CHAPTER 10

NUTRITIONAL MANAGEMENT OF HIV/AIDS, TB, AND OTHER INFECTIOUS DISEASES

Celeste E. Naude, Lisanne M. du Plessis, and Michael K. Hendricks

Outline

• Role of nutrition in immunity and infectious disease
• Human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS)
  • Nutrition and HIV/AIDS
  • Nutritional management of HIV/AIDS
• Tuberculosis (TB)
  • Nutrition and TB
  • Nutritional management of TB
• Other infectious diseases
  • Malaria
  • Measles
  • Acute respiratory infections

Objectives

At the completion of this chapter you should be able to:

• Describe the global burden of infectious disease and the disproportionate impact of these diseases in developing countries
• Explain the relationship between nutrition, immunity, and infectious diseases in general
• Describe the links between nutrition and HIV/AIDS, TB, malaria, measles, and acute respiratory infections, especially in developing countries
• Outline the pathophysiology and transmission of HIV/AIDS, TB, and acute respiratory infections, as well as the disease progression of HIV/AIDS
• Describe the nutritional management of HIV/AIDS and TB in a community setting in a developing country
• Explain the benefits of proper nutrition for people living with HIV/AIDS and TB
• Understand the interactions between nutrition and antiretroviral drugs (ARVs) and TB medications, as well as the side effects that may undermine nutritional health
• Understand the impact of HIV/AIDS and TB on food security and the importance of addressing food security as part of nutritional management
• Recognize the importance of food safety and hygiene for people living with infectious diseases
• Describe the nutrition-specific interventions that form part of the management of malaria, measles, and acute respiratory infections

1. INTRODUCTION

Infectious diseases are caused by pathogenic microorganisms, notably bacteria, viruses, parasites, and fungi. These diseases can be spread, directly or indirectly, from one person to another. In this chapter, we will consider some of the most serious infectious diseases: human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS), tuberculosis (TB), malaria, measles, and acute respiratory infections (ARIs), especially pneumonia. These diseases are major causes of death, disability, and social and economic disruption for millions of people worldwide. Their prevalence in the developing world is especially alarming, not only when they are considered separately but, even more so, when they function as a lethal combination. These illnesses often strike young adults just when they would normally be contributing most to their family, their community, and their country’s economic progress.

The sixth of the eight United Nations Millennium Development Goals (MDGs), adopted by world leaders in the year 2000 and set to be achieved by 2015, is to combat HIV/AIDS, malaria, and other diseases. Although considerable gains have been made since 2000, in many low- and middle-income countries progress has been insufficient. Consider the following:

• An update released by the World Health Organization in January 2014 indicated that, as of the end of 2012, 35.3 million people worldwide had HIV/AIDS. Despite a global decline in the incidence of new infections, the number of new cases in 2012 was estimated at 2.3 million, with sub-Saharan Africa accounting for two-thirds of these cases; of the approximately 1.7 million who people died of AIDS, 230,000 were children. In developing countries, roughly 10 million people were receiving antiretroviral therapy, far short of the number in need of treatment (WHO, 2014b).

• In addition, although the incidence of TB has also been declining, the disease remains a major killer, with the WHO reporting 8.6 million new cases worldwide and 1.3 million deaths in 2012 (WHO, 2014b).

• According to the World Malaria Report 2013, as of the end of 2012 only a little better than half (59 out of 103, or 57%) of the countries that reported ongoing malaria transmission in 2000 had met the MDG goal of reversing the incidence of the disease (WHO, 2013e).

• Pneumonia remains the leading cause of childhood mortality worldwide. The WHO estimates that approximately 1.1 million children under the age of 5 die of pneumonia each year – more than the number who die of AIDS, TB, and malaria combined (WHO 2013c).

The circular relationship between nutrition and HIV infection, TB, and other infectious diseases is reasonably well documented. Inadequate dietary intake compromises the immune system, which increases susceptibility to disease and often culminates in active disease. Disease then depresses appetite and the body’s ability to absorb nutrients, and the cycle is perpetuated. Against the background of existing malnutrition in a given country, a high incidence of infectious illnesses can have serious consequences for public health, felt at the individual, community, and national levels. Even though safe and effective interventions for many of these infectious diseases exist, many people lack access to needed preventive and treatment care.

2. IMPACT OF INFECTIOUS DISEASES

Not only are infectious diseases very prevalent in developing countries, but people suffering from one infectious disease become more susceptible to other infectious diseases, with the result that co-infection is common. For example, persons infected with HIV/AIDS are more vulnerable to TB because of their already compromised immune function (Korenromp et al., 2005; World Food Program, 2004).

The negative impact of infectious diseases is most severe among the poorest people – people whose material, physical, and financial resources are meagre and who have limited or no access to integrated health care, prevention tools, and medications. Children are especially vulnerable to infectious diseases. Pneumonia, diarrhoea, and malaria are leading causes of death among children under the age of 5, and cerebral malaria
can cause permanent mental impairment (Breman et al., 2004; Rudan et al., 2007). Infectious diseases, even when they do not prove fatal, also undermine the lives of adults, causing disability, a diminished capacity for enjoyment, and decreased productivity.

The lost productivity, missed educational opportunities, and extensive health care costs caused by infectious diseases take a huge toll on both families and communities. Specifically, quite apart from its impact on mortality rates, the scourge of HIV/AIDS has had far-reaching consequences in the areas of food security, health, and education and continues to seriously hamper economic and social development (ECSA-HC & FANTA, 2008). Especially in sub-Saharan Africa, the effect on households, communities, businesses, public services, and national economies has been immense. The impact of HIV/AIDS on children, in particular, cannot be overestimated. As parents and family members become ill, children take on more responsibility for earning an income, producing food, and caring for family members. As of 2013, an estimated 17.8 million children worldwide – 85% of them in sub-Saharan Africa – had lost at least one parent to AIDS (UNICEF, 2013). AIDS orphans, defined by the United Nations as children one or both of whose parents have died of the disease, are vulnerable to a host of problems. In addition to malnutrition, these include “increased food insecurity, stigmatization and discrimination, reduced access to education and economic opportunities, and sexual abuse and exploitation” (de Wagt & Connolly, 2005).

Malaria is also responsible for considerable economic losses. Research conducted in 1998 revealed that, in countries with high levels of transmission, the rate of growth in gross domestic product (GDP) fell by as much as 1.3% per year, while as little as a 10% reduction in malaria was associated with a 0.3% increase in the rate of growth (Gallup & Sachs, 2001). Over the long term, these aggregated annual losses have resulted in substantial differences in GDP between countries with and without malaria, particularly in Africa. The health costs of malaria include both personal and public expenditures on prevention and treatment. Like other major infectious diseases, malaria disproportionately affects poor people, who cannot afford treatment or have limited access to health care, thus trapping families and communities in a downward spiral of poverty.

3. ROLE OF NUTRITION IN IMMUNITY AND INFECTIOUS DISEASE

The immune system consists of two main tiers: non-specific and antigen-specific. Non-specific immunity is innate – that is, we are born with it. In contrast, antigen-specific immunity, also known as acquired or adaptive immunity, develops as a result of exposure to particular pathogens and thus varies from one individual to another. The non-specific defences include the skin and mucous membranes, phagocytic cells (which consume potentially harmful microorganisms), mucus, cilia, the complement system, lysozymes, and other humoral factors. These innate mechanisms act as the first line of protection and slow down the establishment of active infection. Antigen-specific mechanisms, which include the B cell system of antibody production and the T cell system of cell-mediated immunity, target specific pathogens and are effective in curbing the spread of infection and eradicating invading organisms. With this system the host’s response adapts to a specific pathogen (e.g., the measles virus) to develop immunologic memory that will respond more quickly and more efficiently the next time the same pathogen is encountered. Non-specific and antigen-specific defences act in synergy in the body (Wolf & Keusch, 1999).

The role of nutrition in immunity is well known. As both epidemiological research and clinical evidence have demonstrated, malnutrition is associated with a reduction of the integrity of the immune system and thus with an increased risk of infection. Although important roles for specific micronutrients in immune function maintenance have been identified, research suggests that generalized malnutrition can explain much about immune dysfunction (Fields-Gardner & Fergusson, 2004). Indeed, in view of the complex interrelationship of nutritional status and immune function, it would be naïve to believe that any single nutrient can meaningfully modulate the immune system.

Nutrition-related deficiencies, ranging from deficiencies of trace elements and vitamins to protein-energy malnutrition, interfere with both non-specific and antigen-specific immune responses. In particular, most immune responses involve the production of proteins (which have a variety of specific functions), and many nutrients are involved, directly or indirectly, in protein synthesis (Scrimshaw & SanGiovanni, 1997).
Dietary protein is especially crucial to the maintenance not only of the immune system but of body cell mass. Additionally, the action of all types of immune cells and their products (such as interleukins, interferons, and complements) depends on various metabolic pathways in which various nutrients play a critical role. Lymphoid tissues are especially vulnerable to the damaging effects of malnutrition. Indeed, lymphoid atrophy is a prominent feature of nutritional deprivation (Anabwani & Navario, 2005). An optimal nutritional status therefore supports the efficient functioning of all components of the immune system.

Although malnutrition has many causes, infection is a common precipitating factor. Infectious disease can lead to a cascade of nutritionally adverse events, such as anorexia, diarrhoea, and an inflammatory response, which occurs early in the disease process and during asymptomatic phases. This results in greater nutrient requirements and poor use of the nutrients by the body (FANTA, 2004). This cascade of events is a function in part of the severity of the infection, but it can lead to the rapid loss of lean body mass and increased dysfunction of the immune system (Powanda & Beisel, 2003). At the same time that infection undermines nutritional health, the impaired immune response that results from malnutrition predisposes the body to infections, including HIV and TB, as well as other conditions associated with loss of immune function. Malnutrition and infection thus interact synergistically and are associated with poorer clinical outcomes.

