

Chapter 8

Improving the Health of Populations: Lessons of Experience



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In the past 50 years, the world has experienced enormous and unprecedented gains in the health of human populations. Progress has been especially apparent in developing countries. Average life expectancy has risen by more than 60 percent, from 40 years in 1950 to 65 years today. In 1950, roughly 28 percent of children died before their fifth birthday, but by 1990, this number had fallen to 10 percent. Furthermore, many of the world's most deadly and debilitating diseases, including leprosy, measles, poliomyelitis (polio), and many childhood illnesses, have been effectively contained in most areas and virtually eliminated in others. Smallpox, a highly contagious and deadly disease that affected more than 50 million people a year prior to 1950, has been completely eradicated.

Researchers have identified economic growth, rising incomes, and better living conditions brought about by rapid social and political transformations in many societies as major contributors to these impressive health gains. However, in recent years, the role of scientific and technological progress has emerged as a crucial, but little understood, factor underlying these gains. As Davis (1956, 306–7) observes, “It seems clear that the great reduction of mortality in underdeveloped areas since 1940 has been brought about mainly by the discovery of new methods of disease treatment applicable at reasonable cost [and] by the diffusion of these new methods.”

New research has sought to validate, and indeed quantify, this basic intuition. For example, Jamison, Lau, and Wang (2005) show that technological progress (which is broadly defined as the generation or adoption of new technologies), together with education, has been a far more important contributor to declining infant mortality rates in developing

countries than income growth. Furthermore, improvements in health brought about by investments in technological progress generate an important and positive feedback loop favoring economic growth and development in these countries.

An important question that follows is what can be done to further consolidate these gains and ensure that the fruits of scientific and technology progress are placed in the hands of the people in developing countries who stand to benefit most? Because the work of the Disease Control Priorities Project (DCPP) focuses primarily on identifying the most cost-effective interventions for diseases and conditions affecting the health of populations in developing countries, this work provides the starting point for analysis. The goal is to isolate the critical factors—in particular those “actionable” through specific public policies—that have contributed to the effective deployment and scaling up of proven cost-effective technologies and services in low-income settings.

To address this question, the DCPP joined forces with the What Works Working Group of the Global Health Policy Research Network, an initiative led by the Center for Global Development in Washington, D.C., and funded by the Bill & Melinda Gates Foundation. DCPP authors were asked to identify outstanding examples of successful implementation of programs and projects geared toward the deployment of proven cost-effective interventions in their respective fields of international health and to speculate on what kinds of programmatic aspects and broader public policy decisions might have contributed to their success.

From an initial set of nominations, the What Works Working Group selected a subset of cases that conformed to strict

selection criteria, researched them thoroughly, and produced a report to be widely disseminated to policy makers and leading health experts in both developed and developing countries. In parallel, the DCPD initiated a systematic review of the case materials to identify commonalities or factors that may have contributed to the deployment and scaling up of those interventions. The objective was to identify a set of specific policy levers and programmatic decisions that could facilitate the transplantation of those and other cost-effective interventions to new and different settings. This chapter presents the results of that study.

RESEARCH METHODS

The study consisted of a qualitative analysis of a set of case studies selected to help illustrate how proven, cost-effective interventions have been successfully deployed and brought to scale with dramatic results in low- and middle-income countries in Africa, Asia, and Latin America and the Caribbean. We examined evidence culled from interviews, peer-reviewed articles published in journals, and official project evaluations and attempted to organize this information in a way that would allow us to reach tentative conclusions about the most significant elements associated with the interventions' success.

The study thus followed one of Mill's (1843) five methods of experimental reasoning: the method of agreement. Such a method postulates that "if two or more instances of the phenomenon (A) . . . have only one circumstance (B) in common, the circumstance (B) in which alone all the instances agree is the cause (or effect) of the given phenomenon (A)." For this study, the phenomenon (A) is represented by success. Cases that qualified as successes had to conform to the following five criteria:

- *Scale.* All cases selected for study involved a national, regional, or global scale. Pilot projects or interventions implemented on a subnational scale were not considered.
- *Importance.* Selected cases addressed a problem of major public health significance that could be expressed, at the program's inception, in terms of disability-adjusted life years, a composite measure of mortality and morbidity caused by the disease.
- *Health impact.* Selected cases had documented evidence of a clear and measurable effect on the health of the population targeted by the intervention. Process indicators, including immunization coverage rates, were not considered an acceptable substitute for health impact data.
- *Duration.* All cases selected for study had a life span of at least five consecutive years.
- *Cost-effectiveness.* Selected cases relied on interventions that had been proven to be cost-effective at a threshold of approximately US\$100 per disability-adjusted life year saved.

The unabashed focus on success meant that the study ignored potentially important information about factors that may be associated with programmatic failures or not-so-successful cases that did not meet the strict criteria described above. However, the inclusion of less-than-successful cases was not an option in light of time, resource constraints, and paucity of available documentation. Thus, a significant limitation of our study results from the lack of variance in the outcome observed. This type of selection bias is a common problem that may result from the nonrandom selection of cases in qualitative research.

Although bias cannot be eliminated without expanding the study to include unsuccessful examples, working skillfully with the presumption of bias to increase the level of confidence in the findings is possible. First, counterfactual examples, even if purely speculative (what would have happened if . . . ?), can be used to further substantiate the hypothesis that circumstance (B) has directly contributed to the observed phenomenon (A). Second, theorizing in a constructive way about what the direction of the bias might be and, therefore, minimizing its impact on the results of the study are also possible. For example, any potential bias more than likely results from overdetermining causality rather than overlooking or ignoring key factors related to success. In a related point, the study design makes discerning the relative contributions of the various factors difficult, because weights cannot be assigned easily.

Remarkably few rigorous studies of this sort attempt to track the implementation of proven, cost-effective interventions in the field. Although we have a good understanding of the efficacy of the available arsenal of interventions for treating and preventing diseases specific to low-income countries, we often know little about the range of programmatic and policy options that are needed to support these interventions in the real world. This study represents the first major contribution toward the development of a body of knowledge in that area, and the preliminary conclusions reached should be understood in that context (Collier and Brady 2004).

CASES

From an initial set of nominations received from DCPD authors as well as from other international health researchers, we selected a subset of 17 cases for study. We could not consider many cases that were nominated because of the absence of reliable data. Thus, the 17 cases selected are merely a subset of the many successes in international health that have been achieved during the past 50 years, not the full universe. Nonetheless, the cases draw from all three continents of the developing world—Africa, Asia, and Latin America and the Caribbean—and involve both communicable and noncommunicable diseases as well as curative and preventive care. Most

cases are national-level programs, but a few involve regional initiatives, and one is global.

Many near misses did not make the cut. The reasons for this exclusion varied. For example, a program in Costa Rica, El Salvador, and Guatemala to promote hand washing appears to have resulted in a dramatic decline in child morbidity and mortality but did not meet the duration criterion because it was fully operational for only three years (1996–99). In another example, the evidence of a health impact was mixed: a successful schistosomiasis control program in the Arab Republic of Egypt that included treatment of blood flukes in infected individuals was later linked to high prevalence rates of hepatitis C caused by the use of improperly sterilized syringes (Frank and others 2000). Nonetheless, the most common rationale for excluding a case from this study had to do with a lack of consistent documentation and of analysis of the health impact of the program in question. Thus, a reasonable conclusion is that the true universe of cases is much larger than the subset of cases we examined.

