oil should be used as alternative.

In second stage, SFP is given for vulnerable groups and TFP are provided to those already severely affected by malnutrition or deficiency diseases.

For distribution of items ration cards should be issued and maintained.Effectiveness of program should be monitored at regular intervals.

Issues Involved in Ensuring Proper Nutrition in Post-CBRN Disaster

Food must be protected from CBRN contamination. Consuming contaminated food may cause illness injury or may be fatal. Foods that are packed in cans, bottles, airtight foil, or film wraps are generally not contaminated by nuclear fallout as long as they remain packaged.[6] Insulated food containers and refrigerators are excellent protection from fallout, and are easy to decontaminate. The two types of biological agents are pathogens and toxins. Stringent sanitation in preparing and serving food along with pest and rodent control is required for protection against contamination by pathogens. To protect food from toxins and chemical agents, food must be stored in sealed, airtight containers and containers should be decontaminated before opening.[1] Heat is the best way to decontaminate biologically contaminated food. In case of chemical exposure food must be discarded, as fatty foods absorb nerve and blistering agents and decontamination is impossible.

The contaminants enter the food chain; therefore, food from the affected area should not be consumed until it is tested safe. Radioactive iodine is transmitted to human breast milk, contaminating this valuable source of nutrition to infants. Cow and buffalo milk, staple diet of children can also be quickly contaminated if radioactive material settles onto grazing areas.

In many European countries, levels of radionuclide such as I-131, Cs-134/137, and Sr-90 in milk, dairy products, vegetables, meat, and fish were found increased immediately after Chernobyl's catastrophe in April 1986. Measurable amounts of

Chernobyl contaminants were found in food products like pasta, chesses, juices,tea, thyme, caraway seeds, and apricots imported from Turkey, Italy, Austria, West Germany, Greece, Yugoslavia, Hungary, Sweden, and Denmark. Milk (7 – 8%) and other products (13 – 16%) from Belarus and Ukraine had Cs-137 exceeding permissible limits even in 2007. Average levels of incorporated Cs-137 and Sr-90 have increased instead of declining from 1991 to 2005 in heavily contaminated territories of Belarus, Ukraine, and European Russia.[9] The ion exchange treatment of milk, which is somewhat expensive, can eliminate more than 90% of the radionuclide of concern, i.e., Sr-90, I-131, and Cs-137.[10]

Potassium iodide (KI), the compound used in iodized salt, when ingested immediately before, during, or shortly after exposure to radioiodine blocks uptake of inhaled or ingested radioiodine. KI is effective in preventing radiation-induced thyroid effects. The guidelines for use of KI are given by American Academy of Pediatrics.[8] The KI can be taken with beverages to mask its salty taste and recommended doses are summarized in Table 3. People living near nuclear power plants should have access to KI as adjunct to evacuation and sheltering.[11–13] When treatment with KI is contraindicated, iodine-free thionamide or potassium perchlorate are suggested.[14] However, in hot and humid climates, thishygroscopic chemical has a poor shelf life due to hydrolytic loss of iodine vapors. On the other hand, another iodine-rich salt, potassium iodate, is quite stable and has a much longer shelf life and also has better taste and is preferred. Use of apple-pectin food additives is helpful in decorporation of Cs-137. Between 1996 and 2007, a total of more than 160,000 Belarusian children received pectin food additives during 18- to 25-days treatment (5 g twice a day). Application of various pectin-based food additives and drinks using apple, currents, grapes, etc is the mosteffective way for individual radioprotection (decorporation) under circumstances when consumption of radioactivity contaminated food is unavoidable.[15]

Table 3

Recommended doses of KI for protection against radioiodine exposure

Patient	Exposure Gly (rad)	KI dose (mg)
>40 year of age	>5 (500)	130
18 – 40 year of age	≥0.1 (10)	130
Adolescent* (12 – 17 years)	≥0.05 (5)	65
Children (4 – 11 years)	≥0.05 (5)	65
Children (1 month – 3 years)	≥0.05 (5)	32
Infants (<1 month)	≥0.05 (5)	16
Pregnant or lactating women	≥0.05 (5)	130 (only once)

