



## Public health

Health services interact with households in two fundamentally different ways. *Public health programs* strike against health problems of entire populations or population subgroups. Their objective is to prevent disease or injury and to provide information on self-cure and on the importance of seeking care. *Clinical services* respond to demand from individuals. They generally seek to cure or to ease the pain of those already sick. This chapter discusses public health; Chapter 5 turns to clinical services.

Public health programs work in three ways: they deliver specific *health services to populations* (for example, immunizations), they promote healthy *behavior*, and they promote healthy *environments*. Governments play a leading role, and provision of information through public education is a central feature of most programs, especially those designed to change behavior. But difficult choices have to be made about the best use of public money. The Expanded Programme on Immunization (EPI), described below, is highly cost-effective, at about \$25 per DALY gained, but not all programs offer such good value for money. This chapter examines six particularly cost-effective public health services in the realms of population-based services (including immunization), nutrition, fertility, tobacco and other drugs, the household and external environment (including control of insect vectors of disease), and AIDS. Public health packages in developing countries should include components in most or all of these six areas.

### Population-based health services

In 1979 the World Health Organization declared that smallpox had been eradicated. It then initi-

ated, in collaboration with UNICEF, a global effort to prevent a range of childhood diseases by immunization. The EPI now reaches about 80 percent of children in developing countries and averts an estimated 3.2 million deaths a year at a cost of \$1.4 billion a year.

Population-based health services such as the EPI rely on personnel with limited training to provide drugs, vaccines, or specific health services directly to specific populations—in schools, at worksites, or in households. Government finance for such programs is justified because the objective is usually to provide services to all in a community, because the services create externalities or indirect benefits, and because the diseases they typically combat are particular problems for the poor. Three types of interventions are immunization, mass treatment for worms and other infections, and screening and referral. Information, education, and communication are critical to many such programs, both to attract participation and to achieve durable change in behavior.

### Immunization

Vaccines to prevent tuberculosis, measles, diphtheria, pertussis, tetanus, and polio have revolutionized preventive medicine over the past two decades. Costs are less than \$10 per DALY gained for measles immunization and less than \$25 for a combination of polio plus DPT (diphtheria, pertussis, and tetanus). These vaccines, together with BCG immunization against tuberculosis and leprosy and immunization of pregnant women against tetanus, form the EPI.

As a result of the EPI, the proportion of children immunized rose from less than 5 percent in 1977 to

20 to 30 percent by 1983. By 1990 coverage with polio, DPT, and measles vaccines had reached approximately 80 percent of all children, and about 35 percent of pregnant women were receiving tetanus toxoid. The lowest vaccine coverage is reported in Sub-Saharan Africa.

Had vaccination coverage remained at the low levels of the 1970s, as many as 120 million DALYs a year (the equivalent of 23 percent of the global burden of disease among children under age 5 in 1990) would be lost to diseases preventable by the EPI. At current levels of vaccination coverage, these diseases cause a loss of 55 million DALYs, or 10 percent of the disease burden among children under age 5 (Table 4.1).

The cost of fully immunizing a child in low-income countries is about \$15, with a range of \$6 to more than \$20, depending on the prices of labor and other local inputs. Reducing the number of contacts needed to immunize each child fully could cut costs dramatically, by as much as 70 percent if only one contact instead of the current five were needed. This prospect depends on the success of ongoing research efforts. Technical improvements in the cold chain (by which vaccines are kept refrigerated until use), good administration, widespread deployment of delivery teams, and effective social mobilization efforts can also contribute to dramatic cost reductions. In the Gambia the cost of immunizations fell from \$19 in 1982 to \$6 in 1988. Costs also depend on the immunization strategy: campaigns achieve high initial coverage, but routine services are more cost-effective. In Ecuador campaigns cost \$66 per DALY gained compared with \$30 for routine services. Because many countries lack the infrastructure to deliver vaccines routinely in remote rural areas, cam-

paigns continue to be justified. In areas with better infrastructure, routine services make more sense.

An ambitious current goal, established in 1988 by WHO's governing body, the World Health Assembly, is to eradicate polio by 2000. Current trends suggest that even if eradication is not achieved on that schedule, it will be soon thereafter. And substantial success has already been achieved: there has been no naturally occurring case of polio in the Western Hemisphere since August 1991.

Two extensions to the EPI appear to be justified. First, coverage should be extended, probably to 95 percent of all children born. The costs of expanding coverage are relatively high, but so are the gains. Those not covered at present often lack any health services and are disproportionately vulnerable to the diseases. Second, it makes sense to include additional items in the package: hepatitis B and yellow fever vaccines for selected countries and vitamin A and iodine supplements in regions where deficiency of these micronutrients is highly prevalent. If micronutrients are not delivered through the EPI, some other vehicle must be found for reaching very young children. Adding these two vaccines and two micronutrients to the EPI (EPI Plus) would improve health substantially, particularly in the poorest households, for a modest increase of about 15 percent in the cost of reaching each child with complete services (vaccine and micronutrients). Table 4.2 summarizes the estimated costs and health benefits of the EPI Plus cluster in two different settings. Total annual costs range between \$2.2 billion and \$2.4 billion for EPI Plus, or less than 2 percent of the public health expenditure of developing countries. Expanding coverage from 80 to 95 percent would probably

**Table 4.1 Burden of childhood diseases preventable by the Expanded Programme on Immunization (EPI) by demographic region, 1990**

<i>Region</i>	<i>Burden (millions of DALYs per year)</i>	<i>Share of the total burden in children under age 5 (percent)</i>	<i>Burden per 1,000 children under age 5 (DALYs)</i>
Sub-Saharan Africa	23	15	242
India	16	12	137
China	1	3	8
Other Asia and islands	7	10	81
Latin America and the Caribbean	.1	3	18
Middle Eastern crescent	7	10	86
Formerly socialist economies of Europe	*	*	1
Established market economies	*	*	1
World	55	10	87

\* Less than 1.

Note: The EPI includes immunizations for pertussis, polio, diphtheria, measles, tetanus, and tuberculosis. These estimates exclude the burden of tuberculosis because most of it falls on adults.

Source: Calculated from Murray and Lopez, background paper.

**Table 4.2 Costs and health benefits of the EPI Plus cluster in two developing country settings, 1990**

<i>Costs and benefits</i>	<i>Low-income countries (high mortality and fertility)</i>	<i>Middle-income countries (low mortality and medium fertility)</i>
Cost per capita (dollars)	0.5	0.8
Cost per fully immunized child (dollars)	14.6	28.6
Cost per DALY gained (dollars)	12-17	25-30
Cost per DALY gained as a percentage of income per capita <sup>a</sup>	0.14	0.03
Potential health gains as a percentage of the global burden of disease	6.0	1.0

Note: Figures are based on 95 percent coverage.

a. Income per capita in 1990 was assumed to be \$350 for low-income countries and \$2,500 for middle-income countries.

Source: World Bank data and authors' calculations.

increase annual costs by between \$500 million and \$750 million. In low-income countries the increase in coverage would reduce by about 6 percent the global disease burden.

#### *Mass treatment for parasitic worm infection*

The most common intestinal worms—roundworms, hookworms, and whipworms—each infect between 170 million and 400 million school-age children annually. Schistosomiasis infection, also caused by parasitic worms, affects almost 100 million school-age children annually. The immediate effects of infection—including failure to thrive, anemia, and impaired cognition—can now be rapidly reversed by low-cost, single-dose oral therapy. Studies of single-course treatment of schoolchildren with hookworm or schistosomiasis in Kenya, with worm-induced disease in India, and with trichuriasis in the West Indies showed remarkable spurts in growth and development in all the populations studied, including the large percentages of children with asymptomatic infections. And treatment also appears to have improved cognitive development.

Curing worm infections is simple with inexpensive modern drugs such as albendazole and praziquantel because it is not necessary to determine which species are present. Furthermore, the high level of safety of these drugs has led WHO to develop protocols for their use on a mass basis (where a high prevalence of infection exists) and by providers who are not medically trained—a combination that makes for high cost-effectiveness. Treatment usually cures the current infection, but in endemic areas children will inevitably become reinfected. A return to pretreatment levels of infection typically takes about twelve months for roundworm and whipworm and twenty-four months or more for hookworm. Rates of reinfection

can be reduced by environmental improvements, especially sanitation, but where this is impractical or unaffordable, it is cost-effective to repeat the therapy at regular intervals.

The benefits of individual treatment can be significantly enhanced by community-wide treatment which, by lowering the overall levels of contamination of the environment with infective stages of the worms, slows the rate of reinfection. Treatment programs targeted at the most heavily infected group (school-age children) reduce infection immediately both among those treated and in the rest of the population. Treatment through schools also allows delivery at relatively low cost: a program in Montserrat was estimated to cost less than \$1.50 per person for a cycle of eight treatments. A program managed by a nongovernmental organization in Jakarta initially cost \$0.74 per capita per year, but after expansion to almost 1,000 schools the costs fell to \$0.26. Such programs are extremely cost-effective, at \$15 to \$30 per DALY gained. In light of this cost-effectiveness and the burden of disease addressed, the Rockefeller Foundation and the UNDP are initiating a major program to document and explore the potential of school-based health interventions that focus on deworming and provision of micronutrient supplements.

#### *Mass screening and referral*

Mass screening for disease control involves the examination of asymptomatic individuals to identify and treat those affected by disease. Although this method has been used to control some infectious diseases, such as tuberculosis, it is mostly used for noncommunicable diseases. Mass screening makes sense for highly prevalent diseases that can be cured by early treatment, especially when latency periods span many years. An example is cer-

vical cancer, which is the leading cause of death from cancer among women in developing countries, accounting for 150,000 deaths each year. Screening with Papanicolaou (Pap) smears is common in industrial countries, but attempts to replicate those efforts in developing countries have rarely been successful. Such programs could, however, be made cost-effective by the use of a simplified design that targets women over 35, screens only every five to ten years, and uses inexpensive outpatient treatment (such as freezing abnormal cells) for severe precancerous conditions. When backed up with good follow-up services, such interventions are cost-effective, at \$150 to \$200 per DALY gained.

### **Diet and nutrition**

Eating well is necessary for good health. Either directly or in association with infectious diseases, inadequate diets account for a large share of the world's disease burden, including as much as a quarter of that among children. Much of this suffering stems from poverty-related underconsumption of protein and energy, but equally important are deficiencies of key micronutrients—iodine, vitamin A, and iron—from which children and women suffer disproportionately. Increasing the incomes of the poor is the most effective means of reducing protein-energy malnutrition, but governments can play an effective direct role through nutrition education, measures to increase consumption of micronutrients, and reduction in diarrheal and parasitic infections among children. Public action is also essential for preventing crop failures from leading to famines.