Each case reviewed here illustrates how a discrete health intervention or combination of interventions was successfully brought to scale in a specific context. To gain insight into this process, we can distinguish between the intervention—for example, the tool or technology that has been proven to be cost-effective for the treatment or prevention of a given disease—and the programmatic characteristics and policies that contributed to the successful delivery or deployment of the intervention through specially designed programs or projects.

The following list of cases selected for review describes the programs or projects that were scaled up, identifies the specific intervention or interventions deployed, and summarizes the existing evidence about health outcomes and impact:¹

- **Chagas disease control.** In 1991, seven countries—Argentina, Bolivia, Brazil, Chile, Paraguay, Uruguay, and later Peru—joined forces as part of an initiative for the Southern Cone countries led by the Pan American Health Organization to combat Chagas disease through a combination of surveillance activities, house-to-house spraying, and other vector control methods. *Health impact*—Disease incidence had fallen by 94 percent by 2000. By 2001, disease transmission had been halted in Chile, Uruguay, and large parts of Brazil and Paraguay. The project is ongoing.
- **Diarrheal treatment.** In Egypt, the government launched a national program in the early 1980s to promote the use by mothers of locally manufactured oral rehydration salts in a four-part strategy that included tailoring product design and branding to accommodate local preferences and customs; strengthening production and distribution channels, both public and private; training health workers; and using social marketing and a mass media campaign. *Health impact*—Between 1982 and 1987, infant and child mortality

dropped by 36 and 43 percent, respectively. Mortality attributed to diarrhea fell 82 percent among infants and 62 percent among children. The project closed in 1991.

- **Guinea worm eradication.** Twenty countries in Asia and Sub-Saharan Africa began a global campaign to eradicate guinea worm in the mid 1980s. Led by the Carter Center, the United Nations Children’s Fund, the U.S. Centers for Disease Control and Prevention, and the World Health Organization, the campaign promoted improved water safety through deep-well digging, environmental control, and the use of cloth filters for drinking water; health education programs; and case management, containment, and surveillance. *Health impact*—By 1998, 9 million to 13 million cases of guinea worm had been prevented and global prevalence had dropped by 99 percent. The project is ongoing in three countries.
- **Family planning.** In Bangladesh, family planning has been promoted since the 1970s through a door-to-door outreach program conducted by young, married women who provide information about limiting family size or spacing pregnancies along with products. An extensive media campaign accompanied the outreach program. *Health impact*—Contraceptive use among married women in Bangladesh is approximately 50 percent today, compared with only 8 percent in the mid 1970s, and the average number of children per family is 3.3, down from 7 in the mid 1970s. The project is ongoing.
- **Hib vaccination.** Chile began to include the Hib vaccine as part of its national immunization program in 1996. In The Gambia, a similar initiative was introduced in 1997. *Health impact*—In Chile, the prevalence of Hib disease fell by 90 percent, and the incidence of pneumonia and other Hib-related illnesses fell by 80 percent. In The Gambia, the number of children developing Hib meningitis fell from 200 per 100,000 to 21 per 100,000 only 12 months following the introduction of the vaccine. The projects are ongoing in both countries.
- **HIV/AIDS prevention.** Thailand launched the 100 Percent Condom Program in 1991 to address the rising incidence of HIV/AIDS in the country. The program provided boxes of condoms to brothels free of charge, mandated the use of condoms by sex workers, and threatened brothels with penalties and closure for noncompliance. *Health impact*—By 1992, condom use in brothels had risen to more than 90 percent, up from 14 percent in 1989. The number of cases of new sexually transmitted infections fell from 200,000 in 1989 to 15,000 in 2001, and an estimated 200,000 new infections were averted between 1993 and 2000. The project is ongoing.
- **Health improvement of the poor using financial incentives.** In 1997, the Mexican government launched a new social welfare program designed to help lift rural families

out of poverty by providing cash payments in exchange for their participation in nutrition and supplementation programs, their use of prevention and basic health care services, and their children's school attendance. *Health impact*—After five years, the children of participating families were 12 percent less likely to experience illness than those of nonparticipating families, and their nutritional status had improved. Adult health indicators also improved. The project is ongoing.

- **Maternal health.** The Sri Lankan government relied on professional midwives and sustained investments in the country's health care system, including in rural areas, to improve maternal health. *Health impact*—The maternal mortality ratio fell from approximately 500 per 100,000 live births in 1950 to 60 per 100,000 in 2003. The project is ongoing.
- **Measles elimination.** In 1996, the seven southern African countries agreed to a coordinated immunization strategy, supported by improved surveillance and laboratory capacity, to eliminate measles by including the vaccine as part of routine immunization for all nine-month-old babies and organizing nationwide catch-up and follow-up campaigns for children age nine months to 14 years. *Health impact*—The number of measles cases reported annually in the region fell from 60,000 in 1996 to 117 in 2000. The number of deaths attributed to measles fell from 166 to 0 during the same period. The project is ongoing.
- **Onchocerciasis control.** The discovery of ivermectin (Mectizan) in 1978 and Merck's decision to provide it free of charge to anyone who needed it allowed early successes based on weekly aerial spraying in 11 West African countries to be further consolidated and later expanded to the other 19 endemic countries in Central and East Africa. *Health impact*—In West Africa, disease transmission has been virtually halted, and 1.5 million previously infected people are now symptom free. In Central and East Africa, the program has helped prevent an estimated 40,000 cases of blindness each year. The Onchocerciasis Control Program (OCP) ended in 2002. The African Programme for Onchocerciasis Control is ongoing.
- **Polio elimination.** In 1985, the Pan American Health Organization launched a campaign to eradicate polio from the Americas. National vaccine days were held twice a year and were targeted at children under the age of five, regardless of their immunization status, to increase coverage in countries with weak routine immunization programs. An extensive surveillance system and mop-up campaigns to address outbreaks were crucial during the campaign's final stages. *Health impact*—The last case of polio in the Americas was reported in 1991.
- **Salt fluoridation.** In Jamaica, a formal agreement between the Ministry of Health and the country's only salt producer introduced fluoridation to salt in 1987 to prevent caries.

Health impact—By 1995, the severity of caries in children between the ages of 6 and 12 had fallen by more than 80 percent. The project is ongoing.