4. HIV/AIDS

AIDS (acquired immunodeficiency syndrome) refers to a cluster of illnesses that are caused by a retrovirus known as HIV (human immunodeficiency virus), which attacks the body’s immune system, undermining its ability to protect the body against further disease and infection. Since HIV/AIDS was first identified in the early 1980s, the scale of the epidemic has steadily increased. The impact of HIV/AIDS varies across continents, regions, and countries, but the effects of the epidemic are felt throughout the world.

4.1 Epidemiology and Burden of Disease

The vast majority of individuals infected with HIV live in developing countries, with sub-Saharan Africa carrying the greatest burden. Globally, however, the incidence of HIV/AIDS has in fact been declining for roughly the past decade, largely in response to public health efforts. According to the 2013 Global Report prepared by the Joint United Nations Programme on HIV/AIDS (UNAIDS), the number of new HIV infections worldwide in 2012 (2.3 million) represented a decline of 33% since 2001 (3.4 million). The mortality rate has also been decreasing, from an estimated 2.3 million deaths in 2005 down to 1.6 million deaths in 2012 (UNAIDS, 2013, p. 4).

Sub-Saharan Africa remains most severely affected, with nearly 1 in every 20 adults (4.9%) living with HIV and accounting for 69% of the people living with HIV worldwide. In 2011 an estimated 23.5 million people in that region were living with HIV. The greatest concentration is in Southern Africa. The region with the second highest number (4 million) is South and South-East Asia (UNAIDS, 2012, p. 8).

Between 2001 and 2011, the incidence of new infections fell by 25% or more in 39 of the world’s countries. The most significant decreases occurred in the Caribbean (42%) and in sub-Saharan Africa (25%), although the latter still accounted for 71% of all new cases. However, during the same years the incidence of HIV increased in several regions including Eastern Europe/Central Asia and North Africa/Middle East (UNAIDS, 2012, pp. 8–12).

Although the overall trend after 2000 has been encouraging, it had become apparent that the MDG 6 target of reversing the incidence of HIV/AIDS by 2015 would not be achieved. In 2011, the UN General Assembly therefore set ten new, and more specific, targets for HIV/AIDS (UN, 2011). These new targets include greater recognition of the socio-cultural and economic factors that work against efforts to halt the spread of the epidemic.

4.2 Transmission

The likelihood that an adult person will be exposed to the HIV virus is primarily, although by no means exclusively, a function of lifestyle, coupled with the prevalence of HIV/AIDS in the region in which the

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The virus is carried in the blood (including menstrual blood), in semen and vaginal secretions, and in breast milk. The virus most commonly enters the body through contact with the mucous membranes in the genitals, anus, rectum, mouth, or eyes or when body fluids in which the virus is present come into contact with an open cut or sore. HIV is not transmitted through insect bites or by contact with saliva, tears, sweat, faeces, or urine.

HIV is transmitted in three ways: sexual, parenteral (by way of syringes), and vertical, or mother-to-child transmission. Sexual intercourse – vaginal, anal, or oral – involves a direct exchange of body fluids. The risk of infection is greatest during anal sex (CDC, 2014), which explains the association between HIV/AIDS and homosexual men. Nonetheless, most HIV infections are the result of heterosexual intercourse (ECSA-HC & FANTA, 2008). People can also be infected with HIV by non-sexual means, such as blood transfusions or a contaminated needle or other sharp object. This is known as parenteral transmission, and it generally involves the passage of the HIV virus directly into the bloodstream. In developed countries, this form of transmission is most closely associated with intravenous drug use. Blood transfusion is another possible route but is now rare because the blood used in transfusions is carefully screened. Health workers can become infected with HIV through needle pricks. Vertical transmission, or mother-to-child transmission (MTCT), occurs when a HIV-positive mother passes the virus to her infant. This can occur in utero and/or during labour and delivery, but the virus can also be transmitted in the mother’s breast milk.

Once a person has been exposed to the HIV virus, the likelihood of infection depends on several factors. One is the type of HIV: some strains are more virulent than others. In the case of sexual transmission, another factor is the specific form of sexual behaviour. In addition, overall health and nutritional status influences a person's vulnerability to infection. Someone whose immune system has already been weakened by illness or malnutrition is at greater risk of infection (of any sort) than is a healthy person. Finally, hereditary factors also play a role: some people are inherently more resistant to infection than others.

### 4.3 Pathophysiology and Clinical Presentation

There are two different types of HIV. The most common type, which occurs worldwide, is HIV-1; the other, HIV-2 is chiefly found in West Africa. The two viruses are closely related, but HIV-2 is less pathogenic than HIV-1, which is characterized by high rates of virus production (Popper et al., 1999). Infection with HIV is the underlying cause of AIDS. HIV invades the genetic core of the CD4 or T-helper lymphocyte cells, causing their progressive depletion and leading to immune deficiency, constitutional disease, neurologic complications, opportunistic infections, and certain forms of cancer. AIDS is a diagnostic term applied to HIV-infected persons who have at least one well-defined, life-threatening clinical condition that is clearly linked to HIV-induced immunosuppression (Fenton & Silverman, 2004). HIV is a slow-acting virus; even in the absence of treatment, it can take around ten years for an HIV-infected adult to develop full-blown AIDS. As with the initial likelihood of infection, the length of this period depends on various factors including the general health and nutritional status at and during the time of infection. An outline of the natural history of HIV infection is provided in Box 10.1.

The primary indicators of disease progression during HIV infection are plasma HIV load and circulating CD4 lymphocyte counts. In many developed countries, it is standard clinical practice to monitor these laboratory indicators. In particular, periodically measuring plasma HIV load is essential in individuals on long-term antiretroviral (ARV) therapy, as this serves to monitor viral resistance to treatment. However, measuring both plasma HIV load and the CD4 lymphocyte count requires quite expensive laboratory instruments and facilities, as well as trained personnel. In developing countries, where little or no access to these facilities exists, monitoring of HIV disease progression usually consists of monitoring the complications that accompany the disease (Villamor et al., 2008). WHO has developed a staging system for HIV/AIDS based on clinical symptoms (WHO, 2007). This system can be used to guide medical decision-making in regions where sophisticated laboratory testing is either unavailable or prohibitively expensive.
Box 10.1: Natural History of HIV Infection

**Initial infection**

When a person comes into contact with an infectious agent, antibodies begin to build up in the blood. Someone infected with HIV begins to develop antibodies relatively soon after infection, but it takes time before these antibodies can be detected in the blood. The time from initial infection to the point at which a person tests positive for HIV (seroconversion) is known as the “window period.” In most cases, this period lasts from 3 to 6 weeks, although its duration depends in part on the sensitivity of the test. By the end of 6 weeks, most HIV-positive individuals will have developed enough antibodies to produce a positive test, although, in rare cases, the window period can last 6 months or more. During the period, flu-like symptoms may appear, including fever, rash, joint pains, and enlarged lymph nodes. Acute infections of the nervous system, such as aseptic meningitis, may also occur, but, as a general rule, newly infected people are unaware that they are HIV positive, with the result that they can easily transmit the virus to others.

**Progression from HIV infection to AIDS**

Following initial infection, a symptom-free period generally ensues before the disease progresses to full-blown AIDS. An adult infected with HIV may have no symptoms for ten years or more. The rate of progression from HIV infection to AIDS depends on the type and strain of the virus, as well as on certain characteristics of the person who is infected. The presence of other infections, as is frequently seen in malnourished individuals, tends to shorten the symptom-free period, and genetic factors probably also play a role. In addition, the disease generally progresses more quickly in people over the age of 40. HIV infects both the central and the peripheral nervous system early in the course of the infection, which can produce a variety of neurological and neuropsychiatric conditions. As HIV infection progresses and immunity declines, people become more susceptible to opportunistic infections.


4.4 HIV in Children

The vast majority of HIV-positive children are infected in the perinatal period, that is, during pregnancy and childbirth. While the progression of HIV infection in children is variable, it is typically more rapid than in adults. Although relatively few children become actively ill during the first few weeks of life, without treatment, roughly a third of HIV-positive children do not live to see their first birthday, and half die before the age of 2. Evidence suggests that beginning antiretroviral treatment before the child reaches the age of 12 weeks can reduce early HIV mortality by as much as 75%. Yet, in 2013, over half (54%) of all pregnant women living in low- or middle-income countries did not receive a test for HIV (UNAIDS, 2014).

As in adults, the rate of progression varies according to the particular strain of HIV, as well as on the efficiency of the child’s immune response. In developing countries, where a high proportion of children are malnourished, the infection tends to progress faster, thereby shortening the survival period. The WHO staging system mentioned above includes clinical criteria for the progression of the disease in children under the age of 15. In addition, it provides criteria on which to base a presumptive diagnosis of HIV in children under 18 months when virological testing is not possible and the HIV status of the mother is unknown (see WHO, 2007, pp. 29–39).

4.5 Diagnosis

The laboratory diagnosis of HIV infection in adults and children over the age of 18 months is made primarily by testing for the presence of the antibodies formed to fight the virus. As we have seen, these antibodies can usually be detected somewhere between 3 to 6 weeks following infection, but the window period can vary. If an initial antibody test is negative, it should therefore be repeated, preferably 3 months after the initial test.

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Infants born to HIV-infected mothers represent a special case for the diagnosis of HIV. A pregnant woman usually passes on HIV antibodies to her child, which remains in the infant’s blood for some time following birth. As a result, an infant born to an HIV-infected mother could test positive for HIV antibodies without in fact being infected. In the absence of more sophisticated methods, such as PCR testing, it is consequently not possible to test for HIV in infants with any degree of reliability until they have reached the age of at least 18 months.