#### *Malnutrition and ill health*

Low height for a given age, or stunting, is the most prevalent symptom of protein-energy malnutrition; approximately 40 percent of all two-year-olds in developing countries are short for their age (see Appendix table A.6). The prevalence of stunting may be as high as 65 percent in India; it is more than 50 percent in Asia other than India and China and about 40 percent in China and Sub-Saharan Africa. Stunted children are often also underweight or have low weight for their age. Wasting (low weight for a given height) is less prevalent—11 percent or less worldwide except in India, where it reaches 27 percent.

Diets must contain both energy and protein. Because little is known about the relative importance

of adding energy or protein to an initially poor diet, the effect of deficiencies in either or both components is combined under the term "protein-energy malnutrition." Foods rich in protein, such as soybeans and animal products, tend to be relatively costly per unit of energy, and low-cost sources of energy such as cassava tend to be expensive per unit of protein. Because food takes up much of a poor household's budget, choosing the protein-energy balance that is right for health can be difficult.

Protein-energy malnutrition raises the risk of death and may reduce physical and mental capacity. Worldwide, about 780 million people are estimated to be energy deficient according to WHO standards. It is not known how many of them are also protein deficient, or how many people who get enough energy may still suffer from shortage of protein. Exploratory studies of the determinants of human growth suggest that at the margin, the importance of additional protein may be greater than is recognized. Malnutrition is not synonymous with hunger because people who have become accustomed to a deficient diet may not consider themselves hungry. If malnutrition is widespread in the community, underweight and lethargic children look normal to parents who do not know how healthy children behave.

Iron deficiency is the most common micronutrient disorder. It reduces physical productivity and children's capacity to learn in school. By reducing appetite, it may diminish children's intake and growth. Women suffer especially because menstruation and childbearing raise their need for iron, and anemia, a shortage of iron in the blood, increases the risk of death from hemorrhage in childbirth. The problem is worst in India, where 88 percent of pregnant women are anemic. Almost 60 percent of women are anemic in other parts of Asia, but the proportion does not exceed 40 percent in China, Africa, or Latin America. Anemia affects 15 percent of pregnant women in the established market economies.

Iodine deficiency causes mental retardation, delayed motor development, and stunting, as well as neuromuscular, speech, and hearing disorders. It is the leading preventable cause of intellectual impairment in the world. Cretinism from iodine deficiency affects about 5.7 million people, and lack of iodine causes another 20 million to be mentally retarded.

Vitamin A deficiency causes varying degrees of vision loss and is the primary cause of acquired blindness in children. It also increases the severity

**Table 4.3 Direct and indirect contributions of malnutrition to the global burden of disease, 1990**  
(millions of DALYs, except as specified)

Type of malnutrition	Sub-Saharan Africa	India	China	Other Asia and islands	Latin America and the Caribbean	Middle Eastern crescent	Formerly socialist economies	Established market economies	World
<i>Direct effects</i>									
Protein-energy malnutrition	2.2	5.6	1.7	0.9	1.0	1.0	0.2	0.2	12.7
Vitamin A deficiency	2.2	4.1	1.0	2.5	1.4	0.5	0.0	0.0	11.8
Iodine deficiency	1.7	1.4	1.0	1.3	0.5	1.4	0.0	0.0	7.2
Anemia	1.0	4.5	2.7	2.3	1.0	1.5	0.4	0.6	14.0
Total direct	7.0	15.5	6.3	7.0	3.9	4.5	0.6	0.9	45.7
Total DALYs per 1,000 population	13.8	18.3	5.6	10.3	8.9	8.9	1.7	1.1	8.7
<i>Indirect effects (minimum estimate)</i>									
Mortality from other diseases attributed to mild or moderate underweight <sup>a</sup>	23.6	14.9	3.3	8.0	2.4	8.0	0.0	0.0	60.4
Mortality from other diseases attributed to vitamin A deficiency <sup>b</sup>	13.4	14.0	1.0	7.0	1.8	2.0	0.0	0.0	39.1

a. Based on the global burden of disease (GBD) attributable to deaths from tuberculosis, measles, pertussis, malaria, and diarrheal and respiratory diseases in children under age 5; in developing countries 25 percent of those deaths are attributed to mild or moderate underweight.

b. Based on estimated deaths attributable to vitamin A deficiency in the age groups 6–11 months and 1–4 years. These account for, respectively, 10 and 30 percent of all such deaths in high-risk countries and for 3 and 10 percent of all such deaths in other countries. Thirty lost DALYs are attributed to each child death; losses are redistributed to the regional classification used in this Report.

Source: For GBD calculations, Appendix B; for estimate of mortality from underweight, Pelletier 1991; for estimate of mortality from vitamin A deficiency, Humphrey, West, and Sommer 1992.

#### Box 4.1 Women's nutrition

Women suffer more than men from iron deficiency anemia, from stunting caused by protein-energy malnutrition, and from iodine deficiency. The largest gap is for iron deficiency anemia, which affects 458 million adult women but 238 million men. About 450 million women are stunted because of protein-energy malnutrition, compared with 400 million men. Iodine deficiency also affects substantial numbers of women, probably more than for men. Corneal lesions and blindness caused by vitamin A deficiency afflict both sexes equally, but deficiency as such is twice as common for girls as for boys. Women's nutritional problems are worst in South Asia, where prevalences of anemia, protein-energy malnutrition, and vitamin A deficiency are the highest in the world and where, as a result of widespread discrimination, girls and women suffer disproportionately.

Small pelvic size among stunted women increases the risk of maternal and infant mortality, as does maternal anemia. Iodine-deficient mothers give birth to more infants with cretinism and other congenital ab-

normalities. A significant proportion of pregnancies end in poor maternal or infant health as a direct consequence of maternal malnutrition.

Iodine and vitamin A deficiencies tend to be localized rather than widely distributed and could be virtually eliminated through targeted, sporadic interventions, given a reasonable health infrastructure and a high level of political will. Anemia and protein-energy malnutrition, by contrast, affect much larger numbers of women and require more continuous intervention. Distribution of a regular supply of ferrous sulfate tablets can prevent or cure anemia among pregnant and lactating women. Such efforts should include all women of reproductive age, certainly where the prevalence of anemia among women in general exceeds 50 percent. To reduce protein-energy malnutrition, much must be done outside the health sector toward making more food available to households, increasing employment opportunities for women, decreasing the time and energy costs of women's home production, and reducing discrimination against women and girls.

of and mortality from a variety of infections, especially measles and diarrhea. WHO calculates that 13.8 million children have some degree of eye damage because of vitamin A deficiency; of these, 250,000 to 500,000 go blind every year, and two-thirds of the blinded children die. Both vitamin A and iodine deficiency are particularly common in Asia and Sub-Saharan Africa.

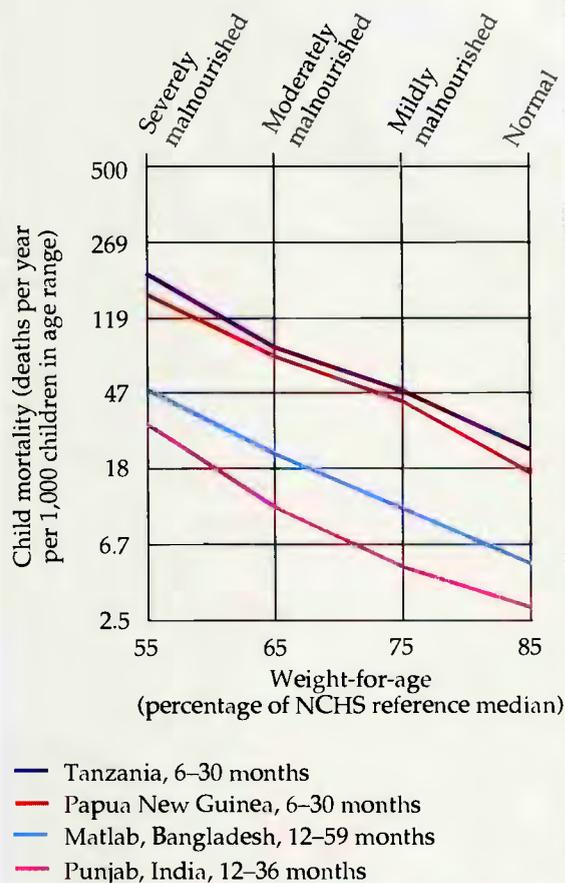
These four diseases of malnutrition caused a direct loss of almost 46 million DALYs in 1990, or 3.4 percent of the global burden of disease (Table 4.3). (The estimates do not include the health damage from deficiencies of other micronutrients. Calcium deficiency may be the most important of these; it causes bone deformities and slows skeletal growth in children, and it may contribute to osteoporosis in the elderly.) The estimated burden is slightly larger for females than males because anemia affects mostly women ages 15–44 (Box 4.1); anemia accounts for 1.3 percent of the total female disease burden but for 24 percent among women in the reproductive ages. Children under 5 are the principal victims of vitamin A deficiency, iodine deficiency, and protein-energy malnutrition. The nutritional disease burden for young children is 32 million DALYs, or 6 percent of their total burden of illness.

The total impact of malnutrition on health is much larger, however, because mild or moderate protein-energy malnutrition and micronutrient deficiencies (as well as overconsumption of energy, fat, salt, and sugar) are risk factors for illness and death. Studies in Asia and Africa consistently show that mild to moderate stunting or underweight in children raises the risk of death (Figure 4.1), contributing to 25 to 50 percent of childhood mortality. The greatest risk occurs for children in their second year, after they are weaned. Malnourished children die principally from measles, diarrheal and respiratory disease, tuberculosis, pertussis, and malaria. Child deaths from these diseases cost 231 million DALYs, making the total burden attributable to malnutrition at least one-fourth that amount, or 60 million DALYs.

Vitamin A deficiency, too, raises the risk of death from other causes. Of the 8 million deaths of children with vitamin A deficiency that occur each year, between 1.3 million and 2.5 million might be prevented by eliminating the vitamin deficiency, for a gain of 39 million to 74 million DALYs. Damage from being underweight and from vitamin A deficiency cannot be added together because many children suffer from both problems. Nonetheless,

*Childhood mortality drops sharply as nutritional status improves.*

**Figure 4.1** Child mortality (in specific age ranges) and weight-for-age in Bangladesh, India, Papua New Guinea, and Tanzania



Note: NCHS, (U.S.) National Center for Health Statistics. The vertical axis shows the child mortality rate, CMR, in log-odds ratio form,  $\log[\text{CMR}/(1000 - \text{CMR})]$ . Thus, for a child in Punjab weighing 60 percent of the reference median, the probability of dying between 12 and 36 months is 18 per 1,000.  
Source: Pelletier 1991.

the total direct and indirect damage from malnutrition is at least 20 to 25 percent of the disease burden in children.