- **Salt iodination.** China launched the National Iodine Deficiency Disorders Elimination Program in 1993. The government requires producers to iodize salt and has stepped up its monitoring and enforcement capacity to ensure compliance. *Health impact*—Total goiter rates among children between the ages of 8 and 10 years fell from 20.4 percent in 1995 to 8.8 percent in 1999. The project is ongoing.
- **Smallpox eradication.** The campaign to eradicate smallpox, led by the World Health Organization and heavily financed by the United States, was launched in the mid 1960s. Strong leadership, dedication, and commitment on the part of the international community and the timely discovery of simple, new technologies—for example, the bifurcated needle and the “ring” strategy of surveillance and containment—characterized the effort. *Health impact*—The World Health Assembly declared smallpox eradicated in May 1980.
- **Tobacco control.** Poland passed groundbreaking legislation in 1995 imposing strong warning labels on cigarette packages, banning smoking from enclosed workplaces, and prohibiting tobacco sales to minors. South Africa passed similar legislation in 1999 to strengthen a previously imposed tax of 50 percent on the retail price of cigarettes. *Health impact*—Cigarette consumption dropped 10 percent between 1990 and 1998, resulting in a 30 percent decline in lung cancer among men age 20 to 44, a nearly 7 percent decline in cardiovascular disease, and a decline in the number of babies with low birthweight. South Africa witnessed a 30 percent decline in cigarette consumption in the 1990s, especially among youths and the poor. The projects are ongoing in both countries.
- **Trachoma control.** The Moroccan National Blindness Control Program, launched in 1991, promoted the use of “SAFE” interventions (surgery, antibiotics to control the infection, facial cleanliness, and environmental improvements), with the goal of eliminating trachoma by 2005. *Health impact*—Overall prevalence rates have fallen by 75 percent since 1999, and the prevalence of active disease in children under the age of 10 has seen a 90 percent reduction since 1997. The project is ongoing.
- **Tuberculosis control.** In 1991, China launched a 10-year program in 13 of its 31 mainland provinces to apply the directly observed therapy short course (DOTS) strategy to tuberculosis (TB) control. Peru, previously one of 23 high-burden countries that collectively account for 80 percent of the world's new TB cases each year, launched a similar effort the same year. *Health impact*—Within two years, China had achieved a 95 percent cure rate for new cases and a cure rate of 90 percent for those patients who had previously completed treatment unsuccessfully. The number of people with

TB declined by more than 37 percent between 1999 and 2000. The project ended in 2001, but important elements have been incorporated in the 10-year National Plan for the Prevention and Control of TB (2001–10). In Peru, disease incidence declined each year by 6 percent. The program achieved a case detection rate of 70 percent and an 85 percent cure rate. The project is ongoing.

GENERAL FINDINGS

Taken as a whole, the cases support four general findings. The first two have special relevance because they serve to disconfirm aspects of the prevailing wisdom about aid effectiveness—or at least present a serious challenge to such wisdom.

First, these cases demonstrate that a wide range of proven, cost-effective interventions exists that can and have been brought to scale in developing countries, even in extremely low-income settings with limited health infrastructure and in challenging macropolicy environments. In West Africa, aerial spraying of the blackflies' breeding sites, part of the strategy promoted by the OCP throughout the 1980s, "continued unabated through wars between member countries and coups that grounded all other aircraft" (Eckholm 1989, 20). In Sudan, despite the difficulties created by the more than 20-year civil war, and in other areas of Sub-Saharan Africa, the campaign to eradicate the guinea worm has made progress. The finding is significant in that it challenges a central tenet of the aid-effectiveness literature: that only countries with a "good" policy environment can benefit from external financial assistance (Devarajan, Dollar, and Holmgren 2001).

The aid-effectiveness literature has tended to focus on a different set of outcomes—for example, macroeconomic and structural reform—rather than on health outcomes, and this focus may partly explain the contradictory conclusions; however, an examination of whether such a conclusion is true goes well beyond the scope of this study. In any event, the cases reviewed for this study displayed a striking degree of variation in the political and economic contexts in which interventions were applied and brought to scale, and no clear pattern of association was apparent between this variation and successful outcomes in relation to health.

Second, the cases provided new evidence of the importance of the public sector to achieving successful health outcomes. This finding was a surprise, especially considering the strength of recent evidence documenting "weak links in the chain between government spending for services to improve health and actual improvements in health status" (Filmer, Hammer, and Pritchett 2000, 199). The specific roles that the public sector played in achieving these outcomes varied tremendously. In some instances, such as promoting maternal health in Sri Lanka and controlling TB in China and Peru, governments were involved in direct service provision. In other instances, the

public sector's regulatory or legislative authority was critical. Governments in Poland and South Africa passed strict laws, despite strong opposition from the tobacco industry, requiring explicit health warnings on cigarette packs, banning smoking in enclosed public places, and prohibiting tobacco media advertisements, among other things. Governments also used their authority creatively to encourage health-promoting behaviors and to discourage risky ones. In Mexico, the government provided direct cash payments to poor families in exchange for visits to health care clinics and school attendance. In Thailand, local police worked in collaboration with health officials to lend credibility to the government's threat to shut down brothels that failed to comply with the no condom, no sex policy, giving teeth to the national campaign.

Third, the cases reviewed for this study share a number of common features or attributes that appear to have contributed to the successful outcomes. Without exception, they enjoyed and managed to reap the benefits of strong leadership, effective management, realistic financing arrangements, country ownership, and openness and receptivity to learning by doing, constantly improving on strategies and processes by incorporating new research findings and technical innovation into program improvements.

For example, successful projects appeared to benefit from a strong champion who could provide the necessary leadership to bring relevant stakeholders together, encourage them to focus and coordinate their activities, and instill in them a sense of purpose and enthusiasm for their work. However, we did find that leadership came packaged in many different shapes and sizes. In Jamaica, the curiosity and persistence of a Ministry of Health dentist led to the identification of the island's only salt producer as the vehicle for fluoridation. In Mexico, President Ernesto Zedillo Ponce de León seized on the innovative proposal of a close adviser, Santiago Levy, then director-general of social security, and launched a program linking education, health, and nutrition as part of an integrated strategy to lift rural families out of poverty, and the program was not abandoned when Zedillo left office. The new Vicente Fox administration, motivated by undeniable evidence of the program's effectiveness, instead sought to expand the program into urban areas and added an educational component. In a less visible but nonetheless critical display of leadership and forward thinking, the sustained investments of the Sri Lankan government over a nearly 50-year period to build a rural health network emphasizing critical elements of maternal health have led to gains in the health of women unparalleled by countries at similar, and higher, income levels.

Strong program management was needed to ensure that plans, once conceived, were implemented effectively. Successful cases had well-delineated goals that were clearly linked to inputs, activities, outputs, and outcomes. This factor was especially evident in the case of global or regional immunization

campaigns, given the many logistical challenges and the need for fluid and effective coordination of many countries and stakeholder groups, often within a highly constrained time frame. However, similar management skills are needed for health service delivery systems, especially when patient referral, tracking, and follow-up are essential components of the intervention. In China, incentive schemes to motivate physicians, extensive training and supervision of health care staff, and substantial investments in local TB dispensaries were all crucial elements in improving management capacity for large-scale rollout of the country's DOTS program, which covered a population of 573 million in 1,208 counties in 13 provinces.

A closely related requirement was having a realistic financing strategy that was compatible with a project's goals. Even when large sums of money were involved, deployment of the intervention yielded tremendous returns at a relatively low cost per disability-adjusted life year. In the case of onchocerciasis control, for which donors have invested US\$560 million over a period of 28 years, transmission has been virtually halted in 20 West African countries, and nearly 600,000 cases of blindness have been averted at an annual cost of only US\$1 per person. In the case of guinea worm control, in which donors have invested approximately US\$88 million over a 12-year period, disease prevalence has fallen by 99 percent, and only 35,000 people remain affected, down from 3.5 million, at a cost of US\$5 to US\$8 per person.

Country ownership was another distinguishing feature of successful programs. A government's willingness to commit scarce funding to scaling up an intervention can be an important indication of this ownership, although not the sole predictor. Despite the extremely constrained budgets of the seven participating countries, the campaign to eliminate measles in southern Africa was almost entirely funded by their ministries of health. The Thai government covered approximately 96 percent of the cost of the 100 Percent Condom Program. In Morocco, the government bore the bulk of the costs for implementing the SAFE strategy to address blindness caused by trachoma, with contributions from the United Nations Children's Fund and the International Trachoma Initiative, an international public-private partnership.