5. NUTRITION AND HIV/AIDS

Nutritional status and HIV are closely interlinked. Deficiencies, and sometimes excesses, of nutrients adversely affect immune responses and other normal body functions. Any immune impairment as a result of HIV/AIDS contributes to malnutrition, which in turn aggravates immune impairment, worsens the effect of HIV, and contributes to a more rapid progression of HIV to AIDS. When malnutrition and HIV/AIDS are concurrent, their effect on the immune system is synergistic.

Nutritional status, specifically the maintenance of weight and crucial body-protein stores (body cell mass, BCM), affects a person’s ability to survive while living with HIV. Characteristic of the wasting seen in patients with AIDS is a depletion of BCM. Regardless of the presence or absence of other infections, death is likely to occur in HIV-infected patients when BCM declines to 54% of the expected value based on height (Fields-Gardner et al., 2004). Micronutrient deficiencies are common in HIV-infected persons and may also accelerate progression of the disease, which in turn leads to further deterioration of nutritional status. The replenishment of micronutrients has been recommended because their blood levels are decreased; However, it is not clear if low levels of micronutrients can be interpreted as evidence of a true deficiency state or whether they are merely a manifestation of the altered metabolism associated with HIV infection and the attendant inflammatory response (Jiménez-Expósito et al., 2002).

Factors contributing to weight loss and malnutrition in persons living with HIV/AIDS (PLWHA) include reduced energy intake, the malabsorption of nutrients, and elevated energy needs during secondary bacterial and/or systemic opportunistic infections. Additionally, a variety of metabolic abnormalities have been reported, namely, increases in insulin sensitivity, protein turnover, and hepatic de novo lipogenesis. Along with reduced energy intake and opportunistic infections, increased resting energy expenditure and chronic diarrhoea play a role in malnutrition among HIV-positive individuals (Melchior et al., 1999). Figure 10.1 illustrates the complex synergistic relationship between malnutrition and HIV.

Figure 10.1: The interactions between HIV and nutrition.

Source: Adapted from Wilson et al., 2013.
5.1 Weight Loss

Weight loss is a strong predictor of death in HIV-infected adults and children (Tang, 2002). Various factors contribute to the weight and protein losses associated with HIV infection, including loss of appetite (anorexia), increased energy use, and poor dietary intake. These factors conspire to produce a condition known as HIV wasting syndrome. Negative nitrogen balance and weight losses are correlated; approximately 80% to 90% of weight loss during acute events can be attributed to protein losses, whereas less protein is lost during the starvation process (Kotler, 2005). HIV-related malnutrition differs notably from simple starvation. The Centers for Disease Control and Prevention (1992, Appendix C) defines HIV wasting syndrome as:

Findings of profound involuntary weight loss of greater than 10% of baseline body weight plus either chronic diarrhoea (at least two loose stools per day for greater than or equal to 30 days), or chronic weakness and documented fever (for greater than or equal to 30 days, intermittent or constant) in the absence of a concurrent illness or condition other than HIV infection that could explain the findings (e.g., cancer, TB, cryptosporidiosis, or other specific enteritis).

HIV-related wasting syndrome involves two different types of wasting: starvation-related wasting and cachexia-related wasting. Starvation refers to the lack of nutrient substrates in the body, whether as a result of a decreased intake of nutrients, their malabsorption, or an increased loss of nutrients from the body (Fields-Gardner & Fergusson, 2004). In cases of HIV, starvation-related wasting is generally seen in otherwise clinically stable individuals who have yet to develop opportunistic infections. Wasting of this sort can be reversed by nutritional support. In contrast, cachexia-related wasting refers to

a disproportionate depletion of lean body mass (LBM) as a result of alterations in metabolism. In fighting disease, metabolic output is redirected to energy requirements and substrates needed to fuel the body’s response instead of normal maintenance of the body. In the long term this leads to protein (especially skeletal muscle) loss. Feeding is not a sufficient intervention to reverse the effects of cachexia. (South African HIV Clinicians Society Expert Committee 2004, p. 22)

Evidence suggests that, in HIV-infected individuals, a combination of nutritional counselling and support, the use of appetite stimulants and anabolic hormones, and exercise designed to build muscle strength (such as resistance training) can reverse weight loss and increase lean body mass (Grinspoon & Mulligan, 2003).

Among the factors that contribute to wasting are malabsorptive disorders. Malabsorption, especially fat malabsorption, appears to occur throughout the HIV disease process, although it is not always accompanied by diarrhoea or other typical symptoms. Factors that have been linked with malabsorption in HIV disease include the atrophy of intestinal villi, damage to intestinal cells, increased gut permeability, and gastrointestinal pathogens (Fields-Gardner et al., 2004). Poor fat absorption also affects absorption of micronutrients such as vitamins A and E, which are important for the proper functioning of the immune system.

Additionally, HIV directly impacts the gut mucosal immune system. Early HIV replication and severe depletion of CD4 cells occurs in gut-associated lymphoid tissue (GALT). Treatment with highly active antiretroviral drugs is able only to partially suppress viral replication and restore CD4 cells in GALT, and persistent HIV replication in this tissue leads to ongoing replenishment of HIV reservoirs. Resulting enteropathic changes are associated with increased inflammation, the activation of the immune system, and reduced levels of mucosal repair and regeneration (Dandekar, 2007).

5.2 Metabolic Abnormalities

HIV infection is associated with metabolic abnormalities, including changes in organ or other tissue function that lead to alterations in the utilization, storage, and excretion of nutrients. These abnormalities may be caused by immune dysfunction, infection of different types, the side effects of medications, or alterations in the hormonal milieu (Fields-Gardner et al., 2004).

Since the introduction of highly active antiretroviral therapy (HAART), several features of abnormal body functioning have been reported. These include altered patterns of body composition, such as the localized loss of fat (lipodystrophy) as well as the deposition of fat in the central section of the body (lipohypertrophy), insulin resistance and/or glucose dysregulation, and dyslipidaemia (abnormal levels of lipids in the blood). HAART has also been associated with mitochondrial toxicity (damage to or depletion of the mitochondria in the body’s cells), lactic acidosis (increased tissue acidity caused by an elevated level of lactate), and irregularities

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in bone mineral metabolism (WHO, 2005). Such complications are not necessarily the result of HAART, however: they can also develop independently. An increase in longevity among HIV-positive individuals suggests that health care professionals will have to address these chronic metabolic and physical alterations as a part of routine health care provision (Fields-Gardner et al., 2004).

5.3 Breast-Feeding and HIV

Prevention of mother-to-child transmission of HIV (PMTCT) is the single most effective way to reduce the burden of HIV in communities. Its optimal implementation is essential to achieving MDGs 4 (reducing infant and child mortality), 5 (reducing maternal mortality), and 6 (combatting HIV/AIDS, malaria, and other diseases).

Extensive research on maternal or infant prophylaxis during breast-feeding has provided data that has prompted action and a review of existing guidelines on infant feeding and HIV (Goga, 2009; WHO, 2010b). It has been established that transmission of HIV during breast-feeding can be reduced to less than 1 percent if

- mothers whose CD4 count is less than 350 cells/ml receive lifelong ARV therapy and their babies receive daily ARV prophylaxis for 6 weeks after birth, or
- babies whose mother’s CD4 count is greater than 350 cells/ml receive daily prophylaxis with Nevirapine (an ARV drug) throughout breast-feeding and for one week after breast-feeding stops.

However, such treatment requires that a mother’s CD4 count be known at the time her baby is born and that ARV treatments are available and affordable. Chapter 5 provides additional recent guidelines on HIV and infant feeding.

6. NUTRITIONAL MANAGEMENT OF HIV/AIDS

WHO recommends that evidence-based nutrition interventions be part of all national HIV care and treatment programmes (WHO, 2008). The nutritional management of HIV-positive individuals has a number of goals:

- To improve nutritional status by maintaining weight and preventing loss of weight and muscle mass
- To ensure adequate nutrient intake by improving eating habits and building stores of essential nutrients
- To prevent foodborne illnesses by promoting good hygiene and food safety
- To provide palliative care during the advanced stages of HIV disease
- To enhance quality of life by managing symptoms that affect food intake

Nutrition care and support for PLWHAs should include nutritional assessment and counselling, as well as supplementation and food provision if indicated. Additionally, advice should be provided about nutritional practices that can help to manage medication side effects and increase drug efficacy, as should referral to other services, if needed. Approaches to implementing nutrition care and support in food-insecure contexts is also an important component of the nutritional management of HIV-positive individuals (ECSA-HC & FANTA, 2008). In this respect we need to be aware that food insecurity and lower levels of nutrient intake are more likely to occur in advanced HIV disease or in populations at risk for deficient intake, such as the economically disadvantaged, elderly, children, injection drug users, the transitionally housed or homeless, and people with compromised mental health.

6.1 Nutritional Assessment

A nutritional assessment gathers information to help guide decisions about nutrition care and support and to monitor the effectiveness of interventions. Especially because food insecurity, inadequate protein intake, general malnutrition, and specific micronutrient deficiencies are endemic in many areas with a high prevalence of HIV, a thorough nutritional assessment should form a routine part of the treatment and care of people who have become infected (WHO, 2008).
An initial assessment should be followed by appropriate interventions and ongoing monitoring. A complete nutritional assessment for PLWHA includes the following:

1. **Anthropometric measurements**: Record weight and weight change, height, body mass index (BMI), and mid-upper-arm circumference.

2. **Biochemical information**: Arrange for laboratory tests to evaluate vitamin and mineral profiles, possible anaemia, and evidence of metabolic complications (such as lactic acidosis and hyperglycaemia), as well as body composition and viral load. Alterations in nutrition-related laboratory values may reflect an inflammatory response as well as nutritional compromise. Whether it is possible to include biochemical tests in a nutritional assessment will depend, of course, on the resources available.

