

ANNEX B: BASIC INFORMATION ON IMPORTANT DISEASES

This chapter describes about twenty of the most common diseases in developing countries. It is intended as a quick reference for sustainable development project team members who do not have health backgrounds or are not familiar with conditions in developing countries. Each disease is described in three parts:

- Description
- Transmission
- Intervention.

Box B-1: Caveat on These Disease Descriptions

These descriptions of diseases are generalizations and may not be accurate for local conditions. Malaria and filariasis, for example, are spread by different species of mosquitoes that exhibit vastly different breeding and feeding habits. Still other diseases, such as measles or sexually transmitted diseases, have not been included, because they rely so heavily on behavioral factors.

Also, the emphasis of these interventions is directed outside the health sector, mainly at such factors as housing, water supply, and sanitation, coupled with health education. The interventions described for each disease generally exclude curative health care interventions. Rehydration, for example, which includes oral rehydration therapy (ORT), is discussed only if it serves as a means to interrupt transmission as a preventive measure for curtailing the spread of cholera, for example.

In addition, please note that much of the information on diseases in general is rapidly changing.

Source: Authors' data.

Individual Diseases

Cholera

- *Description.* Cholera is a serious acute diarrheal disease, characterized by sudden onset, profuse, painless, and watery stools (rice water stools), followed occasionally by cramps and vomiting. These symptoms result from a poison produced by the cholera bacteria or vibrio in the intestines. Cholera's most serious effects are rapid dehydration and shock. These, in turn, cause a chemical imbalance in body fluids and eventually circulatory collapse. Two types of cholera exist: classical, which is generally more serious, and El Tor. Fatality in untreated cases is severe—as high as 50 percent depending on its type—and can occur within hours of onset. With proper treatment, fatality can be reduced to less than 1 percent. Most infections, however, are asymptomatic or cause only short bouts of diarrhea. Cholera affects all age groups. In the malnourished, however, who are more susceptible to the disease in lower doses, even short bouts of diarrhea can have far-reaching consequences; hence, cholera is serious primarily as an epidemic predominantly in low socioeconomic groups for which malnutrition is prevalent. Seven pandemics of cholera, that is, global spread for an extended period (15 or more years), have occurred. For most of this century, cholera has been confined largely to Asia, but is now endemic throughout most of Asia, the Middle East, and Africa. Since the 1960s, it has spread throughout Asia and Africa and extended into Europe, the Americas, and South Pacific. Cholera transmission has been understood for more than a century. The cholera threat probably did more to improve environmental conditions in nineteenth century Europe than any other form of persuasion or logic.

- *Transmission.* Humans are the main carriers of cholera. Certain types of seafood and domestic animals are also known to harbor the disease. For every attack are fifty to a hundred asymptomatic carriers, who can carry the disease for up to two months. Ingestion of water contaminated with feces or vomitus of infected individuals is generally considered the main route of transmission. Contamination of clothing, hands, food, and bed linens by carriers or patients is also important. Transmission is also possible by eating raw or undercooked sea food and, to a lesser extent, food contaminated by flies. Because all of these have been implicated to varying degrees, it is difficult to single out a dominant mode of transmission, although sudden outbreaks are usually associated with a contaminated water supply and/or common food source. Vibrios multiply rapidly in foods such as milk or boiled rice, especially if salt fish or meat is added and can survive in absorbent materials, such as cotton, in bed linens, clothing, and bandages saturated with sweat.
- Infection usually occurs about 2 days after exposure, and its communicability is presumed in most cases to last for a few days after recovery, but may persist for several months among carriers. The cholera vibrios can live in water for up to about 2 weeks, prefer brackish water, and can survive for approximately 2 months in sea water. High water temperatures reduce its endurance, whereas low temperatures extend it. Susceptibility of the population varies and is poorly understood, although it is considered to be a function of an individual's gastric juices, acquired immunity, and nutritional status, hence, its greater severity among children, especially malnourished. In epidemics, however, infection rates rarely exceed 1–2 percent of those exposed.
- *Intervention.* Sanitary disposal of feces, improved housing, proper hygiene, hand washing, protection (chlorination in large doses) and purification of water supplies, and boiling or pasteurizing milk and dairy products are all important general interventions. Tracking and, if necessary, quarantine of known cases is required, but not always possible. Moreover, many governments tend to withhold figures on the incidence of cholera. The many inconsistencies in transmission make it difficult to cite various specific universally applicable steps. Some apparently effective interventions may be due to a natural cyclical fluctuation of epidemics. Immunization is possible, but short-lived (up to 6 months) and only partially effective (about 50 percent). Rehydration of victims, isolation, hospitalization, and medication are necessary curative interventions and also function as means to interrupt the cycle of transmission.

Dengue Fever

Other names: dengue hemorrhagic fever, arthropod-borne viral fever, and breakbone fever.

- *Description.* Dengue is an acute fever with sudden onset and usually lasts about five days. Its symptoms include intense headache, muscle pains, lack of appetite, and rash. A more serious form of the disease, dengue hemorrhagic fever, also exists. Its symptoms include vomiting, hemorrhaging, and shock; fatality in untreated cases can reach 40–50 percent or be brought down to 1–2 percent with proper hospital care. Recovery may entail prolonged fatigue and depression. Dengue has been spreading steadily on five continents and is now endemic throughout tropical Asia, Northern Australia, and Africa, also occurring in the Eastern Mediterranean, Caribbean, and Central and South America. Asian countries have more of the serious hemorrhagic version than the Americas. Since 1981, however, incidence in the Americas has been steadily rising.
- *Transmission.* Humans and certain mosquitoes are the reservoirs (in jungle and forest areas, monkeys are also a reservoir). Dengue is transmitted by an infectious mosquito (genus *Aedes*) that bites during the day. The disease usually develops three to fifteen days after the bite. Human blood is infective for about a week; the mosquito remains so for life. The general population is susceptible, however depending on the type of disease, children or adults can be more seriously affected, especially in the case of dengue hemorrhagic fever in children. In tropical Asia, the hemorrhagic type seems to occur exclusively among children under 15 and is usually spread during the rainy season.
- *Intervention.* The major intervention entails eliminating habitat of aedes, which live in a variety of small pools ranging from tree holes to water storage pots (see the note on mosquitoes in chapter 8-6 in “Malaria and Vector-Related Diseases”). Education of the population on mosquito habitat is indispen-

sable. Protective screening and insecticides are also recommended, but not always practicable or affordable.

Diarrheas and Dysentery

Diarrheas. Diarrheas can entail a mild to severe infection. Usual symptoms are loose stools (more than five episodes in 24 hours) and nausea, often accompanied by vomiting and fever. Diarrheas can be due to more than thirty common communicable diseases; they can occur as a side reaction to another disease or its treatment or they may erupt due to a variety of conditions, such as stress, changing environmental conditions, irregular diet, or nutritional imbalances. Diarrheas are described below in two categories: undifferentiated and specific (see also “salmonellosis” below).

Understanding the cause of diarrhea can be helpful to understanding their eventual control, especially when dealing with their four main types of pathogens: bacteria, viruses, protozoans, or helminthes. Viruses tend to be fragile outside their human host and die rapidly under adverse conditions of temperature and moisture. This has led to the assumption that the majority of transmissions occur through interpersonal contact, rather than water or food. In comparison, bacteria can exist for long periods outside their human host and are more tolerant to adverse conditions of temperature and moisture. This leads to the assumption that bacterial infections as a broad class are probably spread more in food and water than by interpersonal contact. Although prior strategies have emphasized water and sanitation—that is, engineering interventions—this revised emphasis clearly points as well to the pivotal role of education. In this vein, personal hygiene emerges as being at least as important.

Diarrheas: Undifferentiated (Childhood and Traveler’s)

Other names: Undifferentiated diarrhea, acute diarrhea, diarrhea of early childhood, weanling diarrhea, traveler’s diarrhea, la turista, Montezuma’s revenge, and Delhi belly. *See also:* cholera, dysentery (amebic and shigellosis), giardiasis, food poisoning, specific diarrhea, and salmonellosis.

1. Weanling Childhood Diarrhea

- *Description.* This is a common infection that recurs for up to three months in bouts of four to five days. It can affect children both before and after weaning, but is most common after. This is when the child loses the nutritional value of breast milk and some of the immunities acquired from its mother and, at the same time, is being exposed to more and more sources of infection from its external environment, all of which is exacerbated by unsanitary living environments and poor hygiene. Protein-calorie malnutrition is commonly associated with these acute diarrheal episodes. (A typical example would be about 115 attacks a year for every 100 children under five months receiving breast milk, and 275 attacks for the same 100 children after breast feeding.) Mortality can exceed 50 per 1,000 a year in preschool children or be as high as 40 per 100 in premature or low birth weight children. The highest incidence tends to be in hot dry periods, associated with lack of water. A prime consideration is rapid dehydration, which is an important cause of death. Weanling diarrhea occurs at ages of approximately 4 to 30 months depending on the period of weaning and nutritional status of mother and child.
- *Transmission.* Transmission in most cases occurs as a result of ingestion of pathogens in or on food, toys, pets, clothing, and unclean hands of mothers and other children. The transmission cycle is perpetuated in a vicious cycle in cultures in which children’s feces are considered harmless. Unknowingly, mothers jeopardize their child’s health with lax hygiene habits that actually increase exposure.
- *Intervention.* Education on personal hygiene, especially the benefits of breast feeding and hand washing are key interventions. Except in nurseries, however, it is not clear from contradictory findings how effective personal hygiene measures actually are; that is, certain viruses (e.g., rotavirus) have been transmitted in developed countries, although without producing disease, despite high levels of hygiene, sanitation, water supply, and education. The crucial variable may be nutritional levels.

2. Travelers' Diarrhea

- *Description.* Common in tropical areas in newly arrived or departing travelers, migrants or refugees, this diarrhea can be triggered by a radical change in environment and food. Normally, bouts last one to three days, accompanied by nausea, vomiting and sometimes fever. Because high doses are necessary to cause infection, transmission is assumed to be through food or water in which the bacteria or virus have had time to multiply to an infective dose.
- *Transmission.* The majority of traveler's diarrheas are assumed to be transmitted in food and water, including ice, rather than interpersonal contact. Some incidences of diarrhea can be attributed to a radical and abrupt change in intake of food and water, rather than to a pathogen.
- *Intervention.* Precaution should be taken to maintain proper personal hygiene and wash personal items, for example, eating utensils, and less obvious ones, such as soiled clothing and bed linen, because certain bacteria can live in ambient conditions of temperature and moisture. The most important consideration in these cases is the liberal ingestion of safe and nutritious fluids to rehydrate the body and re-establish the various chemicals that have been voided through excessive loss of fluids. Antimicrobials may be used as prophylaxis and have been found effective in up to 90 percent of travelers.