Links between nutrition and growth in childhood persist into adulthood. Both height and

weight affect the risk of adult mortality. For men and women at all ages, greater height is associated with greater survival. Stunted adults are at particularly high risk of cardiovascular disease and obstructive lung disease. If the relative risk of death associated with stunting is the same in low-income countries as for richer populations, approximately 300,000 adult female deaths between the ages of 15 and 59 can be attributed to stunting.

#### *Sources of malnutrition*

Both food consumption and communicable disease affect nutritional status by way of a "malnutrition-infection complex." Food consumption depends both on people's capacity to acquire food and on their knowledge of how to choose a nutritious diet. For infants the chief determinant of nutritional status is whether they are exclusively breastfed for at least the first four to six months of life. In southern Brazil infants who were not breastfed were eighteen times as likely to die from diarrhea and three times as likely to die from respiratory illness as breastfed babies, both because they got less to eat and because of increased risk of infection. After six months children need solid food even if they are still breastfed. The composition and hygiene of this food are crucial to continued good health.

**INCOME AND FOOD SECURITY.** Chronic malnutrition is mostly a consequence of poverty. Higher income allows people to buy a more balanced diet, as well as better hygiene and medical care. In Indonesia during 1984–87 rising incomes translated into reduced malnutrition in nearly all fifty-two regions of the country. The fraction of families eating less than 2,200 calories per person per day—an energy intake adequate for only light physical activity—declined only 2 percentage points, but the decline was 9 percentage points at 1,800 calories and 26 percentage points at 1,400 calories. Conversely, increases in food prices in Côte d'Ivoire during the 1980s reduced the weight of both children and adults. Nutrition is also affected by who in the household controls the money; women's income is more likely than men's to be spent on better nutrition.

Chronic food insecurity for poor people is often made worse by seasonal fluctuations in availability and prices. In India and the Philippines temporal variation in children's food intake is greatest among poor households, and severely malnourished children are more likely to die during that

part of the year when malnutrition is most prevalent. Small variations in diet can be fatal to children already at risk.

The extreme form of this risk is widespread famine as a result of a breakdown in food production, food distribution, or the flow of income with which people buy food. Famines occurred in China in 1959–61, in Bangladesh in 1974, in Ethiopia and the Sahel in 1973–74, in Ethiopia and Somalia in the 1980s, and in Somalia and Sudan in the early 1990s. As many as 30 million people are believed to have died in the Chinese famine and hundreds of thousands in the recent famines in Sub-Saharan Africa. A relatively small number of people die from outright starvation; many die of infectious diseases, to which people weakened by hunger are especially susceptible.

Public action is critical in preventing a food crisis from becoming a famine. A combination of actions is required to ensure that food is available in famine areas (through both market and nonmarket mechanisms) and to sustain the incomes of vulnerable households (through public employment or other transfers). This is particularly difficult when there is a breakdown in order: the major African famines of the past decade were mostly associated with war.

Hunger and crowding into refugee camps facilitate the spread of infectious disease and raise the risk of death from it, particularly when such camps are first established. Control of communicable disease is as crucial as the provision of food or of money to buy food. Even when refugee populations are protected from starvation, they are often exposed to micronutrient deficiencies because they are dependent on just a few foodstuffs. In recent years there have been outbreaks of scurvy (vitamin C deficiency) in Ethiopia and Somalia, pellagra (niacin deficiency) among Mozambican refugees in Malawi, and beri-beri (thiamine deficiency) among Cambodian refugees in Thailand. In nonfamine conditions these diseases make no contribution to the world's burden of disease.

Beyond ensuring food distribution and controlling the diseases that can easily become epidemics in conditions of social and sanitary breakdown, governments have two overriding responsibilities in famines. The first is to recognize the early signs of trouble and act before large numbers of people have become destitute. The second is to allow free flow of information about conditions during the famine so that relief agencies and others can react. Hiding the extent of a disaster only makes it worse.

**DIET AND DISEASE.** Some children receive so little to eat that getting more food is by far the most important means of improving their growth. But for those with a barely adequate diet, controlling infectious disease can be as important as getting more food. (This is the most common situation in poor countries.) In the absence of diarrhea, studies have found little difference in growth in children up to thirty-six months of age despite significant differences in energy intake. Children with both low energy intake and diarrhea grow less. Diarrhea has little effect on the growth of adequately fed children. However, a diet adequate for healthy children may be inadequate under the additional demand imposed by infection.

Control of parasitic worms can also help improve nutrition for older children. Hookworm and other intestinal worm infections cause anemia, and roundworms—the most prevalent of all worms—compete with the host for food. All these infections may suppress appetite and reduce food intake. More than 1 billion people are infected with one or more of these parasites, and about 100 million of them suffer from stunting or wasting. Recent intervention studies show rapid spurts in height after children are treated for worm infections, suggesting that these infections may be significant contributors to malnutrition and that it may be easier to reverse stunting in older children than was previously believed.

Malaria is the other major infection leading to malnutrition, particularly anemia. It is an important risk factor in much of Africa. Control of malaria has led to substantial decreases in the prevalence of anemia.

**LACK OF NUTRITIONAL KNOWLEDGE.** People may eat more poorly than their incomes allow because of ignorance. This is most true for vitamin A; deficiencies persist although almost everywhere in the world foods rich in vitamin A can be grown at low cost in family gardens or commercially. The effect of ignorance cannot be quantified, but it is striking that it often increases the gender or age bias of malnutrition. In a number of Asian and African countries, children and women, especially pregnant women, are discouraged from eating eggs and fruit. Ignorance also interacts with economic factors. When the price of leafy vegetables rich in vitamin A rises in the Philippines, people switch to vegetables containing much less of the vitamin.

**THE NUTRITION TRANSITION AND CHRONIC DISEASE.** Better nutritional status reduces commu-

nicable diseases but can also increase diseases of dietary excess. As diets change, usually to include a smaller proportion of complex carbohydrates and more sugar and animal fat, people become more susceptible to cardiovascular disease and to cancers of the colon, prostate, and breast. Obesity becomes more prevalent and increases the risk of premature death, particularly from cardiovascular diseases and diabetes. Increased sugar consumption contributes to dental caries and may raise the risk of diabetes. High salt intake increases hypertension, raising the risks of stroke and cardiovascular disease. For people eating a modern "Western" diet, a 60 percent reduction in lifetime salt intake would reduce the risk of death from coronary disease at age 55 by 16 percent and the risk of death from stroke by 23 percent. The share of the disease burden attributable to these dietary changes is unknown but may be quite large.

The diseases of overnutrition, which strike people later in life, may seem unimportant compared with those of undernutrition. The burden of cardiovascular disease and of some cancers, however, is already important in Brazil, China, and other developing countries; the demographic and epidemiological transitions documented in Chapter 1 will accelerate this trend. Treatment of chronic disease is often expensive or ineffective, so modifying diet and other risks is the best way of avoiding growth in the burden from these diseases and in unnecessary health care expenditure.

#### *Other interventions for better nutrition*

Six other interventions, in addition to control of infectious diseases, may help to reduce malnutrition: nutrition education, control of intestinal parasites, micronutrient fortification of food, micronutrient supplementation, food supplementation, and food price subsidies. Control of parasites was discussed above; the other five interventions are reviewed here.

**NUTRITION EDUCATION.** Inducing behavioral change—thus enabling families to improve their diets even without additional income—is often the most cost-effective way to improve nutritional status. In Indonesia a large-scale program to teach mothers about child feeding has reduced malnutrition among children at very low cost. In a Colombian program using food supplements and "maternal tutoring," the effects of education on children's height and weight were as large as the effects of extra food. Education about feeding children adequately during illness is particularly im-

portant in dealing with the interaction of malnutrition and infection. It may also ensure that additional food is actually consumed by the family members who need it most.

Probably the most valuable form of nutrition education is promotion of breastfeeding. The principal gain is improved child health, but the nursing mother also benefits from conservation of iron stores (because menstruation is suppressed), better spacing of births, decreased risk of breast or ovarian cancer, and possibly less postpartum bleeding. The economic benefits to families and health facilities can be substantial. Breast-milk substitutes would cost an estimated \$15 billion a year for the 120 million infants now relying on mother's milk. Promotion of breastfeeding in a large Philippine hospital saved 8 percent of the budget by reducing the cost of substitute foods and the time spent in feeding by nursery staff. Such programs require education of both mothers and health professionals (who often discourage breastfeeding)

and may require efforts to compensate for the cost in time that breastfeeding imposes on women. Breastfeeding may be incompatible with some occupations, but in most cases modification of workplace practices can facilitate nursing by working mothers.

**MICRONUTRIENT FORTIFICATION.** Fortifying the foods people already eat raises micronutrient intakes even without a change in eating habits. Brazil's national salt iodization program, which began in 1978, greatly reduced endemic goiter in areas of iodine deficiency. Many experimental programs have also shown the value of fortification. In Chile the addition of iron to powdered milk and soy-based infant formula decreased anemia in nine-month-old babies from 32 to 12 percent and in fifteen-month-olds from 30 to 6 percent. Iron is also often added to flour. Vitamin A can be added to a variety of foods, including sugar, milk, cereals, and monosodium glutamate (MSG). Fortification

#### **Box 4.2 The Tamil Nadu Integrated Nutrition Project: making supplementary feeding work**

In the late 1970s the government of the state of Tamil Nadu in south India was operating twenty-five different supplementary feeding programs. Evaluation showed these programs to be ineffective and identified several reasons. The programs were not directed toward malnourished children; they provided food that was often not suitable for small children and was eaten by other family members; they replaced rather than supplemented home consumption of food; they did not educate mothers; and they failed to provide needed nutrition-related health care. The Tamil Nadu Integrated Nutrition Project, the first phase of which ran from 1980 to 1989, was accordingly designed to target services more effectively, to improve family nutrition and health practices, and to improve maternal and child health services.

Children ages 6–36 months were weighed each month. Of every 100 children selected for feeding, 44 were normal in weight but faltering in growth, 34 were moderately malnourished and faltering, and 22 were severely malnourished. Supplementary feeding was provided immediately to those who were severely malnourished, and feeding for children with faltering growth was provided after one month (for children ages 6–12 months) or three months (for children ages 12–35 months). The children selected were fed for at least ninety days. If they failed to gain at least 500 grams in weight, they were referred to health care, and

feeding was continued for up to 180 days. Intensive nutrition education was directed at mothers of at-risk children. Food supplementation was also offered to women whose children were being fed, to those who had numerous children, and to those who were nursing while pregnant.