3. **Clinical information**: Aim to identify symptoms and illnesses associated with HIV/AIDS infection that can affect nutritional status. Collect information about appetite change, fever, nausea, vomiting, and alcohol intake, as well as symptoms related to appetite change, difficulty with swallowing, mouth and/or throat sores, oral thrush, muscle wasting, TB, fatigue, lethargy, and the effects of drug-food interactions.

4. **Dietary information**: Assess dietary intake to ensure adequate protein and micronutrients for energy needs and the avoidance of potential drug-food interactions.

5. **Food security status**: Gather information about food availability and access, and evaluate individual and household food security (ECSA-HC & FANTA, 2008; WHO, 2008).

(For detailed information on the methods used to assess nutritional status, see Chapter 22.)

### 6.2 Nutritional Requirements

Evidence suggests that as the HIV infection progresses, nutrient requirements change (WHO, 2003). Increased nutritional needs among PLWHA are associated with increased resting energy expenditure, accelerated protein turnover, decreased food intake, diarrhoea, and malabsorption (ASSAF, 2007). Nutritional requirements are the same regardless of whether a person is taking ARV drugs, but they differ for the two distinct phases of HIV infection: asymptomatic and symptomatic. The former corresponds to WHO Clinical Stage I and the latter to Clinical Stages II to IV (WHO, 2003). Moreover, if an HIV-infected individual has a history of malnutrition, additional micronutrients and/or macronutrients (energy and protein) may be required.

#### 6.2.1 Energy

Energy requirements increase by 10% during the asymptomatic phase and by 20% to 30% during the symptomatic phase. These increased needs for energy apply equally to pregnant and lactating women living with HIV/AIDS, on top of the already higher nutritional needs that accompany pregnancy and lactation. When possible, this need for additional energy should be met by increasing consumption of foods with high nutrient densities, as opposed to foods that are high in energy but low in protein and micronutrients, such as foods high in fat and sugar (WHO, 2003).

When weight loss occurs during the symptomatic phase in children, energy needs increase by 50% to 100%. It is often difficult for children with opportunistic infections and weight loss to consume 50% to 100% more energy than normal. It is therefore important to encourage children to consume additional food after periods of illness and weight loss (WHO, 2003).

#### 6.2.2 Protein

Protein requirements for all PLWHA, including children and pregnant and lactating women, are the same as for healthy individuals (WHO, 2003).

#### 6.2.3 Micronutrients

Micronutrient deficiencies are common in HIV-positive individuals and become more pronounced as the disease process advances. Although daily multivitamin supplementation has been recommended for HIV-
positive individuals, and is commonly practised in the USA and Europe, it remains unclear whether this is an effective prophylactic approach to HIV (or, indeed, any disease). Numerous studies have evaluated the effect of micronutrient supplementation in PLWHA. Randomized trials in the USA (Kaiser et al., 2006), Thailand (Jiamton et al., 2003), and Tanzania (Fawzi et al., 2004) have reported associations between multivitamin and/or mineral supplementation and improvements in the immunological and clinical status of people with HIV. However, because these studies (and others) involved a variety of supplements and employed different outcome measures, their results are not readily comparable (Friis, 2006). Consequently, we do not yet have consistent, compelling evidence that the provision of more than the recommended daily allowance (RDA) of any individual vitamin or mineral is beneficial. This RDA is best provided by food, but HIV-positive individuals whose diets are inadequate in micronutrients should be given a daily multivitamin and mineral supplement equivalent to the RDA (WHO, 2008).

6.2.4 Nutritional support and supplements

According to the WHO (2008, p. 36), nutritional support should be provided to HIV-positive individuals whose BMI indicates malnourishment:

Malnourished adults with HIV are at an elevated and progressive risk of HIV disease progression and mortality as BMI decreases, especially below 18.5. The WHO recommends providing supplementary feeding for mild-to-moderately malnourished adults (BMI <18.5), regardless of HIV status. The most common and cheapest supplementary food is micronutrient-fortified, blended flour (e.g., corn-soy blend or CSB) that can be prepared as a porridge, but other forms (e.g., biscuits or pastes) may be used. Severely malnourished adults (BMI <16) should be provided with a therapeutic food that is formulated to be nutritionally equivalent to the therapeutic F-100 milk.

F-100 milk is a formula that provides 100 kcal/100 ml and is used to treat severely malnourished children. As the WHO notes, F-100 milk is commercially available in powdered form but can also be prepared from basic ingredients: dried skimmed milk, sugar, cereal flour, oil, mineral mix, and vitamin mix. The WHO further recommends that supplemental feeding be continued until the person’s BMI has remained stable for 2 to 3 months above 18.5 (WHO, 2008, p. 37).

The standard recommendations for nutrient intake and nutritional support for pregnant and lactating women should be followed, regardless of HIV status (WHO, 2008).

6.2.5 Nutritional guidelines and food safety

Nutritional guidelines and dietary management of HIV-related symptoms should be integrated into health services and outreach activities. Health workers and counsellors can use counselling to assess how clients are managing symptoms and identify alternative options when needed (ECSA-HC & FANTA, 2008). PLWHA should also be provided with practical dietary strategies for addressing common nutrition-related problems, bearing in mind local and personal food habits, food availability, and individual food preferences.

Proper food safety and hygiene are especially crucial for PLWHA because their immune systems have already been weakened, making them more vulnerable to infection. Such infections may lead to diarrhoea and vomiting, which can deplete nutrients and decrease absorption (ECSA-HC & FANTA, 2008). Safe handling of food and water is therefore essential so as to avoid infections caused by bacteria and viruses present in contaminated food and water (FANTA, 2004). Health workers should thus ensure that HIV-positive individuals are provided with guidelines about food safety.

6.3 ARV Medications

ARV drugs and other medications used to treat people with HIV/AIDS significantly decrease HIV replication in the body and slow the progression of the disease, but they do not cure the person. The drugs help to delay the onset of AIDS and help to prevent opportunistic infections, increasing the opportunity for a longer, healthier life. HAART combines multiple ARVs in the treatment regimen to enhance the effectiveness of the drugs (ECSA-HC & FANTA, 2008). Studies have found that an increase in the number of people receiving HAART is correlated with decreases in population or community plasma viral load and a reduced number

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of new HIV diagnoses per year. This suggests that HAART may have the secondary benefit of reducing HIV transmission (Das et al., 2010; Montaner et al., 2010).

ARVs and other HIV-related medications can, however, interact with food and nutrients, and the long-term use of these drugs has been associated with metabolic complications, as described in section 5.2 above. To achieve the full benefits of therapy with ARVs, adequate and appropriate dietary intake is therefore essential. In addition, specific nutritional strategies may be needed not only to minimize the negative effects of these drugs on nutritional status but to enhance their efficacy and minimize their side effects (WHO, 2003). Developing meal plans to support medication regimens may involve changes in meal timing and specific food choices (Fields-Gardner et al., 2004). It is also important that those who will be taking these medications be given clear instructions. Some drugs should be taken with food, for example, and others on an empty stomach, while yet others should not be combined with certain foods or should be taken with foods rich in specific nutrients. The WHO regularly updates its guidelines for the treatment of HIV-infected persons. These guidelines provide detailed recommendations for the initiation of treatment and outlines of first- and second-line ARV regimens. (For the most recent guidelines, see http://www.who.int/hiv/pub/guidelines/en.)

As access to ARVs continues to improve in low- and middle-income countries, there is a need to better understand the impact of these drugs on undernourished populations and the role that nutritional status plays in both the efficacy of ARV medications and the nature and severity of their side effects (WHO, 2003). The availability of ARV drug therapies will, however, require additional training of health workers, as well as an increase in the capacity of health care systems, which will need to arrange for the distribution of these drugs, for laboratory tests, and for patient counselling and follow-up (ECSA-HC & FANTA, 2008).

6.4 Food Security and HIV

Before the onset of the HIV epidemic, many of the areas that are today most severely affected were already food insecure. The presence of HIV/AIDS in a household or community can cause food insecurity, or it can exacerbate existing insecurity. In turn, lack of food can increase a person’s vulnerability to HIV and worsen its impact. As we have seen, PLWHA have greater nutritional needs, and food insecurity can easily make it impossible to meet those needs.

HIV can heighten food security simply by decreasing the workforce and thereby food production. It also depletes human, financial, and physical capital, which may then increase a country’s vulnerability to other shocks, such as crop failure, drought, or conflict. Such shocks have an especially serious impact on HIV-affected households, whose ability to cope has already been weakened by the depletion of food and money reserves (Table 10.1). Potentially productive assets may have been sold, and a family’s earning capacity is limited by illness and care-giving responsibilities (ECSA-HC & FANTA, 2008).

Table 10.1: The relationship between HIV/AIDS and food security

<table>
<thead>
<tr>
<th>Effects of HIV/AIDS on food availability and access</th>
<th>Effects of food insecurity on HIV/AIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Reduces the availability of labour</td>
<td>- Limits the quantity and quality of food available to households</td>
</tr>
<tr>
<td>- Decreases income, depletes savings, and leads to the sale or loss of assets</td>
<td>- Increases vulnerability to illness and infection</td>
</tr>
<tr>
<td>- Depletes food reserves</td>
<td>- May cause people to resort to livelihood strategies that increase the risk of infection</td>
</tr>
<tr>
<td>- Interrupts knowledge transfer</td>
<td></td>
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<tr>
<td>- Weakens safety nets and support systems</td>
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Issues of food security must be addressed as part of the nutritional management of HIV/AIDS. A nutritional assessment is not complete without an evaluation of possible obstacles to improved nutritional practices, including limited food access and availability, as well as a lack of knowledge about nutritional needs. In addition, an assessment should aim to identify a person’s or household’s strategies for coping with financial pressures, as well as any negative effects of these strategies. Any actions that can feasibly be taken to
improve household food consumption and dietary options should be identified and implemented. If at all possible, households should be linked up with organizations that can provide food assistance, micronutrient supplementation, and advice about means of livelihood and/or skills training. Food security status should then be monitored regularly and the necessary support provided (ECSA-HC & FANTA, 2008).