Repeated doses should be on the advice of public health authorities.
*Adolescent with >70 kg body weight should be given adult doses

Medicinal plants like *Podophyllum hexandrum*, *Hippophe rhamnoides*, *Radiola imbricate*, and *Tinospora cordifolia* have been found to have promising efficacy in experimental animals against radiation exposure.[16–21] Much work is going on in this area for identification of active constituents of these plants, and radioprotective nutraceuticals may be available in near future.One of the mechanisms of radioprotection by plant products is their antioxidant activity.

CAUSES OF MALNUTRITION IN EMERGENCIES:

Malnutrition comes in many forms. Simply put, it means poor nutrition. It includes:

- **Undernutrition**: when a person does not get enough food to eat, causing them to be wasted (this is also called acute malnutrition, when someone is too thin for their height) and/or stunted (this is also called chronic malnutrition, when someone is too short for their age). Undernutrition increases the risk of infectious diseases like diarrhoea, measles, malaria and pneumonia, and chronic malnutrition can impair a young child's physical and mental development.

- **Micronutrient deficiencies**: when a person does not get enough important vitamins and minerals in their diet. Micronutrient deficiencies can lead to poor health and development, particularly in children and pregnant women.
- **Overweight and obesity**: linked to an unbalanced or unhealthy diet resulting in eating too many calories and often associated with lack of exercise. Overweight and obesity can lead to diet-related non-communicable diseases such as heart disease, high blood pressure (hypertension), stroke, diabetes and cancer.

Starvation is a severe lack of food which can result in death.

In emergencies, people are at higher risk of undernutrition and micronutrient deficiencies. Those whose nutrition was poor before the crisis are even more vulnerable. Acute malnutrition weakens the immune system, which then becomes more susceptible to developing diseases that can be fatal.

Undernutrition and micronutrient deficiencies can be widespread among refugees and displaced people, as adequate food and health services are often not readily accessible.

Inadequate nutrition and repeated bouts of infection during the first 1000 days of a child's life can cause stunting, which has irreversible long-term effects on the physical and mental development of children. Worldwide in 2015, there were 156 million stunted children, about 45% of them living in fragile and conflict-affected countries.

Emergencies can also aggravate diet-related noncommunicable disease, such as heart disease, high blood pressure (hypertension), diabetes and cancer. Healthy foods may not be regularly available and appropriate medical care may not be accessible, leading to the interruption or cessation of treatments for these diseases. Given that many populations have high levels of noncommunicable diseases, emergencies can cause a significant increase in illness and even death from these diseases.

Young children and women who are pregnant or breastfeeding are most vulnerable to under nutrition. Their bodies have a greater need for nutrients, such as vitamins and minerals, and are more susceptible to the harmful consequences of deficiencies.

Children are at the highest risk of dying from starvation. They become undernourished faster than adults. Severely wasted children are 11 times more likely to die than those with a healthy weight. Undernourished children catch infections more easily and have a harder time recovering because their immune systems are impaired. Globally, undernutrition is an underlying factor in more thanhalf of child deaths from pneumonia and malaria, and more than 40% of measles deaths.

Severe acute malnutrition is when a person is extremely thin and at risk of dying. They need immediate treatment. The response to acute malnutrition is broad and includes several elements such as medical, food, water and hygiene, and social services.

Children who still have an appetite can stay at home and receive outpatient care. They need treatment with specially-formulated foods, and their recovery must be monitored regularly by a trained health worker.

Children who have medical problems and do not have an appetite need inpatient care in a clinic or hospital. They need specially-formulated milks and treatment for infections or other potential complications.

