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Recommendations of the International Task Force for Disease Eradication

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Foreword

CDC is proud by means of this publication to make available in one place all the recommendations of the International Task Force for Disease Eradication. My immediate predecessor as Director of CDC, Dr. William Roper, CDC's Deputy Director Dr. Walter Dowdle, and many other CDC professional staff participated in the deliberations of the Task Force. In addition, this project illustrates the close collaboration between CDC and our colleagues at The Carter Center of Emory University.

This systematic review of diseases as possible candidates for eradication is an important follow-up to the successful eradication of smallpox in 1977, a campaign that ranks among the finest achievements of CDC, in conjunction with other organizations. The World Health Organization has now targeted two other diseases for eradication. Dracunculiasis (Guinea worm disease) is scheduled to be eradicated by the end of 1995 and poliomyelitis by the end of the year 2000. The substantial progress already evident toward achieving these two goals confirms the wisdom of the Charles A. Dana Foundation in making a grant in 1988 to establish the secretariat of this Task Force. In addition to endorsing the two targets of dracunculiasis and poliomyelitis eradication, the Task Force has helped to chart logical next steps for humankind's use of the powerful weapon of eradication. It has done this by identifying four other diseases as potential long-term targets for eradication—rubella, mumps, cysticercosis, and filariasis—and by establishing clear criteria that can be used in an ongoing process of evaluation of candidate diseases and conditions in the light of new discoveries.

As the world gains more confidence with successful disease eradication campaigns, I hope we shall have the courage and foresight to embrace other appropriate targets for eradication and work diligently to achieve them.

David Satcher, M.D., Ph.D.

THE INTERNATIONAL TASK FORCE FOR DISEASE ERADICATION

Members

Edward Andrews, Jr., M.D.
The Charles A. Dana Foundation
(Alternate: Stephen Foster)

Dr. Sune Bergstrom
Swedish Academy of Sciences

Ralph H. Henderson, M.D., M.P.H., M.P.P.
Task Force for Child Survival and Development (WHO) (Alternate: Ciro de Quadros, M.D.)

Terrel Hill, Ph.D.
Task Force for Child Survival and Development (UNICEF) (Alternate: Newton Bowles)

Robert S. Lawrence, M.D.
Task Force for Child Survival and Development (Rockefeller Foundation) (Alternate: Dr. Scott Halstead)

Adetokunbo O. Lucas, M.D.
Carnegie Corporation of New York and Harvard School of Public Health

Anthony Measham, M.D.
Task Force for Child Survival and Development (The World Bank)

William L. Roper, M.D., M.P.H.
CDC (Alternate: Walter R. Dowdle, Ph.D.)

Timothy Rothermel
Task Force for Child Survival and Development (United Nations Development Program)

Yusuke Tada, M.D.
Japan International Cooperation Agency

Samuel Thier, M.D.
Institute of Medicine and Brandeis University

CONSULTANTS

Andrew Arata, Ph.D.
Vector biology and control (Chagas' disease)

George M. Baer, D.V.M., M.P.H.
CDC (Rabies)

Paul A. Blake, M.D., M.P.H.
CDC (Cholera)

Robert T. Chen, M.D., M.A.
CDC (Diphtheria)

Steven L. Cochi, M.D.
CDC (Rubella)

Joseph Davis, M.D.
CDC (Neonatal tetanus)

Michael S. Deming, M.D., M.P.H.
CDC (Neonatal tetanus)

John Duffy, M.D.
National Hansen's Disease Center (Leprosy)

Brian O. L. Duke, M.D., Sc.D.
Armed Forces Institute of Pathology (Onchocerciasis)

Anne Gershon, M.D.
Columbia University (Varicella/zoster)

Roger I. Glass, M.D., M.P.H., Ph.D.
CDC (Rotavirus)

Ralph H. Henderson, M.D., M.P.H., M.P.P.

Donald R. Hopkins, M.D., M.P.H.
The Carter Center (Dracunculiasis, mumps, ascariasis, hookworm, amebiasis, clonorchiasis, enterobiasis, Bartonellosis)

Glen Maberly, M.D.
Emory University (Iodine deficiency)

Harold S. Margolis, M.D.
CDC (Hepatitis B)

Dr. Andre Meheus
World Health Organization (Yaws and endemic syphilis)

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Recommendations of the International Task Force for Disease Eradication

Summary

This report summarizes the conclusions of the International Task Force for Disease Eradication (ITFDE), a group of scientists who were convened by a secretariat at the Carter Center of Emory University six times during 1989–1992. The purpose of the ITFDE was to establish criteria and apply them systematically to evaluate the potential eradicability of other diseases in the aftermath of the Smallpox Eradication Program. The ITFDE defined eradication as "reduction of the worldwide incidence of a disease to zero as a result of deliberate efforts, obviating the necessity for further control measures."

The names of the members of the ITFDE, the criteria they developed and used, and summaries of the papers that were presented to the ITFDE by various experts are included in this report, as well as a brief history of the concept of disease eradication since the late 19th century. The ITFDE considered more than 90 diseases and reviewed 30 of these in depth, including one noninfectious disease. It concluded that six diseases—dracunculiasis, poliomyelitis, mumps, rubella, lymphatic filariasis, and cysticercosis—could probably be eradicated by using current technology. It also concluded that manifestations of seven other diseases could be "eliminated," and it noted critical research needs that, if realized, might permit other diseases to be eradicated eventually. The successful eradication of smallpox in 1977 and the ongoing campaigns to eradicate dracunculiasis by 1995 and poliomyelitis by 2000 should ensure that eradication of selected diseases will continue to be used as a powerful tool of international public health.

INTRODUCTION

This issue of

outcome" was the impetus that the members of the ITFDE gave to initiating a demonstration project to control intestinal parasites among schoolchildren in Ghana.

A SPECTRUM OF DISEASE CONTROL

Between the extremes of disease "control" (reduction in incidence and/or prevalence) and "eradication," several intermediate levels of impact on diseases may be described. The term "elimination" is sometimes used synonymously with "eradication," but it refers to a single country, continent, or other limited geographic area, rather than global eradication. True eradication usually entails eliminating the microorganism itself or removing it completely from nature, as in the case of smallpox virus, which now exists only in storage in two laboratories. It is also theoretically possible to "eliminate" a disease in humans while the microbe remains at large, as in the

history of disease eradication over the years have been summarized (Table 2). Contagious pleuropneumonia of cattle, a disease that had been imported into the United States in 1843, was declared eradicated from the country in 1892, following a 5-year, $2-million campaign to identify and slaughter infected animals (*13*).