The project cut severe malnutrition in half and prevented many at-risk children from becoming malnourished. Of those receiving food supplementation, 67 percent gained enough weight to graduate in ninety days; all except the severely malnourished graduated within 150 days. Because participants were fed only when required, food was only 13 percent of the project's total cost, much less than is typical in supplementation programs. (The initial share dropped during the course of the project as the number of children who needed feeding declined.) When the program began, in 1980, 45 to 50 percent of the children required feeding; by 1988 the project had brought the share down to 24 percent. Selective, limited-duration supplementary feeding worked in Tamil Nadu because the community nutrition workers were well trained and highly motivated and because mothers came to understand the importance of feeding for healthy growth and were pleased when their children grew well. The experience of Tamil Nadu suggests that appropriate supplementary feeding is both an inexpensive and an effective form of nutrition education.

of MSG in Indonesia cut child mortality by 30 percent. Whenever a food consumed by the target population can be fortified at reasonable cost, fortification can provide the same benefits as promoting changes in diet and may be quicker and easier.

**MICRONUTRIENT SUPPLEMENTATION.** Supplying micronutrients separately from food requires regular, sometimes frequent, contact with the target population. This may make it more difficult to sustain high coverage. It may also make supplements more costly than fortification of foods—although micronutrient supplementation can be added at very low marginal cost to immunization programs or school-based deworming programs. Vitamin A can be given in capsules at intervals of one week to six months, reducing the risk of blindness substantially. Vitamin A supplementation can reduce mortality from measles and diarrheal disease by about 30 percent but has little effect on deaths from respiratory disease.

Iodine can also be provided as a supplement to diets. Oral doses of iodized oil protect for two to four years, and injectable oil protects for three to five years. Side effects are usually not serious and occur mostly in older adults. Supplements for women of reproductive age prevent mental retardation in their children and reduce the risks of infant mortality. Iron deficiency is the most difficult micronutrient shortage to combat by supplementation: tablets must be taken every day, and they often cause side effects. Because these problems limit compliance, supplements are usually given only to pregnant women, who suffer most from anemia. When the principal cause of iron deficiency is infection with hookworm and other parasites, however, iron supplements are also given to all those treated for a limited period after deworming.

**FOOD SUPPLEMENTATION.** Programs that provide food instead of micronutrient supplements are harder to implement effectively. Inadequate targeting, replacement of food from the normal diet, or lack of attention to other causes of malnutrition often mean that the food is wasted. With proper targeting and attention to changing behavior, however, some supplementation programs have been made to work. A program in Tamil Nadu, India, achieved remarkable gains by distributing food only when children's growth faltered, while providing information to mothers continuously through highly motivated community nutrition workers (Box 4.2). This success came despite eco-

nomie stagnation. There was no improvement in districts not participating in the program. A large-scale program in Chile substantially reduced childhood malnutrition while increasing the use of the public health system. In many countries free meals for schoolchildren may have little effect on their nutritional status but improve school attendance and performance. In general, food supplementation works best when it is used to motivate and educate mothers to care for their children's health, when it can be concentrated within a crucial interval (during pregnancy, for example), or when it provides additional, nonnutritional benefits.

**FOOD PRICE SUBSIDIES.** Letting people buy basic foodstuffs more cheaply can, in theory, increase intake of particular foods, but there are often practical problems in targeting subsidies to needy households. Targeting by locale or by commodities eaten primarily by poor people is more efficient than wasteful general subsidies but less precise than targeting according to specific needs. Inefficiencies in administration can eat up much of the potential benefit. One large urban subsidy program in Brazil has often sold food for nearly the same price as private markets, despite a nominal 20 percent price reduction. When such waste is avoided, targeted subsidies can effectively transfer income to poor households. As with direct transfers of income or of food, subsidies are more likely to improve nutrition and health when they are combined with nutrition education and related health interventions. Unless that is done, subsidies are not cost-effective.

There is a strong case for government intervention to improve health by improving nutrition, but not for interfering generally in food markets, except in extraordinary conditions such as famine. Government action in nutrition has often been wasteful because it has duplicated what private markets do and has paid too little attention to the causes of poverty and to cost-effective measures that improve families' knowledge and capacity to feed themselves adequately. Reductions in mortality, blindness, mental impairment, and anemia can make fortification and supplementation extremely cost-effective, comparable to the best control measures for other diseases (Table 4.4). A year of healthy life can be bought for less than \$10 with some micronutrient interventions and for less than \$100 with programs that provide food supplements sparingly and combine them with behavioral change and health care. Improved adult health, more productive schooling, higher in-

**Table 4.4 Cost-effectiveness of nutrition interventions**

Intervention	Target group	Approximate cost (dollars)	
		Per death averted	Per DALY saved
Iron supplementation	Pregnant women	800	13
Iron fortification	Entire population	2,000	4
Iodine supplementation	Women of reproductive age	1,250	19
Iodine supplementation	Entire population	4,650	37
Iodization of salt or water	Entire population	1,000	8
Vitamin A supplementation <sup>a</sup>	Children under age 5	50	1
Vitamin A fortification	Entire population	154	4
Food supplementation	Children under age 5	1,942	63
Food supplementation	Pregnant women <sup>b</sup>	733	24

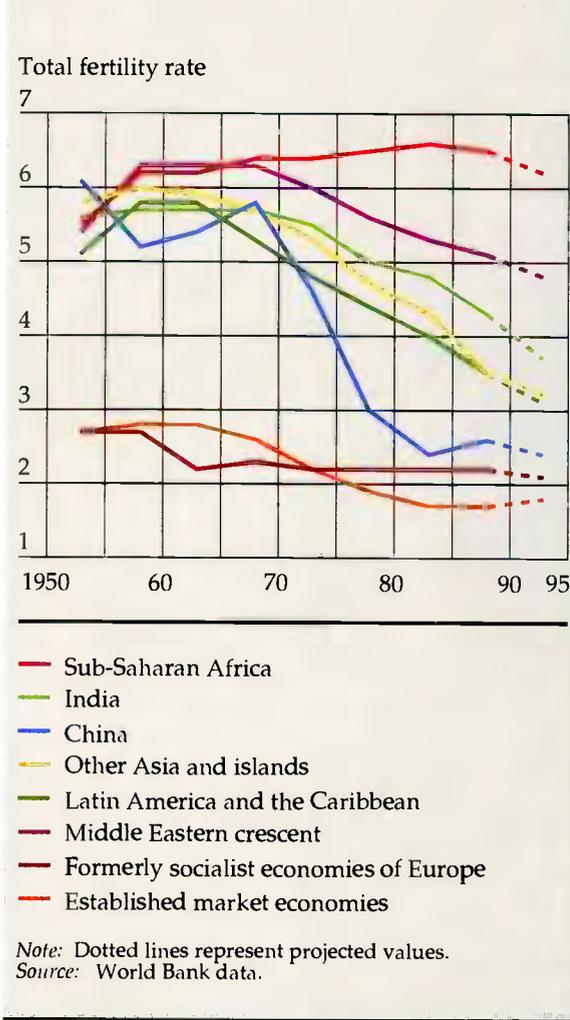
a. Semiannual mass dose.

b. Deaths averted and DALYs saved are for fetal deaths.

Source: Pinstrip-Andersen and others forthcoming; Levin and others forthcoming.

*Fertility has been declining worldwide, but at different paces.*

**Figure 4.2 Total fertility rates by demographic region, 1950–95**



comes, and other benefits that come with good childhood nutritional status strengthen the case for appropriate nutrition interventions.

### Fertility

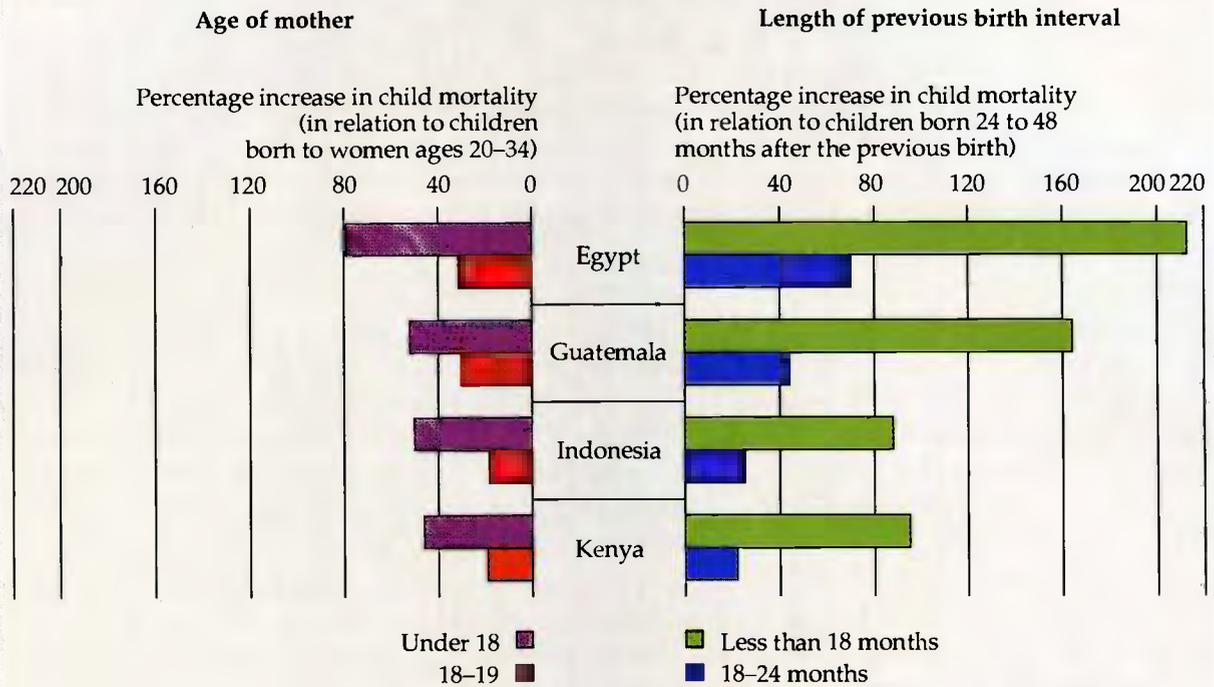
All pregnancies and births carry some health risks to the mother and the child. But the risks are higher when women have health problems (such as high blood pressure, heart disease, malaria, or diabetes) that could be aggravated by pregnancy, when pregnancies come too early or too late in a woman's reproductive life, when they are too closely spaced or are unwanted, and when they occur to high-parity women (for example, those who have already had four or more babies).