SPECIFIC DEFICIENCIES:

Among the five classes of immunoglobulins: IgG, IgA, IgM, IgD, and IgE, IgG has the predominant role in protection against infection. Some patients have normal levels of immunoglobulins and all forms of IgG, but do not produce sufficient specific IgG antibodies that protect us from some viruses and bacteria. Patients who otherwise produce normal immunoglobulin levels but who lack the ability to produce protective IgG molecules against the types of organisms that cause upper and lower respiratory infections are said to have Specific Antibody Deficiency (SAD). SAD is sometimes termed partial antibody deficiency or impaired polysaccharide responsiveness.

Definition of Specific Antibody Deficiency

The previous chapters described forms of hypogammaglobulinemia and IgG subclass deficiencies in which patients may have recurrent infections due to a lack or low level of these IgG molecules. Each individual IgG molecule is uniquely designed to protect against a specific pathogen. We call these molecules "specific antibodies," and they are usually formed in response to natural exposure to bacteria and viruses, or through exposure to vaccines. They can be measured in the laboratory, and these levels (or titers) are used to help diagnose problems with immunity.

Children less than 2 years of age often do not have a robust response to infections with bacteria such as Streptococcus pneumoniae, Moraxella catarrhalis, or Haemophilus influenzae. This is primarily due to an inability to make antibodies against the polysaccharide (sugar) coat that covers these bacteria. Normally, most children begin to make stronger immune responses to these bacteria around 2 years of age, and can fight off these infections more effectively. Children and adults who fail to develop the immune response to the polysaccharide coating on bacteria (and therefore lack protection to these microbes) but who otherwise have normal antibody levels have SAD.

Specific IgG antibodies are important in fighting off infections; however, other components of our immune system also work to eradicate bacteria and viruses. T-cells, complement proteins and IgA antibodies (to name a few) are parts of our immune system that work together during a complete immune response. If these other components work well, some patients with low specific antibody levels may rarely get sick. Antibodies of certain IgG subclasses interact readily with the complement system, while others interact poorly, if at all, with the complement proteins. Thus, an inability to produce antibodies of a specific subclass or mild deficiencies of other arms of the immune system may render the individual susceptible to certain kinds of infections but not others. These factors must be taken into account before an individual immune system is considered to be abnormal, either by virtue of having a low IgG subclass level or an inability to make a specific type of antibody.

Clinical Presentation of Specific Antibody Deficiency

Recurrent ear infections, sinusitis, bronchitis and pneumonia are the most frequently observed illnesses in patients with SAD. Some patients will show an increased frequency of infection beginning in the first years of life. In otherpatients, the onset of infections may occur later. Often a child with SAD will first come to the physician's attention because of recurrent ear or other respiratory infections. At any age, recurrent or chronic sinusitis, bronchitis and/or pneumonia may develop. In general, the infections suffered by patients with SAD are not as severe as those suffered by patients who have combined deficiencies of IgG, IgA and IgM, like X-linked Agammaglobulinemia (XLA) or Common Variable Immune Deficiency. However, patients may present with a single severe pneumonia or other infection at the time of diagnosis.

Diagnosis of Specific Antibody Deficiency

Problems with specific antibody production may be suspected in children and adults who have a history of recurrent infections of the ears, sinuses, bronchi and/or lungs. The recommended evaluation usually includes measurement of total immunoglobulins, IgG subclasses and antibody titers to specific bacteria such as tetanus, diphtheria, and/or Streptococcus pneumonia. When total immunoglobulins or IgG subclasses are low, a more profound immunodeficiency is usually present. Some patients have low antibody titers to *Streptococcus pneumoniae* during the initial evaluation, and this finding usually requires vaccination and additionaltesting. Patients older than 1 year of age may be immunized with the pneumococcal polysaccharide vaccine (Pneumovax 23 or Pnu-immune 23). These vaccines have the ability to induce protective titers to 23 strains (serotypes) ofthese bacteria. Antibody titers are measured again four to six weeks later to determine if adequate protective antibody titers were produced. It is felt thatnormal individuals respond to a majority of the serotypes in these vaccines and retain those protective titers for years after receiving it. Antibody responses may not last as long in young children. For therapy, it is also possible to reimmunize with Prevnar 13, a different type of pneumococcal vaccine, which, for most patients, may be more immunogenic than Pneumovax. However, this vaccinecannot be used to diagnose SAD.