Most of the cases we reviewed benefited from new research findings and technical innovation. Successful cases appear to display the openness and receptivity needed to make good use of new knowledge and to support ongoing research when appropriate or when gaps in knowledge prove to be a hindrance to progress. In Bangladesh, a program to treat childhood diarrhea trained mothers to make their own salt solution when the authorities determined that mass production and distribution of prepackaged oral rehydration salts was unrealistic. Control of Chagas disease in the Southern Cone of Latin America required public health officials in each country to devise and deploy environmental control strategies appropri-

ate to local conditions and vector behavior. Finally, adoption of the ring vaccination strategy marked a crucial turning point in the global campaign to eradicate smallpox, enabling rapid containment of the disease in remote parts of the world without vaccination of every child.

In sum, a small number of features appear to be common to all the successful cases. A reasonable hypothesis suggested by the evidence is that these five attributes represent the known set of necessary, but not sufficient, conditions for successfully implementing cost-effective health interventions in the developing world.

Fourth, despite the obvious limitations of case study methods in hypothesis testing and confirmation, the evidence from the cases sheds important light on two important debates in international health policy. First, the cases suggest that much more is involved than what is currently understood about whether weak policy environments can make good use of carefully selected, strategic investments in health. As the next section indicates, different types of programmatic characteristics and policies are needed for the deployment of different types of interventions. How these characteristics interact with different policy environments—whether strong, weak, or in between—deserves further scrutiny and exploration. Second, evidence from the cases of successful government action should call into question any premature and overly general conclusions about public sector ineffectiveness in developing countries. Even though such a small sample of cases is surely insufficient to close the book on these important policy debates, it should at least encourage further study and refinement of the arguments.

INTERVENTION TYPE, PROGRAMMATIC CHARACTERISTICS, AND POLICIES

Programmatic characteristics and policies associated with successful outcomes appear to vary by intervention type. The starting point for this discussion is the intervention, technology, or tool in question. What allows for the widespread deployment of a proven, cost-effective intervention? What are the steps for converting a proven, cost-effective intervention into a fully fledged health program that has been successfully brought to scale, preferably at the national level? Is it possible to distinguish between the specific health intervention and the programmatic characteristics and public policies associated with its successful deployment?

The cases under review were grouped according to the primary type of intervention deployed by the program or project in question. The types of interventions varied in terms of their emphasis on the delivery of standardized products to a population (product-intensive interventions), the delivery of clinical services (service-intensive interventions), a personal

behavior change (behavioral change interventions), the control of environmental hazards (environmental control interventions), or some combination thereof.

Further scrutiny of subgroupings of cases revealed that certain programmatic characteristics, delivery modalities, and public policy instruments also appeared to vary by intervention type. This finding appeared to substantiate the claim of the first edition of this volume (Jamison 1993, 11) that “commonalities of logistics, policy instruments, and approach” vary by intervention type and play a role in determining whether the intervention or interventions will be deployed successfully.

The typology presented here differs from the one elaborated by *World Development Report 2004: Making Services Work for Poor People* (World Bank 2004), in that the classification depends on characteristics inherent to the intervention in question. By contrast, *World Development Report 2004* identifies three classes of service delivery arrangements: individual-oriented clinical services, population-oriented outreach services, and community- and family-oriented services that support self-care. The focus is on differences in the relationship between provider and client and how these differences interact with market and public sector dynamics.² However, our focus was on how characteristics of the interventions themselves give rise to certain programmatic or policy imperatives that may contribute, ultimately, to successful health outcomes.

This section presents the five intervention types and explores the clusters of programmatic characteristics and policies that appear to support the successful deployment of each intervention type, based on case study analysis.

Product-Intensive Interventions

These types of interventions (box 8.1) involve the simple transfer of a standardized technology to an individual or to an entire population. They can be targeted at either prevention or cure, but the distinguishing feature is standardization. Unlike service-intensive interventions, product-intensive interventions need not be tailored to the unique health care needs of the individual receiving treatment.

To the degree that product-intensive interventions place relatively low technical demands on health care staff at the point of delivery, they may be more easily deployed in low-resource settings than other types of interventions. Compared with service-intensive interventions, they are less transaction intensive, requiring fewer interactions between providers and clients. Also, compared with behavioral-change interventions, they are less dependent on individual compliance, requiring simply that individuals make themselves available for treatment. Product-intensive interventions include mass drug administration (chemotherapy), childhood immunizations, mineral fortification, and nutritional supplementation. (These specific interventions are addressed in detail in chapters 20, 22, and 28.)

Product-intensive interventions are often, though not necessarily, linked to vertical rather than horizontal delivery modalities. According to Gonzalez (cited in Mills 1983, 1972), the vertical approach “calls for the solution of a given health problem through the application of specific measures through single-purpose machinery.” By contrast, the horizontal approach “seeks to tackle . . . health problems on a wide front and on a long-term basis through the creation of a system of permanent institutions commonly known as ‘general health services.’” Where health systems are weak and poorly functioning, vertical programs—in particular, mass campaigns—can be an effective means of rapidly providing coverage to a large population. However, the same approach could result in an unfortunate duplication of effort in countries where the health care system is already strong and functioning properly.

Mass Drug Administration. Of the product-intensive interventions, those that can be delivered in pill or capsule form in standardized doses, often through what is referred to as *mass drug administration*, are perhaps the least complex to deliver and, as a result, may be the least costly. Onchocerciasis, also known as river blindness, can be treated by a single dose of ivermectin administered annually to infected individuals. Lymphatic filariasis can be treated in much the same way using a two-drug combination therapy of albendazole plus either diethylcarbamazine or ivermectin administered annually in

Box 8.1

Product-Intensive Interventions: Illustrations from Cases

Hib vaccine

Ivermectin

Measles vaccine

Oral polio vaccine

Salt fluoridation

Salt iodination

Smallpox vaccine

Source: Authors.

single doses for four to six years (the estimated productive life span of the adult-stage parasite).

The importance of product-intensive therapies can easily be illustrated by reference to the case of onchocerciasis control in most parts of Africa. Although aerial spraying, an environmental control intervention, had been used successfully to slow disease transmission in 11 West African countries, it was not a viable option for 19 countries of East and Central Africa because of geographical differences. However, Merck scientists' discovery of ivermectin in 1978 and the company's generous commitment to provide the drug free of charge to anyone who needed it changed the parameters of what was possible. Seizing the opportunity, the African Programme for Onchocerciasis Control, an international partnership led by the World Bank, the World Health Organization, the United Nations Development Programme, and the Food and Agriculture Organization of the United Nations, was created in 1995 with the goal of eliminating onchocerciasis as a disease of public health and socioeconomic importance in East and Central Africa.

It quickly became apparent that the weak and sometimes nonfunctioning health systems of many African countries were not up to the task; thus, a new approach was tried that took advantage of the fact that the success of the intervention no longer depended on a clinic-based delivery system. Under the supervision of national public health ministries and non-governmental organizations, community volunteers received training on organizing and managing the local ivermectin campaigns. The community-directed approach of treatment with ivermectin has been so successful that it has been considered as a possible model for delivering other types of treatments to remote areas.