The Rockefeller Foundation began campaigns to eradicate hookworm in 1907 and yellow fever in 1915. Both these campaigns against diseases of humans failed: the hookworm campaign because mass treatment of affected populations with anthelmintic therapy reduced the severity of individual infections but rarely eliminated them and thus did not prevent rapid reinfection (*14*); and the campaign against yellow fever because of the previously unknown, inaccessible cycle of disease among nonhuman primates living in forests (*15*). Acceptance of the concept of eradication declined during the late 1920s and early 1930s, after the futility of the eradication of hookworm and yellow fever was recognized.

The concept became popular again in the late 1940s, following the elimination of *Anopheles gambiae* mosquitoes from Brazil and Egypt, the elimination of malaria from Sardinia, reductions in the prevalence of yaws in Haiti, and the introduction of a stable freeze-dried vaccine against smallpox (*13,15*). By 1955, WHO had declared goals of global eradication of yaws and malaria, and in 1958 it adopted the goal of smallpox eradication as well. The yaws campaign failed, partly because persons with inapparent latent cases were not adequately treated, in addition to persons with clinical disease. Many such latent infections relapsed to produce infectious lesions soon

TABLE 1. Criteria for assessing eradicability of diseases and conditions

Scientific Feasibility

- Epidemiologic vulnerability (e.g., existence of nonhuman reservoir; ease of spread; natural cyclical decline in prevalence; naturally induced immunity; ease of diagnosis; and duration of any relapse potential)
- Effective, practical intervention available (e.g., vaccine or other primary preventive, curative treatment, and means of eliminating vector). Ideally, intervention should be effective, safe, inexpensive, long-lasting, and easily deployed.
- Demonstrated feasibility of elimination (e.g., documented elimination from island or other geographic unit)

Political Will/Popular Support

- Perceived burden of the disease (e.g., extent, deaths, other effects; true burden may not be perceived; the reverse of benefits expected to accrue from eradication; relevance to rich and poor countries).
- Expected cost of eradication (especially in relation to perceived burden from the disease).
- Synergy of eradication efforts with other interventions (e.g., potential for added benefits or savings or spin-off effects)
- Necessity for eradication rather than control

after mass treatment teams visited a community. Later, disease-specific control measures were withdrawn prematurely, allowing the infection to reappear in several areas (*16*).

Failure to achieve malaria eradication, after an expenditure estimated at $1.4 billion during the period 1955–1965, brought the concept of eradication into disfavor again (*17*). Resistance of some vectors to insecticides and of some parasites to treatment, the unexpected diversity and tenacity of some vectors, administrative shortcomings, and rising costs were all factors in the decision to abandon the goal of eradicating malaria (*18*). (WHO officially revised the goal to one of control in 1969.) The achievement of global smallpox eradication in 1977 and its official certification by WHO in 1980 did not at first bring about the acceptance of the concept of eradication. Concerns were raised that a new eradication effort might detract from efforts to focus attention on the need for developing comprehensive primary health services, rather than focusing on one or two diseases (*19*). However, several diseases (e.g., schistosomiasis, rotavirus diarrhea, brucellosis, and leprosy) that were then being considered as possible targets for global eradication did not have potential for success given the current technology. Several reports and conferences have considered the potential for eradicating other diseases, of which poliomyelitis, mumps, and rubella were among those most frequently cited (*18,20–23*

1888	Charles V. Chapin urges eradication of tuberculosis (TB).
1892	Contagious pleuropneumonia of cattle declared eradicated from United States after 5-year campaign costing $5 million, begun in 1884.
1896	Rabies eradicated from England.
1901	Gen. William C. Gorgas eradicates yellow fever from Havana.
1907	Rockefeller Foundation establishes Sanitary Commission for Eradication of Hookworm Disease in the United States; eventually stimulates projects in 52 countries.
1915	Rockefeller Foundation establishes Yellow Fever Commission to eradicate that disease, under leadership of Gorgas. Fear of importing yellow fever to Asia via Panama Canal.
1917	Decision to eradicate bovine TB from United States.
1922	Rockefeller Foundation's hookworm campaign begins phasing out after evaluation shows little impact on transmission.
1923	Yellow fever reappears in Brazil after nearly a year's absence.
1928–1929	Other outbreaks of yellow fever in Brazil, including in Rio de Janeiro.
1930	*Anopheles gambiae* mosquito discovered in Brazil.
1933	Yellow fever realized to be widespread in South American forests; search for hidden breeding sites of *A. aegypti* vector reveals its disappearance from cities of coastal Brazil.
1934	Eradication of *A. aegypti* in Brazil is proposed.
1937	Wade Hampton Frost reports human TB is being eradicated in the United States and other countries.

1969	WHO officially changes malaria eradication policy back to malaria control, after expenditure of estimated $1.4 billion during 1955–1965.
1970	Smallpox is eradicated from the Americas.
1975	Europe free of malaria for first time in history.
1977	Smallpox eradicated worldwide.
1978	U.S. goal of measles elimination by 1982 is announced.
1980	Smallpox eradication declared by WHO; International Conference on Eradication of Infectious Diseases held in Washington; India

eradication, elimination, or improved control were also highlighted by the ITFDE in its discussions of the 30 diseases that it considered in depth (Table 3).

Summaries* of the 30 background papers that were presented to the ITFDE appear below. At least two of the papers prepared for meetings of the ITFDE have been published or accepted for publication (*25,26*).

Diseases Targeted for Eradication

Dracunculiasis (Guinea Worm Disease)

Dracunculus medinensis now affects as many as 2 million persons in India, Pakistan, and approximately 16 African countries, where >100 million persons are at risk for the disease (*27*). Persons are infected by drinking water containing immature forms of the parasite. A year later, the female adult worms, each about 1 meter long, emerge through the skin, causing crippling pain that prevents these persons from car-

TABLE 3. Diseases considered as candidates for global eradication by the International Task Force for Disease Eradication

Disease	Current annual toll worldwide	Chief obstacles to eradication	Conclusion

TABLE 3. Diseases considered as candidates for global eradication by the International Task Force for Disease Eradication, cont'd.

