Combating Tropical Infectious Diseases: Report of the Disease Control Priorities in Developing Countries Project

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(See the editorial commentary by Keusch on pages 879–80)

Infectious diseases are responsible for >25% of the global disease toll. The new Disease Control Priorities in Developing Countries Project (DCPP) aims to decrease the burden of these diseases by producing science-based analyses from demographic, epidemiologic, disease intervention, and economic evidence for the purpose of defining disease priorities and implementing control measures. The DCPP recently reviewed selected tropical infectious diseases, examined successful control experiences, and defined unsettled patient treatment, prevention, and research issues. Disease elimination programs against American trypanosomiasis (Chagas disease), onchocerciasis, lymphatic filariasis, leprosy, trachoma, and measles are succeeding. Dengue, leishmaniasis, African trypanosomiasis, malaria, diarrheal diseases, helminthic infections, and tuberculosis have reemerged because of inadequate interventions and control strategies and the breakdown of health delivery systems. Application of technologies must be cost-effective and intensified research is essential if these and other scourges are to be controlled or eliminated in the 21st century.

Among all diseases, infectious and parasitic diseases remain the biggest killers, and they account for one-fourth of the global burden of disease [1, 2]. The African, Southeast Asian, and eastern Mediterranean regions (as defined by the World Health Organization [WHO]) are most heavily burdened by these perils (table 1). Through an unprecedented level of international cooperation and the employment of new tools for diagnosis, patient treatment, and vector control, the prevalence of lymphatic filariasis, dracunculiasis, onchocerciasis, trachoma, Chagas disease, and leprosy has decreased to levels at which these diseases may soon be eliminated [3]. Simultaneously, breakdowns in public health infrastructures and the lack of cost-effective interventions have allowed African trypanosomiasis and dengue to reemerge [4].

The Disease Control Priorities in Developing Countries Project (DCPP) is a new partnership of the Fogarty International Center of the National Institutes of Health (NIH), WHO, and the World Bank; the DCPP is producing science-based analyses derived from demographic, epidemiologic, intervention, and economic evidence to inform health policy-making and to improve disease-control programs in developing countries. The DCPP is funded by the Bill & Melinda Gates Foundation and will produce a greatly expanded second edition of a book on establishing disease priorities and implementing control measures in low-income countries [5].

A workshop focusing on tropical infectious diseases was held in Rio de Janeiro at the Fundacão Oswaldo Cruz (FIO-CRUZ) from 28 April through 1 May 2003. The objectives of this workshop were to review national disease priority-setting processes and the formulation of health and research policies and programs, to examine successful and unsuccessful tropical infectious diseases control and

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elimination experiences, to define controversial and unsettled issues, and to prioritize research.

DISEASE CONTROL, ELIMINATION, ERADICATION, AND EXTINCTION

"Control" is defined as the reduction of disease incidence, prevalence, morbidity, or mortality to an acceptable level, as determined by the country or area in question. "Elimination" is defined as the reduction of disease incidence to zero in a defined geographic area; elimination requires ongoing public health measures to prevent disease reemergence. "Eradication" is defined as the reduction of disease incidence to zero; intervention efforts are no longer required. Table 2 indicates the disease targets for possible elimination and eradication [3]. "Extinction" is defined as the eradication of the pathogen and the destruction of all laboratory isolates. Commitment to disease control, elimination, or eradication depends on the pathogen's biology and requires the political will and resources to maintain gains once they have been achieved.

PRIORITY SETTING: THE TROPICAL DISEASE RESEARCH EXPERIENCE

The United Nations Development Programme/World Bank/WHO Special Programme for Research and Training in Tropical Disease Research (TDR) was created in 1975 to develop improved and new disease-control tools for 10 diseases and to strengthen the research capabilities of affected countries. TDR promotes use-inspired basic (and applied) research and cost-effective interventions for the control of neglected diseases [6, 7]. TDR groups the 10 diseases into 3 categories on the basis of whether the disease burden is (1) emerging or uncontrolled and lacking effective interventions, (2) persisting despite available (but variably effective) strategies, and (3) decreasing as a result of effective and applied control strategies.