Diarrheas: Specific

Other names: Campylobacter, E. coli, rotavirus, Norwalk; common names: epidemic diarrhea and vomiting, epidemic collapse, epidemic nausea and vomiting, winter vomiting disease, severe gastroenteritis in infants and children, and sporadic gastroenteritis.

- *Description.* Gastroenteritis or diarrhea is an infection of the intestines, causing nausea, vomiting, diarrhea, fever, and abdominal pain. It can be severe in children and require hospitalization. When not specifically identified, it can also be classified as an "undifferentiated diarrhea." It usually lasts about 1–6 days, depending on the type. Gastroenteritis or diarrhea occurs worldwide, most frequently in the winter months in temperate climates and year-round in the tropics. This feature suggests a high level of interpersonal contact, including the possibility of air-borne transmission. The viral types are normally referred to as gastroenteritis and the bacterial types as diarrhea. For component interventions, this distinction is not significant, because the general response would be to treat them in the same manner. They each, however, have different characteristics. Three of the four account for high percentages of infant and childhood mortality (*E. coli*, rotavirus, and campylobacter). Rotavirus, for example, which may account for up to 10 percent of childhood diarrhea, is most common in children 3 months–6 years old, that is, after weaning and until they have been able to acquire immunity from exposure. In developing countries, an estimated 870,000 diarrheal deaths are due to the rotavirus. In comparison, *E. coli* requires a large dose to cause infection, relative to other diarrheal diseases, for which personal hygiene and interpersonal contact may be more important. In dealing with infants and children, however, it is difficult to determine when they have swallowed an "infective dose," given the range of ways they are exposed. The high presence of antibodies in the blood (which show that an individual has been exposed to the disease) throughout the industrialized countries indicates that these diseases are being transmitted—although with much lower rates of morbidity and mortality—in spite of the high levels of education, hygiene, and water and sewerage services. Individual resistance, due to higher standards of living and better nutrition, may be a key factor. Unfortunately, a great deal is still not known on this topic.
- *Transmission.* Humans are the major reservoir. The actual mechanism of transmission is still not known due to many complicating factors and multiple routes of transmission. Diarrheas are all clearly transmitted by the fecal-oral route, with both food and water implicated. Respiratory spread is also probable. In the case of children, the variety of means of transmission is infinite. Diarrheas usually occur within 1–5 days after exposure depending on type. Individuals can spread the infection to others for duration of infection, which can last up to several weeks, depending on type. The entire population is susceptible, although children more severely. Some acquired immunity is apparent, but its duration depends on the virus or bacteria and often is unknown, so reinfection is possible.

- *Intervention.* Because of the number of complicating factors in transmission, recommendation of specific interventions is difficult. Proper hygiene and food handling and sanitary disposal of waste remain, of course, of paramount importance. In some cases, transmission is also possible through animals, that is, pets (dogs and birds), poultry, pigs, sheep, and cows. Their actual role is, unfortunately, still unknown. This feature clearly defines a potential strategy: additional care in food preparation and avoidance of nonpasteurized milk. Special care to have children avoid pets and domestic animals is also desirable, although hardly practical. As with all diarrheas, rehydration is important.

Dysentery: Amebic

Other names: Amebiasis. (See also: salmonellosis or bacillary dysentery.)

- *Description.* Amebiasis is an infection, primarily of the large intestine, with the parasite *Entamoeba histolytica*. Most cases are asymptomatic or cause only mild abdominal discomfort. When a serious infection develops, it causes fulminating (rapid onset and termination) dysentery, that is, fevers, chills, and, in its severe forms, bloody or mucoid diarrhea. (Blood and mucus in the stools are characteristic of dysentery, but not diarrhea.) Long-term infection can cause ulcers or abscesses or lead to secondary infections. The precise factors causing the more serious forms are still unknown. Ameba can absorb nutrients and blood, but feed mostly on bacteria in the intestines and, in most cases, appear not to be a primary contributor to malnutrition. Death from amebic dysentery is rare. Amebic dysentery ranks as a low to moderate problem for society; because most regular infections are asymptomatic, endemic areas tend to be localized, and epidemics tend to be localized. In the already malnourished, however, its social importance increases from “low to moderate” to “moderate to high.”
- *Transmission.* Amebiasis occurs worldwide. It is rare, however, in children below age 5 years old. In areas with poor sanitation, prevalence reaches about 30 percent, but can go as high as 80 percent. Asymptomatic humans or those who are chronically ill with the disease are the main carriers. The parasite exists in two forms that can transmit the infection, a cyst, which is reasonably hardy and can live several days, and a trophozoite, which is extremely fragile and susceptible to gastric acid. It is the latter, which is common during an acute attack or epidemic and, hence, not extremely infectious because of its fragility. Transmission usually occurs by ingestion of cysts expelled in feces. Cysts cling to the surface of raw vegetables or fruit that have been contaminated by flies or the soiled hands of food handlers or that have been washed or freshened by sprinkling contaminated water. Cysts can remain alive on vegetables, bread, cheese, and fruits for up to 48 hours; in fecal matter under fingernails for 45 minutes; or on hands for 10 minutes. They are also relatively resistant to chlorine at concentrations used for water purification. Transmission is also possible through drinking water or improperly prepared local brews. In epidemics, infection is more commonly spread through contaminated drinking water. Infection occurs commonly two to four weeks after exposure, although varying from a few days to several months or even years. A mildly symptomatic or asymptomatic infected person, if untreated, can be communicable for years.” The general population is at risk, although all who are infected do not develop symptoms.
- *Intervention.* Sanitary disposal of feces, protection of water supplies from contamination, screening of food handlers, hand washing, and general hygiene education, especially of mothers, are the primary recommended interventions. Unfortunately, extensive case studies do not show a consistent pattern that clearly implicates any single or collective means of transmission; hence, preventive interventions such as sanitation are most likely to have a sustainable effect only in the long term. For drinking water, sand filtration removes nearly all cysts, whereas filtration with diatomaceous earth removes all. Standard chlorination does not destroy cysts, but iodine tablets are effective for small quantities of water. In areas where sewage effluent is treated, primary treatment is not especially effective because of the small size and low density of cysts. Secondary treatment and tertiary treatment can both achieve 100 percent reduction of cysts, depending on the methods. Disinfectant dips for fruit and vegetables are not proven, although it is certainly recommended that vegetables be prepared using iodine solutions, strong vinegar or boiling. Infected individuals can be treated with amebicidal drugs.

Dysentery: Shigellosis

Other names: Bacillary dysentery; can also sometimes be considered as food poisoning, gastroenteritis or undifferentiated diarrhea

- *Description.* Shigellosis is an acute bacterial disease primarily of the large intestine, characterized by diarrhea, fever, vomiting, cramps, strained urination and defecation, and blood, mucous, and pus in the stools. (Blood and mucous are characteristic of dysentery, but not diarrhea.) The illness is generally self-limiting and lasts for an average of 4 to 7 days. Symptoms usually develop within 1–3 days of exposure, but may take up to a week. The severity of infection depends on the dose and type of the organism and the age and nutritional state of the infected individual. The mortality rate in some cases can be 25 percent, if untreated, and can exceed 20 percent, even in hospitalized patients. Shigellosis occurs worldwide. Its prevalence and fatality are greatest among children ages 1–4 years; 60 percent occurs in children under 10. (Children under 6 months appear to have gained immunity from their mothers). It is common and serious where nutrition and sanitation are poor and is more readily transmissible by an infected individual than many other diarrheal diseases. Shigellosis, therefore, can be readily spread by interpersonal contact and houseflies. The potentially high mortality rate of certain strains and ease of transmission make it an important health problem.
- *Transmission.* Humans are the reservoir. Transmission occurs by direct or indirect transfer of feces from an infected individual or carrier to another. An extremely low dose may suffice to cause infection. (Under laboratory conditions, only 10–100 bacteria were able to cause an infection in 10–40 percent of adult volunteers.) The prime method of transmission seems to be from unwashed hands or fingernails after defecation. Most transmission occurs within the household, except for occupational hazards. A large variety of transmission routes are possible besides direct physical transfer among individuals, for example, clothes, toilet seats, and glasses. Low temperature and lighting and high humidity extend the bacteria's survival, for example, 3 hours on hands, 17 hours on toilet seats, and 1 week in cotton. *Shigella* multiply in contaminated food that is not served immediately. Water-, milk-, and fly-borne outbreaks are also possible. The bacteria can survive for up to 3 months under optimum conditions in foods, such as flour, eggs, milk, and some mollusks, and up to 2 weeks in acidic foods, such as citrus juices. Individuals remain infectious as long as *shigella* is present in feces, usually under one week and not more than four weeks. Because of its requirement for low temperature and light, plus high humidity, transmission on crops is not a major route. Survival on crops is rare beyond one week and probably very low beyond 2 days in hot arid climates. The bacteria can, however, be spread by aerosol droplets in flush toilets and spray irrigation systems; groups working with wastewater are, therefore, at risk in irrigation or treatment. The general population is susceptible, but the disease is more severe in children than adults and in the aged or those suffering from malnutrition. Breast feeding is protective for infants.
- *Intervention.* Most studies show that shigellosis reduction correlates most highly to water availability. Personal hygiene, especially of hands and fingernails; sanitary disposal of feces; fly control; education; and proper cooking and storage of prepared foods are the major preventive interventions. Emphasis on home, schools, or workplaces will vary according to standards of personal and food preparation hygiene. Standard chlorination is effective in reducing *shigella* in drinking water. As in the case of diarrheas, rehydration is important for those with the disease. Antibiotics appear to shorten the illness, but resistance to them is common.

Filariasis

Other names: Wuchereriosis, Bancroftian filariasis, elephantiasis, Malayan filariasis, Brugianis, Timorean filariasis, and lymphatic filariasis.

See also “Malaria and Vector-Related Diseases” in chapter 8 and table 8-6.

- *Description.* This section refers to lymphatic filariasis, which is the most widespread. Filariasis is an infection with a small worm that causes inflammation and blockage of the lymphatic system (a part of the circulatory system). Reaction to this blockage, in turn, can cause headaches, nausea, fever, and painful swelling of the lower extremities, genitalia, and breasts, often with thickened and rough skin.