Immunizations. Product-intensive interventions may vary in complexity, which has implications for their delivery or deployment. For vaccines, the need to maintain an effective cold chain adds an additional layer of complexity to the delivery system. Other pertinent factors are whether the intervention can be delivered as a single shot or iteratively, whether it can be bundled together with other products or must be delivered separately, and whether the number of distribution points is few or many. In many cases, the characteristics of the disease or condition being addressed may affect the level of complexity.

For example, the overwhelming success of the global effort to eradicate smallpox has been attributed, at least in part, to specific characteristics of the variola virus. Unlike other infectious diseases, such as malaria or yellow fever, smallpox depends solely on the human host and does not have an animal or insect carrier. Unlike polio, smallpox does not produce silent or asymptomatic infection, thereby facilitating diagnosis and surveillance of the disease (Tucker 2001). Other notable differences from other diseases have more to do with the vaccine than the virus. Tucker (2001, 64) explains that “a freeze-dried smallpox

vaccine was available that was easy to manufacture, cost only about a penny a dose, protected for several years with a single inoculation, and was relatively stable in warm climates, reducing the need for refrigeration. Whereas most vaccines took months to induce immunity, the smallpox vaccine acted with remarkable speed, providing nearly total protection within ten to twelve days.” This unique set of characteristics together meant that a “surveillance-containment” approach could replace mass vaccination entirely, in effect reducing the number of distribution points required by the intervention, thereby permitting major strides in the global eradication campaign.

The more complex the intervention, the more challenging—and probably costly—it will likely be to implement. Interventions that can be delivered in a single shot or that can be easily incorporated into routine immunization (bundled) are clearly the easiest to implement. As the case of Hib vaccination in Chile illustrates, delivering the intervention was relatively straightforward after the government got past the hurdle of evaluating its cost-effectiveness relative to other interventions. The government determined that the creation of a combined diphtheria-tetanus-pertussis and Hib vaccine was worthwhile and that the vaccine could be administered as part of an already well-functioning system of routine immunization.

Some of the common complexities associated specifically with immunizations range from the need for multiple inoculations administered at regular intervals, to the need to maintain a reliable cold chain, or to the need for the large population coverage required to achieve “herd immunity”—whereby the likelihood of person-to-person transmission is drastically reduced, even among the unimmunized population. In view of these potential complexities, polio elimination in the Americas represents a remarkable achievement. The oral polio vaccine must be administered in three properly spaced doses, and coverage must be high to prevent “silent” epidemics. In the 1970s, before the campaign was launched, polio caused an estimated 15,000 cases of paralysis and 1,750 deaths each year (Musgrove 1988). However, a carefully orchestrated campaign organized around achieving and maintaining high coverage through routine immunization and national vaccination days, the prompt identification of new cases, and the aggressive control of outbreaks led to the elimination of polio from the Americas in 1991. The creation of the Inter-Agency Coordinating Committee, made up of representatives from the Pan American Health Organization, the United Nations Children's Fund, the U.S. Agency for International Development, the Inter-American Development Bank, Rotary International, and the Canadian Public Health Association, played a key role not only in generating political and financial support, but also in helping address the logistical and managerial challenges inherent to the campaign. The Inter-Agency Coordinating Committee model was so effective that it was quickly duplicated at the country level.

The technical and logistical challenges associated with measles elimination in southern Africa were no less complex. Measles is one of the most contagious of all human diseases. The measles vaccine requires 90 percent coverage to achieve herd immunity and to stop the spread of the virus. Furthermore, it often requires two doses to be effective and must be administered to infants no earlier than nine months of age, or about six months later than other recommended vaccines. If given earlier, the vaccine will fail to trigger an active immune response, because infants are passively protected by their mothers' antibodies until that age. Thus, the vaccination interval falls outside of what most routine immunizations require.

To overcome this challenge, the southern African countries adopted a strategy known as catch up, keep up, and follow up. In each country, beginning with the program's launch in 1996, the strategy involved organizing a national catch-up campaign in which mobile teams vaccinated all children, regardless of their vaccination status, between the approximate ages of 9 months and 14 years; sustained routine coverage; and ran at least one follow-up campaign several years later. The countries also strengthened their surveillance and laboratory capabilities to investigate all suspected measles cases.

Mineral Fortification. A different type of product-intensive intervention, mineral fortification, requires fewer points of delivery and is far less labor intensive. However, potential challenges include the need for a different set of technical capacities than is typical for health sector solutions; the possibility of a need for significant initial investments to modify production processes or manufacturing capabilities; and the involvement of non-health sector entities, such as private industry.

Jamaica's salt fluoridation program beautifully illustrates the simplicity of a single delivery point for an intervention. With the agreement of the island's only salt producer, Alkali Limited, in place, universal coverage was easy to achieve. All that was needed was a complementary legal and regulatory framework to oversee the process. In this case, the start-up costs were small: only US\$3,000 worth or so of new equipment was needed, which the company was easily able to recoup with a slight increase in the price of salt.

In China, salt fortification with iodine was more difficult, involving a larger investment in the production process and a

greater number of potential delivery points. Because salt production is licensed at the provincial level in China, implementing the change involved working with several layers of government bureaucracy; however, perhaps ironically, the system of central control eased the challenge. During a four-year period, 55 salt factories were upgraded and 112 iodination centers were established throughout the country to support the initiative. The government also introduced changes in bulk and retail packaging to help consumers more easily recognize iodized salt. The basic plan achieved nearly 90 percent coverage, but the remaining challenge is to address the numerous delivery points that function outside the national system, for instance, in areas where people live near the sea and produce their own salt.

Summary. In sum, product-intensive interventions can be extraordinarily complex even though they involve fewer transactions between providers and clients and lower technical requirements at the point of delivery than other types of interventions, particularly service-intensive interventions. However, the relative simplicity of deployment when the scientific and technical issues of development and production have been addressed may help explain why product-intensive interventions are perceived to be easier to implement than other types of interventions and why countries experiencing political and economic instability might prefer them.

Service-Intensive Interventions

Service-intensive interventions (box 8.2) include the full range of diagnostic and therapeutic health services usually provided not only in the clinic setting, but also in the home or at school. Unlike product-intensive interventions, service-intensive interventions cannot easily be standardized and may require careful—and time-consuming—monitoring and reporting on patients' progress. Thus service-intensive interventions are highly transaction intensive and typically place high technical demands on the health staff at the point of delivery. Examples range from primary care services, including essential obstetrical care, to surgical procedures, to treatment of communicable and noncommunicable diseases.

The complexity of service-intensive interventions may vary, just as in the case of product-intensive interventions. The more

Box 8.2

Service-Intensive Interventions: Illustrations from Cases

Bilamellar tarsal rotation procedure

DOTS for TB

Maternal health care using midwives

Primary and basic health care services

Source: Authors.

standardized the treatment protocol, the easier it will be to administer on a large scale. However, standardized or not, the transaction-intensive character of this type of intervention means that its successful deployment depends on the program's or project's ability to overcome potential (and likely) constraints on human resources. A related concern is the overall health system's capacity to effectively manage competing demands on these resources. In contrast to product-intensive interventions, human capacity constraints for service-intensive interventions are harder, but not impossible, to address through community mobilization or the use of volunteers, because of the need for specialized training. Chapter 71 investigates developing countries' experiences with new types of professionals in service delivery settings that have traditionally relied on physicians.