Estimates using disability-adjusted life years (DALYs, an aggregate measure of premature mortality, morbidity, and disability) show that several types of infectious diarrhea and the soil-transmitted helminth infections (e.g., hookworm) outrank many of the infections in the TDR disease portfolio [8, 9]. Table 3 indicates that almost all of the individual infectious

and parasitic disease burden falls most heavily on Africa, Southeast Asia, the eastern Mediterranean, and the western Pacific (as those regions are defined by the WHO). Recent research advances include the successful testing of artemisinin-based drug combinations for treating malaria, the registration of oral miltefosine for treating visceral leishmaniasis, the use of prepackaged antimalarial drugs, and the development of evidence-based guidelines intended to eliminate lymphatic filariasis using drug combinations. There is great optimism for development of newer antimalarials and vaccines that use the recently sequenced genomes of major tropical pathogens and their vectors [10].

ESTABLISHING NATIONAL PRIORITIES USING DEMOGRAPHIC, EPIDEMIOLOGIC, POLITICAL, AND ECONOMIC DATA

Demographic surveillance systems. The inadequacy of in-country data is being remedied through Demographic Surveillance System (DSS) surveys, now functioning in 30 locations in 13 sub-Saharan African countries [11]. The DSS maintains continuous monitoring of demographic

Table 1. Disease burden, worldwide and by region, 2001.

Region	Population in thousands (%)[a]	DALYs		
		For all diseases, no. in thousands (%)[b]	For infectious and parasitic diseases, no. in thousands (%)[b]	For infectious and parasitic diseases, %[c]
Africa	655,476 (10.7)	357,884 (24.4)	189,047 (55)	53
Southeast Asia	1,559,810 (25.5)	418,844 (28.5)	93,995 (22)	26
Eastern Mediterranean	493,091 (8.1)	136,221 (9.3)	34,741 (26)	10
Western Pacific	1,701,689 (27.8)	257,868 (17.6)	23,163 (9)	6
The Americas	837,967 (13.7)	145,217 (9.9)	12,555 (9)	3
Europe	874,178 (14.3)	151,223 (10.3)	5,876 (4)	2
Total worldwide	6,122,210 (100)	1,467,257 (100)	359,377 (24)	100

NOTE. Adapted from [2]. Infections of the lower and upper respiratory tract and otitis media, pertussis, poliomyelitis, diphtheria, tetanus, meningitis, and hepatitis B and C are not included in the data. DALYS, disability-adjusted life years.

[a] Percentage of total worldwide population.
[b] Percentage of total worldwide DALYs for all diseases.
[c] Percentage of total worldwide DALYs for infectious and parasitic diseases.

Table 2. Candidate diseases for elimination or eradication.

Noninfectious conditions
    Folic-acid–preventable spina bifida and anencephaly
    Iodine deficiency
    Iron deficiency
    Vitamin A deficiency
Infectious diseases
  Bacterial
    Congenital syphilis
    Diphtheria
    Haemophilus influenzae type B
    Leprosy[a]
    Neonatal tetanus
    Pertussis
    Trachoma[a]
    Tuberculosis[a]
  Parasitic diseases
    Chagas disease (American trypanosomirasis)[a]
    Lymphatic filariasis[a]
    Onchocerciasis[a]
    Schistosomiasis
  Viral diseases
    Hepatitis B
    Measles[a]
    Rubella and congenital rubella syndrome
    Yellow fever

NOTE. Adapted from [3].

[a] Indicates a disease considered during the Disease Control Priorities in Developing Countries Project Tropical Infectious Diseases Workshop, Fundacão Oswaldo Cruz, Rio de Janeiro, 28 April–1 May 2003.

and disease data by enumerating denominator populations at household visits, reporting numerator vital events continuously, and determining cause of death through verbal autopsy. In Tanzania, the DSS produces years-of-life-lost data by age, sex, and disease causes. These data are simplified into profiles of the disease burden addressed by each intervention [12]. To determine whether district priorities are reflected proportionately in their resource allocations, a computer-based tool was developed. The majority of districts allocated resources equally across all diseases and interventions rather than on the basis of disease burden. Among the essential interventions, malaria, integrated management of childhood illness, and tuberculosis (TB) were underprioritized, and the expanded program on immunization, HIV, and Safe Motherhood received priority consistent with the measured burdens of disease. The cost of producing DSS data in Africa is $0.01 per capita per year.