7. **TUBERCULOSIS (TB)**

TB is primarily a disease of the lungs, but it can spread to other parts of the body, including bone, lymph nodes, and the central nervous system. Despite a recent decline in the overall incidence of TB, the disease remains an enormous public health problem, with developing countries carrying by far the greatest burden of disease. The emergence of multidrug-resistant TB (MDR-TB) – a form of TB that fails to respond to standard first-line treatment – has exacerbated this global public health threat. Extensively drug-resistant TB (XDR-TB), while still relatively rare, occurs when resistance to second-line drugs develops on top of MDR-TB. These conditions pose a very serious threat to TB control, especially in developing settings, where many TB patients are also infected with HIV. The WHO has urged all countries to implement its Stop TB Strategy, which recognizes the need to “address TB-HIV, MDR-TB, and the needs of poor and vulnerable populations” (WHO, 2014d). WHO and its international partners have also formed the TB/HIV Working Group, which develops global policy on the control of HIV-related TB and advises those fighting against TB and HIV on how best to work together to address this lethal combination.

7.1 **Epidemiology and Burden of Disease**

7.1.1 **Prevalence and incidence**

According to the *Global Tuberculosis Report 2013* (WHO, 2013a), 8.6 million new cases of TB were reported in 2012, 1.1 million of them among HIV-positive individuals. Asia (defined by the WHO as its South-East Asia and Western Pacific regions combined) accounted for well over half (58%) of all new cases, and the African region for another 27%. The African region also had the highest rate of cases and deaths relative to population – more than double the global average. The number of new cases was highest in India (26% of the worldwide total), followed by China and then South Africa. High numbers are also seen in Nigeria, Indonesia, and Bangladesh. The WHO also estimates that some 2.9 million cases went either undiagnosed or unreported that year. Of the 1.3 million people who died of TB, 95% of them lived in low- and middle-income countries, and nearly one quarter (24.6%) were HIV-positive. The WHO (2013a, p. 1) describes the number of TB deaths as “unacceptably large given that most are preventable if people can access health care for a diagnosis and the right treatment is provided.”

The number of new cases of MDR-TB in 2012 was estimated at 450,000 worldwide and the number of deaths at 170,000 (WHO, 2013a). However, such figures depend on the ability of individual countries to detect (and report) cases of MDR. Undiagnosed cases of MDR-TB and global gaps in treatment coverage constituted what the WHO report characterized as a “public health crisis.” Globally, about 82% of those individuals identified as eligible for second-line treatment were started on such treatment, but that figure was much lower in certain countries – only 51% in the African region, for example (WHO, 2013a, p. x).

The pandemic of HIV, the emergence of MDR-TB, and the greater mobility of populations are complicating the current worldwide TB epidemic. The TB and HIV epidemics overlap in many regions of the world, especially in sub-Saharan Africa, and the possibility that TB will spread even further is cause for serious alarm, especially in areas where the HIV epidemic is already rampant (van Lettow & Whalen, 2008).

7.1.2 **Highest-risk groups**

Like so many potentially fatal infectious illnesses, TB is a disease of poverty. Although TB affects people of all ages, it is most commonly seen among young adults, people who would otherwise be entering their most productive years. It is an airborne illness, easily transmitted from one person to another. The WHO estimates that, globally, one out of three people has been infected with TB bacteria, although, as latent carriers, they are not actively ill, nor can they transmit the disease (WHO, 2014d). On average, people who have been infected with TB are at a 10% risk of developing active TB over the course of their lifetime, but that risk...
escalates dramatically in the presence of other factors. Understandably, those who live in close quarters with
others, as in nursing homes, dormitories, or prisons, run a greater risk of being exposed to the disease (van
Lettow & Whalen, 2008). HIV-positive individuals who have been infected with TB are 21 to 34 times more
likely to develop active TB than are HIV-negative people (WHO, 2014d). However, anyone whose immune
system is compromised – the malnourished, the elderly, those who already have infections – is at greater risk
of developing active TB, as are people who smoke. Children under the age of 5 are particularly vulnerable,
specifically to extrapulmonary forms of the disease such as TB meningitis. In addition, it appears that children
who have recently had the measles are more prone to develop TB (Duke & Mgone, 2003).

7.2 Transmission, Pathophysiology, and Clinical Presentation

TB is caused by a bacillus bacterium, *Mycobacterium tuberculosis*. When individuals with active TB in their
lungs cough, sneeze, or even speak, they expel these bacteria into the air. These bacteria can stay in the air
for several hours, and if another person breathes them in, that person may become infected. Infection occurs
when these bacteria, which are carried in aerosol droplets, are deposited onto alveolar surfaces in the lungs.
TB is not transmitted by touching: or as a result of kissing or sharing food: the bacteria must be inhaled (CDC,
2012).

TB infection is initially a latent infection, and during this phase, the person infected exhibits no symptoms.
Active TB develops when the body’s immune system fails to contain the infection and physiological functions
are disrupted, thereby producing symptoms. In some individuals, the initial infection progresses directly
to active illness: this is known as progressive primary disease. In others the infection remains latent for an
extended period of time, until conditions conspire to reactivate the previously dormant infection. As we
have seen, 90% of those infected with TB never develop active TB at all. Whether the progression from
latent to active TB will occur depends on several factors. An important one is the intrinsic strength of an
individual’s immune system, as determined by genetics. Environmental factors are also of major importance.
TB progression is more likely with a lack of adequate food and sanitation, crowded living conditions, and
insufficient rest that serve to weaken the immune system (Smith, 2003; van Lettow & Whalen, 2008).

Pulmonary disease – the most common form of active TB – is characterized by a persistent cough, one
that lasts at least 3 weeks and generally produces sputum. Other symptoms include fevers, night sweats, and
weight loss. Occasionally, haemoptysis (coughing up blood), dyspnoea (shortness of breath), and chest pain
develop. However, although TB bacteria initially settle in the lungs, the disease can invade virtually any
site in the body, producing a wide array of conditions that are collectively known as extrapulmonary TB.
Extrapulmonary TB occurs in approximately 20% of cases; the most common sites are the lymph nodes,
pleura, kidneys, meninges, and bone or joints (van Lettow & Whalen, 2008). Another rare, but frequently
fatal, form of TB is miliary TB, which develops when TB bacteria enter the bloodstream and are disseminated
throughout the body, causing small lesions to develop, most commonly in multiple sites.

7.3 Diagnosis and Treatment

The tuberculin skin test is the principal means of determining whether a person is infected with TB. Although
a number of such tests exist, which employ different TB antigens and somewhat different methods, the
Mantoux test, or PPD (purified protein derivative) test, is now most widely used, having largely supplanted
other versions of the test, such as the Heaf test. In a skin test, tuberculin antigens are injected into the epidermis
and, two to three days later, the area is examined for signs of reaction. For a variety of reasons – some relating
to the immunological status of the person being tested, others surrounding the care with which the test is
administered – both false positives and false negatives can occur. The reliability of the test thus depends in
part on how much is known about the medical status and life circumstances of the person receiving the test.
(For a detailed discussion of tuberculin skin testing, see American Thoracic Society, 2000.)

Active TB can manifest itself in a variety of clinical syndromes. Because TB bacteria lodge in the
lungs, a chest X-ray can be used as an initial guide, although the presence of abnormalities is not definitive
evidence of TB. If TB is suspected, the diagnosis is confirmed by the identification of tuberculosis bacteria
(*M. tuberculosis*) in a sample of sputum or some other specimen drawn from the presumed site of infection. A
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microbacterial culture should be performed, which allows for the identification of *M. tuberculosis* in particular (CDC, 2011; van Lettow & Whalen, 2008).

Once TB is diagnosed, a course of antibiotics is prescribed. However, if a person takes a single antibiotic for an extended period of time, as is the case in TB treatment, resistance to the drug tends to develop. For that reason, it is standard practice to use multiple medications in the treatment of TB, which should prevent resistance to any one of them from developing. The standard treatment regimen lasts for 6 months and typically begins with an 8-week “intensive” phase. However, specific recommendations vary somewhat and are frequently updated by both the WHO and the CDC Centers for Disease Control and Prevention, an agency of the government of the United States.

Despite the use of multiple medications in the treatment of TB, strains of *M. tuberculosis* that are resistant to more than one drug have emerged in recent decades (CDC, 2008; WHO, 2012). As mentioned earlier an especially dangerous forms of TB is multidrug-resistant TB (MDR-TB). It fails to respond to standard first-line treatment. An even more dangerous type of TB is extensively drug-resistant TB (XDR-TB). These forms of TB pose a serious global public health threat.

The emergence of MDR-TB is a direct consequence of inadequacies in the initial treatment regimen, whether these involve the choice of medications, the dosages prescribed, or incomplete adherence to the regimen on the part of the patient (van Lettow & Whalen, 2008). Although MDR-TB can be successfully treated, the WHO (2014d) points out that “second-line treatment options are limited and recommended medicines are not always available. The extensive chemotherapy required (up to two years of treatment) is more costly and can produce severe adverse drug reactions in patients.”