Disease	Current annual toll worldwide	Chief obstacles to eradication	Conclusion
Diseases that are not eradicable now			
Ascariasis (roundworm)	1 billion infected; 20,000 deaths	Eggs viable in soil for years; laborious diagnosis; widespread	Not now eradicable
Cholera	Unknown	Environmental reservoirs; strain differences	Not now eradicable
Diphtheria	Unknown	Difficult diagnosis; multiple-dose vaccine	Not now eradicable
Hookworm disease	900 million infected; 60,000 deaths	Laborious diagnosis; adult worms may live 5 years; widespread	Not now eradicable
Leprosy (Hansen's disease)	11–12 million cases	Need for improved diagnostic tests and chemotherapy; social stigma; potential reservoir in armadillos	Not now eradicable
Measles	Almost 1 million deaths, mostly among children	Lack of suitably effective vaccine for young infants; cost; public misconception of seriousness	Not now eradicable
Pertussis (whooping cough)	40 million cases; 400,000 deaths	High infectiousness; early infections; multiple-dose vaccine	Not now eradicable
Rotaviral enteritis	80 million cases; 870,000 deaths	Inadequate vaccine	Not now eradicable
Schistosomiasis (bilharziasis)	200 million infected	Reservoir hosts; increased snail-breeding sites	Not now eradicable
Tuberculosis	8–10 million new cases; 2–3 million deaths	Need for improved diagnostic tests, chemotherapy and vaccine; wider application of current therapy	Not now eradicable
Yellow fever	>10,000 deaths	Sylvatic reservoir; heat-labile vaccine	Not now eradicable
Diseases that are not eradicable			
Amebiasis	500 million cases; 40,000–110,000 deaths	Asymptomatic infections; difficult diagnosis, treatment	Not eradicable
Bartonellosis	Unknown	Asymptomatic infections; difficult diagnosis, treatment	Not eradicable
Clonorchiasis	20 million cases in China alone	Animal reservoir; asymptomatic infections; carrier state	Not eradicable
Enterobiasis	Unknown	Widespread; mild disease	Not eradicable
American trypanosomiasis (Chagas' disease)	15–20 million infected	Difficult diagnosis, treatment; animal reservoirs	Not eradicable
Varicella zoster	3 million cases in USA alone	Latency of virus; inadequate vaccine	Not eradicable

appendages (elephantiasis) from interaction of the parasite with the host's immune system. Many infected persons have no symptoms, and the infection is not fatal.

The impact of this infection and disease has been reduced in several areas by mass treatment of populations with diethylcarbamazine (DEC). DEC also has some adulticide effect. Ivermectin is another effective drug that is inexpensive and easily administered. Some side effects may occur after either drug, which may be administered once a year. Improved tests are needed for detecting and monitoring infection. More data are needed about costs of intervention and the effects of ivermectin mass treatment of onchocerciasis on filariasis in West Africa. This disease may be eradicable by using single doses of invermectin, DEC, and salt containing DEC.

Mumps

Mumps is a viral disease that occurs worldwide and usually affects children (*30*). It is characterized by fever and painful swelling of the parotid salivary glands. Complications may include orchitis, meningitis, and encephalitis, but inapparent infections are common. Spread by direct contact and airborne droplets, mumps is less contagious than measles or varicella. Humans are the only reservoir of this infection, which confers lifelong immunity. The global impact of mumps is unknown but is perceived to be less than that caused by rubella.

Mumps vaccine is highly effective in a single dose when administered after 1 year of age. Most commonly the vaccine is administered in combination with rubella and measles vaccines as MMR vaccine, which requires refrigeration and is administered by injection. Several countries in the Americas, Western Pacific, and Europe include MMR vaccine among the standard group of vaccines recommended for children. Mumps meningitis reportedly disappeared in Cuba following increased vaccination of young children with MMR vaccine. Additional studies are needed to evaluate the impact of mumps (and rubella) in developing countries, as well as the impact of mumps vaccine, including effects of underimmunization (partial suppression of wild virus). The potential synergy of a combined campaign against mumps along with measles and rubella is perhaps the factor most favoring its eradication. Mumps is probably eradicable with MMR vaccine.

Rubella

Rubella causes mild disease when acquired postnatally, but it can cause severe birth defects in at least 20%–25% of infants born to women infected during the first trimester of pregnancy (*31*). It occurs worldwide. Most infections are subclinical, but these do not appear to play an important role in transmission. Little is known of the disease's impact in developing countries, but serologic surveys indicate that most African children are immune to the virus by their tenth birthday. There is no animal reservoir of infection, and this disease is less contagious than rubeola.

The live-virus vaccine is effective in a single dose and is often administered as part of a triple vaccine against measles, mumps, and rubella (MMR), so that its marginal cost is extremely small. Use of the vaccine has reduced or interrupted transmisssion in several countries, including Cuba, Sweden, Finland, and the United States. Immunization strategies include universal vaccination of children and susceptible women of childbearing age. The potential for increasing susceptibility in women by underimmunization of children (partial suppression of wild virus) must be avoided. An increasing

number of countries include MMR vaccine in their routine immunization services. Rubella can be eradicated, and the availability of the MMR combined vaccine has lowered the marginal costs of rubella eradication. More data regarding rubella's impact in developing countries are needed. A strategy that does not inadvertently increase the number of susceptible women should be used.

Taeniasis/Cysticercosis (Pork Tapeworm)

Human beings are the only definitive hosts of *Taenia saginata* (beef tapeworm) and *Taenia solium* (pork tapeworm) (*26*). The beef tapeworm is associated with cattle husbandry; it is the more widespread of the two and is increasing in Europe. Both species are most prevalent in Latin America, Asia, and Africa. Humans are infected by eating inadequately cooked, contaminated beef or pork. The eggs of *T. solium* are also infective to humans, who may develop a life-threatening dissemination of larvae to cause cysts in various tissues. Epileptic seizures are a major manifestation when such cysts occur in the brain. Approximately 50 million persons are infected with both parasites; some 50,000 die of cysticercosis annually.

Effective means now exist for surveillance to identify foci of transmission of *T. solium* and for mass treatment of humans (e.g., praziquantel and niclosamide) to help eliminate such foci. This parasite causes a substantial economic burden to the pork industry. *T. solium* has disappeared gradually from most European countries even without targeted control measures. Research priorities include development of a more sensitive diagnostic test for use in pigs and a better way to identify infected

about 15 years. It is not possible to eradicate hepatitis B now, but it is technically feasible to eliminate its transmission by universal vaccination programs.

Iodine Deficiency Disorders

More than a billion persons are at risk for this noninfectious condition, which is the leading preventable cause of intellectual impairment in the world (*33*). The number of persons affected is unknown, but prevalences of the most severe form, cretinism, often reach 3%–15% in areas where the disease is highly endemic. Goiter and hypothyroidism are other manifestations of the deficiency. The main risk factor involved is exclusive or nearly exclusive consumption of locally grown foods in areas where the soil is deficient in iodine.

Interventions include adding iodine to salt, tea, fish paste, or bread, at a cost of US $0.02–0.04 per person per year for iodized salt. Iodized oil is available in injectable or oral forms. Interventions for iodine deficiency can also be combined readily with interventions for vitamin A and/or iron deficiency. A new assay is available to measure levels of thyroid hormone in samples of blood from a fingerstick. Methods such as iodized salt were used to eliminate iodine deficiency disorders more than 40 years ago in Australia, England, New Zealand, Switzerland, and the United States. Bolivia and Ecuador have almost eliminated the condition. WHO has endorsed a goal of elimina-

eyes, and other tissues. Some microfilariae are taken up from the skin by blackflies to continue the reproductive cycle. About 18 million persons are affected, mostly in Africa (99%), Yemen, and Latin America. Both living and dead microfilariae cause severe itching in the skin and sometimes blindness after many years. Approximately 340,000 persons have become blind from the disease.