Role of multilateral banks. The world's development banks are now increasing their attention to and resources for tropical infectious disease priorities and are using the report of the WHO Commission on Macroeconomics and Health, the World Bank World Development Indicators, and the United Nations Millennium Development Goals to establish epidemiologic baselines, operational targets, and frameworks for long-term financing [13, 14]. By increasing the annual international expenditure on tropical infectious diseases to $26 billion by 2007 and $46 billion by 2015, there could be a two-thirds reduction in annual number of deaths due to tropical infectious diseases and a great reduction in extreme poverty by 2020. There is increasing coordination between development banks and donors and increasing initiation of new funding mechanisms for health programs (including the Global Fund for AIDS, Malaria, and TB, which aims to generate $8 billion annually by 2007; a Global Health Research Fund is projected to disburse $1.5 billion per year) [13].

TROPICAL DISEASES WITH EFFECTIVE CONTROL MEASURES

Chagas disease. Despite impressive reductions of Chagas disease transmission by vectors and transfusions in the southern cone of the Americas, 12 million patients remain in Central and South America [15]. Twenty percent to 30% of infected individuals develop chronic cardiomyopathy, and as many as 10% develop digestive tract disease (including megacolon). The elimination of Chagas disease transmission has been achieved in several countries by control of the *Triatomine* vector using pyrethoid insecticide spraying and serological screening of blood donors. In Brazil, the control program cost $516 million dollars between 1975 and 1995, of which 78% was for vector control and 4% for housing improvement. Prevention of 277,000 infections and 85,000 deaths translated into savings of 1,620,000 DALYs—41% from deaths prevented and 59% from disabilities prevented. A cost-benefit analysis showed that each $1.00 spent on vector control and blood donor screening in Brazil resulted in $2.01 and $0.19 of savings, respectively [15, 16].

Onchocerciasis. Eighteen million people are infected with onchocerciasis,

and 750,000 are blind or severely visually impaired as a result of onchocerciasis infection. The infection occurs in 37 countries, with 99% of the disease burden in sub-Saharan Africa [17]. There are 3 regional control programs: the successful Onchocerciasis Control Program in West Africa (OCP) (which closed in 2002), the newer African Program for Onchocerciasis Control (APOC), and the Onchocerciasis Elimination Program for the Americas. Although the OCP was founded on the concept of vector control, ivermectin (Mectizan, donated by Merck), a safe and potent microfilaricidal drug, is the mainstay of all 3 programs. Over 35 million persons covered by the OCP in its 11 countries are free from infection, with >250,000 cases of blindness prevented and 25 million hectares of land free for reset-

tlement. APOC is a partnership of ministries of health, Merck, the WHO, the World Bank, and numerous nongovernmental organizations that began in 1995 in 19 non-OCP countries in which onchocerciasis is endemic. The systems developed for mass distribution of ivermectin can apply to other mass treatment programs [18]. Research is addressing possible ivermectin resistance and the development of new drugs, diagnostics, predictive models, and heath systems.

Lymphatic filariasis. Approximately 120 million people in tropical and subtropical parts of the world are infected with lymphatic filariasis, of whom 90% harbor *Wuchereria bancrofti* [19]. The Global Program to Eliminate Lymphatic Filariasis (GPELF), begun in 1997, is supported by >35 partners and is active in 43

of the 80 countries worldwide in which lymphatic filariasis is endemic. GPELF strategies include treatment of at-risk populations with drugs to interrupt transmission by suppressing circulating microfilariae and reduction of secondary bacterial and fungal infections contributing to genital and limb deformities (elephantiasis) by improved hygiene, self-care, and therapy. It is cost-effective to link filariasis programs with other programs that use population-based chemotherapy. Studies conducted in India and Papua New Guinea indicate that elimination of lymphatic filariasis is feasible and cost-effective [20]. The $100 million needed to cover 350 million filarial-exposed people by the year 2005 can save $2 billion in patient treatment costs and reduced working time annually. Research has resulted