Although it can result in serious complications to the circulatory system, the disease is more disfiguring than life threatening except in serious cases. Disfigurement and deformity, which may take up to 20 years to manifest themselves, may have a greater social consequence as a handicap than its actual health effects. Filariasis is endemic across the equatorial belt in most warm regions where mosquitoes can live (genus: *Aedes*, *Culex*, *Anopheles*, and *Hansonina*). Cases currently occur in 73 countries worldwide, more than half in Southeast Asia, especially India. In the Western Hemisphere, filariasis occurs in the West Indies, República Bolivariana de Venezuela, Suriname, French Guiana, Haiti, the Dominican Republic, Costa Rica, Panama, parts of the Guyanas, and Brazil. Approximately 1 billion people live in areas where filariasis is endemic. Because mosquitoes spread filariasis, it can be either urban or rural. It has been suggested that the disease is increasing because water development projects have expanded year-round mosquito habitats in rural areas. Similarly, a proportionate lack of development projects to keep pace with urban growth and population migration is potentially expanding the mosquito's urban habitat; wastewater contaminated with organic matter, storm drains functioning as open sewers, and pit latrines are of particular importance. Stagnant and improperly maintained water sources also play a role. These provide breeding sites for the culex mosquito, which accounts for most of the disease distribution. In Africa, however, anopheles, which breeds in clean water, accounts for most cases. In the South Pacific, the disease is spread by a species of aedes, which is rural.

- *Transmission.* Mosquitoes spread the disease when they pass on the blood of an infected individual. Humans are the major reservoir (although, in some species, mammals can provide an intermediate host). Mosquito biting habits bear on local transmission and intervention. *Culex*, the major source of filariasis, bites at night. (It is interesting to note that a heavily infected human can kill the mosquito.) Development of the disease in humans takes three months or more after the bite. Humans can infect mosquitoes and continue the chain of infection, as long as humans are infective, up to five years or more.* All humans are at risk, although the physical symptoms of the disease are rare among children, because it may take up to 20 years for the disease to cause a blockage in the lymph system. Severity varies considerably according to various geographical differences. Repeated infection can occur.
- *Intervention.* Control of mosquito breeding grounds is of paramount importance. *Culex* mosquitoes, the principal vector, prefer to breed in water contaminated with sewage or other organic matter. This implicates poor sanitation, especially pit latrines in spread of the disease near homes. Ventilated improved pit (VIP) latrines are effective for control of breeding in latrines; however, in urban areas, filariasis is primarily associated with sewage and sillage in drains and ditches. Where waste stabilization ponds are used for wastewater treatment, overhanging vegetation has been associated with *Culex* breeding. By and large, mosquito control should focus on (a) eliminating mosquito breeding sites through land fill or application of oil or insecticides and (b) altering the physical environment. Local factors will, obviously, determine the efficacy of any measures. High water tables, seasonally or throughout the year, and increased water use compromise many sanitation methods. Detergents in wastewater emulsify oil, limiting its efficiency (oils inhibit respiration of mosquito larvae). Natural predators, for example, guppies, are only possible in canals large enough to contain adequate oxygen. Some mosquitoes readily build up resistance to insecticides. Nonetheless, numerous possibilities exist that are universal: (a) keeping drains as clear as possible to reduce stagnation, (b) fitting and retrofitting septic tanks, latrines, and vent pipes with mosquito netting (more mosquitoes escape through vents than holes in squat plates or toilet seats), (c) covering or repairing soakage pits, septic tanks, and latrines, (d) fitting or retrofitting water seals, (e) avoiding, where possible, open drains for sewage and sillage, and (f) using insect traps. Use of insecticides, however, is compromised by their high cost. Because of the short breeding cycle, that is, approximately 2 weeks, all methods require recurrent attention. This factor, in turn, requires community involvement and education. Protective netting and spraying against mosquitoes in houses are effective only for "domesticated" mosquitoes, but not for sylvan types. Medication and, in extreme cases, surgery are the major curative interventions; no vaccine exists at the moment.

* The worms undergo development in the mosquito in about 2 weeks and then are passed on to another human. When they are deposited on the skin during a bite, the worms later penetrate the skin, probably at the punctured skin area. The mosquito, which takes about 2 weeks to hatch, becomes infective 10 days after the blood meal and remains infective until larvae are discharged from its system.

Food Poisoning

Other names: Food-borne intoxication, food-borne disease, and botulism.

- *Description.* Food poisoning is a general term referring to illnesses, usually, vomiting, caused by contaminated food or water. It is often, but not necessarily, accompanied by diarrhea, cramps, or fever. Food poisoning can be considered more an intoxication than an infection. Toxicants or poisons can be chemical or bacterial or consist of a variety of naturally occurring organic substances present in such foods as mushrooms or shellfish. Vomiting and diarrheas from gastroenteric infections, for example, salmonellosis or typhoid, can also be classed as food poisoning, whenever their identification is not possible. A characteristic feature of food poisoning is its rapid onset. Food poisoning occurs worldwide and is relatively frequent. Indeed, WHO even considers illness due to contaminated food as perhaps the most widespread health problem in the contemporary world.
- *Transmission.* The most common mode of transmission is through food, especially meats and food prepared with milk products that have been undercooked or kept unrefrigerated, allowing time for the pathogen to reproduce to a toxic dose (in the case of botulism, food that is insufficiently cooked prior to canning). Of particular risk are large quantities prepared for groups where portions of the food cool or are reheated unevenly. Most cases produce symptoms within 1–14 hours depending on the type of food and toxin. Food poisoning is not directly communicable among humans.
- *Intervention.* Proper food handling and storage is essential, although this is not always feasible. Cooking to 60°C or 140°F for at least 15 minutes is recommended to ensure chemical breakdown of the toxins, as is covered storage of food under 4°C or 40°F. In the case of cooked foods, cooling time of 2 or more hours is sufficient time for food to become contaminated. Curative interventions include rehydration and patience, because the best method is often for the body to purge itself of the toxicants.

Giardiasis

Other names: Giardia enteritis, lambliaosis, and giardia duodenalis.

- *Description.* Giardiasis is an infection of the small intestine. Often only mildly symptomatic or even asymptomatic, the disease can cause diarrhea, bloating, malodorous stools, inflammation of the bile duct, malabsorption of nutrients especially fat and fat-soluble vitamins, fatigue, weight loss, and malaise. The disease usually lasts less than three months and is rarely fatal. Giardiasis is more likely to be severe in prolonged cases and in individuals with protein-calorie malnutrition, low gastric acidity and immunodeficiency, all of which predispose individuals to contract the disease. In severe cases, the disease can persist for years. Giardiasis can be one of the causes of traveler's diarrhea and is now one of the most commonly found intestinal parasites throughout the world today. Giardiasis occurs worldwide; children are more frequently infected than adults (perhaps three times more). A prevalence rate of 30 percent among children is not uncommon. Current prevalence is estimated at about 2–7 percent of the world's population. Giardiasis is more prevalent in areas of poor sanitation and poor hygiene and among malnourished children. A direct correlation between poor sanitation and economic development is not clear, because outbreaks regularly occur in economically developed countries with high standards of living and in children in developing countries who are not disadvantaged.
- *Transmission.* Humans are the main carriers, but it can also be spread by animals. Beaver and deer are known and rats possible vectors. Flies are probable vectors in areas of high prevalence. The disease is spread primarily through fecal contamination of water, and also by fecal-oral transmission in food and interpersonal contact. Epidemics tend to be water-borne. Contaminated hands are probably the main sources of transmission in outbreaks where water supply is protected. Development of the disease varies, but usually within 3 weeks of exposure. A high rate of asymptomatic carriers contributes markedly to its continuation. Up to 900 million cysts can be shed by an infected individual, although it is not clear that all are infective; twenty-five to 100 cysts are sufficient to cause an infection. An infected individual remains communicable for the duration of infection, usually under three months.

- **Intervention.** Sanitary disposal of feces to protect water supplies is the main preventive intervention, because the disease is primarily waterborne. Protection of water supplies is clearly more difficult for animal than human feces. Sand filtration is effective in eliminating cysts, when done under high standards of operation. Chlorination is probably not effective at currently practiced standards. Because of the many means of transmission, hygiene education may be the most important intervention (as with amebiasis). Cysts are killed by desiccation and freezing, but resistant to wide ranges of acidity (pH) and ambient temperatures. Secondary sewerage treatment is effective in reducing 50–90 percent and waste stabilization ponds in reducing 100 percent of the cysts. Because the normal night soil and sludge treatment process does not produce a hostile environment for cysts, their reduction and elimination is a function of time and temperature. Evidence exists of protective immunity after repeated exposures. Medication is available for infected individuals.

Guinea Worm Disease

Other names: Dracontiasis, Dracunculiasis

- **Description.** Dracontiasis is an infection of the tissues with a large roundworm. Its most frequent characteristics are blisters or skin ulcers that last up to several months and appear when the female worm is ready to release its larvae. The blisters and ulcers normally occur on the lower extremity, especially the foot (90 percent of cases), but also elsewhere on the body. The threadlike worms measure 30–120 centimeters. Symptoms include burning, itching of skin, nausea, fever, vomiting, and diarrhea. The disease does not kill, but is extremely debilitating. The worm infestation itself, secondary infections, and presence of an open sore can result in abscesses, arthritis, and tetanus. Some worms remain in the body and are calcified. These repercussions determine its social importance—devastating consequences to agricultural productivity—because the disease debilitates during planting and harvest seasons. In endemic areas, affliction of 50 percent of a village with the disease is not uncommon. About 30 percent of cases result in incapacitation, about 0.5 percent with permanent disability, and 0.1 percent with mortality. Disability ranges from 5–10 weeks in untreated cases. In western Nigeria, for example, the average disability lasted 100 days. In essence, the disease means a significant wage loss for those whose livelihood depends on seasonal labor. Prolonged periods of school absenteeism is more difficult to measure, but certainly important. The global incidence of the disease has decreased tremendously in the past decade; by 1996, WHO estimated fewer than 153,000 cases, most of which occurred in Sudan. At present, the disease still thrives in several countries in Sub-Saharan Africa, India, and the Arabian Peninsula, particularly Yemen.
- **Transmission.** The disease is spread by infected humans and the only one spread exclusively in drinking water. Larvae are discharged by the worm periodically for 2–4 months when the infected individual immerses the blister in water when, for example, swimming, fetching water, or doing laundry. These larvae, which can survive in water for up to a week, are then swallowed by a small crustacean (*Cyclops*) about the size of a flea and then develop in about two weeks. Humans who drink water harboring this crustacean can acquire the infection when the worms are released in the stomach and then migrate to muscle tissue.* Individuals with high stomach acidity are less prone to multiple infections. This feature tends to increase susceptibility for those actively engaged in farming. That is, they tend to drink more to replenish water lost in heat and, being away from their houses, probably eat less frequently. These, in turn, dilute or lower stomach acidity. The species of *Cyclops* that spreads the disease favor stagnant water, that is, unprotected wells, ponds, and inlet pools and not flowing rivers or streams. Transmission is seasonal, depending on geography and rainfall. In dryer regions, peaks in the disease occur when a rainy season produces seasonal ponds supportive of *Cyclops*. Transmission in wetter regions, in comparison, decreases where rain overflows ponds or causes turbidity unsuitable for *Cyclops*.
- **Intervention.** Protection of water sources from contamination by infected individuals is a straightforward and effective measure. Simple architectural improvement of water sources, such as sealing wells