Single-Shot Surgical Services. If the intervention is relatively standardized, it can sometimes be deployed using a vertical modality in a manner similar to the more standardized, single-shot, product-intensive interventions. This was the case of the surgical procedure used in Morocco as part of the broader SAFE strategy to address trachoma. A relatively simple surgical procedure, the bilamellar tarsal rotation procedure, can be used to halt corneal damage to prevent the onset of blindness caused by repeated trachoma infections. Morocco's Ministry of Health organized mobile surgical teams of doctors and nurses to carry out the corrective surgery in small towns and communities throughout the country. In just eight years, the teams carried out more than 26,000 surgeries. The effort required the involvement of 43 physicians and 119 nurses working in 34 clinics. However, despite the relatively standardized nature of this kind of service-intensive intervention, human capacity constraints may slow progress. Compared with product-intensive interventions for which community volunteers can be recruited to assist with distribution, service-intensive interventions require a more specialized workforce. Even when nurses and other health workers with lower-level skills can substitute for more highly trained physicians, constraints on human resource capacity may persist. Morocco faces a backlog of about 15,000 cases, many of which are urgent.

Strengthened Outreach and Referral Systems. If the intervention is not easily standardized, or if it is highly transaction intensive, its successful deployment will also depend on well-developed outreach and referral systems. Outreach systems are needed to ensure that those requiring care will have access to care, and referral systems are needed to route patients requiring additional care toward specialized care and treatment facilities. However, ensuring that such systems are in place for specific programs and projects is a major challenge in countries where the health care system is already weak and under considerable strain.

The cases we reviewed relied on a variety of strategies to address this problem. Although the specific interventions varied, the strategies ranged from traditional investments in public sector provision to improve access, to supply-side incentives to address quality concerns, to demand-side incentives to strengthen the effective demand for health care services. For example, in an effort to improve maternal health even in remote areas, Sri Lanka adopted the traditional model of public sector provision, but with a twist. Instead of a physician-based solution, which would have been extremely costly, Sri Lanka relied instead on professional midwives to provide widespread access to maternal health care, building on a strong health care system that provides free health care. Midwives serve a population of 3,000 to 5,000 each and live locally. They visit pregnant women in their homes, register them for care, and encourage them to attend prenatal clinics (run by doctors). Midwives receive 18 months of training and are backed up by supervision and a well-functioning referral network. Established procedures for service delivery and supervision, along with frequent in-service training, help keep midwives current and delivering high-quality services. Health clinics are supported by a network of cottage hospitals (clinics having doctors as well as nurses assigned to them), rural hospitals, and maternity homes at the secondary level; tertiary provincial hospitals with specialist services; teaching hospitals; and specialist maternity hospitals.

China faced a similar dilemma with regard to establishing an effective system of outreach and referral to address a growing TB problem by scaling up DOTS. Although DOTS is relatively standardized as far as service interventions go (see chapter 16), the treatment protocol is highly transaction intensive, and complicated cases may require specialized treatment. DOTS is thus also highly dependent on well-developed systems of outreach and referral for its success. However, China faced a challenging situation because most village doctors who were needed to conduct patient diagnosis, treatment, and surveillance in rural areas were in private practice and had little incentive to treat patients for whom drugs were now provided free of charge. In response, the government created a financial scheme to provide incentives for these doctors to participate. For each patient enrolled in the treatment program, village doctors received US\$1. They received an additional US\$2 for each smear examination carried out in the county TB dispensary during a two-month period and another US\$4 for each patient who completed treatment. Simultaneously, the government made significant administrative, managerial, and institutional investments. Tens of thousands of staff from TB dispensaries were trained, and supervisory systems were put into place. Furthermore, the government set up a national TB project office and a TB control center to oversee and coordinate the various levels of government involvement.

Demand-Side Incentives. Demand-side incentives can be designed to complement supply-side investments. Indeed, both skeptics and supporters of governments' ability to translate public spending into effective service provision and positive health outcomes encourage the use of demand-side incentives as a means of quality control to improve routine care (Filmer, Hammer, and Pritchett 2000). Economists consider demand-side incentives to be valuable tools for stimulating weak demand for services or for overcoming barriers to use that can artificially dampen demand. This was how at least two of the cases included in this study constructively used demand-side incentives. However, in neither case was this use an either-or proposition; that is, both demand-side and supply-side investments were relied on to generate the successful outcomes that qualified the cases for this study.

In Peru, the newly revised National Tuberculosis Control Program offered food packages, employment training, and stipends to patients to improve compliance with the drug treatment regime. Simultaneously, the program was dramatically scaled up and the number of participating health centers rose from 977 to 6,539 over the next decade. In the clinics, nurses were the medical personnel responsible for administering DOTS. In isolated rural areas, the program recruited local leaders to serve under the direction of the nursing staff to administer the treatment and follow up with patients.

Mexico's Education, Health, and Nutrition Program (originally known as PROGRESA, but now called "Oportunidades") also provides a compelling example of how a program can use demand-side incentives to stimulate demand for basic health care services. The program offers cash transfers to families in exchange for the attendance of mothers and children age five and under at nutrition monitoring clinics and to pregnant women if they agree to prenatal care visits and nutritional supplementation. The program also includes cash transfers to promote school attendance and performance. A rigorous evaluation provided evidence of the program's effect on the use of health services: after just one year of implementation, attendance at health care clinics was significantly higher in participating localities. However, the increased demand for services was also met with significant improvements in the quality of services available through public providers. Health care providers in participating localities were paid more and

received more on-the-job training, and clinics benefited from a steadier flow of pharmaceutical and other supplies.

Summary. In sum, service-intensive interventions are highly transaction intensive, especially compared with product-intensive interventions. The more standardized the intervention, the more likely that it can be delivered by means of military-like campaigns in the same manner as product-intensive interventions, although the skill level of the health workers involved will need to be higher. If complications of treatment are possible—or if the intervention cannot easily be standardized—its deployment will likely require fairly elaborate systems of outreach and referral. Although recent scholarship has strongly encouraged the use of demand-side mechanisms, particularly in an effort to address quality concerns in public sector service provision, evidence from the cases highlighted in this chapter suggests that a variety of modalities are possible and that a mix of supply- and demand-side incentives may even be desirable.

Behavioral Change Interventions

Behavioral change interventions (box 8.3) are designed to induce or encourage an individual behavior change or habit modification to achieve specific health goals. The focus is usually on prevention, but need not be exclusively so—for example, the use of oral rehydration therapy to treat childhood diarrhea. Behavioral change interventions are often linked to the uptake of a specific product, as in the case of condoms and insecticide-treated bednets. However, unlike product-intensive interventions, behavioral change interventions require active participation by the individual and cannot be passively received in the form of an injection or supplement. Also, unlike service-intensive interventions, behavioral change interventions do not depend on the involvement of a health care professional on an ongoing basis. Illustrative examples include the uptake of oral rehydration therapy for use by mothers in the home, not the clinic; face washing to prevent trachoma; and condoms to prevent HIV infection or other sexually transmitted infections.