The use of family planning services by couples is an effective means of avoiding many of these fertility-related health risks, and it enables families to achieve their fertility goals. In many parts of the world, fertility has been falling over time as the use of family planning spreads (Figure 4.2). Governments can do much to help couples by promoting family planning as a socially acceptable practice, by providing information on the health effects of fertility regulation, by teaching couples about effective methods of contraception, and by removing restrictions on the marketing of contraceptives. Subsidies may be justified in low-income populations, in rural areas, and for programs targeted to young people. Nongovernmental organizations and the private sector will often have a large role in service provision. Ensuring access to safe abortion can complement family planning services in improving health.

### Fertility patterns and health

Births to very young women elevate the health risks to both mother and child. Births that are too

Figure 4.3 Risk of death by age 5 for fertility-related risk factors in selected countries, late 1980s



Source: Hobcraft 1991.

closely spaced increase the risk of child mortality; births at older ages and higher parities are riskier to mothers, as are unwanted pregnancies that lead to unsafe abortion or to neglect of prenatal care.

**THE TIMING OF BIRTHS AND CHILD HEALTH.** Short birth intervals pose substantial risks to child health throughout the first five years of life (Figure 4.3). In Kenya, for example, infants born within eighteen months of the birth of a previous child are more than twice as likely to die as those born after a longer interval. In Egypt the risks are more than triple. Babies born to teenage women are also at greater risk of dying. In Indonesia, for example, babies born to mothers age 18 and under are 50 percent more likely to die than those born to women ages 20-24.

Surveys taken in twenty-five developing countries in the 1980s show that, on average, nearly 35 percent of births occur within twenty-four months of the previous birth and that many women wish

to avoid such births. If the closely spaced births were delayed until mothers wanted them, overall child mortality in those countries might be reduced by more than 20 percent. The reduction could be as large as 30 percent in Brazil, Colombia, Ecuador, Peru, and Tunisia, where between 40 and 50 percent of births are spaced too closely.

**CHILDBEARING AND MATERNAL HEALTH.** Each year about 430,000 women in developing countries die from complications associated with childbearing. In the absence of obstetric care, women who have a birth before age 18 are three times as likely to die in childbirth as those who have a birth between ages 20 and 29; for women over 34, the risk of maternal mortality is five times as high. First births are often riskier than second or third births, but as parity rises thereafter, the risk of maternal mortality also climbs. In Jamaica the risk increases by 65 percent after the third birth. In Kenya, the Philippines, and Zimbabwe 30 to 60 percent of

pregnant women are estimated to be at elevated risk of death on account of either age or parity.

Maternal deaths also arise from unsafe abortion. Almost 30 percent of pregnancies end in abortion, for a total of about 55 million induced abortions in the world each year; 25 million of these are performed under unsafe conditions. The damage to maternal health arises mainly from infection (the long-run consequences of which include ectopic pregnancy, chronic pain, and infertility), hemorrhage, damage to the cervix or uterus, and reaction to anesthesia and the drugs used to induce abortion. About 60,000 women a year are estimated to die from unsafe abortions (see Appendix table B.8); other estimates range as high as 200,000. Treatment of abortion-related complications can consume significant resources. In Brazil in 1988 about 2 percent of all hospital admissions in the publicly financed, privately provided health system were for abortion-related complications, and the costs amounted to about 6 percent of all spending on obstetrics and 1 percent of all hospital spending in that system.

#### *Better health through family planning services*

Family planning services can help women reduce the health risks from mistimed and unwanted pregnancies. In low-income populations and in rural areas there is a strong case on equity grounds for the government to subsidize and organize the provision of family planning services, using public as well as nongovernmental and private channels as appropriate. In these settings subsidized family planning services are often the most effective way of transmitting family planning information to the poor. They can also be an efficient means of improving the welfare of poor families, especially when private medical care is unavailable. For both reasons, family planning services are part of the minimum essential clinical package discussed in the next chapter. Special efforts are also appropriate for addressing the needs of adolescents, both because they tend to be particularly uninformed about reproductive health risks and because they often misjudge the consequences of early childbearing.

Beyond providing subsidized services to specific populations, the government also has a role in ensuring access to family planning services for those able and willing to pay. Encouraging better services and availability of more contraceptive methods requires various changes, including removal of price controls and bans on contraceptive advertising, easing of restrictions on the importa-

tion of contraceptives, and abandonment of unnecessary prescription requirements. Experience in the formerly socialist economies of Europe has shown that all such constraints reduce contraceptive use and often damage maternal and child health. Demand for many contraceptive supplies and services can be met by private doctors and commercial outlets, especially in towns and, for some methods (such as condoms), in rural areas as well.

Use of contraceptives is the best way to avoid unwanted pregnancies, but it is not foolproof. For women who wish to terminate their pregnancies, access to safe abortion as a complement to contraceptive services is also important to women's health.

**REACHING LOW-INCOME AND RURAL POPULATIONS.** The health infrastructure in poor countries is often limited in its ability to reach highly dispersed populations in rural areas. In rural Uganda, for example, travel time to the nearest family planning facility averages one hour, whereas it is only fifteen minutes in rural Thailand. Long waits at the facility are another problem; a study of clinics in several Latin American countries found that waiting times for initial visits averaged one hour and twenty minutes. In many countries rural women have no access to family planning fieldworkers who can provide information and simple services. In Guatemala, for example, 86 percent of rural women live in communities without a family planning fieldworker; in Egypt the figure is only 33 percent. Community-based strategies have been used with success in some countries to reach low-income women. In Colombia, Zaire, and Zimbabwe community-based-distribution (CBD) workers serve the dual purpose of spreading information about family planning and providing the most isolated populations with family planning methods—primarily barrier methods, such as condoms and foaming tablets, but also oral contraceptives.

Family planning services provided through community-based distribution are a highly cost-effective means of improving maternal and child health. In countries where both mortality and fertility are still relatively high, the cost per child death averted is extremely low. In Mali, for example, it averages about \$130, which corresponds to a mere \$4 to \$5 per DALY gained. In other countries, such as Colombia, Mexico, and Thailand—where mortality and fertility are substantially lower—CBD family planning services cost no more than

\$25 per DALY gained and thus remain highly cost-effective.

**REACHING YOUNG PEOPLE.** In developing countries childbearing among teenage women (ages 15–19) is common. Surveys in the 1980s in Liberia, Mali, and Uganda show that more than one in five teenage women had had at least one child or was pregnant at the time of the interview. In Latin American and Caribbean countries 16 percent of all births in 1992 were to teenage mothers. Adolescent pregnancies are often unintended and tend to be more prevalent among low-income women. In both Ghana and Kenya, for example, about 40 percent of married teenagers who have had children said their first pregnancies were unintended; among unmarried teenagers the proportion of unintended births rose to 58 percent in Ghana and 77 percent in Kenya. A 1986 study of Brazilian women showed that 65 percent of those who became mothers before age 20 came from poor families (that is, those with household income below the national median), in contrast to 48 percent for women who delayed childbearing.

Family life education in schools and other venues can help teenagers make informed choices about sexual behavior and the prevention of sexually transmitted disease (STD). Family planning services are needed to help sexually active adolescents prevent pregnancies. And programs to help teenagers cope with unintended pregnancies, especially premarital ones, can be especially valuable. In Jamaica the Women's Center Program has had some success in helping young mothers to complete their schooling after childbirth and to avoid another mistimed pregnancy.

**IMPROVING SERVICES AND ENCOURAGING GREATER VARIETY IN METHODS.** The quality of family planning services in developing countries has been improving, but more can be done. Providing good counseling to clients is important, in part because women's contraceptive needs change over the reproductive life cycle. Temporary methods are more appropriate earlier in the cycle, while permanent methods are more appropriate toward the end. And certain methods are more or less suitable depending on the duration of protection desired and on whether the woman is breastfeeding. Competent advice offered with sensitivity can help clients choose the right method at each stage and use it effectively while also addressing their concerns about possible side effects. Dissatisfaction with services and contraceptive failure often cause

women to discontinue contraceptive use. In Thailand and Colombia, where the programs offer good services, about 6 percent of users quit each year for these reasons; in Paraguay as many as 18 percent of users discontinue annually.

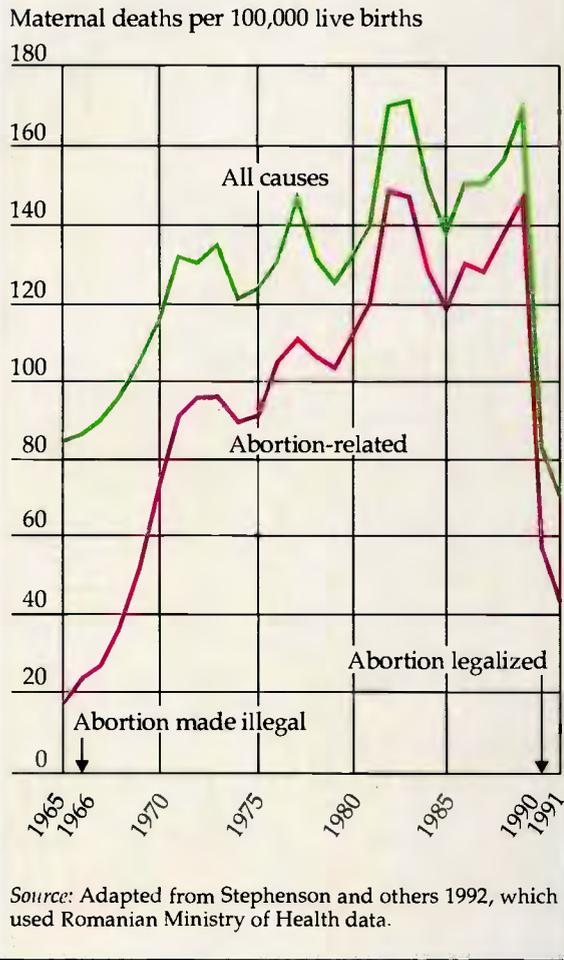
There is considerable scope for broadening the range and quality of contraceptive methods. India, for example, has for a long time heavily emphasized sterilization and offered attractive financial incentives to both clients and providers. A nationwide survey in 1986–87 showed that among non-sterilized couples seeking a temporary method of contraception, nearly 75 percent of those who wanted intrauterine devices (IUDs) reported failure to get them, 67 percent reported failure to get contraceptive pills, and 40 percent reported not being able to get condoms. In China, where steel-rod IUDs have been in widespread use, the government, because of concern about the risk to women's health, recently decided to switch to the safer Copper-T IUDs. In some countries the range of available methods is constrained because public sector providers are required to use products on an essential drug list and the list mistakenly excludes some contraceptive methods. Other constraints on method availability include excessively restrictive medical screening requirements, unnecessary or duplicative approval procedures, packaging and labeling requirements that perform no useful function but increase costs, and import restrictions or tariffs. A study in Indonesia that surveyed a group of women eighteen months after they started using contraceptives found that, all else being the same, women who failed to get their contraceptive method of choice were more than three times as likely to have discontinued use as women who did receive their preferred method.