* After discharging her eggs, the female is expelled and the open sore can heal. Females live about 12–18 months; it takes about 1 year to produce eggs.

with covers or adding a platform on which to stand, can prevent immersion of infected parts, usually the lower leg. Boiling or filtering water eliminates the crustacean. Holding tanks are not effective, because it is possible for larvae to be released from a dead *Cyclops* crustacean. Treatment of water with chlorine or copper sulfate is also effective. High-risk groups are those engaged in farming, a sweat-inducing activity; they may drink unfiltered, unboiled water or directly from ponds. Education on the disease's life cycle is vital, but it is not always possible to change behavior where water sources are not protected from contamination where they are accessed. The most common form of treatment is to remove the worm physically from the sore by wrapping it around a twig, little by little, until the worm is fully removed. Chemical control of *Cyclops* is possible, but of limited utility due to the cost and practical difficulties of application in rural areas. Several medications exist that can control the worm once in the body, but these are too expensive for mass treatment and have toxic side effects. Traditional herbal remedies also exist, but their potential use is often compromised by people who think the disease is not preventable, especially because the disease does not manifest itself for as much as a year after drinking contaminated water.

Hepatitis

Other names: Type A hepatitis, viral hepatitis, epidemic hepatitis, epidemic jaundice, infectious hepatitis, and catarrhal jaundice.

- *Description.* Hepatitis is actually a general term referring to an infection of the liver. The three main types of hepatitis are type A, type B (or serum), and type C (formerly called non-A and non-B). The description below pertains only to type A. The remaining two types, although serious health problems, do not fall within the purview of this work, because their transmission revolves around contamination of blood (e.g., in transfusions and dirty needles) and, to a certain extent, sexual intimacy.

Hepatitis is a serious infection of the liver with an abrupt onset of fever, malaise, loss of appetite, nausea, abdominal discomfort, followed in a few days by jaundice (yellowing of skin and whites of the eyes). It can be a mild illness of one to two weeks or last several months. A long convalescence is generally necessary, but completely effective. The severity of the disease seems to increase with age. Many children are only mildly symptomatic and escape diagnosis. Most cases are diagnosed in older children and adults. Mortality is usually less than 1 percent. Even in countries with high standards of living, exposure to hepatitis is widespread, but underreported because infections are mild and go undetected. Outbreaks are common in institutions and for lower socioeconomic groups; epidemics are common in school-age children and young adults and in situations of congested housing with poor hygiene. The disease tends to be more prevalent in rural rather than urban areas. Hepatitis is endemic worldwide with a tendency to cyclic recurrences. In temperate countries, incidence is higher in autumn and winter except in cases of epidemics.

Transmission. Humans are the main carriers. The disease is transmitted in feces, urine, and probably also discharges from the throat and nose. Interpersonal contact is the main route of transmission, presumably of fecal-oral. Outbreaks are most frequently related to contaminated water supplies, but can also be due to food, including milk and raw or undercooked mollusks (e.g., clams and oysters), which retain and accumulate the viruses. Transmission via mollusks appears to be dose related, because it is not clear that cooking kills all the virus. Spread of hepatitis in this way, therefore, appears to reflect general levels of contamination of saltwater habitat. Depending on dose, the disease develops normally about 28–30 days after exposure and is most highly communicable while still developing within the infected individual, that is, usually about two weeks before symptoms set in. Infants and preschool children are infected, but frequently do not exhibit symptoms. Hepatitis imparts an immunity, but its strength and longevity are not certain.

- *Intervention.* Personal hygiene, proper human waste sanitation, and thorough cooking of shellfish are the main interventions. Precise interventions concerning water and wastewater treatment still remain speculative because of past difficulties in isolating the virus from actual field outbreaks. The hepatitis virus appears to resist normal chlorination, but water meeting conventional bacteriological standards does not appear to cause the disease. Hepatitis A vaccine is available, but usually lasts under four

months, after which a booster may be necessary for longer term protection. No specific medication for hepatitis exists.

Intestinal Worms (Ascaris and Hookworm)

Intestinal Worms: Ascariasis

- ***Description.*** Ascariasis is a worm (nematode or roundworm) infection of the small intestine, which causes digestive and nutritional disturbances, rashes, restlessness, and insomnia. Symptoms in 85 percent of the cases are mild or absent. During its development, the worm larvae migrate through the circulatory system. This can lead to numerous other secondary infections, such as pneumonia. In heavily infected children, ascariasis can cause other serious complications, for example, severe malnutrition or intestinal blockage.* Prevalence is worldwide, but mostly in tropical countries where it can infect 50 percent of the population. Young children are more frequently and more heavily infected. Prevalence from 60–90 percent of children and 10–50 percent of the aged are not uncommon. In Africa, an estimated one-third of the population is infected. It has been suggested that mortality due to ascariasis as a contributing factor is much higher than estimated, but generally underreported or attributed to another disease. Its widespread mild occurrence has, unfortunately, led many people to assume it is a harmless part of life. Ascariasis tends to be spread in the immediate vicinity of households. Where night soil or sewage effluent is used as fertilizer, ascariasis can be spread through raw or undercooked vegetables. Distribution of the disease near households, therefore, may be due to cultural and occupational factors, because the very young and very old—the most vulnerable—tend to spend more time near the house, compounding the problem in a vicious cycle. Because it is so widespread and difficult to eliminate, due to the persistence of ascaris eggs, ascariasis is a serious health problem. In view of its proportionately low mortality rate (less than 0.02 percent) and asymptomatic infection, however, it is not considered a priority when compared with other diseases that seem to be more serious.
- ***Transmission.*** Humans are the reservoir, but pigs, chickens, cats, and dogs can act as vectors by eating human feces and passing on the eggs, aggravating transmission in work and living environments. Ascariasis is spread by ingestion of eggs from soil contaminated with human feces. Salads and raw vegetables are the most frequent vehicles, especially when manured with human feces. Dirty hands and children's playthings that have fallen on the ground also tend to be major vehicles of transmission. By and large, the bulk of transmission in highly endemic areas appears to focus on household activities, exacerbated by small children's defecating indiscriminately around living areas. Soil on feet, shoes, and sandals can also transport eggs for long distances. Transmission in dust is also possible. Even bank notes have been implicated in transmission. After eggs are swallowed, they eventually develop passing through the circulatory system and settling in the intestines as mature worms, a process that takes about 2 months. About 2 to several weeks after being shed in feces, eggs develop into an infective stage in soil under ambient conditions (loose, moderately damp soil with ample oxygen and temperature higher than 15°C), although eggs can tolerate adverse conditions. Eggs die within 1 hour at temperatures higher than 50°C and within 15 hours of exposure to direct sunlight. Humans remain infective as long as live female worms inhabit the intestines. A female can produce 200,000 eggs daily, or 26 million eggs in her lifetime, about 6–18 months average. About 60 percent of these can become infective. Average worm lifespan extends 12 to 24 months. Eggs in the soil can remain viable for several months; up to 10 years has been reported. The general population is at risk, although some individuals seem to develop some immunity with age.
- ***Intervention.*** Because water is not significant in transmission, proper disposal of feces and prevention of contamination in areas adjacent to living quarters, especially play areas, are some of the primary preventive measures. Because children appear to be the main reservoirs of infection, education about hygiene and food handling is indispensable, as is the design of toilets. Given that eggs do not become

* Estimates of nutritional consequences vary. Twenty adult worms, a normal mild infection, consume about 3 grams of carbohydrate and 1 gram of protein daily, hence, the consequences of infection depend on the load. Similarly, this could consume 1 ounce of a child's protein and cause deficiencies in vitamins A and C. In addition to this consumption, worms also can inhibit nutrient absorption.

infective for about two weeks, regular environmental cleanup of household areas is not unrealistic. A variety of sanitation measures are possible and effective, but depend on three overriding complementary variables: time, temperature, and moisture. Mass deworming with drugs is of questionable value except in severe cases, because of the high probability of reinfection unless effective sanitary measures and hygiene education are also taken. To be effective, deworming campaigns should be repeated at intervals of less than 2 months as long as individuals are shedding eggs. Otherwise, reinfection to pre-treatment levels are likely to return within 6–12 months. Effective sanitation measures, however, will only work if accompanied by proper education.