Until the 1980s, the main control measure was to use larvicides to kill immature blackflies in rivers. This method has been used effectively by the multicountry Onchocerciasis Control Program to reduce the incidence of the disease in part of West Africa over the past 2 decades, but it is expensive. Since 1987, the drug ivermectin has been provided by the manufacturer free of charge to control programs for treating persons with onchocerciasis. This treatment is effective in a single oral dose, administered once annually; it prevents accumulation of microfilariae in persons at risk. No drug suitable for mass treatment can kill the adult worms in the host's body, and onchocerciasis cannot be eradicated without such a means. The blindness, however, can be eliminated.

Rabies

More than 50,000 persons die of rabies each year, mostly in China and India (*35*). Humans are infected by saliva introduced into wounds by the bite of a rabid wild or domestic animal, usually a dog. Canine rabies is endemic throughout most of Asia, Africa, and Latin America. Rabies also is endemic among some wild animals (e.g., foxes, raccoons, skunks, and bats) in North America and Europe. Rabies is almost always fatal.

Some developed countries have virtually eliminated rabies in humans by mass vaccination of domestic dogs and destruction of stray dogs. This approach is difficult to apply in rural areas of most developing countries, where animals may not be privately owned, destruction may be unacceptable, and such campaigns may be expensive. Some Latin American countries are conducting successful campaigns in cities, however. Attempts are being made to control rabies in wildlife by development of oral vaccines that can be safely distributed in baits. Eradication of rabies is not feasible, primarily because of the extensive, varied animal reservoirs of the virus and the inability to eliminate those reservoirs through available technology. It is possible to eliminate human rabies in urban areas, although the costs and benefits of doing so should be considered.

Trachoma

Trachoma is a chronic inflammatory disease of the eye caused by repeated infection with certain types of *Chlamydia trachomatis,* which often results in blindness (*36*). Approximately 500 million persons are infected worldwide, some 6–8 million of whom have become blind. The disease progresses to blindness in about 5%–20% of the infected population. It is transmitted mainly among children and from them to women, perhaps during child care. Important risk factors include low socioeconomic status and inadequate supplies of water.

Effective interventions include mass treatment with tetracycline ointment, which is effective in the short term. The disease, however, usually returns within 6–12 months to pretreatment levels in a community. Promotion of increased face-washing and surgery of the scarred eyelids to prevent continued damage to the cornea by turned-in

lashes are other interventions. There is need for more research into the costs and benefits of interventions, the epidemiology of various risk factors, and documentation of previous successes in control of the disease. It appears scientifically feasible to eliminate blindness caused by trachoma—but not the infection or agent itself— by a

eradicable, but it could be better controlled through mass chemotherapy and hygiene education of schoolchildren.

Cholera

Cholera, characterized by severe watery diarrhea, dehydration, and high mortality in untreated cases, is caused by the bacterium *Vibrio cholerae* 01 (*39*). Many infections are asymptomatic. Although cholera disappeared from much of the world in the 19th century, the current pandemic of the El Tor cholera biotype has been exacerbated by larger human populations, faster travel, and greater survival in the environment. The disease has appeared in more than 100 countries in the past decade and >70,000 cases were reported to WHO in 1990, but the global prevalence of cholera is unknown. It is associated with unsanitary conditions and may be spread by fecal contamination of food, water, or hands. No effective immunity develops.

There is no known animal reservoir, but foci of the organism are now known to persist for years in aquatic environments in the Gulf of Mexico and eastern Australia. The current vaccine gives only limited protection for several months. Oral rehydration can reduce mortality rates. Antibiotic drugs may shorten the duration of illness and stop excretion of the vibrios. Cholera is not now eradicable, although better control is possible by providing clean water, sanitation, and health education. Priority research needs are to understand the environmental reservoirs better (e.g., how does the organism survive? are there other such foci?) and to understand the molecular basis for differences among strains of *V. cholera*.

Diphtheria

This disease, caused by infection with *Corynebacterium diphtheriae*, is characterized by respiratory obstruction and/or myocarditis as a result of a toxin released by some strains of the bacteria. It is spread by direct contact and airborne droplets (*40*). Less harmful infections of the skin occur more commonly in developing countries. An asymptomatic carrier state may follow infection. In the prevaccine era, diphtheria was a major cause of illness and death in children in urban temperate areas. The global toll is unknown, but cases reported to WHO declined from 77,000 in 1974 to <24,000 in 1988. It is not known if the nontoxigenic strain of diphtheria induces immunity to infection. Humans are the only reservoir.

The vaccine is an antitoxin, which usually is administered as a part of the DTP or DT vaccines, in at least three doses administered by injection at 1-month intervals. Booster doses are also necessary. Widespread use of this vaccine has reduced the incidence of diphtheria in developed and many developing countries. In the United States, fewer than five cases were reported annually during the 1980s. No cases were reported in Sweden for a 24-year period. Recently, DTP vaccine has been used more widely in developing countries. There has been a recent resurgence of this disease in Russia. Diphtheria might be eradicable, but its effects in developing countries and the epidemiologic impact of immunization are not completely understood.

Hookworm Disease

Hookworm infections in humans are usually caused by *Ancylostoma duodenale* or *Necatur americanus*, which together infect an estimated 900 million persons in tropical and subtropical areas (*41*). Local prevalence rates vary from 10% to 90%; they

peak in the later teenage years and among young adults. Infections become clinically important when enough worms are present to cause anemia from loss of blood as a result of the worms, which live in the intestine. About 60,000 persons die of the infection annually, but many infections do not cause symptoms. Hookworm is transmitted when skin comes into contact with moist soil or vegetation that harbors infective larvae hatched from eggs in the feces of an infected person. Adult worms may live 1–5 years. Larvae in soil remain viable for 3–4 weeks. Humans are the only known reservoir of this infection.

Preventive measures and treatment are similar to those for ascariasis, except that wearing shoes also protects against hookworm larvae and administration of iron supplements can reverse the resultant anemia. Sociologic barriers to control include the association of the disease with poverty, poor personal hygiene and defecation practices, and use of human feces as fertilizer—all factors that are difficult but not impossible to change. An attempt to eradicate hookworm in the United States early in the 20th century failed, and there is little or no political support for another attempt. Hookworm is not now eradicable.