Providing an appropriate mix of contraceptive methods can also help to reduce the spread of STDs and human immunodeficiency virus (HIV). Linking the provision of family planning services with screening programs for STDs requires a clinical setting in which positive diagnoses may be followed up with treatment. The discussions of AIDS in this chapter, below, and in Chapter 5 address this point in more detail.

**ENSURING ACCESS TO SAFE ABORTION.** In 1990 about 40 percent of the world's population lived in countries where induced abortion was permitted on request, 25 percent lived where it was allowed only if the woman's life was in danger, and the remaining 35 percent lived in places where abortion laws varied in strictness between these ex-

*In Romania, maternal deaths shot up when abortion was banned and fell sharply when it was legalized.*

**Figure 4.4 Maternal mortality in Romania, 1965–91**



tremes. In countries where abortion is illegal, women resort to clandestine, and often unsafe, abortions at high risk to their health. Legalizing abortion is inadequate for protecting maternal health when problems with access continue. In India, for example, abortion is legal but not readily available, and many women continue to rely on unsafe abortion, with detrimental effects to their health.

Romania's experience is the most striking example of the impact of abortion laws on maternal health. In 1966 the government banned abortion and contraception and took steps to enforce the law. The consequences were dramatic: by 1970 the

maternal mortality rate had risen by nearly 40 percent above the level in 1965 (Figure 4.4). Before 1966 Romania's maternal mortality rate was similar to the rates in other Eastern European countries. By 1989 it was at least ten times the rate of almost any other European country. In 1990 Romania's new government legalized abortion, and the decline in maternal mortality was immediate and even sharper than its rise following the ban: only one year after abortion was legalized, maternal mortality had fallen to just 40 percent of the 1989 level. The percentage of all maternal deaths caused by abortion dropped from nearly 90 percent before the ban on abortion was lifted to just over 60 percent in 1990.

**COSTS AND POTENTIAL GAINS IN HEALTH.** Family planning services, particularly when delivered through community-based distribution, are among the most cost-effective means of improving maternal and child health. There is much scope for improving services in developing countries, where more than one woman in five who wants to avoid pregnancy is not using contraception. In Bolivia, Ghana, Kenya, Liberia, and Togo at least one in three women ages 15–49 falls into this category. Lack of access to family planning services is one reason for not using them—although it is certainly not the only one. The cost of supplying family planning services to women without access (numbering an estimated 120 million in the developing world) is estimated at about \$2 billion annually for developing countries as a whole. Selective allocation of public resources to address the needs of these women, particularly those in poor families, would be a cost-effective means of promoting their well-being, as well as that of their children. Satisfying the expressed wish of women to space or limit future births might each year avert as many as 100,000 maternal deaths and 850,000 deaths among children under 5.

### Reducing abuse of tobacco, alcohol, and drugs

Decisions about the use of tobacco, alcohol, and other drugs are among the most important health-related choices that individuals can make. Because individual options are limited by the strongly addictive character of these substances, and because addiction is often established in adolescence, decisions about the control of tobacco and other addictive substances are among the most important health-related choices that societies can make collectively. In many populations prolonged cigarette

smoking is already the greatest single cause of premature death. Alcohol and other drugs also contribute to disease and disability. The damage from substance abuse is not limited to the individuals involved; others also suffer indirectly because of drunk driving, fires, passive smoking, and drug-related crime and violence.

Several sorts of government policy can be used to discourage consumption of tobacco, alcohol, and other drugs. Educating the public about the harmful effects of these substances is essential. Appropriate action will often involve special emphasis not only on reaching school-age children but also on helping adults to escape from addiction. Tax policies on tobacco and alcohol have also reduced consumption, especially by discouraging use by young adults before they become addicted. Governments can ban all direct or indirect advertising or promotion of tobacco goods or trademarks and could do the same for alcohol.

### *Tobacco*

Tobacco is in legal use everywhere in the world, yet it causes far more deaths than all other psychoactive substances combined. About 3 million premature deaths a year (6 percent of the world total) are already attributable to tobacco smoking. If current trends continue, deaths from tobacco worldwide are projected to reach 10 million a year, or more than 10 percent of total deaths, by the second quarter of the next century. Tobacco is already responsible for 30 percent of all cancer deaths in developed countries, including deaths from cancers of the lung, oral cavity, larynx, esophagus, bladder, pancreas, and kidney. Even more people die from tobacco-related diseases other than cancer, including stroke, myocardial infarction, aortic aneurysm, and peptic ulcer. In countries where smoking has long been widespread, tobacco use is now responsible for about 30 percent of all male deaths in middle age. Smoking also harms the health of others. Among nonsmokers, exposure to environmental tobacco smoke increases the risk of lung cancer. And the babies of mothers who smoke weigh, on average, 200 grams less at birth than those of nonsmokers.

Per capita consumption of tobacco is decreasing slowly in industrial countries and has remained relatively unchanged in the formerly socialist economies. By contrast, per capita tobacco consumption is rising in many developing countries among both men and women and is expected to increase by about 12 percent between 1990 and 2000 (see Appendix table A.6). In China the in-

crease in consumption from 500 billion cigarettes in 1978 to 1,700 billion in 1992 has produced smoking patterns that, if they persist, will eventually result in about 2 million deaths a year from tobacco. Similar consumption patterns exist in several other countries. If, as now, about one-third of the world's young adults become regular cigarette smokers and, as in industrial countries, more than one-third of them die prematurely because of the habit, then, of the 120 million who reach adult life each year, more than 10 percent—more than 12 million a year—will die prematurely because of tobacco. On current smoking patterns, the chief uncertainty is not whether mortality from tobacco will reach 12 million a year in the second quarter of the next century, but exactly when it will do so.

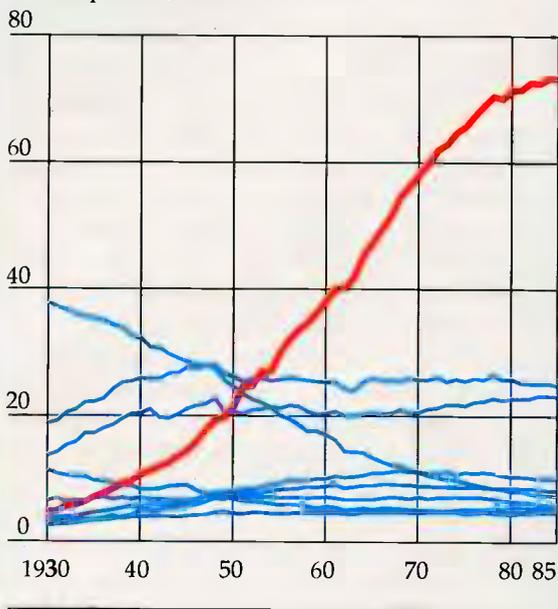
Largely because of the long delay between cause and full effect, people tend to misjudge the hazards of tobacco. When a generation of young adults begins to smoke, they do not witness the high mortality associated with their behavior until they reach middle age. The best-documented example of this delay is that of men in the United States, among whom the main increase in smoking took place before 1945. In 1945 smoking was common but lung cancer rare, as in developing countries today. Over the next forty years (1945–85) the smoking habit did not change greatly among young men in the United States, but lung cancer in this population rose sharply (Figure 4.5). Among U.S. nonsmokers lung cancer remained approximately constant at a low level during 1965–85, but among smokers the rates increased twentyfold. In 1985 tobacco caused the large majority (110,000) of all lung cancer deaths, among both males and females, in the United States, as well as an even larger number (290,000) of deaths from other diseases, for about 20 percent of 2 million U.S. deaths. About half of those killed by tobacco were still in middle age (35–69) and thereby lost almost twenty-five years of nonsmoker life expectancy.

Effective discouragement of addiction to tobacco involves slow social changes that take place over many years. Public education is central to this process. In China, the United Kingdom, and the United States, autonomous national action groups such as Action on Smoking and Health have helped sustain serious efforts to alert people to the hazards of tobacco consumption and, through legal action, to protect the public from the harmful health effects of the habit. Governments can contribute to the efforts of citizen groups by, for example, requiring prominent health warnings on ciga-

*The spread of cigarette smoking among U.S. males was followed by mounting lung cancer rates—but only after a decades-long delay.*

**Figure 4.5 Trends in mortality from lung cancer and various other cancers among U.S. males, 1930–90**

Deaths per 100,000 males<sup>a</sup>



— Lung cancer  
— Various other cancers

Note: Other cancers shown include leukemia and cancers of the bladder, esophagus, pancreas, liver, prostate, stomach, and colon and rectum.

a. Adjusted to the age structure of the U.S. population in 1970.

Source: Boring, Squires, and Tong 1993.

rette packages and advertisements, as well as by targeting of clear messages not only to school-age children but also to adults. Reaching adults is important because over the next few decades it is those who are already smoking who will account for nearly all of the tens of millions of deaths per decade caused by tobacco. Some countries go further by banning commercial promotion of tobacco goods and tobacco trademarks and by placing restrictions on public smoking. Singapore has been in the forefront of public activism in Asia: it has prohibited advertising (since 1971), issued strong warnings on health effects, and created smoke-

free zones. Tobacco consumption per adult appears to have fallen between 1975 and 1990. China, with 300 million smokers, is following a similar path: in 1992 it banned most tobacco advertising, mandated health education for youths, prohibited smoking in many public places, and required progressive reduction of tar levels. In support of countries' efforts to discourage tobacco consumption, the World Bank in 1992 set forth a new policy on tobacco (Box 4.3).

Tobacco has traditionally been taxed, although probably because it is a good source of revenue rather than for the health gains. Taxation reduces consumption, especially among the young. In industrial countries a 10 percent price increase reduces consumption by about 4 percent in the general population and about 13 percent among adolescents. Besides having few resources, most adolescent smokers probably have not been smoking long enough to be fully addicted and so tend to be more price sensitive than other smokers. In India cigarette sales declined by 15 percent after the excise tax on most of the popular cigarette brands more than doubled in 1986. In Papua New Guinea a 10 percent increase in the tobacco tax reduced consumption by 7 percent.

#### *Alcohol and illegal drugs*

Alcohol-related diseases affect 5 to 10 percent of the world's population each year and accounted for about 3 percent of the global burden of disease in 1990. Of the 2 million alcohol-related deaths that occur worldwide each year, about 50 percent stem from cirrhosis of the liver, about 35 percent from cancer of the liver or esophagus, 10 percent from alcohol dependence syndrome, and 5 percent from injuries caused by motor vehicles. The problems caused by alcohol abuse consume scarce medical resources and extend beyond the damage that drinkers do to themselves. In many Latin American countries in the 1980s, 20 percent of all hospital and emergency room admissions were alcohol-related. In Papua New Guinea more than 85 percent of fatal road accidents in the 1980s involved either drunk drivers or drunk pedestrians. Within households, drinking often leads to assault and injury, although the scale of the problem is hard to quantify.