8. **NUTRITION AND TB**

8.1 **Malnutrition**

A two-way relationship exists between TB and malnutrition. On the one hand, TB – an illness once called “consumption” – is associated with wasting. In particular, active TB has been linked to abnormalities in protein metabolism, specifically a condition known as anabolic block, in which the body oxidizes a disproportionate quantity of the proteins from food, rather than using them for protein synthesis (Gupta et al., 2009). On the other hand, malnutrition weakens the immune system, with the result that malnourished persons are more susceptible to primary infection with *M. tuberculosis*. Similarly, malnutrition increases the risk that the primary infection will progress to active illness, whether in the short term, as progressive primary disease, or in the longer term, in the form of reactivation. Nutritional deficiencies are known to adversely affect precisely those immunological mechanisms that are crucial for the control of mycobacteria, namely, the functions of T-lymphocytes and a variety of phagocytic cells (North & Jung, 2004). Nutritional deficiencies are therefore generally associated with both an increased risk of TB infection and greater severity of the active illness.

It is very likely, therefore, that providing nutritional support to malnourished populations at high risk for TB could reduce the incidence of active TB in these groups, although this has not been directly proven. Because mild-to-moderate malnutrition typically affects larger segments of the population than severe malnutrition, such prevention efforts are unlikely to be successful if they target only the severely undernourished (USAID, 2008).

Without eliminating it completely, a successful immune response is able to keep TB infection in check in most individuals (Stewart et al., 2003). However, TB is often associated with other co-morbid conditions that affect nutritional status and disease risk, such as HIV (Perez et al., 2006) and alcoholism (Mason et al., 2004). Any immunosuppressive condition, such as HIV infection, malnutrition, or ageing, may tip the balance in favour of the pathogen, resulting in reactivation of TB disease (Lillebaek et al., 2002). HIV and TB form an especially dangerous combination. It is known, for instance, that TB patients with concurrent HIV infection tend to be more severely malnourished (see, for example, Schwenk & Macallan, 2000; van Lettow et al., 2003). Nevertheless, in active TB and likewise in HIV/AIDS, it is often difficult to distinguish between predisposing nutritional deficiencies and disease-induced malnutrition (ASSAF, 2007).

Nutritional deficiencies can also inhibit efforts to treat TB by interfering with the action of medications. In most circumstances, current antimycobacterial drug regimens are highly effective, but concomitant malnutrition may diminish the pharmacodynamic effectiveness of these medications (Calder & Jackson, 2000).
Moreover, malnutrition can hamper the protective efficacy of the BCG (Bacillus Calmette-Guérin) vaccine, thereby increasing the occurrence of disease in vaccinated populations that are nutritionally vulnerable or deficient (ASSAF, 2007).

Proper attention to nutritional status, in combination with pharmaceutical therapy, can help to reduce the burden of disease and promote an enhanced quality of life in TB patients. As antimycobacterial medications begin to take effect, appetite increases, metabolic efficiency improves, and the body’s need for additional nutrients and energy diminishes. At the same time, it appears that improvements in nutritional status are chiefly limited to increases in fat mass, as opposed to muscle tissue, which points to the conclusion that “adequate nutritional intake during TB care and recovery is needed to fully restore nutritional status during and following TB treatment” (USAID, 2008, p. 1). Efforts to improve nutritional status can thus serve as an important adjunct to TB treatment, by helping to build muscle and strengthen immunity.

As was mentioned earlier TB is associated with poverty. A major reason for this is because poverty leads to food insecurity and thence to malnutrition and reduced resistance to TB. The active disease then reduces the ability of people to work which then worsens the problem of food security and nutrition. This also happens in reverse: treatment of TB enhances health which improves the ability of people to work. It is important to bear this in mind so that efforts to prevent and treat TB are seen in their wider context.

8.2 Nutritional Assessment

The nutritional assessment of people with TB is closely similar to the assessment carried out with HIV-positive individuals. It should begin with a basic anthropometric evaluation. In adults, the following measurements are generally recommended: weight, height, BMI, and mid-upper-arm circumference (WHO Expert Committee, 1995). This evaluation should be supplemented by a clinical assessment that aims to identify symptoms and conditions specifically associated with TB, including those that can affect nutritional status, such as fatigue and loss of appetite. As in the case of HIV-positive individuals, diet should be assessed to ensure a sufficient intake of energy, protein, and micronutrients and to rule out potential drug-food interactions. Information about individual and household food security should also be determined. The initial nutritional assessment should again be followed by any needed interventions and by ongoing monitoring.

8.3 Nutritional Requirements

8.3.1 Energy and protein

According to the WHO (2013b), no evidence currently exists to suggest that the optimal proportion of protein, fat, and carbohydrate in the diet differs for people with active TB. The standard recommendation is that protein account for 15% to 30% of overall energy intake. However, people with TB routinely require increased energy intake and fluids. This may be especially the case for people with chronic infections and those who perform physically demanding manual labour (Mueller, 2008). The recommendations for TB patients are based on the nutrient and energy requirements for hypercatabolic and undernourished patients (Roberts et al., 2006). Increased nutrient and energy requirements (macronutrients and micronutrients) need to be met since they are known to be associated with increased resting energy expenditure, accelerated protein turnover, decreased food intake, and gastrointestinal symptoms such as nausea.

8.3.2 Micronutrients

Deficiency of single or multiple nutrients can reduce an individual’s resistance to any infection. Reduced micronutrient intake, especially of vitamins A, E, and C, as well as zinc and selenium, has been associated with an impaired immune response. Indeed, at the time of diagnosis, patients with active TB often exhibit depressed blood levels of various micronutrients, including retinol, vitamins C and E, zinc, iron, and selenium (USAID, 2008). As mentioned earlier, however, it is difficult to determine how far these deficiencies reflect pre-existing conditions and how far they are a result of the immune system response to infection. Malnutrition-induced impairments of immune function are nonetheless reversed fairly rapidly once the nutritional deficiencies are corrected (Calder & Jackson, 2000).
For TB, as with other infections, intake of iron beyond that needed to correct iron deficiency may have deleterious effects and should be avoided. Otherwise, data concerning the impact of micronutrient supplementation on TB outcomes are, unfortunately, limited. Research has suggested a link between lower vitamin D levels and both latent and clinical TB (Friis et al., 2008; Gibney et al., 2008; Wejse et al, 2007). Supplementation with vitamin D may be necessary if dietary intake is inadequate and/or exposure to sunshine is limited, although further research is needed on the impact of supplementation with this vitamin during TB treatment. A review which examined the effect of various combinations of nutritional supplements on people being treated for active TB, led the authors to conclude that high-energy supplements and some combinations of zinc with other micronutrients may help people with TB to gain weight. However, evidence was insufficient to allow the effect of other combinations of nutrients to be assessed (Abba et al., 2008).

Additional research is needed on the impact of multiple micronutrient supplements on TB in regions where predominantly cereal-based local diets are unlikely to provide adequate micronutrient intake (USAID, 2008). Regarding micronutrient supplementation and TB, the WHO concludes that “there is currently no reliable evidence that routinely supplementing at or above recommended daily amounts has clinical benefits” (WHO, 2013b, p. 17).

8.4 Food Intake and Medications

Health care workers need to be familiar with the possible interactions between food and nutrients and the drugs used in the treatment of TB, which differ from medication to medication. Both isoniazid and rifampicin should, for example, be taken on an empty stomach, whereas ethambutol, which can cause indigestion, is best taken with food. Because isoniazid and rifampicin are associated with the potential for liver damage, the consumption of alcohol must be avoided. Isoniazid may also produce adverse reactions if combined with certain foods, notably bananas, yogurt, avocados, liver, smoked or pickled fish, and yeast (FANTA, 2004).

In addition, isoniazid inhibits the proper absorption of vitamin B₆, often producing peripheral neuropathy, a condition characterized by numbness and a burning sensation, typically in the feet and hands. Patients receiving isoniazid may thus require supplemental vitamin B₆ (USAID, 2008). Isoniazid also interferes with the metabolism of vitamin D, which can in turn decrease the absorption of calcium and phosphorus (Mueller, 2008).

9. MALARIA

Malaria is a potentially fatal disease caused by a parasitic protozoa known as Plasmodium. Most cases of malaria are caused by one of four species: Plasmodium falciparum, Plasmodium vivax, Plasmodium malariae, and Plasmodium ovale. Of these, P. falciparum, which is especially common in sub-Saharan Africa, is associated with the most acute forms of the disease and with higher mortality rates.

While the gravity of the illness depends in part on the species of Plasmodium, it also reflects a given individual’s degree of immunity to the disease. Malaria is transmitted to people by bites from infected Anopheles mosquitoes. As in TB infection does not automatically produce active disease. People who live in regions where malaria is highly endemic are repeatedly exposed to the infection and may thus develop considerable immunity. Children who live in these areas who reach the age of 10 are at relatively low risk of acute morbidity or mortality. Somewhat ironically, as rates of transmission decline, the risk of severe or fatal illness escalates (Shankar, 2008).

After multiplying in the liver, the malaria parasite then infects red blood cells. The initial symptoms are fever, chills, headache, and vomiting (WHO, 2014a). The classic symptom of malaria is, however, malarial paroxysm, that is, the cyclic occurrence of high fever, preceded by chills and shaking and followed by profuse sweating. The cycle initially occurs daily but after a few weeks it occurs every second or third day, depending on the species of Plasmodium involved. However, especially in people (including children) who have little immunity, and especially in cases caused by P. falciparum, malaria can produce rapid and acute illness and, if not treated, can quickly become life-threatening by disrupting the blood supply to vital organs.
9.1 Epidemiology and Burden of Disease

9.1.1 Prevalence and incidence
Approximately half of the world’s population is at risk of malaria – some 3.4 billion people, according to the *World Malaria Report 2013* (WHO, 2013e). At the time the report was written, 97 countries had ongoing malaria transmission, including 43 countries in the African region, and malaria was still considered endemic in another 7. Globally, there were an estimated 207 million cases of malaria in 2012, 80% of them in Africa, and some 627,000 people died of the disease, 90% of them in Africa. More than three-quarters of those who died – 482,000, or 77% – were children under the age of 5.