As Jamison (2002) notes, some changes in behavioral practices associated with improved health, such as improved

Box 8.3

Behavioral Change Interventions: Illustrations from Cases

Stopping smoking

Using condoms to prevent HIV/AIDS

Using nylon filters to purify water

Using oral rehydration salts

Source: Authors.

hygiene and better nutrition, are linked to rising incomes, but the pathway for this link is not entirely clear, especially at the individual level, which makes it difficult to predict which mix of programs and policies can be used to change behavior at the population level. Information plays an important role, but the evidence suggests that its effect may be limited if it is not combined with other mechanisms to induce behavioral change.

The cases under review typically used a mix of strategies to induce behavioral change, including information, education, and communication (IEC) campaigns; regulatory policies; taxation or subsidies; and financial incentives or disincentives. The evidence is suggestive, but hardly conclusive, that a relative hierarchy exists among the available strategies and policy instruments and that some are more effective than others at altering how individuals perceive risk and weigh the costs and benefits of behavioral change. Chapter 11, for example, provides an in-depth discussion of how and when fiscal instruments may be used effectively to alter producers' and consumers' decisions in ways that encourage healthy behaviors.

Information, Education, and Communication. Recent studies have challenged the effectiveness of mass IEC campaigns (Kremer and Miguel 2003), and evidence from the cases appears to support a degree of healthy skepticism. However, IEC campaigns did appear to have an effect in the cases under review when they were accompanied by the promotion of a new technology or a product. Also, acceptability appeared to increase if the product was adapted to fit the local circumstances or cultural context. In Sub-Saharan Africa, educational campaigns to stop transmission of the guinea worm to humans have encouraged the construction and maintenance of safe water sources (through deep-well digging and the application of larvicide to contaminated ponds) and the use of cloth or nylon filters to purify drinking water, in addition to case identification and containment. The primary IEC tool was so-called worm weeks—that is, weeks of intensive health education and community mobilization.

In Egypt, in addition to nurses and physicians, mothers were a primary target of the campaign to promote the use of oral rehydration salts for the treatment of diarrhea in children, especially those under three years of age. Television was the primary educational medium and proved to be an effective strategy for reaching a broad population base, including rural, illiterate households. Appropriate product design and branding were essential. Oral rehydration salt packets were supplied in a 200-milliliter size, not the standard 1-liter packs, because mothers did not have appropriate containers at home and felt that a full liter was too much to give to a child to drink. By contrast, in Bangladesh, where few households had access to a radio, much less a television, health workers went door to door to teach mothers how to make the solution in their homes.

In these cases, the targeted population not only was aware of the health care problem, but also was eager to adopt solutions to address it. Clearly this situation does not always prevail, but a reasonable conclusion is that a relatively simple technology that addresses a recognizable, but as yet unmet, need will find a receptive audience. In Bangladesh, a mass media campaign to encourage families to have fewer children was backed up by a large cadre of female outreach workers, who went door to door in rural areas to provide information to young married women and to make family-planning commodities available to them. Market research indicates that almost all Bangladeshi women were in favor of family planning but were unable to go against their husbands' objections if they were opposed to the use of contraceptives. The fact that the campaign and the provision of contraceptive commodities addressed an unmet need among Bangladeshi women may provide a partial explanation for the rapid acceptance of the program when it was launched on a large scale.

Regulatory Policies. By contrast, other behavioral changes, such as using condoms to prevent HIV infection and other sexually transmitted infections and stopping smoking, have clearly been harder to induce, although the precise reasons for this difficulty remain elusive (see, in particular, chapters 18 and 46). Nevertheless, evidence from the cases suggests that governments can put the right mix of policies in place to either discourage high-risk behaviors or encourage health-promoting behaviors. For example, they may use regulatory policies to ensure compliance through nonfinancial means and may complement these by using fines and sanctions as an enforcement mechanism.

The Thai government's 100 Percent Condom Program is an excellent example of such a strategy. In 1991, the National AIDS Committee launched a national program to be implemented at the provincial level requiring all workers in brothels and other commercial sex establishments to refuse to have sex with any client not using a condom. The program had several components, including free distribution of condoms to health workers during regular health checks and a media campaign to raise awareness of the risks of HIV and the dangers associated with unprotected sex. What gave the program its unique character was its regulatory and enforcement component. Local governments, health authorities, and police officers were responsible for monitoring and enforcing condom use in the brothels. Those brothels that failed to comply with the strict policy would be fined or forced to shut down. The results were impressive. Condom use in brothels exceeded 90 percent in just the first year of the program, up from 14 percent in 1989. The number of new HIV infections fell by more than 80 percent, from 142,819 cases in 1991 to 25,790 cases in 2001. Furthermore, the program appears to have generated important spillover effects, or externalities, in unexpected places. For example, studies

indicate that indirect sex workers—a group that cannot be reached through similar enforcement strategies—have also begun to insist that their clients use condoms.

Taxation and Subsidies. Another option for discouraging high-risk behaviors is the adoption of taxation policies. A 1997 study by the World Bank in partnership with the World Health Organization found that a price increase of 10 percent on cigarettes would lower smoking rates by about 4 percent in high-income countries and about 8 percent in low-income countries (Jha and Chaloupka 2000, 358). In South Africa, a 50 percent tax on the retail price of cigarettes contributed to a 30 percent decrease in consumption. In Poland, an increase in taxes on cigarettes from 30 to 47 percent of the retail price, in conjunction with other policies—including a ban on smoking in health care establishments, schools, enclosed spaces in the workplace, and elsewhere—contributed to a dramatic decline in smoking rates. Before the fall of communism, Poland had the highest cigarette consumption in the world, but by the end of the 1990s, there were 4 million fewer smokers compared with the previous decade, and cigarette consumption had fallen by 10 percent. These successes led to a 30 percent decrease in lung cancer among men age 20 to 44 and a 19 percent decrease among men age 45 to 64 over the same period.

The section on service-intensive investments has already discussed the remarkable power of explicit subsidies to encourage health-promoting behaviors. The Mexican case of PROGRESA offers a by now familiar example of such a strategy. Although none of the cases included in this study dealt with subsidies explicitly directed at behavioral change interventions, evidence suggests that they have a significant effect. However, as Nugent and Knaul discuss in chapter 11, poorly targeted subsidies can be costly, particularly relative to the result achieved. Much more research is needed in this area to understand the specific contexts in which subsidies can achieve their desired effects and their cost-effectiveness relative to other types of interventions.

Summary. In sum, behavioral change interventions differ from both product-intensive and environmental control interventions in that they require active participation by the individual for the intervention to be fully effective. In some cases, this requirement is also true for service-intensive interventions, but it is not as exclusively true as for behavioral change interventions. The degree to which incentives (or disincentives) are needed to induce (or discourage) behavior depends on the interaction between the usage characteristics of the intervention, the perceived risk of not using the intervention, and the perceived effectiveness of the intervention. To have an effect, policy incentives (and disincentives) must either succeed in changing the individual's risk-benefit assessment or make ignoring the policy extremely costly.

Environmental Control Interventions

As with behavioral change interventions, environmental control interventions are geared toward prevention and are used in conjunction with other treatments or alone when effective vaccines or other prophylaxes are unavailable. However, rather than focus on risk factors associated with individual behavior, environmental control interventions target risks associated with the physical environment that are largely beyond the individual's control. The *physical environment* refers to media in the natural (water, air, or soil) or man-made (housing, roads) environment. Examples of environmental control interventions include many vector control strategies, such as aerial and household spraying, water and sanitation projects, and air quality control measures. (See, in particular, chapters 41 and 43.)