Table 3. Infectious and parasitic diseases burden, worldwide and by region, 2001

Disease	Disease burden worldwide, DALYs in thousands (%)[a]	Disease burden by region, %[b]					
		Africa	Southeast Asia	East Mediterranean	Western Pacific	The Americas	Europe
HIV/AIDS	88,429 (6.0)	65.0	15.4	1.9	2.2	3.1	1.0
Diarrheal disease	65,451 (4.3)	32.9	34.2	16.5	6.3	4.3	1.3
Malaria	42,280 (2.9)	85.2	8.7	4.8	1.0	0.3	0.1
Tuberculosis	36,040 (2.5)	24.8	44.3	8.3	15.3	2.6	4.7
Measles	26,495 (1.8)	57.1	26.1	11.5	4.4	0.0	0.9
Sexually transmitted disease[c]	12,404 (0.8)	41.4	34.8	10.7	5.1	5.1	2.9
Lymphatic filariasis	5,644 (0.4)	34.2	49.6	8.7	7.2	0.2	0.03
Trachoma	3,997 (0.3)	38.2	6.2	15.1	40.6	0.0	0.0
Leishmaniasis	2,357 (0.2)	17.0	67.3	11.8	1.1	2.5	0.3
Hookworm disease[d]	1,825 (0.1)	23.3	45.7	9.0	13.6	8.2	0.0
Schistosomiasis	1,760 (0.1)	80.6	0.2	11.5	2.9	10.4	0.0
Trichuriasis[d]	1,649 (0.1)	7.5	26.0	2.2	46.6	17.7	0.0
African trypanosomiasis	1,598 (0.1)	97.4	0.0	2.5	0.0	0.0	0.0
Ascariasis[d]	1,181 (0.1)	10.2	22.8	5.2	46.4	14.6	0.7
Onchocerciasis	987 (0.1)	95.0	0.0	4.7	0.0	0.3	0.0
Japanese encephalitis	767 (0.1)	0.0	45.2	10.6	44.3	0.0	0.0
Dengue	653 (0.0)	0.9	55.1	13.0	17.2	13.8	0.0
Chagas disease	649 (0.0)	0.0	0.0	0.0	0.0	99.8	0.0
Leprosy	177 (0.0)	9.0	67.2	9.0	4.0	10.2	0.0
All infectious and parasitic diseases	359,377 (24.5)	52.6	26.2	9.7	6.4	3.5	1.6

NOTE. Adapted from [2]. Infections of the lower and upper respiratory tract and otitis media, pertussis, poliomyelitis, diphtheria, tetanus, meningitis, and hepatitis B and C are not included in the data. DALYS, disability-adjusted life years.

[a] Percentage of total worldwide DALYs for all diseases.
[b] Percentage of total worldwide DALYs for the specified disease.
[c] Includes syphilis, chlamydia, and gonorrhea.
[d] Intestinal nematode infection.

in the development of a sensitive and specific test for filarial antigen, allowing diagnosis from blood samples obtained during the night or during the day.

Leprosy. In 2002, 780,000 cases of leprosy were detected, the majority of which were detected in the Indian subcontinent and Southeast Asia. Since 1985, the number of at-risk countries has decreased from 122 to 14, and the prevalence of leprosy has decreased precipitously; however, since the early 1990s, the incidence has remained constant [21]. Multidrug chemotherapy is efficacious, prevents disabilities, reduces stigma, and is cost-effective. Approximately $30 per patient per year results in $12 per year of healthy life saved. Research continues on in vitro culture of *Mycobacterium leprae,* genetic susceptibility, presence of *M. leprae* in the environment, and possible animal reservoirs. Health systems research is assessing whether multidrug therapy for leprosy can block transmission.

Infectious losses of vision and hearing. Two-thirds of the 45 million cases of blindness in the world are preventable, and 90% of all cases of blindness occur in the developing world; the major causes are cataract (42%), trachoma (16%), and glaucoma (15%). Trachoma is a major health problem for mothers and children in impoverished areas. The prevalence is highest among children aged 1–5 years and women. There are currently 146 million active trachoma infections and 6 million persons blinded due to trachoma, resulting in an annual loss in productivity of $2.9 billion. A new approach by the International Trachoma Initiative proposes to eliminate blinding trachoma by implementing the surgery, antibiotics, face washing, environmental change (SAFE) strategy [22]. Azithromycin (donated by Pfizer) is used for treatment because of its long half-life and good penetration into *Chlamydia trachomitis*–infected cells. In Morocco, Tanzania, and Vietnam, a 50% reduction of follicular trachoma in children occurred after implementation of the SAFE strategy. Research is focusing on improving eyelid surgery and on better use of azithromycin. Chronic serous otitis media is the most common cause of decreased hearing in the developing world.