Leprosy (Hansen's Disease)

This chronic infectious disease caused by *Mycobacterium leprae* affects an estimated 11–12 million persons worldwide (*42*). Leprosy is usually nonfatal but may be severely disfiguring and disabling, and affected persons are often ostracized. Prolonged contact with an infected person is required for transmission. Wild infected armadillos shed the bacteria into the soil and may transmit the disease from animal to animal.

The introduction of sulfones for chemotherapy in the 1940s was a major breakthrough, although many years of therapy were required for cure. Combination therapy with two to three drugs has had a major impact on the severity of the disease over the past decade. The new drug regimens are shorter but still require 6–24 months of therapy. Resistance of leprosy bacilli to chemotherapeutic drugs is an increasing problem. China, Japan, and South Korea have rapidly reduced the incidence and prevalence of this disease in recent years. India and China established national programs with goals of halting transmission of leprosy by 2000. In 1991, WHO set the goal of eliminating leprosy (defined as incidence <1/10,000 population) worldwide by 2000. This disease is not now eradicable. Impediments include absence of a fast, simple diagnostic test; persistence of organisms, even in treated persons; cost and side effects of drugs; duration of chemotherapy; patient compliance; and the social stigma associated with the disease.

Measles

Almost a million persons, mostly infants and young children, die annually from measles. Especially in Africa, it often leads to death from pneumonia, diarrhea, and malnutrition (*43*). Measles is highly contagious and spreads by airborne droplets exhaled by infected persons up to 2 days before the characteristic rash appears. Persons who recover are immune to reinfection for life. The successful global campaign to improve vaccination levels by 1990 reduced the incidence of measles substantially. A

single injection of vaccine is usually sufficient to confer long-lasting immunity, but to be effective it must be administered after the infant's maternal immunity has waned.

Measles vaccine has been used to reduce the incidence of the disease in the United States, Canada, Cuba, and some European countries, but the disease has not yet been eliminated from any large country. In 1977, the United States established the goal of eliminating measles from the country by 1982. It reduced reported cases to <3000 per year from prevaccine levels of >100 times that number, only to have the disease rebound to 25,000 cases in 1990. European and Caribbean countries plan to eliminate measles by 1995. WHO has established the goal of reducing the global incidence of measles by 90% by 1995. The ineffectiveness of the vaccine for infants at birth or soon after and the high degree of contagion of the infection are the principal barriers to eradication of measles.

Pertussis (Whooping Cough)

This disease, caused by the bacterium *Bordetella pertussis*, occurs worldwide (*44*). It primarily affects infants and young children, with peak incidence in the first 2 months of life, and is characterized by a severe, protracted cough. Globally, pertussis still causes about 40 million cases and 400,000 deaths annually. It is spread from person to person by direct contact and airborne droplets and is highly contagious. Persons who recover are immune. Humans are the only reservoir of the infection.

Pertussis vaccine is part of the combined Diphtheria-Tetanus-Pertussis vaccine (DTP), which is administered by injection and requires three to four doses to be effective. Use of this vaccine has reduced pertussis incidence by more than 99% in the United States since 1940. The high infectiousness of pertussis, the occurrence of much of its impact within the first 2 months of life, and the need to administer at least three doses of vaccine (each dose at 1-month intervals) to achieve adequate protection are major impediments to control. Better control could result from an improved vaccine (e.g., fewer doses, greater efficacy, and safety for adults), improved diagnostic methods, and study of the epidemiology of pertussis in developing countries. If a safe antigen were available for use in adults, researchers could investigate the possibility of protecting infants by booster vaccination of pregnant women. Pertussis is not now eradicable.

Rotaviral Enteritis

Some 80 million episodes of moderate to severe diarrhea and an estimated 870,000 deaths per year are due to rotavirus, which is the most common cause of severe diarrhea in children (*45*). It is found in both developed and developing countries. The virus is spread mainly by the fecal-oral route, but the mode of spread among young children is uncertain. Some infections in India may originate from cattle. Infection appears to protect children against subsequent attacks of severe disease.

Improved hygiene, including handwashing, is the main available mode of preventing spread of the disease. Use of oral rehydrating solution can mitigate clinical effects. An effective vaccine is not yet available for preventing this infection. Priority research needs include development of an effective vaccine, studies of the antigenic diversity of strains of the virus in developing countries, development of an animal model, and

further investigation of mechanisms of immunity. Rotaviral enteritis is not now eradicable.

Schistosomiasis (Bilharziasis)

Most human infections with this debilitating disease are caused by *Schistosoma mansoni*, *S. japonicum*, or *S. hematobium* (*46*). All three parasites, except possibly *S. hematobium*, have important nonhuman reservoir hosts. About 200 million persons are affected in Asia, Latin America, and especially Africa. Infection is usually acquired in childhood, with peak prevalence and intensity among persons 10 to 19 years of age. Untreated, chronic infection may last 3–4 decades. Persons are infected when they enter fresh water sources and larval forms of the parasite penetrate the skin. Such sites are contaminated by egg-bearing feces or urine from infected persons, allowing

vectors in sylvatic settings. A permanent cycle of the virus is maintained in jungle-dwelling primates.

An effective vaccine has been available for more than 50 years, although it must be refrigerated and administered by injection. It is recently being included in Expanded Programmes of Immunization in some African countries, as recommended by WHO. Research to improve the current vaccine would be helpful. More aggressive use of the current vaccine could stop urban yellow fever and reduce epidemics in rural areas. Because of the sylvatic reservoir of infection, however, yellow fever cannot be eradicated.

Diseases that Are Not Eradicable

Amebiasis

Amebiasis is caused by the protozoan *Entamoeba histolytica*, a parasite that usually lives in the large intestine of humans, who are its only reservoir (*49*). Some 500 million persons may be infected worldwide, of whom 38 million may develop serious complications (e.g., liver abcess and colitis); 40,000–110,000 persons may die annually. The disease is associated with specific strains of the parasite that have characteristic enzyme patterns. It is especially prevalent in parts of Latin America, Africa, and Asia. The infection is spread by ingestion of the hardy cysts on food or hands or in contaminated drinking water. Most infected persons are asymptomatic; some may excrete cysts for years.

Diagnosis usually requires examination of fecal specimens by a skilled microscopist. Serologic tests and imaging techniques to detect internal abcesses are also used. Drug therapy can eliminate the parasite in the intestine and other organs, but most such drugs must be administered for several days. Proper disposal of human feces, education of persons at risk, and detection and treatment of infected persons are key interventions. Amebiasis is not now eradicable. Current barriers might be overcome if an effective, safe drug became available that could be administered to large groups in a single oral dose without prior testing. Control would also be facilitated if it can be established that only amoebae from symptomatic persons cause symptomatic disease in others.