Alcohol consumption is stable in the industrial world but is on the rise in many developing countries. Between 1960 and 1981 annual beer consumption per capita rose from 12 liters to 135 liters in Gabon and from 3 liters to 20 liters in Côte d'Ivoire. Total world production of beer nearly

### Box 4.3 World Bank policy on tobacco

In 1992, in recognition of the adverse effects of tobacco consumption on health, the World Bank articulated a formal policy on tobacco. The policy contains five main points.

- The World Bank's activities in the health sector—including sector work, policy dialogue, and lending—discourage the use of tobacco products.

- The World Bank does not lend directly for, invest in, or guarantee investments or loans for tobacco production, processing, or marketing. However, in the few countries that are heavily dependent on tobacco as a source of income and of foreign exchange earnings (for example, those where tobacco accounts for more than 10 percent of exports) and especially as a source of income for poor farmers and farmworkers, the World Bank treats the subject within the context of responding most effectively to these countries' development

requirements. The World Bank seeks to help these countries diversify away from tobacco.

- To the extent practicable, the World Bank does not lend indirectly for tobacco production activities, although some indirect support of the tobacco economy may occur as an inseparable part of a project that has a broader set of objectives and outcomes (for example, rural roads).

- Unmanufactured and manufactured tobacco, tobacco-processing machinery and equipment, and related services are included on the negative list of imports in loan agreements and so cannot be included among imports financed under loans.

- Tobacco and tobacco-related producer or consumer imports may be exempt from borrowers' agreements with the Bank to liberalize trade and reduce tariff levels.

doubled between 1970 and 1989, far surpassing population growth, with much of the increase occurring in developing regions.

As with alcohol, abuse of illegal drugs causes serious health and social problems. Individuals run the risk of death from infectious, circulatory, respiratory, and digestive diseases, as well as from violence, overdose, and AIDS. Users of cocaine, especially in the form of "crack," often suffer acute cardiovascular problems that require emergency room services, and the babies of pregnant users of cocaine are often born with severe health problems.

Reliable data on trends and patterns in illegal drug use are scarce. Users typically fall in the age group 15–44, although most are in their mid-twenties. In the past decade the production and consumption of illicit drugs, especially cocaine, appear to have increased considerably worldwide. In some developing countries the use of psychoactive drugs such as inhalants is also a serious problem.

Taxes and judicial penalties have been used to discourage alcohol abuse. A 1982 U.S. study indicated that an increase in the liquor tax of about \$3.50 (at 1991 prices) per gallon equivalent of pure alcohol would lower demand enough to reduce the incidence of liver cirrhosis by 5 percent in the short run and perhaps twice as much in the long run. In industrial countries mandatory license sanctions on drunk drivers are estimated to decrease traffic fatalities by about 10 percent; the imposition of a minimum legal drinking age and the assessment of relatively large mandatory fines

(that is, about one to two months' wages) are estimated to reduce traffic fatalities by about 5 percent. Mandatory jail sentences for drunk driving have also been weakly effective. The effect of information campaigns concerning alcohol consumption has not been quantified, but there is evidence that in countries where alcohol is legal but commercial promotion is not, per capita alcohol consumption is 30 percent lower than elsewhere and deaths from motor vehicle accidents are 10 percent fewer. As a successful alcohol rehabilitation program in south India demonstrates, community efforts are generally more effective than medical interventions in helping individuals to overcome alcohol dependence, in part because of the importance of sustained encouragement, which is more easily offered by the community than by health service institutions.

Prohibition is a common approach to drug abuse. In the United States prohibition as an approach to control of alcohol failed early in this century. It appears to be having, at best, limited success in controlling use of other drugs now. In other settings, including Malaysia and Singapore, prohibition coupled with a mandatory death penalty for drug trafficking appears to have been more effective. The successes achieved in controlling the use of alcohol and tobacco—through restrictions on promotion and access, high taxation, rehabilitation of addicts, and public education—may also be relevant for efforts against other drugs. For alcohol and tobacco, past successes with these measures should spur efforts toward full implementation.

## Environmental influences on health

The environment in which people live has a huge influence on their health. For poor people and poor regions, it is the household environment that carries the greatest risks to health. By providing information, reducing poverty, and facilitating and stimulating private sector action, governments can deploy potent mechanisms to improve this environment. Potential health gains from these efforts total nearly 80 million DALYs a year in developing countries. Other government actions, designed to ameliorate or remedy unsafe conditions in the workplace and pollution of the ambient environment, could save 36 million and 8 million DALYs a year, respectively. Finally, feasible reductions in the toll taken by road traffic injuries could avert the loss of 6 million DALYs a year.

### *The household environment*

Poor households generally live in a domestic environment with high health risks caused by poor sanitation and inadequate water supply (often

compounded by poor hygiene), inadequate garbage disposal and drainage, heavy indoor air pollution, and crowding. The diseases associated with poor household environments occur mainly in developing countries, where they account for nearly 30 percent of the total burden of disease (Table 4.5). Modest improvements in household environments would avert almost a quarter of this burden, mostly as a result of reductions in diarrhea and respiratory infections.

**WATER AND SANITATION.** About 1.3 billion people in the developing world lack access to clean and plentiful water, and nearly 2 billion people lack an adequate system for disposing of their feces (Figure 4.6). Feces deposited near homes, contaminated drinking water (sometimes caused by poorly designed or maintained sewerage systems), fish from polluted rivers and coastal waters, and agricultural produce fertilized with human waste are all health hazards. Water quantity is as important as water quality. Washing hands after defecation and before preparing food is of particular impor-

**Table 4.5 Estimated burden of disease from poor household environments in demographically developing countries, 1990, and potential reduction through improved household services**

<i>Principal diseases related to poor household environments<sup>a</sup></i>	<i>Relevant environmental problem</i>	<i>Burden from these diseases in developing countries (millions of DALYs per year)</i>	<i>Reduction achievable through feasible interventions (percent)<sup>b</sup></i>	<i>Burden averted by feasible interventions (millions of DALYs per year)</i>	<i>Burden averted per 1,000 population (DALYs per year)</i>
Tuberculosis	Crowding	46	10	5	1.2
Diarrhea <sup>c</sup>	Sanitation, water supply, hygiene	99	40	40	9.7
Trachoma	Water supply, hygiene	3	30	1	0.3
Tropical cluster <sup>d</sup>	Sanitation, garbage disposal, vector breeding around the home	8	30	2	0.5
Intestinal worms	Sanitation, water supply, hygiene	18	40	7	1.7
Respiratory infections	Indoor air pollution, crowding	119	15	18	4.4
Chronic respiratory diseases	Indoor air pollution	41	15	6	1.5
Respiratory tract cancers	Indoor air pollution	4	10 <sup>e</sup>	*	0.1
All the above		338	—	79	19.4

\* Less than one.

Note: The demographically developing group consists of the demographic regions Sub-Saharan Africa, India, China, Other Asia and islands, Latin America and the Caribbean, and Middle Eastern crescent.

a. The diseases listed are those for which there is substantial evidence of a relationship with the household environment and which are listed in Appendix B. Examples of excluded conditions are violence related to crowding (because of lack of evidence) and guinea worm infection related to poor water supply (not listed in Appendix B).

b. Estimates derived from the product of the efficacy of the interventions and the proportion of the burden of disease that occurs among the exposed. The efficacy estimates assume the implementation of improvements in sanitation, water supply, hygiene, drainage, garbage disposal, indoor air pollution, and crowding of the kind being made in poor communities in developing countries.

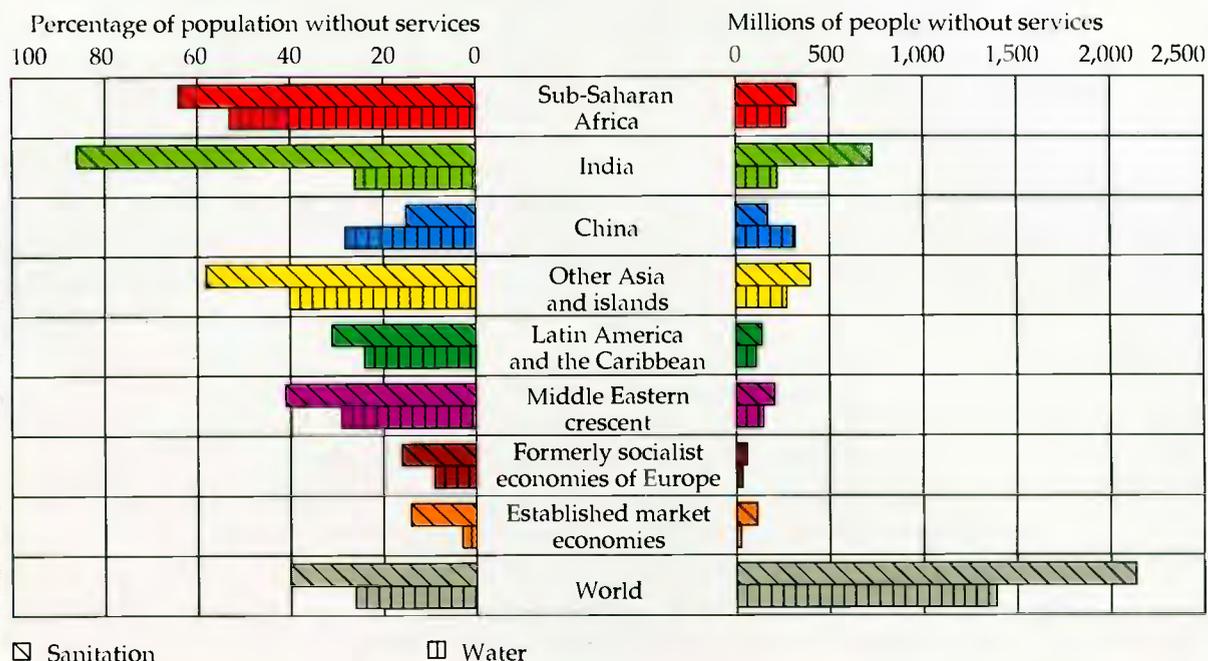
c. Includes diarrhea, dysentery, cholera, and typhoid.

d. Diseases within the tropical cluster most affected by the domestic environment are schistosomiasis, South American trypanosomiasis, and Bancroftian filariasis.

e. Based on very inadequate data on efficacy.

Source: Appendix tables B.2 and B.3 and authors' calculations.