Intestinal Worms: Hookworm

Other names: Ancylostomiasis, necatoriasis, uncinariasis, and ankylostomiasis

- *Description.* Ancylostomiasis is a chronic and debilitating infection of the small intestine with hookworm (a nematode, *Necator* sp. or *Ancylostoma* sp.) causing anemia of varying severity depending on the worm load. The anemia is caused by the blood-sucking worm, which attaches itself to the intestinal wall. (Its head end is curved like a hook, hence, the name.) It can be asymptomatic with mild or heavy levels of infestation, lead to mental retardation and stunted physical development in children, especially if they are malnourished. Symptoms include abdominal pain, indigestion, diarrhea, constipation, and a desire to eat soil (geophagy). Pregnant and lactating women are especially vulnerable. The consequences of anemia can include lower productivity, poor memory, heart disease, and a variety of adverse effects to the reproductive system, for example, infant and maternal mortality, miscarriages, still births, abortions, and delayed puberty. In tropical Africa, hookworm-related anemia is one of the most common causes of hospitalization. The disease is widely endemic in hot, humid tropical and subtropical countries with poor sanitation, ideal conditions for egg or larva survival. Prevalence of up to 50 percent is common. Distribution is relatively even among all ages, except for the very young and aged, where prevalence appears low. Sanitary measures to control hookworm is not always considered high priority in public health campaigns, because it often goes underdetected and has a relatively low mortality rate, compared with the infection rate; yet, together with malaria and schistosomiasis, it rates as one of the three most important parasitic diseases afflicting humankind. (Bear in mind that diarrheas are not considered parasitic diseases.) It has been suggested that the mortality is much higher than estimated, but generally underreported or attributed to another disease.
- *Transmission.* Humans are the main reservoir, although dogs and cats spread certain varieties in Southeast Asia. Eggs in the feces of an infected individual are deposited in the ground and, where soil density, moisture, and temperature are favorable (loam or sandy soil of about 20 to 30°C), hatch into larvae. The larvae, which become infective about a week after hatching, live in the soil or attach themselves to grass where they can survive for up to 15 weeks. Transmission tends not to be in the immediate vicinity of homes because soil is packed too tightly. High transmission probably occurs at regular defecation sites where the larvae density is high, soil is moist, but not waterlogged, and feet come into prolonged and stationary contact with the soil. (Sunlight and urine, however, are lethal to the larvae.) The larvae penetrate the skin, usually through the feet or legs (sometimes hands and, buttocks), producing dermatitis, “dew itch,” or “ground itch.” Certain types can also be ingested, although this is less common. The larvae pass through the body to the small intestine, where they attach themselves to the intestinal wall. They then develop to maturity and begin producing eggs to complete the cycle, which usually takes between 1 and 2 months. Depending on species, hookworms produce from as few as 9 to 30,000 eggs a day. Symptoms develop after a few weeks, but can take up to several months depending on the worm load and nutritional status of the infected person, specifically iron intake. In the absence of treatment, infected individuals are potential egg spreaders for up to 7 to 15 years depending on the species, although most worms die within 3 years. Hookworm infection and, therefore, transmission varies seasonally, but the particulars are not clear. Generally, anyone can contract the disease, although some immunity is thought to develop with infection.
- *Intervention.* Proper disposal of feces (night soil and sewage effluents are particularly hazardous when used as fertilizer) is of paramount importance, together with proper education. This includes identification of high-risk defecation sites such as cool, shady areas with moist soil. Encouragement on wearing shoes or sandals is extremely important, although not always feasible for economic and cultural reasons. Deworming is of questionable value, except in cases of heavy loads, due to the likelihood of reinfection, unless the entire population is treated and effective hygiene education measures are also taken.

Improved excreta facilities alone have not proved especially effective in areas of high prevalence. Because hookworms continue to produce eggs in an individual for an average of 3 years, programs to eradicate the disease are predictably slow. A variety of sanitation measures are possible, but depend on time, temperature, and moisture.

Malaria

Other names: Palladiums, *Palludisme* (in French), Roman fever, Chiggers fever, marsh fever, tropical fever, and ague.

See also “Malaria and Vector-Related Diseases” in chapter 8 and table 8-6.

- *Description.* The term malaria is derived from the Italian for bad air (malaria). In general, malaria is characterized mostly by general malaise, shaking chills, rapidly rising fever, usually with headache, nausea and profuse sweating. The symptoms, which are produced by the activity of the malarial parasite in the blood, repeat themselves from one to three days depending on type of malaria. (It is this variation which is responsible for their names, tertian and quartin which follow the Roman system of dating.) This initial attack sequence varies from a week to a month if untreated. Relapses are frequent with recurrence of symptoms lasting at irregular intervals from 2–5 years, but usually extending beyond 1.5 years. There are actually four types of human malaria which is essentially a parasitic invasion of the blood. The most serious type (falciparum or malignant tertian) causes periodic bouts of fever, chills, and sweating which can lead eventually to anemia, jaundice, blood coagulation, shock, kidney failure, acute inflammation of the brain (encephalitis), delirium and coma. Prompt treatment is essential as irreversible complications can occur. Case fatality rate in children and nonimmune adults exceeds 10 percent.* This more serious type of malaria accounts for approximately 50 percent of all malaria worldwide and is the type more widespread in tropical Africa. In the milder forms of malaria (vivax or benign tertian, quartan, and ovals), the symptoms are similar, but are not life threatening, except in infants or those suffering from other diseases. Of these three milder types of malaria, one type (vivax) is found mostly in Asia and accounts for about 40 percent of global malaria, but has a low prevalence in Africa.
- Malaria has been mostly eradicated in temperate climates, occurs primarily in the tropics and subtropics (i.e., 60°N to 40°S latitude) wherever anopheles mosquitoes breed, and is usually absent in dry regions or altitudes above 1,500 meters. Malaria tends, however, to be more of a rural disease that adversely affects agricultural development, although urban malaria has recently been recognized. Malaria remains one of the world’s most severe health problems and one of the most difficult to combat.† For Africa, malaria appears to be worsening and accounts for about 20–50 percent of all admissions to health services and for one in five childhood deaths. WHO has certified some forty countries as having eradicated malaria, but 103 countries have not achieved this. Malaria is staging a resurgence in the past decade in southern Asia, Latin America, and Turkey. Mosquitoes have unfortunately become increasingly resistant to insecticides, and the parasite in the blood has grown resistant to drugs.
- *Transmission.* Humans are the main reservoir. Malaria is transmitted predominately through the bite of an infected (female) anopheles mosquito. (It can also be transmitted in transfusions of blood from an infected human or the use of contaminated needles.) Anopheles mosquitoes tend to bite from dusk through dawn; many species favor feeding indoors and in areas around human habitations. They have a complicated life cycle. When the mosquito bites a human with active malaria, it ingests parasites that undergo a transformation, which is temperature dependent (i.e., 21–27°C or 70–80°F and does not occur under 16°C or 60°F). These parasites are eventually passed on to a human, in whom they further develop and actually cause the disease. On average, it takes humans 1–4 weeks to develop malaria (a 1-

* Blackwater fever, that is, “urine blackened” by blood, is a condition associated with this type of malaria among non-immune individuals who have undergone repeated malarial attacks without adequate medication (e.g., quinine) to suppress the disease. Mortality in these cases is 20–50 percent.

† Its most obvious symptoms, fever and chills, are symptomatic of numerous illnesses and, thus, can be incorrectly overdiagnosed. It can also be underreported. (Proper diagnosis requires blood tests.)

though some strains take up to ten months). In comparison, it takes the mosquito about 8 to 35 days to become infective after the blood meal from an infected human. The human can be infective as long as the parasite is in the blood, which can occur irregularly for up to three years. Once infected, a mosquito remains so for the duration of its life, which lasts from a few days to about a month. The general population is susceptible to malaria, but the degree is lessened by previous infection. Tolerance is evident in adults in some areas where malaria is highly endemic and where exposure has been frequent for several years. High-risk groups are children 6 months to 5 years old and pregnant mothers.

- *Intervention.* Mosquito eradication and control, treatment of infective cases to reduce spread, house spraying with repellents, bed nets, protective clothing, proper control of blood for donations and transfusion, and protective medications are the full range of possible interventions, each with varying complexity and possibility of success. Because the young anopheles must pass its early development stages in water, drainage of all possible breeding grounds is important, although certainly not always possible. The same climatic factors that encourage people to wear protective clothing, that is, cold weather, naturally reduce mosquito reproduction. Limited immunity occurs from exposure to the disease. Antimalarial medications are available, but their efficacy has been compromised in recent years by resistance of the parasites.

Onchocerciasis

Other names: River blindness, onchocerciasis

- *Description.* River blindness is a chronic, but nonfatal disease caused by infestation with a roundworm (nematode). The disease is characterized by small lumps (nodules) in the skin, seen mostly in areas where bones are near the surface of the skin. The female worm within an infected individual discharges small threadlike worms (microfilariae), which cause skin itching and dermatitis, rash, pigmentation change, swelling (edema, because of abnormal accumulation of fluids), and wasting (atrophy) of the skin. Progression of its various stages has given the disease its local names (e.g., skin of an orange, lizard, or crocodile). The loss of skin elasticity, the last stage, is responsible for hanging groin and hernia that frequently accompany the disease. In endemic areas, populations sometimes associate the intense itching and change in skin as part of the aging process. Worms reaching the eyes can produce blindness. Severity of individual infection depends on progressive buildup of microfilariae, which can take up to 30 years to cause blindness.

Although not a life-threatening disease, river blindness has enormous socioeconomic consequences. The dermatitis, for example, causes premature aging in appearance and intense itching, which can inhibit sleep and reduce overall work productivity—sometimes of whole communities. In endemic areas, for example, parts of Africa, as many as 50 percent of a local population have the disease, 30 percent have impaired sight, and 10 percent or more have gone blind. The overall effects have caused entire communities to move away from fertile river valleys to less productive land. This in itself can produce adverse effects on the agricultural economy and environment through overpopulation and overcropping. Water resource development projects can have positive effects by reducing breeding areas for the fly in vegetation and rocks near fast-moving water. (The flies need high amounts of oxygen.) Spillways and drainage canals, in contrast, can extend the habitat. Because the severity of infection depends on buildup of the microfilariae for years, the pattern of communitywide blindness leading to abandonment of the village may take up to 60 years. River blindness occurs primarily in Sub-Saharan Africa (in a belt of thirty countries from Senegal to Ethiopia and from Angola to Mozambique) and irregularly in Latin America (Guatemala, southern Mexico, República Bolivariana de Venezuela, and parts of Colombia, Ecuador, and Brazil) and the Middle East (Yemen). In eleven countries in West Africa, the disease is on the verge of being eliminated as a public health threat.

- *Transmission.* Humans are the only known reservoir. Transmission occurs through the bite of an infected female black fly (genus *Simulium*). When the fly ingests blood of an infected individual, it becomes infective within 7–14 days depending on the temperature and climate of the area. The flies breed on vegetation and rocks in fast-flowing water, which provides sufficient oxygen for the fly eggs to develop. Disease distribution tends to be highest within 5 kilometers of the water habit. (Flight range, however, averages 40 kilometers and reaches a maximum of 150 kilometers.) The flies normally

bite during the day outdoors and do not like bright sun. An infected individual can be communicable up to 15 years, if untreated. The population at large is at risk, and reinfection can occur, because no immunity has been demonstrated.