Bartonellosis

This bacterial infection (*Bartonella bacilliformis*) is limited to certain mountainous areas of Peru, Ecuador, and Colombia, where it is transmitted by the bite of an infected sandfly (*50*). It also can be transmitted by transfusion of blood from an infected person. Infected persons may harbor the bacterium in their blood for many years. The disease may manifest as severe anemia with fever or as a painful skin eruption accompanied by pain in the muscles and joints. The number of persons affected is unknown, but approximately 40% of cases may be fatal and as many as 5% of populations in areas where the disease is endemic may harbor asymptomatic infections. Humans are the only known reservoir of the infection. Persons may remain infective to sandflies for many years.

The infection is diagnosed by microscopic examination of blood or affected skin or by culturing blood on special media. Treatment requires administration of high doses

of antibiotics for at least 7 days. The risk of sandfly bites can be reduced by appropriate insecticides and other protective measures. This infection is not eradicable.

Clonorchiasis

This infection (caused by the parasite *Clonorchis sinensis*) is endemic in parts of China, Japan, Korea, and Southeast Asia (*51*). More than 20 million persons are infected in China alone. Persons become infected by eating raw or inadequately cooked freshwater fish (e.g., carp species or crayfish). In humans, the parasite lives in the bile ducts, and its eggs are discharged in the feces, sometimes for as many as 30 years. After the eggs are discharged, the parasite must first enter a snail, then a fish as intermediate host. Infection in humans is often asymptomatic, but it can cause abdominal pain, gallstones, and cancer of the biliary tract. Pigs, dogs, cats, and rats are also reservoirs of this parasite. Transmission is most frequent, however, in areas where human feces are used to fertilize fish ponds and where harvested fish are eaten raw.

Diagnosis is made by identifying the eggs in fecal specimens, but the eggs of a similar parasite (*Opisthorchis*) are identical. Serologic testing is also helpful. Drug treatment for 1–2 days is effective. Preventive measures include proper disposal of human feces and thorough cooking or freezing of freshwater fish for at least 5 days. This infection is not eradicable because of the nonhuman reservoir, the many asymptomatic infections of humans, and the fact that some infected persons can shed eggs for decades. Its prevalence could be reduced, as with that of several other infections, by promotion of sanitary disposal of human feces.

Enterobiasis (Pinworm)

Enterobiasis is an extremely common parasitic infection, often of young children, in temperate and tropical countries (*52*). Humans are the only hosts of the infection, which is caused by pinworm, *Enterobius vermicularis*. The tiny adult worms live in the large intestine for ≥90 days. They deposit larvae-containing eggs on or near the anus, where their presence causes itching. Children are infected by putting fingers that have been contaminated from scratching into their mouths or by inhaling and then swallowing the eggs, which may become airborne with household dust. The eggs can remain viable in the environment for approximately 2 weeks. Associated pathology is unusual, but the parasite may cause chronic appendicitis or invade the female genital tract.

Diagnosis is made by identifying the microscopic eggs in scrapings or on adhesive tape that has been pressed to perianal skin. Several anthelmintic drugs are effective when administered in a singe oral dose, but infected persons, their families, and other close contacts usually should be treated simultaneously at least twice, at 2-week intervals. It would be nearly impossible to arouse support for the eradication of this widespread infection, since its clinical effects are usually mild or nonexistent.

American Trypanosomiasis (Chagas' Disease)

Approximately 15–20 million persons in impoverished rural areas of the Americas from Mexico to Chile are infected with the parasite *Trypanosoma cruzi* (*53*). The infection is transmitted by the bite of a triatomine bug ("kissing bug") or by blood transfusion, after which there is a long latent period with few or no symptoms. Manifestations may include swelling of the eyelid, followed by fever and enlargement of

onchocerciasis (or *Haemophilus influenzae* b, for which conjugate vaccines have been licensed).

If the epidemiologic benefits of eradication are not incentive enough, the fiscal rewards may help ensure the concept's acceptability. The United States alone has been recovering its total investment of about $30 million in the global Smallpox Eradication Program every 3–4 months since the early 1970s. Since smallpox was eradicated in 1977, that total investment has been returned to the United States every 26 days. Based on the current rate of progress towards eradication of poliomyelitis, WHO predicts that campaign will "produce [global] savings of half a billion dollars by the year 2000, increasing to U.S. $3 billion annually by the year 2015."

The main obstacle to the concept's current acceptance is that if the concept of eradication is invoked against inappropriate or unattainable targets, it can again be brought into disrepute. The declared targets of "elimination" of neonatal tetanus by 1995 and of leprosy by 2000 are potential examples of such dangers. Care should be taken to reserve use of the terms "eradication" and "elimination" only for carefully chosen diseases that have a high likelihood of being eradicated.

Continued advocacy is required to maintain appropriate consideration of the issues considered and suggestions made by the ITFDE. The Task Force for Child Survival and Development, which includes several key members of the ITFDE, will review updates of this topic annually. If new information or the appearance of new control measures, for example, suggest the need for it, a group may be reconvened to consider other diseases in depth (e.g., *H. influenzae* b) or reconsider diseases that were discussed by the ITFDE. In the interim, the most urgent task for promoting the concept of disease eradication is to ensure the successful eradication of dracunculiasis by 1995 and of poliomyelitis by 2000.

TABLE 4. Diseases targeted for eradication/elimination

1990	Poliomyelitis elimination in Americas [achieved in 1991]
1991	Dracunculiasis elimination in Pakistan [achieved in 1993]
1995	Dracunculiasis eradication
	Poliomyelitis elimination in Europe, Western Pacific
	Measles elimination in English-speaking Caribbean
	Neonatal tetanus elimination
2000	Poliomyelitis eradication
	Measles elimination in Europe
	Leprosy elimination (defined as <1 case/10,000 population)
2007	Elimination of onchocerciasis in the Americas

Acknowledgment

The International Task Force for Disease Eradication (ITFDE) was established in 1988 to systematically review potential candidate diseases for eradication and to provide leadership and advocacy for the concept of eradication where appropriate and useful. The secretariat for the ITFDE was supported by a grant from the Charles A. Dana Foundation to William H. Foege, M.D., M.P.H., then the Executive Director of the Carter Center of Emory University.