TROPICAL DISEASES LACKING EFFECTIVE CONTROL MEASURES

Dengue in the Americas. In 1982, the Brazilian Ministry of Health estimated that 11,000 cases of dengue (of serotypes 1 and 2) occurred [23]. From 1990 through 2002, there were an estimated 2.8 million cases of dengue, an increase attributable to a proliferation of *Aedes aegypti* breeding sites, a breakdown in basic health services in some areas, increased urbanization, and complacency. All 4 dengue serotypes are present in Brazil, and dengue hemorrhagic fever is widespread in much of the Americas. Priority research includes work on rapid viral detection by PCR and improved serological tests, understanding the pathogenesis and clinical manifestations of the disease, vector competence, epidemic predictive factors, and vaccine development [24].

Leishmaniasis. Leishmaniasis control is complicated by zoonotic transmission with multiple animal reservoirs and anthroponotic (i.e., human-to-human) transmission, both of which occur through sandfly hosts. Visceral leishmaniasis (VL) is a potentially fatal disease. Anthroponotic VL was responsible for a recent deadly epidemic in The Sudan. Of the estimated 500,000 annual cases of VL, 90% occur in Bangladesh, Brazil, India, Nepal, and The Sudan, as do 90% of the 1.5 million annual cutaneous leishmaniasis (CL) cases [25]. Human migration, deforestation, new irrigation schemes, HIV/AIDS, and famine are associated with the reemergence of VL and CL. Parasitological diagnosis is made on the basis of biopsy results, and treatment requires drugs that are toxic and expensive. Spraying of houses with residual insecticide is difficult to sustain, as is control of animal reservoirs (e.g., dogs, for VL). Recent research has resulted in the development of insecticide-treated bednets, miltefosine, and cheap and reliable serological tests for leishmaniasis [25, 26].

Human African trypanosomiasis. Sixty million people are at risk for human African trypanosomiasis (HAT), particularly in Angola, the Democratic Republic of the Congo, Uganda, and The Sudan. Since 1975, a catastrophic situation has evolved as a result of conflicts in the affected countries, with the prevalence of HAT increasing to levels not seen since the 1920s [27]. Only 37,000 cases were reported to the WHO in 1999, but 300,000–500,000 new cases have occurred since that time. Control of the disease relies on treatment of confirmed cases and active detection in villages; clinical diagnosis is problematic, because screening lacks specificity and parasitological diagnosis lacks sensitivity. The supply of partially effective drugs is dwindling, and the incidence of drug resistance is unknown. Some promise exists for the development of nifurtimox therapy, for which collaboration with industry is essential.

WIDESPREAD MAJOR INFECTIOUS DISEASES

Malaria. A total of 1–3 million malaria deaths and 1–5 billion clinical febrile episodes occur annually in malarious areas [28]; this burden falls most heavily on African children and extracts the greatest economic toll of all tropical infectious diseases (table 1) [2, 7]. Anemia, hypoglycemia, and low birth weight due to placental infection are the major contributors to this disease burden. Drugs, insecticide-impregnated bednets, and integrated vector control are the most cost-effective interventions [29, 30]. Because of the increasing resistance of *Plasmodium falciparum* to drugs and of *Anopheles* to dichloro-diphenyl-trichloroethane (DDT), novel drugs, insecticides, and vac-

cines are sorely needed. The broad research agenda includes development of new diagnostics, drugs, and vaccines, as well as the use of the recent DNA sequence information from the human, *Plasmodium*, and *Anopheles* genomes.

Diarrheal diseases. Assessment of the diarrheal disease burden is difficult because of the multiplicity of agents and transmission modes involved. Three billion to 5 billion episodes of watery diarrhea occur annually, with the highest incidence in children aged 6–24 months. Mortality from watery diarrhea is due primarily to dehydration; since the early 1980s, yearly mortality has decreased from 6 million to <2 million deaths [31, 32]. Dysentery disease accounts for only 5% of diarrheal episodes. Infectious diarrhea control relies on microbial exposure reduction, rehydration, proper diagnostics, and, in the case of dysentery diseases, use of antimicrobials. Major successes in control of diarrheal disease include increases in protected water supplies, in exclusive breastfeeding, and in food safety. Breakthroughs in the prevention of diarrheal disease include the development of selected vaccines, use of nutrition supplementation, and improvements in oral rehydration. Major research needs are for identification of low-cost, low-maintenance water safety systems, improvement of diagnostics, development of new antimicrobials on the basis of genomics, and attainment of a better understanding of the malnutrition-infection-immunity axis [33].