Few of the cases reviewed for this study involved “pure” environmental control interventions; although in several cases environmental control measures were coupled with other types of interventions. Whenever activities involved in executing the intervention fall outside the realm of typical health care services, nonhealth government agencies will be involved, and strong political and technical leadership will be required of the ministry of health to ensure that proper attention is given to health care concerns during implementation.

Successful interventions in this category also appeared to be associated with strong multicountry partnerships, particularly in relation to vector control activities. This factor raises an interesting question concerning governments' capacity to engage in these types of partnerships. Technical capacity, although essential, is just the first hurdle, because what is ultimately required is a political and financial commitment at the highest levels in participating countries.

In the case of Chagas disease control, the Southern Cone Initiative brought together the seven countries in the endemic region under a coordinated, comprehensive, Chagas disease control strategy. This multicountry approach was led by the Pan American Health Organization, following the recognition that disease transmission from neighboring countries was threatening the health gains achieved under Brazil's national eradication plan. A central aim of the Southern Cone Initiative was to eliminate the protozoan parasite, *Trypanosoma cruzi*, in the region by coordinating technical efforts to detect and eliminate it. This coordination ensured consistent use of highly effective control measures across the region and limited any possibility of reinvasion. Infested homes throughout the region were treated with long-lasting pyrethroid insecticides and structurally improved to eliminate hiding places for the blood-sucking insects that spread the parasite. These coordinated environmental control efforts, combined with blood screening, proved to be highly successful at interrupting Chagas disease transmission in the region.

Environmental control interventions also appear to be characterized by many consecutive years of sustained activity. In

some cases, this activity may take the form of ongoing maintenance of filters and distribution systems to prevent recontamination. In other cases, as in the case of vectorborne disease control in which elimination or eradication is within reach, the intervention must be sustained at least until transmission has been interrupted in humans. (The intervention may need to be sustained for much longer, or indefinitely, if the disease has an animal host.) In the case of onchocerciasis, the lifetime of the filarial load is 14 years, and vector spraying would need to be sustained for at least 14 years to cut transmission. If reinvasions or native vector population growth are allowed to take hold before the human loads die off, transmission will occur and the disease will not be effectively controlled. The OCP in West Africa has demonstrated the effectiveness of a long-term commitment to vector control in reducing the burden of onchocerciasis. Since its inception in 1974, the OCP has used aerial spraying of blackfly breeding sites to control vector populations and interrupt transmission. The original OCP area remains free of onchocerciasis transmission following the withdrawal of regular spraying after 14 years. This sustained attention proved to be highly successful in eliminating onchocerciasis transmission and infection. Even after the introduction of ivermectin drug therapy to the program, vector control has remained a key strategy for maintaining health benefits in the expansion area of the OCP.

In sum, environmental control interventions are associated with intersectoral collaboration, multicountry partnerships, sustained activity, and attentiveness to context (for example, epidemiological conditions, patterns of disease transmission, and vector behavior). These factors place special capacity requirements on governments that may differ markedly from nonenvironmental interventions. Thus, to be effective, ministries of health must be capable of advocacy and influence within the broader structures of government.

Combination or Bundled Interventions

A two-front battle involving both prevention and treatment must be waged against most diseases and conditions to achieve the desired effect on morbidity and mortality. Under such circumstances, a combination or bundling of interventions is needed, adding an additional layer of complexity to the deployment of any particular intervention. An effective malaria control strategy, for example, demands effective distribution and uptake of insecticide-treated bednets (a behavioral change intervention) and rapid treatment of malaria symptoms through strong outreach and referral systems (a service-intensive intervention). Similarly, countries have adopted a dual approach to controlling the spread of HIV/AIDS: promoting safe sex practices (a behavioral control intervention) and supporting the scale-up of antiretroviral therapy (a service-intensive intervention). In this context, global partnerships

have a critical role to play in providing technical assistance to countries in formulating policies and developing strategic plans that are tailored toward their specific needs and capabilities.

Perhaps the most successful example of bundling interventions included in our study is the Moroccan National Blindness Control Program, launched in 1991. The program was based on the development in the mid 1980s of SAFE, a comprehensive strategy to treat and prevent trachoma. The philosophy of the new strategy, which was heavily researched and promoted under the support and guidance of the Edna McConnell Clark Foundation, was to augment the traditional medical approach to the treatment of trachoma with behavioral and environmental changes. The four main interventions the strategy recommended were surgery (service-intensive intervention); antibiotics (product-intensive intervention); face washing (behavioral change intervention); and environmental activities, including water and sanitation programs (environmental control intervention).

The program consisted of a wide-ranging partnership that included five government divisions: the Ministry of Health, the Ministry of National Education, the Ministry of Employment, the Ministry of Equipment, and the National Office for Potable Water. Targets were set—Morocco's political leaders were committed to eliminating trachoma by 2005—and the institutional and policy artillery to support the initiative was quickly put in place. Mobile surgical teams were deployed to small towns and villages to perform a simple, quick, and inexpensive procedure of the eyelid to halt corneal damage in infected patients; treatment campaigns were organized to distribute the newly discovered antibiotic, azithromycin, that could be administered in a single dose; IEC campaigns were launched at the community level with the participation of the Ministry of Education to educate the population about the causes of the disease and how to prevent it; and the National Office for Potable Water has expanded water and sanitation projects in many areas of the country. By 1999, prevalence levels had dropped 75 percent, from 28 to 6.5 percent, and acute infections in children had been reduced significantly.

CONCLUSION

The accumulation of evidence presented in this study should help allay any remaining doubts about whether existing technologies and interventions, proven to be cost-effective in randomized controlled trials, can be successfully deployed to improve the lives and health of people throughout the developing world. The evidence suggests not only that it is possible, but also that it has been achieved in many parts of the world, in many different socioeconomic and political settings.

The study also found important commonalities among programs and projects that appear to have contributed to the successful deployment and rapid scale-up of cost-effective

interventions. Strong leadership, effective management, realistic financing, country ownership, and application of new research findings and technical innovation all played a role in implementation and appeared to have made major contributions to the positive achievements of the cases under review.

In some respects, the study also presents a sobering view of the difficulties inherent in moving from a cost-effective intervention to a successful program or project. No single formula is available, and identification of unique characteristics and attributes that will permit the large-scale, effective deployment of many known interventions is difficult.

In addition, evidence from the case studies suggests that the programmatic characteristics and policies associated with successful outcomes vary depending on the type of intervention. Although no single formula exists, the implementation of the programs and projects structured around various types of interventions appears to depend on certain types of organizational, managerial, and financial capacities that can be anticipated and specifically targeted for strengthening before the full-scale launch of a program or project. Thus, the findings of this study may serve as pointers for future research seeking to understand the range of government capacities that are needed to support the successful deployment and scaling up of interventions in various contexts and in different parts of the world.

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NOTES

1. Unless otherwise indicated, the background information and health impact data presented about the 17 cases reviewed for this study are drawn from Levine and What Works Working Group (2004). All materials are available at www.cgdev.org/publication/millionssaved.

2. According to *World Development Report 2004* (World Bank 2004), because the relationship between provider and client differs, each of the three types of service arrangements will experience a different constellation of market, government, and accountability failures. The report proposes that if these failures are properly addressed and client power

increases, the quality of service delivery will improve, especially among poorer groups.

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