- *Intervention.* Vector control, protective clothing, and repellents are all possible control measures of varying feasibility for rural populations. For example, according to geographic distribution, certain flies bite above the waist, others below the waist, but this is of little practical value in interventions. Current practical measures include larvicides in infected streams and medication of infected individuals. Of the variety of interventions, alteration of fly-breeding habitat has proved the most effective. Its major drawbacks are the length of time necessary for implementation and follow-up, that is, 15–20 years; expense; and complexity of achieving broad environmental coverage without adverse effects to the environment. DDT, for example, has been used effectively in Africa. (See “Pesticide Use” in chapter 8 and “Use of Pesticides and Fertilizers” in chapter 9 for discussion of DDT and current World Bank policies on use of pesticides.) Efficiency, however, depends on repeated spraying, even of remote areas for 15 years to avoid reinvasion throughout the lifespan of adult worms. An extensive program of onchocerciasis research and control in the Volta River Basin of West Africa was launched in 1974 and has considerably reduced the incidence of the disease in eleven countries in the area.

Respiratory Diseases (Acute, Flu, and Pneumonia)

Respiratory diseases are divided into three categories: acute, influenza, and pneumonias. Other respiratory diseases, such as asthma, bronchitis, and cancer, are not covered below.

Respiratory Disease: Acute Respiratory Illnesses (Short-Term and Mild)

Other names: laryngitis, bronchitis, earache, and the common cold.

- *Description.* Acute respiratory illnesses are broad categories of diseases characterized by a variety of reactions, such as chills, headache, body aches, malaise, loss of appetite, and localized inflammations of the respiratory tract. (The absence of fever in the common cold, however, distinguishes it from the other upper respiratory tract infections, e.g., laryngitis, bronchitis, tonsillitis, and earache.) Symptoms usually subside within a week, unless complicated by another infection. These infections are generally nonfatal, but constitute a major reason for reduced efficiency and absenteeism from work and school. Irritation of the respiratory tract predisposes individuals to other more serious complications, such as pneumonia. Respiratory infections and their complications are most serious to children under 5 years, who normally have the highest incidence. This set of infections occurs worldwide. In temperate zones, incidences tend to be highest in winter months and, in tropical areas, in wet and cold weather.
- *Transmission.* Humans are the main carriers. Respiratory diseases are spread directly presumably by interpersonal contact and droplet spread and indirectly by contact with soiled articles and eating utensils of an infected individual. The role of hands appears now to be more important in transmission than was considered earlier. The period of symptom development and communicability varies by disease and individual, but is usually under one week. The general population is susceptible. Illness is more frequent and more severe in infants and children. Reinfection is possible, but usually milder if induced by the same strain of pathogen.
- *Intervention.* Immunization is possible for certain illnesses, but not those that induce the common cold. Major interventions include reducing crowded living conditions, improved ventilation, improved stoves for cooking, heating, and lighting (especially irritants such as smoke), and education on personal hygiene (especially concerning sneezing and coughing and disposal and cleaning of soiled articles).

Respiratory Disease: Influenza

Other names: Flu.

- *Description.* Influenza is a short-term infection of the respiratory tract characterized by abrupt onset of fever, chills, headache, muscle ache, and cough and often accompanied by a common head cold and

sore throat. It normally lasts 2 to 7 days. Influenza is an important public health problem because of the rapidity of its spread, high attack rate, the seriousness of frequent complications (especially pneumonia), and severity in the malnourished, elderly, and chronically ill. (The name influenza, which derives from Italian for “influence,” is traced to the Medieval Latin belief that epidemics were influenced by the stars.) Distribution of influenza is worldwide and seems to follow a 10- to 11-year serious pandemic (i.e., worldwide epidemic) cycle (i.e., 1889, 1918, 1947, 1957, and 1968). Influenza infections also occur in swine, horses, and other animals, but transmission from these animals to humans has not been demonstrated. In temperate climates, epidemics tend to occur in winter months; in the tropics, no seasonal pattern seems evident. Several distinct strains of the virus exist, which evolve into different substrains at irregular intervals. This development of new strains at irregular intervals is responsible for the pandemics.

- *Transmission.* Humans are the source of human infections, although some animals are suspected of providing strains of virus that recombine with human strains. Influenza is spread by direct contact, droplet infection (i.e., airborne through coughing or sneezing), and by indirect contact with freshly soiled articles. The influenza virus can persist for several hours in dried mucous, which increases the potential for spread, especially in children and groups with poor personal hygiene. Most frequent outbreaks occur in crowded living conditions. Infection develops usually within 24 to 72 hours of exposure. Communicability of individuals is probably limited to 3 days after symptoms begin. The general population is susceptible. Infection produces immunity only to a particular strain.
- *Intervention.* Personal hygiene (especially washing hands and encouraging individuals to cover their mouths when coughing or sneezing) and immunizations are the major preventive interventions.

Respiratory Disease: Pneumonias

Other names: pneumococcal pneumonia, bacterial pneumonia, mycoplasma pneumoniae pneumonia, pneumocystis pneumonia, infant pneumonia, viral pneumonia.

- *Description.* Pneumonias are a category of diseases that affects the lungs, inhibits breathing, and thereby negatively affect oxygen exchange and blood purification. In most cases, pneumonia is actually a secondary infection, which results from preceding infections to the upper respiratory tract (e.g., flu, whooping cough, or measles) that spread to the lungs to become pneumonia. The pneumonias are, therefore, especially significant in malnourished children, the aged, the chronically ill, and others weakened by another disease that has left them susceptible to lung infection. Pneumonia is characterized by fever, pain in the chest, difficult breathing, increase in white blood cells, and a sputum-producing cough; vomiting and convulsions are also possible at disease onset. Pneumonia is an important cause of death, especially in the aged and infants; hospitalized patients have a fatality rate of 20 to 40 percent. Antibiotics have helped reduce this fatality for certain types of pneumonia, which is now down to about 5–10 percent; but early diagnosis and treatment is still important for effective cure. Pneumonia remains common in developing countries, especially in industrial cities and poor economic groups. It occurs in all climates and seasons with the highest incidence in winter and spring months of temperate zones. Incidence also commonly increases with epidemics of respiratory infections, especially influenza. Humans are the carriers of infective bacteria that cause one of the more common types of pneumonia, commonly found in the mouth, nose, and throat of healthy persons.
- *Transmission.* Pneumonias are spread, directly, by droplets through sneezing and coughing and by oral contact or, indirectly, by contact with articles freshly soiled with respiratory discharges. Depending on its type, pneumonia can develop up to a month after exposure. Individuals remain highly communicable for probably under 2 weeks, depending on the type of pneumonia. Resistance to pneumonia is generally high, but is lowered by exposure to wet and cold environments, physical fatigue, alcoholism, chronic lung disease, or a preceding respiratory infection. Immunity is imparted for the specific strain for a few months to years.
- *Intervention.* Reducing crowded living conditions and potential irritations to the respiratory tract, for example, smoke or dust, through proper ventilation of houses or workplaces is the major recommended intervention.

Salmonellosis (Salmonella and Typhoid)

Salmonellosis: Salmonellosis (see also Dysentery)

Other names: Can sometimes be considered a food poisoning, undifferentiated gastrointestinal infection, gastroenteritis, or enteric fever.

- *Description.* Salmonellosis is an acute gastrointestinal infection characterized by sudden onset of abdominal pain, diarrhea, nausea, and sometimes vomiting, usually with fever. It is often accompanied by a loss of appetite, which can last for a few days. Dehydration is an important concern, especially in infants, who, together with children, have the highest infection rate. Salmonellosis occurs worldwide, and epidemics are frequent. In many developing countries, however, salmonellosis represents only a small portion of the more important diarrheas of infancy and childhood. Mortality is generally low. Salmonellosis is one of the few diarrheal diseases in which humans and animals can infect each other and one of the few fecal-oral types of disease spread predominately by animals rather than humans. Because of this feature, typhoid and paratyphoid, also types of salmonellosis, are considered separately in the literature. Salmonella occurs worldwide, although it tends to be reported more frequently in North America and Europe, where it is classified as a food-borne disease.
- *Transmission.* Primarily domestic animals and, to a lesser extent, wild animals (poultry, swine, cattle, sheep, horses, rodents such as rats and mice, and pets such as turtles, dogs, cats, and baby animals) are the main reservoirs of the disease. Humans also transmit the disease, as well as fleas, ticks, lice, and flies. In short, these are animals and insects that share the habitat of humans. Transmission occurs by ingesting food contaminated with feces of infected animals or persons. Most frequently, contamination occurs at its source, less frequently by contaminated food handlers and finally interpersonal contact. It can also be spread in milk, raw eggs (especially cracked), egg products (including frozen and dried), meat and meat products (e.g., preserved meats and sausages), poultry, some pharmaceuticals of animal origin, and animal feeds and fertilizers prepared from contaminated meat scraps, fish meal, and bones. Individuals or animals can spread the disease throughout the course of infection, which varies from days to weeks. Humans can spread the disease for 2 months, but seldom more than a year. Salmonellosis develops usually within 36 hours of exposure. The entire population is susceptible. Severity of infection depends on the type of organism and dose. Ultimately, the level of production and consumption of meat and dairy products is a determining factor in its spread to the general population. Water-borne epidemics are, of course, also possible, although not the major source of transmission.
- *Intervention.* Major preventive measures are thorough cooking of foodstuffs derived from animal sources, especially poultry and egg dishes (and avoiding use of cracked eggs). Food handlers tend to be a high risk both for acquiring and spreading the disease and should be a focal point of any education program, as should producers of meat and dairy products for public consumption. Careful cooking hygiene and proper storage to prevent contamination of food are the essentials of hygiene education, which should also include the possible dangers of pet animals such as chickens, ducks, and turtles. This latter group, however, is of dubious practicality. No curative measures exist except for rehydration. The existence of such a large animal reservoir, however, makes any intervention strategies extremely complicated. Standard treatment of raw sewage and effluents are practical to inactivate salmonella to acceptable levels. Outbreaks have been tracked, however, to the presence of salmonella on crops, consequently, use of furrow, subsurface, or drip irrigation are preferable to flooding or spraying types. Discontinuance, if possible, of contaminated water, 10 days to 2 weeks prior to harvesting is an added precaution, because heat, sunlight and low humidity will substantially reduce salmonella on crops.

Salmonellosis: Typhoid and Paratyphoid

Other names: enteric fever, typhus abdominal, typhoid fever, and paratyphoid fever.

Typhoid and paratyphoid are salmonella-type infections, but are treated separately, because they are not spread to humans in animal feces. Unless indicated, this section focuses on typhoid, because it is more serious.