The criteria for the diagnosis of SAD have been somewhat controversial. However, most immunologists now agree that several patterns of response are seen after receiving the vaccine. Patients may fail to respond to any of the serotypes included in the vaccine and have a more severe form of SAD. Responses in which children respond to less than 50% of serotypes and adults respond to <70% have a moderate form of SAD with an increased risk of upper/lower respiratory tract infections that may warrant treatment. An additional subset of patients appears to respond normally initially then lose protective levels within months.

Inheritance of Specific Antibody Deficiency

No clear-cut pattern of inheritance has been observed with SAD.

Natural History of Specific Antibody Deficiency

The natural history of patients with SAD is not completely understood. SAD seems to occur more often in children, probably due to the natural "maturation" of the immune response. Children may "outgrow" SAD over time. Adults with similar symptoms and poor response to vaccination are less likely to improve over time. Both IgG subclass deficiencies and SAD may evolve into CVID. *(See chapter titled "Common Variable Immune Deficiency.")* At the present time, it is notpossible to determine which patients will have the transient type of deficiency and in which patients the deficiency may be permanent or the forerunner of a more wide-ranging immunodeficiency, such as CVID. For these reasons, periodic reevaluation of immunoglobulin levels and specific antibody titers is necessary.

Treatment of Specific Antibody Deficiency

Patients with SAD frequently suffer recurrent or chronic infections of the ears, sinuses, bronchi and lungs. Treatment of these infections usually requires antibiotics. One goal of treatment is to prevent permanent damage to the ears and lungs that might result in hearing loss or chronic lung disease with scarring. Another goal is to maintain patients as symptom-free as possible so that they may pursue the activities of daily living such as school or work. Sometimes antibiotics may be used for prevention (like prophylaxis) of infections.

For immunodeficiency diseases in which patients are unable to produce adequate levels of the major immunoglobulin classes (IgG, IgA and IgM) and fail to make antibodies against proteins or polysaccharide antigens, like XLA and CVID, immunoglobulin (Ig) replacement therapy is clearly needed. *(See chapter titled "Immunoglobulin Therapy and Other Medical Therapies for Anitbody Deficiencies.")*

As in IgG subclass deficiency, the use of Ig replacement therapy for SAD is not as clear-cut as it is for those with XLA or CVID. For patients with SAD in whom infections and symptoms can be controlled with antibiotics, Ig replacement therapy is usually not necessary. However, for patients whose infections cannot be readily controlled with antibiotics or who have more frequent and severe infections, Ig replacement therapy may be considered.

Since many young children appear to outgrow SAD as they get older, it is important to reevaluate the patient to determine if the deficiency is still present. If replacement therapy has been initiated, reevaluation requires discontinuation of Ig therapy and at least four to six months of observation before immunity is re- evaluated. Measurement of antibody levels and consideration of re-immunization with pneumococcal vaccines is done at this time. If the response to vaccination is adequate, Ig therapy may be discontinued and the patient observed. It is reasonable to reevaluate antibody levels periodically to document retention of protective antibody levels. If the diagnosis of SAD is made in teenagers or adults, resolution of the deficiency is less likely.

Expectations for Patients with Specific Antibody Deficiency

The outlook for patients with SAD is generally good. Many children appear to outgrow their deficiency as they get older, usually by age 6. For those patients for whom the deficiency persists, the use of antibiotics and, in certain circumstances, the use of Ig therapy may prevent serious infections and the development of impaired lung function, hearing loss or injury to other organ systems.