Helminths. The major soil-transmitted helminths (STHs; i.e., ascariasis, trichuriasis, and hookworm) and schistosomiasis account for 40% of the global morbidity from all tropical infections, excluding malaria; helminthiases affect >2 billion persons [8, 34]. Hookworm causes iron deficiency anemia (IDA), and >50% of IDA cases in parts of Africa and Asia are attributable to hookworm. Children aged 5–15 years have the highest prevalence of STH infections (excepting hookworm) and schistosomiasis. The WHO

and World Bank goal is to ensure regular treatment with antihelminthics (i.e., albendazole and praziquantel) of ≥75% of at-risk school-age children by the year 2010. Because of the high rates of hookworm reinfection, the need for development of a vaccine is urgent [35].

TB. The burden of TB is exceeded only by that of lower respiratory tract infections, HIV/AIDS, diarrheal diseases, childhood diseases, and malaria (table 3) [36, 37]. India and China have the most patients with TB. However, a rapid increase in TB-related deaths is occurring in Africa (linked to HIV infection) and the countries of the former Soviet Union [4]. Major interventions include diagnosing and treating active disease to prevent transmission using directly observed therapy, short course (DOTS) and preventing and treating HIV/AIDS. The global target for TB control by 2005 is to achieve a 70% case-detection rate and an 85% cure rate by "going to scale" with national programs. Rapid diagnosis, drug resistance, and drug and vaccine development are research priorities.

Measles. Approximately 98% of the 700,000 annual childhood deaths due to measles occur in low-income countries, especially those in sub-Saharan Africa, central Asia, and India [38]. However, 92% of the estimated $176 million spent on measles vaccine costs is for high and upper-middle income countries. Measles elimination is succeeding in the Americas. Global success will depend on complete vaccination coverage and will cost $3.7 billion.

RESEARCH AND RESEARCH CAPACITY STRENGTHENING

The "10/90 gap" alludes to the fact that 90% of the world's health research dollars address 10% of the disease burden, with that 10% of the disease burden occurring mainly in industrialized nations [39]. To address this imbalance, the Commission on Macroeconomics and Health recommended that ≥5% of all resources

targeted to global health be devoted to "project-related" operational research and at least $3 billion per year be invested in research and development [13]. An international equivalent of the United States' NIH or the United Kingdom's Medical Research Council has been proposed, which would involve a consortium of research agencies from the north and the south, with an emphasis on peer-reviewed, merit-based research and training initiatives [40]. Leadership training in research and program operations in low-income and collaborating countries is essential for long-term maintenance of "scaled-up" programs.

CONCLUSIONS

Recent updates indicate that 10.8 million children die each year, mainly of neonatal disorders (33%), diarrhea (22%), pneumonia (21%), and malaria (9%); >60% of these deaths are preventable [41]. One-half of these deaths occur in 5 African and Southeast Asian countries. Setting health priorities for combating tropical diseases involves defining and quantifying the problem, assessing the efficacy and cost of interventions, and translating these metrics into analyses of cost-effectiveness. Interventions for many diseases can be "bundled" at health facilities or in mass treatment programs [18, 42]. Health management systems must capture and analyze morbidity and mortality trends promptly, determine intervention costs, identify inequities in resource allocation, and track quality of services. Often ignored, good governance and political stewardship are crucial. Research is an essential component of every control program. Without studies demonstrating the benefits of ivermectin for treating onchocerciasis, azithromycin for treating trachoma, and an attenuated vaccine against measles, elimination of those diseases would be impossible. Achieving success is essential to ensuring increased support for expanded control and research activities. A "success" is defined as a dis-

ease program that is large-scale (i.e., national in scope), uses cost-effective interventions, has been sustained for ≥5 years, and has had a major health impact [43]. Added to the triumph of smallpox eradication (and, soon, poliomyelitis and dracunculiasis eradication) are the programs against measles and against some parasitic and bacterial diseases. What are the benefits (measured in decreased disease burden and DALYs saved) of these efforts? Answers will help decision-makers prioritize and plan future battles against diseases that have not yet been conquered—some of which are reemergent, and others of which are yet to appear.

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