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APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication*

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Actinomycosis	Infrequent; worldwide	Found in normal flora of oral cavity	Surgery, prolonged chemotherapy	None	—
Acquired immunodeficiency syndrome	Spreading worldwide; 200,000 deaths/year; 6–8 million infected	Sexual transmission; no natural immunity; difficult diagnosis	Health education, condoms; mitigate infection with azidothymidine (AZT)	High	—
Angiostrongyliasis	Infrequent; Pacific islands, Cuba, E. Africa	Reservoir in snails, slugs, rats	Rat control, cook seafoods	None	—
Anisakiasis	Infrequent; Asia, N. Europe, Latin America	Wide reservoir in marine fish and squid; difficult diagnosis	Avoid eating inadequately cooked marine fish	None	—
Anthrax	Sporadic, occasionally epidemic; worldwide, endemic in parts of Asia, Africa	Viable spores in soil for years, also on animal hides; zoonosis	Immunization, antibiotic treatment, disinfection	Low	—
Arenaviral hemorrhagic fever	Bolivia, Argentina; 300–600 cases reported/year	Wild rodent reservoir; no specific treatment or vaccine	Rodent control; isolation of patient	None	—
Arboviral encephalitis (eastern equine encephalitis (EEE), western equine encephalitis, Japanese encephalitis (JE), St. Louis encephalitis) (also fever)	N. America, parts of Asia (JE)	Reservoirs unknown or widespread in animals	Mosquito control, vaccine for JE, EEE	Low; epidemic economic burden	—

*To determine which diseases could qualify for further consideration by the International Task Force for Disease Eradication (ITFDE), these draft criteria were used to screen 94 infectious diseases listed in the 14th edition of *Control of Communicable Diseases in Man* (Benenson AS, ed. Washington, DC; American Public Health Association, 1985). The preliminary proposed disposition is indicated in the last column of the table under "Comment;" a line (—) means the disease was deemed unsuitable for further consideration by the ITFDE. Note that diseases discussed in the text are not listed here.

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Aspergillosis	Worldwide; uncommon	Reservoir in decaying vegetation; spread by inhalation of airborne spores	Treatment difficult	None	—
Babesiosis	N. America, Europe, rare	Rodent or cattle reservoir	Rodent, tick control; chemotherapy	Low	—
Balantidiasis	Worldwide; low incidence	Reservoir in swine, feces, possibly others; resistant to water chlorination	Sanitation, chemotherapy	None	—
Blastomycosis	Uncommon; Asia, Africa, N. America	Reservoir probably in soil; inhaled	Chemotherapy difficult	None	—
Brucellosis	Worldwide; 200 cases/ year reported in USA	Reservoir in domestic and wild animals; serologic diagnosis	Education, milk pasteurization; chemotherapy	Low	—
Candidiasis	Worldwide	Part of normal human flora	Treatment difficult	None	—
Capillariasis	Philippines; 1,500 cases since 1963; 10% case-fatality rate	Possible reservoir in aquatic birds; life cycle uncertain	Avoidance of raw fish	None	—
Chancroid	Worldwide, especially tropics	Sexual transmission; no immunity; difficult diagnosis	Oral antibiotic treatment for 7–10 days	None	—
Cat-scratch disease	Worldwide; uncommon, usually self-limited	Reservoir in cats; no specific treatment	None	None	—
Chlamydial infections (genital)	Worldwide; common; important cause of infertility	Sexual transmission; most patients asymptomatic; no immunity; diagnosis difficult	Health education; antibiotic therapy	Low	—
Chromomycosis	Worldwide; sporadic	Reservoir in wood, soil, decaying vegetation	Treatment very difficult	None	—

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Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Coccidioidomycosis	Arid parts of Americas	Reservoir in soil; inhalation; most infected persons acquire immunity; occupational exposure; diagnosis by culture and skin test	Outdoor dust control; treatment difficult	Low	—
Cryptococcosis	Sporadic; worldwide, increased incidence related to AIDS	Reservoir in soil, pigeon droppings; difficult diagnosis	Disinfection (chemical); difficult treatment	None	—
Cryptosporidiosis	Probably worldwide	Reservoir in cattle, other domestic and wild animals; fecal-oral transmission; diagnosis by fecal smear or intestinal biopsy	Personal hygiene	None	—
Cytomegalovirus disease	Common; worldwide; severe infection in some infants; some morbidity in infected adults; increased incidence related to AIDS	Humans only known reservoir; many inapparent infections; direct contact with infected secretions; viral shedding in urine or saliva for years; diagnosis by viral isolation, serology	Sanitation, hygiene; no vaccine or treatment	None	—
Dengue fever	Tropical Asia, W. Africa, Caribbean and Central America; periodic epidemics with fatalities	Possible monkey reservoir; homologous immunity; dengue hemorrhagic fever associated with *Aedes aegypti* vector; four serotypes; diagnosis by serology, culture	Mosquito control	Low	—

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Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Campylobacter diarrhea	Causes 5%–14% of all diarrhea worldwide; some traveler's diarrhea	Reservoir in many animals, including pets; diagnosis by stool isolation	Sanitation; oral rehydration, some antibiotics	Low	—
Diphyllobothriasis	N. America, Europe	From inadequately cooked freshwater fish; reservoir also in dogs and bears; diagnosis by fecal examination	Praziquantel treatment	None	—
Ebola-Marburg virus	Some parts of Africa; often fatal	Unknown reservoirs in African animals; person-to-person transmission	Disinfection; quarantine	None	—
Echinococcosis	Asia, America, Africa in association with herd dogs	Diagnosis by microscopy, x-ray, serology; contaminated hands, food, water; wide reservoir in domestic and wild animals	Hygiene, surgery; destruction or mass chemotherapy of dogs	None	—
Fascioliasis	Cattle-raising areas of Asia, Americas, Europe	Reservoir			

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Gonorrhea	Common worldwide; major cause of infertility, abdominal infections (acute)	No nonhuman reservoir; chronic carrier state possible; sexually transmitted; no natural immunity; diagnosis by microscopy	Health education; condoms; chemotherapy limited by wide resistance to penicillin	Low	—
Herpes simplex	Both types common worldwide	Humans only reservoir; direct contact, sexual transmission; long latency; microscopic, serologic diagnosis	Condoms; health education; acyclovir orally or topically	Low	—
Histoplasmosis	Almost worldwide; common focal infections, clinical disease uncommon	Reservoir in dust/soil associated with chickens, bats and starlings; not transmitted person to person; diagnosis by culture, skin test, or microscopy	Disinfection; chemotherapy difficult	None	—
Hymenolepiasis	Cosmopolitan; uncommon cause of disease	Possible reservoir in mice; infections persist for years; many asymptomatic infections; diagnosis by stool smear	Hygiene and sanitation; chemotherapy	None	—
Influenza	Worldwide; major cause of morbidity and mortality; epidemic potential	Animal reservoir suspected; highly infectious by respiratory route; numerous serotypes, shifting; type-specific immunity	Partially effective vaccine; chemoprophylaxis for type A	Moderate	—
Lassa Fever	West and Central Africa; exportation to Europe, N. America; fatal in epidemics	Wild rodent reservoir; natural immunity after recovery; diagnosis by isolation, dangerous	Rodent control; quarantine; disinfection; plasma and ribavirin	Low	—