On the positive side, the WHO (2013e) estimated that, between 2000 and 2012, the global incidence of malaria declined by 25% and by 31% in the African region. Worldwide, mortality rates fell by 42%. At 49% (54% among children), the rate of decrease was also slightly higher in the African region.

9.1.2 Highest-risk groups
As is evident from mortality rates, young children are among those at high risk of malaria, as they are unlikely to have developed only limited immunity against the disease. Pregnant women are another at-risk group. Even if a woman has built up some immunity to the disease, malaria can cause miscarriage, as well as low birth weight in babies. Women who are HIV-positive are at greater risk of malaria, as are all people who have HIV/AIDS. In particular, a woman who develops a malarial infection of the placenta is at greater risk of passing the HIV virus to her unborn child. Another high-risk group consists of people who have been living in an area in which malaria is not endemic, and who thus have no immunity, and who then travel or move into an area in which it is. This includes people who originally came from areas in which the disease is endemic but who subsequently immigrated to a country where malaria does not occur. As a result, their immunity will have been lost or weakened, placing them at greater risk if they return home (WHO, 2014a).

9.2 Treatment
Malaria is treated with a variety of drugs. Treatment plans differ in their specifics, depending on the species of *Plasmodium* and the severity of the infection. (For details, see WHO, 2010a.) The development of drug-resistant strains of *Plasmodium*, especially *P. falciparum*, is a continuing source of concern. As in the case of antimycobacterials, resistance is especially apt to result from monotherapy (the use of only a single medication), from inadequate dosages, and from poor compliance.

9.3 Nutritional Interventions and Malaria

9.3.1 Iron
The relationship between iron intake and malaria has been the subject of controversy (Raiten et al., 2009). There is little evidence that an iron deficiency offers any protection against malaria. However, some studies have suggested that, in malaria-endemic regions, iron supplementation could actually increase the risk of malaria, by providing parasites with additional iron. Evidence indicates, moreover, that the parenteral administration of iron increases the risk of malaria in infants and pregnant women and should therefore be avoided (Menéndez & Dobaño, 2004). It is important to bear in mind that in many areas where malaria is common iron deficiency is also common. For that reason the best approach may be the fortification of foods with iron, especially for foods intended for infants, children, and women (Raiten et al., 2009). However, the amount of iron used and the iron compound selected needs to be carefully controlled.

For a variety of reasons, including the overall reduction of side effects, the WHO (2011) now recommends the intermittent, rather than daily, use of iron supplements and proposes that, in malaria-endemic areas, iron supplementation be accompanied by concerted efforts to prevent malaria and to diagnose and treat it promptly.

9.3.2 Zinc
As is well known, zinc is essential to the proper functioning of the immune system. In particular, it is crucial to lymphocyte functions that appear to have a role in resistance to malaria (Shankar, 2008). Whether zinc
supplementation has a protective effect against malaria remains to be determined, however. A randomized double-blind trial conducted in Burkina Faso, for example, found that, in children up to the age of 6, combined vitamin A and zinc supplementation led to a significant decrease (roughly one-third) in both the prevalence of malaria and the number of malaria episodes (Zeba et al., 2008). Similarly, in a study conducted in Ghana, children up to the age of 24 months who received both zinc and vitamin A supplements proved to have 27% fewer episodes of malaria than children who received vitamin A only (Owusu-Agyei et al., 2013). Others studies, however, have found no evidence that zinc supplementation produces any significant benefit with regard to malaria (see, for example, Veenemans et al., 2011). Clearly, then, further investigation is needed into the effect of zinc supplementation, alone or in tandem with other supplements, on malaria morbidity and mortality.

9.3.3 Vitamin A

As we saw in Chapter 9, given that vitamin A deficiency is a serious health problem in many developing countries. In the case of malaria, some evidence exists to support the protective effects of vitamin A. The first major documentation came in the form of a study conducted in Papua New Guinea, which demonstrated a 30% decrease in malaria episodes among preschool children as a result of vitamin A supplementation (Shankar et al., 1999). Since then, studies have suggested that vitamin A supplementation reduces the impact of malaria on children’s growth, protects pregnant women against malaria, and reduces the severity of malaria episodes (see Shankar, 2008). In a review, SanJoachin and Molyneux (2009) concluded that “although vitamin A supplementation reduces the incidence of uncomplicated malaria by about one-third, it does not appear to reduce the rate of deaths that can be specifically attributed to malaria.” They nonetheless recommended the use of vitamin A supplements in children who live in malaria-endemic regions, partly because it is associated with a reduction in all-cause mortality.

10. MEASLES

Measles (rubeola) is a highly communicable acute viral infection. The disease is characterized by a high fever and a rash, coupled with coughing, inflammation that affects the upper respiratory tract, and conjunctivitis. The virus is transmitted by droplets spread by coughing and sneezing and hence by close personal contact with an infected person. Transmission is thus more likely to occur in densely populated areas or under conditions of overcrowding, such as refugee camps. Measles can have severe complications, including pneumonia and other severe respiratory illness, encephalitis, and blindness. Especially in young children, it can also produce acute diarrhoea, which can lead to potentially life-threatening dehydration. Death most commonly results not from the primary disease but from ensuing complications (WHO, 2014c).

10.1 Epidemiology and Burden of Disease

10.1.1 Prevalence and incidence

As a result of routine vaccination, measles is now rare in developed countries, but it remains common in many developing countries, especially in sub-Saharan Africa and Asia. The WHO estimates that upwards of 20 million people contract measles each year. Most of them survive, but, in 2012, some 122,000 people died from the disease, primarily children under the age of 5. The vast majority (over 95%) of deaths occur in low-income countries, where public health services are often inadequate. At the same time, the advent of the measles vaccine has produced a massive drop in the mortality rate. In 1980, when vaccination was not yet widespread, the death toll stood at roughly 2.6 million people; by 2000, the figure had fallen to 560,000. It then fell by another 78% between 2000 and 2012, largely as a result of large-scale immunization campaigns (WHO, 2014c).

10.1.2 Highest-risk groups

Unvaccinated young children are at highest risk of measles. Malnourishment and, in particular, vitamin A deficiency increases risk, as do impairments to the immune function, such as those associated with HIV/
AIDS. Children under the age of 5 are also more prone to complications. Those under the age of one year are at greatest risk. Pregnant women who contract the measles likewise run a higher risk of severe complications, including miscarriage or premature delivery. Having the measles confers lifetime immunity, but anyone who has not had the disease or has not been immunized against it is at risk.

Poverty also plays a significant role in the degree of risk, as it is associated not only with crowded living conditions but also with lower rates of immunization, which in turn lead to a higher incidence of the disease (Hussey, 2008). Outbreaks of measles can cause many deaths, especially among young, malnourished children. Such outbreaks often occur following a natural disaster, such as an earthquake or severe famine, or in war-torn countries, where health services are disrupted or overwhelmed (WHO, 2014c).

10.2 Nutritional Interventions and Measles

10.2.1 Vitamin A

Although high-dose vitamin A supplementation, as recommended by the WHO, appears to reduce a child’s overall vulnerability to illness, it is not generally recommended as a treatment for infectious disease. However, numerous studies have established that it can have a beneficial effect in children who have measles. A systematic review of the literature demonstrated that two 200,000 IU doses of vitamin A administered on successive days reduced mortality by 82% in children under the age of 2 (Huiming et al., 2005). The WHO thus recommends that all children in developing countries who are diagnosed with measles should immediately be given two doses of vitamin A, one day apart. Children under the age of 6 months should receive 50,000 IU per dose, children between 6 and 11 months of age should receive two 100,000 IU doses, and children 12 months and older should receive 200,000 IU per dose. In addition to reductions in mortality, vitamin supplementation can also prevent possible eye damage and even blindness (WHO, 2014c; see also Hussey, 2008).

10.2.2 Additional nutritional support

Mothers should be encouraged to provide adequate nutritional support to a child who has measles, even if the child is suffering from diarrhoea. If the child is being breast-fed, feeding should continue; otherwise, mothers are advised to increase the child’s energy intake by adding a teaspoon of vegetable oil and a teaspoon of sugar to milk or other suitable food. Children must also be given additional fluids, to prevent dehydration, and preferably also a multivitamin tablet (Hussey, 2008).

11. PNEUMONIA AND OTHER ACUTE RESPIRATORY INFECTIONS

Acute respiratory infections (ARIs) are typically classified according to the site of the infection. Acute upper respiratory infections include colds, sore throats, sinusitis, and tonsillitis. Acute lower respiratory tract infections (ALRIs) involve the larynx, glottis, bronchioles, and alveoli. They include laryngitis, bronchitis, and, above all, pneumonia.

11.1 Epidemiology and Burden of Disease

11.1.1 Prevalence and incidence

Pneumonia is the world’s leading cause of death in children. The WHO estimates that pneumonia accounts for roughly 18% of all deaths in children under the age of 5, with some 1.1 million of them dying each year from the disease (WHO, 2013c). Although it occurs worldwide, it is most prevalent in sub-Saharan Africa and South Asia, and the overwhelming majority of children who die of from pneumonia live in developing countries. In the words of the Global Action Plan for Prevention and Control of Pneumonia, “The burden that pneumonia places on families and the health system in low-resource countries in turn exacerbates inequalities; overwhelmingly, children who are poor, hungry and living in remote areas are most likely to be visited by this ‘forgotten killer’” (WHO & UNICEF, 2009, p. 1).
11.1.2 Highest-risk groups

Risk factors associated with ALRIs can be broadly divided into two categories, one more strictly medical and the other pertaining to environmental conditions. Among the former are low birth weight, lack of breastfeeding, and malnutrition, including deficiencies of vitamins A and D, zinc, and selenium. Suppression of the immune system, as in HIV/AIDS, and prior respiratory infections also increase risk, as does the presence of sickle-cell disease. Environmental factors include overcrowded and unhygienic living conditions, as are typically associated with poverty, dampness (whether seasonal or characteristic of the living quarters), the presence in the household of someone who smokes or who has a respiratory illness, and the use of indoor cooking fires or solid fuels for heating (Lanata & Black, 2008). As always, anyone who is in poor health initially or who lacks adequate immunization is a greater risk of infection.