- *Identification.* Typhoid is a salmonella-type infection of the intestines characterized by continued fever, headache, malaise, loss of appetite, slow pulse rate, spleen enlargement, and rash. Because the infection spreads beyond the intestines, it causes fever, which is usually the distinguishing feature of salmonellosis from other gastrointestinal infections. Constipation is more common than diarrhea (although diarrhea is a symptom of paratyphoid). Typhoid has had a fatality rate of 10 percent, which has been reduced by antibiotics to less than 1 percent. The spread of typhoid in contaminated water was recognized as early as 1838. Since that time, typhoid has become a benchmark for the spread of water-borne diseases. In both the United States and Europe, improved water supplies have been recognized as the single most important factor in reducing the disease—up to 80 percent within five years of water treatment and filtration. Typhoid occurs worldwide, but its incidence has been greatly reduced—virtually eliminated in the industrialized countries—because of improved water, sanitary facilities, reduction in the number of carriers, and the availability of antibiotics. This is not, unfortunately, the case in developing countries. Typhoid is still considered a major public health problem in many developing countries. Furthermore, strains of salmonella that are resistant to antibiotics have been reported in Asia, Latin America, and the Middle East. Patients who are HIV positive have a significantly increased risk of contracting the disease. In general, the salmonellosis are not a major cause of infant and child diarrhea morbidity and mortality.
- *Transmission.* Humans are the main reservoirs. Asymptomatic carriers play an important role in spreading typhoid. Transmission occurs by ingesting food or water contaminated by feces and, to a lesser extent, urine. Relatively high doses are normally needed to cause infection. Improperly cooked, starchy foods and pastries that allow typhoid to multiply to an infective dose are the most common vehicles. Raw fruits and vegetables, whole milk, and milk products are also frequent vehicles. Transmission can also occur in shellfish from contaminated waters or food stored in, cooled in, or “freshened” with contaminated water. Contamination is most commonly spread by hands of carriers, although flies can also be involved. Depending on the size of dose, typhoid develops within three weeks of exposure. (Most other salmonellosis occur within 36 hours.) Individuals remain communicable as long as 3 months; under 5 percent become permanent carriers, mostly through their feces. A large proportion of asymptomatic carriers spread the disease. Curiously, these individuals frequently acquire illness in middle age, females more than males. The general population is susceptible, but is increased in individuals with low gastric acid levels. In countries where the disease is most prevalent, the disease is most common among individuals ages 4 to 19 years old. Resistance to small doses follows recovery or after immunizations; in endemic areas, attack rates usually decline with age. As with other salmonellosis, typhoid tends to peak in the warmer months, whether dry or wet.
- *Intervention.* Protection and chlorination of water supplies, proper disposal of excreta are the main preventive intervention. Controlling flies through insecticides and eliminating breeding and feeding grounds through proper garbage collection and control are also recommended, but less important, because these are not main routes of transmission. Proper kitchen hygiene, cooking, and storage, especially of milk and dairy products should be at the core of proper education, especially of food handlers. Identification and treatment of carriers, as well as immunization are also recommended. The latter is not always practical, and the majority of carriers, who are asymptomatic, are unknown. Typhoid and polio are the only diseases spread by human excreta, for which vaccination is possible. It requires, however, periodic boosters every three years.

Schistosomiasis

Other names: Bilharziasis, bilharzia, snail fever, *Schistosomiasis hematobium*, *S. intercalatum*, *S. japonicum*, *S. mansoni*, and *S. mekongi*.

- *Description.* Schistosomiasis is an infection with a parasitic worm (trematode or blood fluke), which lives in the veins around the bladder, intestines, and liver of the infected individual. The worms deposit large numbers of eggs most commonly in the intestines or urinary tract. The presence of the worms and their eggs and the migration of both are responsible for the symptoms, which, depending on the type of the disease, affect either the liver and intestines or urinary tract. These, in turn, can cause complications for example, obstruction of the intestines, tissue scarring, ulcers, bleeding, organ enlargement, and possibly bladder cancer. Blood in the urine is characteristic of the urinary type and is responsible

for its scientific name. Minor symptoms, such as cough and fever, occur as the worm matures. Major symptoms occur in response to long-term egg laying during 2–5 years. (Similar, but relatively mild infections occur in many parts of the world, typified by “swimmers itch,” “clam diggers itch,” and skin rash, but the invading organism is limited to skin infections.) Schistosomiasis occurs in seventy-four countries of the Middle East, Africa, Asia, some parts of Latin America and the Caribbean. The type that affects the urinary tract (*S. hematobium*) is restricted primarily to the African continent and Middle East and tends to be somewhat less severe.

- In endemic areas, as much as 80 percent of the population can be infected, most commonly those 5–20 years old. Because of the intermediate snail vector, schistosomiasis tends to be primarily a rural disease; however, it can exist in ponds and streams of periurban and urban areas and be carried by people who acquire the disease in rural areas. Schistosomiasis has existed since pharaonic times and was clinically identified by Dr. Theodore Bilharz in 1851 in Cairo during construction of the Suez Canal. It is ironic that this development project played a role in its identification, because it is now seen also as a development disease. The spread of schistosomiasis has increased, because of extension of snail habitat in water resource development projects: dams, reservoirs, irrigation schemes, hydroelectric power, fisheries, and so on. Schistosomiasis is often considered an occupational disease of fishermen and farmers. Women and children doing domestic chores, however, are at an equal, if not greater risk through their regular contact with water. Even though mortality is low, schistosomiasis is a major health problem, because of its widespread prevalence and the difficulty in eradicating the snail vector.
- *Transmission.* Humans are the principal reservoir for types common in Africa and the Americas. With the Asian version, dogs, cats, pigs, cattle, water buffalo, horses, rodents, and wild rats also act as animal hosts. In all cases, transmission depends on a snail as an intermediate host. These snails generally live near slow-moving water. Transmission is seasonal, because rainfall affects snail habitat and, therefore, the possibility of exposure. Some snails, however, can withstand dry periods by burrowing into mud. The disease has a complicated life cycle. Eggs of the mature worm, schistosome, are passed in urine or feces, depending on the type of schistosomiasis. The eggs hatch in fresh water as “miracidia” and enter the snail where they develop, usually after several weeks, and are passed on as free swimming “cercariae.” The cercariae then penetrate the skin (within minutes) or, sometimes, are ingested when humans come into contact with infested waters. The worms reach maturity in the human usually within six weeks after infection. The worms then begin to produce eggs, some of which are expelled and must reach water to hatch into “miracidia,” which, in turn, penetrate fresh water snails to continue the cycle. Both the miracidia and cercariae must find a host within 6 and 48 hours respectively or die. The disease, because of the necessary snail intermediary, is not directly communicable among humans. Humans remain infective as long as eggs are discharged in the urine or feces of an infected individual, usually one to two years, but this can last up to 5 years for the type expelled in urine and 30 years for the type excreted in feces. The snail can remain infective for several weeks. The general population is at risk, and resistance from a prior infection has not been conclusively proven.
- *Intervention.* The overall aim of intervention is to break the cycle of transmission at any of several possible stages: eggs reaching water, humans being exposed to water, and eliminating snails or their habitat. A convenient, close water supply away from snail habitats is one of the most effective means. Essential to any intervention is proper disposal of urine and feces; this is an especially difficult task where animals are a reservoir (occurs only in the type common in Asia). Equally important are improved irrigation, drainage, and agricultural practices, which reduce exposure to contaminated waters or eliminate habitat of snails (i.e., slow-moving water). Provision of water for drinking, bathing, and household use, free from cercariae infestations, is also possible. Retaining pools or storage tanks that hold water for 48 hours are effective as a partial intervention. Coagulation and sedimentation are not effective in eliminating the cercariae. Filtration and chlorination, if properly implemented, can be effective. Biological control of snails through natural predators is also possible, but requires extensive preliminary study and monitoring. Because the miracidia and cercariae can swim 5 meters, building “beaches” to limit human access, where appropriate, to about 10 meters.
- Drugs have been available for about 60 years, but generally have had undesirable side effects; new drugs suitable for wide-scale use, however, show promise.

- Even though schistosomiasis is a sanitation deficiency disease, sanitation measures alone have not been effective in curtailing transmission. Because of the large number of eggs produced—hundreds to thousands a day, depending on the species—effective treatment and control require coverage of an entire community. Moreover, urination behavior, especially among 5–20 year olds is difficult to modify. This is complicated by some species of schistosomiasis with maximum egg output in the afternoon when people are most likely to be in contact with water. In general, reduction of snail populations appears to have been the most effective single intervention, coupled with chemotherapy of infected individuals, water supply, sanitation, and hygiene education.

Tetanus

Other names: Lockjaw, infant tetanus, tetanus neonatorum.

- *Description.* Tetanus is an infection of the musculature, which responds to toxic substances produced by the tetanus bacillus. The disease is characterized by painful muscular contractions primarily of the neck muscles (hence the term lockjaw) and, secondarily, of the trunk. In the absence of immunization or treatment, fatality can range from 10–90 percent, depending on the age of the infected individual and the available medical intensive care. Because the tetanus bacillus can only produce its toxin in the absence of oxygen, it is an important source of infection from puncture wounds or superficial wounds with an accumulation of dead tissue. Tetanus occurs worldwide, most commonly in agricultural regions where contact with animal excreta is frequent. In developing countries, infant tetanus commonly results from application of a poultice to the umbilical cord, which is used to close the wound.
- *Transmission.* The tetanus bacillus can live in soil, intestinal canals of animals (especially horses), and also humans. It usually enters the body through a puncture wound contaminated with soil, street dust, or animal feces, but also through burns or scratches or the unhealed umbilical cord of infants. Tetanus has little to do with water quality, because, even if ingested, the toxin produced is not absorbed by the bowel. The disease usually develops within 14 days of exposure. Tetanus cannot be transmitted directly from human to human. Tetanus spores, however, are resistant to drying and high temperatures and even boiling for short periods, which means that, in principle, soil or street dirt can possibly be dangerous for extended periods. The general population is susceptible. Immunization lasting ten years is available, but recovery from tetanus only imparts short-term immunity.
- *Intervention.* Apart from immunization, the greatest interventions fall in the realm of education about treatment of small wounds, burns, puncture wounds, and hygiene. Special education about the need for thorough cleansing of all wounds because tetanus develops where oxygen is absent (i.e., under anaerobic conditions) should be directed to all high-risk groups. This includes midwives and those involved with birth on proper procedures for severing and healing umbilical cords; farmers; and workers in abattoirs and so on, who have frequent small wounds and exposure to animal feces. Provision of adequate supply of water is important as a first-aid means to clean wounds.