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Legionellosis	Nearly worldwide cause of acute pneumonia, fever; sometimes fatal	Reservoir in water systems, possibly soil; no person-to-person transmission; diagnosis by isolation or serology	Disinfection of water systems; antibiotic treatment	None	—
Leishmaniasis (cutaneous, visceral)	Extensive sporadic infection in Old and New World; estimated 12 million cases; over 400,000 new cases/year; visceral form sometimes fatal	Extensive wild and domestic animal reservoirs; multiple strains of parasite; immunity after healing; diagnosis by microscopy, serology, or biopsy	Insecticide control of sandfly; destroy animal reservoirs; chemotherapy difficult	Low	—
Leptospirosis	Worldwide zoonosis; low fatality rate; hazard in occupations with animal contact	Extensive reservoirs in wild and domestic animals; many serotypes; diagnos			

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Lymphocytic choriomeningitis	Uncommon, localized infection	Mice, hamster reservoir; asymptomatic infections; diagnosis by viral isolation, serology	Sanitation and hygiene	None	—
Lymphogranuloma venereum	Worldwide, especially tropical, subtropical	Humans only reservoir; sexually transmitted, often asymptomatic, very chronic; diagnosis by microscopy, serology	Condoms; 2 weeks of oral antibiotics	None	—
Malaria	Mainly tropical; 1–2 million deaths/year	Humans main reservoir; relapses, asymptomatic infections; multiple strains; diagnosis by microscopy	Chemotherapy (resistance); vector control (resistance); chemoprophylaxis (resistance)	High	Legacy of failed campaign
Melioidosis	Asia, Africa, Americas; uncommon	Reservoir in some soil and water; various animals; often asymptomatic; relapses; diagnosis by isolation, serology	Chemotherapy	None	—
Meningococcal mening					

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Infectious mononucleosis (Epstein-Barr virus [EBV])	Common, worldwide; usually mild; same agent (EBV) associated with Burkitt's lymphoma, nasopharyngeal cancer	Humans only reservoir; spread by saliva; convalescent immunity; difficult clinical differential diagnosis; laboratory tests required	Disinfection; reduce malaria to reduce incidence of Burkitt's lymphoma	Low (vaccine would elevate)	—
Nocardiosis	Worldwide; occasional, chronic	Reservoir in soil; transmitted by inhalation; diagnosis by microscopy	Some patients respond to antibiotic therapy	None	—
Paragonimiasis	Extensive in Asia, also parts of Africa, Latin America; chronic effects in lung	Reservoirs in domestic and wild carnivores; no immunity; diagnosis by stool examination, chest x-ray	Avoidance of inadequately cooked crabs; sanitation	None	—
Pediculosis (body lice)	Worldwide, not fatal	Humans only reservoir; spread by direct contact (including sexual)	Health education, hygiene; disinfection of clothing, homes; lotion or powders	None	—
Plague	Focal but worldwide distribution in wild rodents; high fatality rate; sporadic in western USA	Extensive wild rodent reservoir; pulmonary form spreads human to human; fleas infective for months; microscopic diagnosis	Wild rodent and flea control; killed bacterial vaccine; quarantine; antibiotic treatm		

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Psittacosis	Worldwide; sporadic human cases	Apparently healthy carriers in birds; infection by inhalation; serologic diagnosis	Destruction of infected birds; public education; weeks of antibiotic therapy	None	—
Q Fever	Worldwide; epidemics rarely fatal	Extensive reservoir in cattle, sheep, goats; serologic diagnosis	Vaccine; health education; disinfection; antibiotics	None	—
Relapsing fever	Asia, Africa, Americas; endemic fatality rates may be as high as 50%	Epidemic if borne by lice, endemic if by ticks; tick-borne reservoir in wild rodents and ticks; infected ticks can live for years; limited immunity; diagnosis by darkfield microscopy	Personal and environmental vector control; tetracycline treatment	Low	—
Tick-borne rickettsioses (Rocky Mountain spotted fever)	Americas or other, case-fatality rate up to 20%	Reservoir in ticks, dogs, rodents; diagnosis difficult, by serology	Health education, tick control, antibiotic therapy	Low	—
Salmonellosis	Worldwide, cause of diarrhea and sometimes severe infections; common	Wide reservoir in wild b			

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Strongyloidiasis	Widespread in tropics and some temperate areas; autoinfection possible, potentially fatal	Possible reservoir in dogs as well as humans; larvae actively penetrate skin from fecally contam			

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Trichinosis	Worldwide endemic, sporadic occurrences, potentially fatal	Reservoir in mice, rats, dogs, wild animals,; associated with eating poorly cooked pork, wild animal meat	Proper cooking practices, freezing of meat	None	—
Trichomoniasis	Prevalent worldwide, not fatal	Humans only reservoir; sexual transmission; often asymptomatic; diagnosis by microscopy	Health education, condoms; chemotherapy	None	—
Trichuriasis	Worldwide, especially in tropics, usually asymptomatic	Humans only reservoir; microscopic diagnosis	Sanitation and hygiene; chemotherapy	None	—
African trypanosomiasis	Only in tropical Africa; estimated 25,000 cases and 20,000 deaths per year; major problem for domestic livestock	Reservoir in wild game for one of the two types; no immunity; diagnosis by microscopic exam of blood or spinal fluid; serologic diagnosis improved	Chemotherapy improved; brush clearing for vector control; locally made tsetse traps; residual insecticides	Low–moderate	—
Tularemia	N. America, Europe, USSR, Japan; contact with wild animals	Extensive reservoir in wild animals; transmission by direct contact, inhalation, or tick bite; immunity; diagnosis by serology or culture	Gloves; live vaccine, antibiotic therapy, education	None	—
Typhoid fever	Worldwide; fatality rate up to 10%, 25,000 deaths/year	Human asymptomatic carrier state; drug-resistant strains; diagnosis by blood culture	Hygiene, water, sanitation; antibiotic therapy; partly effective vaccine	None	—

APPENDIX 1. Diseases screened for potential eradicability by the International Task Force for Disease Eradication

Disease/condition	Extent of problem	Epidemiologic vulnerability	Intervention(s) available	Political will	Comment
Epidemic louse-borne typhus	Mountainous cooler regions of Latin America, Africa, Asia; case-fatality rate 10%–40%	Zoonosis of flying squirrels in USA; asymptomatic cases; relapses after years; difficult serologic diagnosis	Chemical delousing, personal hygiene; immunization, antibiotic therapy	None	—
Murine typhus	Worldwide; milder than louse-borne typhus; in association with mice	Reservoir in rats; other wild or domestic animals may be infected	Rat, mouse control; insecticides against flea vectors, antibiotics	None	—

The