11.2 Pathophysiology and Clinical Presentation

Respiratory tract infections are most often transmitted when people touch their mouth, nose, or eyes after their hands have come into contact with nasal secretions from an infected person. These infections can also be spread via the lungs, when someone breathes air containing droplets produced by the coughing or sneezing of an infected person.

The respiratory tract is vulnerable to a great many pathogens, both bacterial and viral. Although some of these pathogens are closely associated with specific diseases, a specific pathogen can be implicated in more than one disease. The bacterium *Streptococcus pneumoniae* is a major cause of bacterial pneumonia, but *Haemophilus influenzae* (once mistakenly thought to be responsible for influenza) can also cause pneumonia, in addition to a variety of other respiratory ailments. ARIs can also result from a broad range of viruses, with the influenza A virus, the measles virus, and respiratory syncytial virus (RSV) most closely implicated in mortality.

RSV, which is the leading cause of ALRIs in young children, tends to be prevalent during rainy seasons, in the form of seasonal epidemics. It most commonly presents as bronchiolitis, which chiefly affects infants under the age of 12 months, with the incidence highest between the ages of 2 and 6 months (Riley, 2004). However, some 30% of children who are infected with RSV have pneumonia (Lanata & Black, 2008). The development of an RSV vaccine is a public health priority, and research is currently underway.

Pneumonia occurs when the pathogens overwhelm the host defences in the lower respiratory tract. It may lead to a reduction in lung volume and pulmonary function later in life (Lanata & Black, 2008). The main bacterial causes of pneumonia in children aged 2 months to 5 years and living in developing countries are *S. pneumoniae* and *H. influenzae*. In developing countries, children encounter these bacteria at a younger age and higher carriage rates occur (Rasmussen et al., 2000).

11.3 Diagnosis

Acute upper respiratory infections typically produce one or more of a sore throat, runny nose, cough, and earache. ALRIs manifest themselves in a cough plus additional symptoms of respiratory distress, such as an increased rate of respiration, wheezing, and chest in-drawing (in which the lower chest wall retracts, rather than expanding, during inhalation) (Lanata & Black, 2008). In adults, pneumonia is usually diagnosed by means of clinical symptoms – a cough, difficulty breathing, chest pain, and fever – plus a chest X-ray. In children under the age of 5, however, the low specificity of chest X-rays makes them unreliable as an initial diagnostic tool: for example, in one study, 82% of children suffering from non-severe pneumonia proved to have normal chest X-rays (Hazir et al., 2006). Instead, pneumonia in young children is diagnosed chiefly on the basis of clinical signs, foremost among them fast breathing – defined by the WHO as more than 40 breaths per minute in children aged 1 to 5 years, more than 50 breaths in children aged 2 to 11 months, and more than 60 breaths in children under one month old – and chest in-drawing. Children who display additional symptoms such as cyanosis, very pronounced chest in-drawing or other signs of serious respiratory distress, and general danger signs, including convulsions, lethargy, and/or the inability to breast-feed or drink, are suffering from severe pneumonia and require hospitalization. Children with non-severe pneumonia require antibiotics but can usually be treated at home (WHO, 2013d).

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11.4 Nutrition and Pneumonia

11.4.1 Zinc

There has been much research into the effectiveness of zinc supplementation for the prevention of ARLIs in young children in developing countries. Results have been generally positive. Reviewing the results of six randomized controlled trials from four countries, Lassi et al. (2010) found that zinc supplementation reduced the incidence of pneumonia in children between the ages of 2 months and 5 years. Another review, which summarized the findings from ten studies, looked more broadly at ARLIs (rather than just pneumonia). Zinc supplements reduced the incidence of ARLIs in children aged under age 5 (Roth et al., 2010). Both reviews reported that quite different results were reported based on the method of diagnosis. The effect of zinc supplementation was negligible when fast breathing (with or without chest in-drawing) was used as the basis for diagnosis, but when the diagnosis was confirmed by chest examination and/or X-ray, zinc supplementation was shown to be effective. Results to date thus suggest that, in regions where zinc deficiency is prevalent, routine zinc supplementation can have a protective effect against pneumonia.

Twenty trials have been carried out to determine whether zinc supplements are of value in the treatment of pneumonia in children aged under age 5. Four studies have been carried out in developing countries and taken together they indicate that zinc supplements are of no value when given in addition to the usual treatment (Haider et al., 2011).

11.4.2 Vitamin A

A systematic review was carried out of studies conducted in developing countries that investigated whether supplements of vitamin A are of value with respect to pneumonia in children. The overall conclusion based on the twenty studies included in this review was that vitamin A supplements have no useful benefit in either the prevention or treatment of pneumonia (Mathew, 2010). These findings are somewhat surprising as vitamin A deficiencies have often been reported in developing countries and this is closely associated with a depressed state of the immune system.

11.4.3 Selenium

Evidence suggests that selenium deficiency may increase the risk of respiratory infections among malnourished children. A study of low-birth-weight infants found that low plasma selenium levels were significantly correlated with an increase in respiratory morbidity (Darlow et al., 1995). Studies conducted in China in the late 1990s indicated that a 1 mg dose of sodium selenite had a positive impact in children hospitalized with pneumonia related to RSV or Mycoplasma pneumonia, while subsequent studies in Russia pointed to a similar effect from food additives that contain selenium (see Lanata & Black, 2008). However, further research is required to determine the role of selenium in the management of ALRIs in children.

11.4.4 Breast-feeding

Breast-feeding has been found to protect infants from ARIs. Infants who are being breast-fed acquire antibodies from their mother through her milk, and breast milk also contains antibacterial and antiviral substances that help to ward off infections and decrease the severity of infectious illnesses. Breast-feeding also reduces the risk of infection from formula feed, as may occur, for example, when it is prepared with contaminated water. A study conducted in Bangladesh demonstrated that breast-feeding significantly reduces the risk of mortality from both ARIs and diarrhoea (Arifeen et al., 2001). The authors estimated that if 80% of all children were exclusively breast-fed during the first 4 months of life, infant mortality could be reduced by a third. In addition, the results of another study suggested that the prevention of malnutrition and low birth weight could reduce deaths from pneumonia by at least 25% (Victora et al., 1999). In short, exclusive breast-feeding is probably the single most effective way to safeguard infants from pneumonia and other serious infections.
DISCUSSION QUESTION AND EXERCISES

In view of the importance of nutritional status in people living with and affected by HIV/AIDS, TB, and other infectious diseases, the student is encouraged to answer the following question:

1. Develop a nutritional management plan for a primary health-care facility to ensure adequate nutritional care and follow-up of HIV/AIDS and TB patients. The nutrition care plan should take the format of a flowchart.

Case Study 1

Thandi is a 2-year-old girl. Her mother brought her to the local clinic because she has a rash on her face, arms, and chest and she has been crying a lot. On closer assessment, the clinical nurse practitioner establishes that Thandi has a fever and a persistent cough. She is also underweight for her age and appears lethargic. The nurse further inquires about the rest of the members of the household. There are eight people living together, three adults (two men and the mother) and five children (three are under 5 years of age) in an old brick house with two rooms and one bathroom. The house becomes damp in winter. There is no running water in the home, and they use paraffin for cooking. Only one of the adult men, the brother of the mother’s husband, earns an income. He smokes and sometimes comes home drunk. The family does not always have enough food for all members of the household. As a result, the mother sometimes first feeds the two men and the children, and she then goes without food in the evening. She reports that she has lost her appetite, she has been coughing for a while, and she sweats a lot at night. She shows the nurse that her skirt, which fitted her nicely a few months ago, is now very loose around her waist.

1. Describe the vicious cycle of infectious disease.
2. Discuss the family’s food security dilemma and its consequences.
3. Devise a plan of action to assist the family with medical and nutritional care. Make this plan appropriate for your community.

Case Study 2

Rafael, 29, came to the city from the small village in which he grew up to look for work. He has frequently been unemployed and has had a series of girlfriends, some of whom helped him out financially. When he was 22, Rafael discovered that he was HIV positive. He was prescribed antiretroviral drugs, but they were very expensive, and the side effects were unpleasant, so he stopped taking them. He seemed to be doing fine, but for the past several weeks he hasn’t been feeling well. He seems to have no energy, he often feels nauseated, his appetite is poor, and he’s been losing weight. Now he’s noticed small white patches on his tongue, so he decides to go to the health care centre for some advice.

1. Describe how you, as a health worker, would go about assessing Rafael’s overall medical situation.
2. What treatment plan would you recommend? Describe both its immediate and longer-term goals.
3. Describe the steps you would take in hopes of making it possible for Rafael to return to ARV therapy and remain on it.

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**ADDITIONAL RESOURCES**

AVERT: Averting HIV and AIDS. http://www.avert.org/

CDC (Centers for Disease Control and Prevention)

HIV Topics: http://www.cdc.gov/hiv/topics/

Malaria: http://www.cdc.gov/malaria/

Measles: http://www.cdc.gov/measles/

Tuberculosis (TB) Topics: http://www.cdc.gov/tb/topic


World Health Organization (WHO) Guidelines:

HIV: http://www.who.int/hiv/pub/guidelines/en

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