Trachoma

- *Description.* Trachoma is one of the leading causes of preventable blindness in the world today. Trachoma is an eye infection causing inflammation of the cornea and conjunctiva, that is, the delicate membrane that lines the inner surface of the eyelids and covers the whites of the eyes. (The name trachoma comes from the Greek for “rough eye.”) If untreated, trachoma can last for years and eventually lead to deformity of the eyelids, impair vision, and eventually cause blindness. Trachoma exists worldwide, generally associated with poor hygiene and crowded living conditions, especially in dry, dusty regions. In endemic areas, up to 3 percent of the population may eventually become blind as a result. The infection tends to increase with a seasonal decrease in water supply.
- *Transmission.* Humans are the reservoir of the disease. Trachoma is spread by direct contact with ocular discharges and possibly with mucous secretions from the nose of infected persons. Indirect transmission also occurs from contact with articles soiled by these discharges, especially by using the same towels, wash basins, and washing water. Flies may contribute to the spread of the disease. Communi-

cability is relatively low, but endures as long as the infection is active and repeated infections appear to be an important factor in transmission. The general population is susceptible, although children are infected more frequently than adults. The severity is related to environmental conditions, such as lack of water and exposure to dry winds; dust and sand appear to act as irritants and contribute to the severity of diseases.

- *Intervention.* Personal hygiene, increased supply of water, and hygiene education are the prime interventions. The availability of water plays a crucial role in short-term perceptible decreases in trachoma.

Trypanosomiasis (African Sleeping Sickness and Chagas' Disease)

Trypanosomiasis: African Sleeping Sickness

- *Description.* African sleeping sickness is a disease transmitted by the tsetse fly. Two main types of the disease exist; one causes anemia and the other is potentially far more serious. Depending on the fly species, symptoms are characterized by fever, intense headache, insomnia, lymph node enlargement, anemia, localized swelling, and rash, which are eventually followed in later stages by body wasting (atrophy), sleepiness (in the West African strain, hence, the name), and disorders of the central nervous system, which can lead to lethargy and mental retardation. This frequently fatal disease can last for several years or cause death within a few weeks or months without treatment. In addition, the fly bite leaves a sore for up to two weeks, which can lead to secondary infections. In endemic areas, as much as 40 percent of the population can be infected. Its occurrence is limited in tropical Africa to between 15°N and 25°S of the equator, according to the distribution of the tsetse fly.
- The disease occurs primarily in rural areas. Specific distribution depends on the fly species and their preferred habitats: riverine areas and savanna. In west and central Africa, this tends to be near streams and, in eastern Africa, in savanna. Males aged 20–40 years show the highest incidence and, because the riverine species bites in the day, are at highest risk of the disease as an occupational hazard of farming. The disease can infect the general population, but women and children who fetch water are at the next greatest risk. In general, the riverine type tends to favor west and central Africa, be spread only through a human-fly-human cycle and is less severe and fatal than the eastern African type. By contrast, in the eastern African type, the flies prefer savanna; cattle and wild animals are important reservoirs. Fly populations tend to decrease in dry seasons, but people tend to gravitate closer to streams and water sources also in dry seasons, bringing them into closer contact with the flies. Normally, the disease is not present on flat plains or closely cultivated areas, probably because of disruption of the fly habitat, that is, the flies deposit their larvae in soil underneath shrubs and adults use shrubs as resting points. In general, incidence of human trypanosomiasis appears to have decreased. This may be a result of a shift of population from rural to urban areas and increase in agriculture, which destroys the fly larvae. The disease is not considered a major public health problem in Africa, except in pockets. In contrast, the disease is considered a major hurdle to development of a livestock industry, due to the different species of tsetse fly that share the same habitats. Apart from its economic effects on agricultural development, it affects human health by hampering production of animal protein, milk, and dairy products, which otherwise must be imported.
- *Transmission.* Humans, wild game, domestic animals are the reservoirs. (The importance of animal reservoirs, however, depends on the fly species.) The disease is transmitted in a cycle through the bite of an infective tsetse fly, which is itself infected when it bites an infected human or animal. The flies hunt by sight and are attracted by dark moving objects. High-risk groups are those working with livestock and those fetching water. Once infected, a process that takes about 3 weeks, the fly remains infected for its lifetime, about three months. In an endemic area, the percentage of infected flies is generally less than 5 percent. Transmission can also occur as a direct mechanical transfer of blood by any insect, for example, horse fly, from one infected person directly to another. Depending on the species, the disease develops in humans within 2 to 3 weeks, but may take several months or even years. Individuals and animals with the disease are communicable normally for the duration of the infection, which varies greatly, as long as the parasite is present in the blood. The general population is susceptible. Seasonal migration of animals in search of water and vegetation (transhumance) contributes to the spread.

- *Intervention.* Destruction of tsetse fly habitat is the major intervention, that is, brush clearing along streams near villages and application of insecticides. Where possible, relocation of population to areas not infested with the flies is a potential intervention, but not always practical. For the riverine species, an approach is to create an area of access to water or passage around water that is free of flies, for example, a stretch of land about 730 meters long and 45–135 meters wide. The savanna species are more difficult to eradicate. In addition, education about transmission and recommended precaution against fly bites would also be included.

Trypanosomiasis: Chagas' Disease (American)

- *Description.* Chagas disease is an acute infection that generally occurs in children, but can also be a chronic condition manifested later in life. Approximately 75 percent of cases are younger than 21 years old. The acute stages consist of variable fever, malaise, infection of the lymph glands, and enlargement of the liver and spleen; inflammation of the site of initial infection (chagoma) may last up to eight weeks. Symptoms can develop into life-threatening complications, involving the heart and inflammation of the brain. Chronic symptoms cause dilation of the heart and enlargement of the esophagus and colon. Chagas' disease is confined to the Western Hemisphere, especially in rural Mexico and Central and South America. It is endemic in twenty-one countries. Of these, after several years without symptoms, about 27 percent will probably develop chronic, severe Chagas' disease with cardiac manifestations that may be fatal. Others may develop a form of the disease involving the digestive or nervous system. In some areas, chronic Chagas' disease accounts for 10 percent of adult mortality. In endemic areas, around 15 percent of the population may be infected. It tends, however, to be most common in rural areas, poverty groups, and families living in thatched or adobe huts, which provide an excellent habitat for the cone nose bug, which spreads the disease.
- *Transmission.* The disease is spread by a blood-sucking cone nose bug and has numerous reservoirs: infected humans, domestic and wild animals (dog, cat, pig, guinea pig, bat, house rat, wood rat, fox, opossum, and armadillo). The bugs defecate when feeding; their feces transmit the disease by contaminating the eye, mucous membranes, abrasions, and wounds, including the bite wound itself, the most common point of entry. Cone nose bugs tend to bite at night. The disease develops within two weeks after the bite. The bugs become infective within a month after biting an infected host and remain so for life (about two years). All ages are susceptible, but the young are more severely affected.
- *Intervention.* Elimination of insects from dwellings through insecticides or physical repair (they like to hide in small crevices), use of bed nets, and education concerning cycle of transmission are all recommended interventions. The cost of physical repair to poor housing, however, makes this potential solution difficult. No drugs have yet proven their value as a curative or preventive measure.

Tuberculosis

Other names: TB, Koch's disease, Pthisis

- *Description.* Tuberculosis is a chronic infection with most serious repercussions in the lungs, characterized by cough, fatigue, fever, weight loss, hoarseness, chest pain, and coughing up blood. Symptoms often do not become apparent until TB has already reached a severe stage. (Other forms of tuberculosis can involve meningitis, blood formation, bones, joints, eyes, lymph nodes, kidneys, intestines, larynx, skin, or abdominal membranes, but these forms are much less common.) TB is actually a quite common infection, but most healthy people overcome it without ill effects through natural resistance. TB occurs worldwide and has, until recently, had a downward trend in industrialized countries. Since the 1980s, because of AIDS, cases have again increased among population groups with a high prevalence of HIV infection. Incidence is usually higher in cities than rural areas. Severity of infection and subsequent mortality is higher among the poor and in males more than females, and increases with age. European TB began to decline before the discovery of the TB bacillus and effective drugs to combat it, hence, the disease is related to general improvements in living conditions. TB's socioeconomic significance stems from the fact that in developing countries, 80 percent of the cases occur in the most productive age groups (15–59 years) and accounts for more than one-fourth of avoidable adult deaths

within this group. Because of the AIDS epidemic, the number of TB deaths is increasing rapidly, particularly in Sub-Saharan Africa.

- *Transmission.* Humans are the major reservoir; in some areas, infected cattle and their raw milk can spread TB. Transmission occurs through exposure to tubercle bacilli from droplets of an infected person by coughing, spitting, sneezing, laughing, and talking. Prolonged household exposure among family members may lead to infection. Indirect transfer from soiled personal articles may also occur, but this is of lesser importance. (Bovine tuberculosis in humans usually results from drinking unpasteurized milk from tuberculous cows and, sometimes, is spread through the air to farmers or animal handlers.) TB bacilli are resistant to drying, but susceptible to sunlight, hence, dark, dusty rooms promote their spread. TB usually develops within 3 months of exposure; progressive cases sometimes take years. Infected individuals remain contagious as long as the infection is active, which can last intermittently for years. With treatment, communicability is generally reduced within weeks. The general population is susceptible. Incidence is highest in children younger than three years, is lowest later in childhood, then increases in adolescents and young adults. Undernourished persons or persons suffering from a variety of other chronic illnesses are especially susceptible.

Recently, air transportation has been implicated in TB transmission, because of prolonged close exposure; however, evidence is still inconclusive; a low likelihood of transmission in this way is possible.

- *Intervention.* Reduction of overcrowding and improvements in ventilation, nutrition, and general living conditions are the main preventive intervention. Screening (i.e., lab sputum tests) for active cases and follow up for treatment and immunization of family members are also necessary for effective elimination of the disease. An easy and effective skin test is available that has helped identify carriers. About 75 percent of cases must be treated before disease transmission can be sufficiently interrupted to reduce incidence in a community. Control of cattle industry and processing of dairy products where appropriate is also important. Education includes the importance of personal hygiene and household ventilation.
- If air transport is implicated, provisions are needed to prevent and follow up documented cases.