Figure 4.6 Population without sanitation or water supply services by demographic region, 1990



Note: Coverage is defined in accordance with local standards.  
Source: World Health Organization data.

tance in reducing disease transmission, but without abundant water in or near the home, hygiene becomes difficult or impossible. The lack of water supply and sanitation is the primary reason why diseases transmitted via feces are so common in developing countries. The most important of these diseases, diarrhea and intestinal worm infections, account for an annual burden of 117 million DALYs, or 10 percent of the total burden of disease in developing countries. In addition, an inadequate water supply increases the risk of schistosomiasis, skin and eye infections, and guinea worm disease (Box 4.4).

**INDOOR AIR POLLUTION.** Indoor air pollution, which *World Development Report 1992* identified as one of the four most critical global environmental problems, probably exposes more people worldwide to important air pollutants than does pollution in outdoor air. Whereas air in such cities as Delhi, India, and Xian, China, contains a daily average of 500 micrograms per cubic meter of total

suspended particulates, smoky houses in Nepal and Papua New Guinea have peak levels of 10,000 or more. Rural people in developing countries may receive as much as two-thirds of the global exposure to particulates. Women and young children suffer the greatest exposure.

Indoor air pollution contributes to acute respiratory infections in young children, chronic lung disease and cancer in adults, and adverse pregnancy outcomes (such as stillbirths) for women exposed during pregnancy. Acute respiratory infections, principally pneumonia, are the chief killers of young children, causing a loss of 119 million DALYs a year, or 10 percent of the total burden of disease in developing countries. Data from the Gambia, Nepal, South Africa, the United States, and Zimbabwe suggest that reducing indoor air pollution from very high to low levels could potentially halve the incidence of childhood pneumonia.

Adults can suffer chronic damage to the respiratory system from indoor pollution. Studies in China, India, Nepal, and Papua New Guinea have

#### Box 4.4 After smallpox: slaying the dragon worm

Guinea worm disease, or dracunculiasis ("infection with a little dragon"), was endemic from ancient times in a belt stretching from West Africa through the Middle East to India and Central Asia. It has been successfully eliminated from the Central Asian republics and from Iran, where the last case was seen in the 1970s, and it has spontaneously disappeared from most of the Middle East and from several African countries, such as the Gambia and Guinea. There are now probably fewer than a million cases worldwide.

The disease does not kill people, but it causes pain and disability to its victims for several weeks in the year as the 60-centimeter-long female worm emerges from a blister, usually on the leg. In some cases the disability is permanent. The worms usually emerge in the early rainy season, the time when the incapacitated victims would otherwise be planting and weeding their crops. Children whose parents are stricken by guinea worm are more likely to be malnourished in the following year.

Because dracunculiasis can only be caught by drinking infected water, improving the water supply is an important preventive measure. Health education is also essential. Villagers need to be persuaded to stay

out of sources of drinking water when they have guinea worm blisters on their legs and to filter their water with a cloth if they do not have a safe water source.

Eradication of dracunculiasis by the end of 1995 has been adopted as an international goal. Pakistan may have achieved eradication in 1992, and Cameroon, India, and Senegal may do so in 1993. Between 1987 and 1992 cases reported per year fell from 653,000 to 201,000 in Nigeria, from 180,000 to 33,000 in Ghana, and from 17,000 to 900 in India. In general, these advances have been achieved through "vertical" programs—that is, programs specific to dracunculiasis. The eradication of the disease from the poor, sparsely populated endemic countries in West Africa will, however, require integrated programs in which the resources available for guinea worm control are shared with other activities, such as immunization. A by-product of guinea worm eradication will be community-based surveillance systems, which can be used by communities to monitor and improve their own health and by public health workers to combat other diseases, such as polio.

shown that up to half of adult women (few of whom smoke) suffer from chronic lung and heart diseases. Nonsmoking Chinese women exposed to indoor coal smoke (which is especially harmful) have a risk of lung cancer similar to that of men who smoke lightly. Comprehensive improvement in indoor air quality in the developing countries might avert a loss of 24 million DALYs each year by reducing the burden of acute respiratory infections and chronic respiratory diseases by 15 percent and of respiratory tract cancers by 10 percent (Table 4.5).

**HOUSING.** In many cities 30 to 60 percent of the population live in overcrowded and deteriorating shanties, tenements, and boardinghouses. Crowding is associated with increased airborne infection and personal violence. Poor structures lead to greater exposure to heat, cold, noise, dust, rain, insects, and rodents. And housing locations are often unhealthy because of, for example, poor drainage.

**POLICIES FOR IMPROVING THE HOUSEHOLD ENVIRONMENT.** The most powerful forces for reducing domestic risks to health are rising incomes and increased education for household members. Higher incomes make it possible for people to af-

ford the household improvements, including better water and sanitation services, that they desire. As people acquire more education, their hygiene improves, and their responsiveness to public information programs increases. To support households' efforts, governments have an important role in setting and enforcing appropriate environmental standards and disseminating information, for example, the health benefits of good hygiene and the effects of exposure (especially of babies) to smoke. Governments should also concentrate on strengthening security of tenure (which is essential for encouraging households to invest in their housing) and on establishing a legal, regulatory, and administrative framework that facilitates responsive, accountable, and efficient provision, often by private suppliers, of services that people want and are willing to pay for. And they should refrain from supplying services directly and from granting indiscriminate, widespread subsidies. Such subsidies are often captured by wealthier consumers, go for improvements that households would make anyway, or encourage consumption patterns that are detrimental to health. (For example, subsidies for coal used in cooking lead to more indoor air pollution than would be the case with cleaner liquid or gas fuels.)

Past experience in water and sanitation illustrates the limitations of direct government provision of household services. Despite technical progress in developing affordable engineering solutions to the problems of water, sanitation, drainage, and housing, the delivery and maintenance of these services, especially by governments, have been disappointing. At the end of the International Drinking Water Supply and Sanitation Decade (the 1980s), most people in the poorer regions of the world still lacked sanitation, and the number of urban residents without water had not been reduced.

Supply-side failures are largely caused by inefficient and unresponsive public sector monopolies which, in the water sector, typically provide subsidized services at between one-third and two-thirds of the full economic cost. Massive public investments, often supported by the donor community and the World Bank, have been made in public or quasi-public agencies responsible for the delivery and maintenance of household services. The net result has often been bloated public agencies with low accountability to their customers and few incentives for improving efficiency; a middle class that is increasingly well served with subsidized services; a

poorer class that receives little or no service; and a ripe environment for political patronage.

The poor usually miss out on both services and subsidies. They suffer the substantial health consequences described in Table 4.5 and pay high prices for inadequate services. In Lima poor people may pay \$3 for a cubic meter of contaminated water collected by bucket from a private vendor, while the middle class pays 30 cents per cubic meter for treated water provided on tap in their houses by the publicly subsidized water company.

Broadly based subsidies are not necessary for ensuring access to safe water and sanitation. In most urban communities households are willing to pay the full costs of water service and often the full cost of sanitation services. Willingness to pay for water may be high in rural areas as well, but what people can afford is commonly not enough to cover the high costs of supply. Subsidy may be justified in such situations. But the rationale should be primarily one of redistribution: a society may choose to provide cheap water or other services to the poor as one of many alternative means of improving their welfare. Health benefits alone do not generally provide a rationale for public subsidy of water and sanitation (see Box 4.5).

#### **Box 4.5 The costs and benefits of investments in water supply and sanitation**

People want safe water and good sanitation and are willing to pay for these services, especially for plentiful water in or very near the home. Improvements in water supply raise productivity through savings in the fuel used to boil polluted water and, even more important, through the time and energy savings for women who have to collect water from distant sources. Provision of public handpumps in Imo State, Nigeria, reduced the median time that each household spent on water collection in the dry season from six hours a day to forty-five minutes. In Lesotho, not an especially dry country, the benefits in time saved alone are sufficient to justify investments in rural water supply. Sanitation improvements have high amenity value, making possible a cleaner and more pleasant environment.

The costs of water supply and sanitation services vary by technology, population density, the hydrologic and geologic environment, and design standards. Design standards for water supply can range from one handpump per 250 people, supplying 20 liters per person per day, to multiple-tap in-house connections that supply several hundred liters of fully treated water per person per day. Design standards for sanitation can vary from a pit latrine to flush toilets connected to a sewerage system, with downstream treatment prior to

discharge. The cost of water and sanitation services can range from \$15 per person per year for simple rural systems to \$200 for full-fledged urban systems. Poor households cannot afford the design standards of industrial countries, but such standards are not necessary on health grounds. Completely eliminating fecal bacteria requires expensive chlorination, but low concentrations present little health hazard and should be tolerated.

If households pay the total cost of water and sanitation services because of the productivity and amenity benefits, substantial health gains are an added bonus achieved at no cost per DALY gained. When willingness to pay is much less than costs, it is usually a mistake to justify subsidies on the basis of health benefits alone. First, such subsidies compromise the demand-driven approach to service provision (that is, provision of services that people want and are willing to pay for); lack of accountability and inefficiency are the inevitable consequences. And second, if publicly financed investments in these services are being considered for health reasons, it should be noted that such investments generally cost more per DALY gained than other health interventions recommended in this Report.

#### Box 4.6 Environmental and household control of mosquito vectors

Diseases transmitted by insect vectors account for losses of 44 million DALYs worldwide each year (35 million in Sub-Saharan Africa), or 3 percent of the world burden (12 percent in Sub-Saharan Africa). Although widespread application of insecticides is helping to control river blindness in West Africa (see Box 1.1) and Chagas' disease in South America, it is no longer the mainstay of vector control against other diseases. Emphasis has shifted to a range of targeted biological, physical, and behavioral approaches supported by insecticides when necessary. Two examples are given here.

##### Impregnated bednets

Bednets impregnated with a pyrethroid insecticide of low mammalian toxicity form lethal traps for mosquitoes attracted by the carbon dioxide and body odor emitted by the occupants. In Sichuan Province, China, up to 2.25 million nets—already owned by nearly all householders—have been treated each year since 1987. If nothing else, the cost is much lower than spraying the same houses with DDT. In Emei County, Sichuan, the number of malaria cases had been steady at about 4,000 between 1980 and 1986. After bednet treatment began, the number declined steadily, to 352 in 1991. In the Gambia a combination of net treatment and chemoprophylaxis, carried out by primary health care personnel, reduced overall child mortality by 63 percent.

##### Polystyrene beads

The application of polystyrene beads to pit latrines has proved successful in reducing the breeding of *Culex* mosquitoes and the transmission of filariasis. The beads form a floating layer that discourages egg laying and suffocates any mosquito larvae that do hatch. In the town of Makunduchi (population 12,000) in Zanzibar, Tanzania, a combination of polystyrene-bead application and mass drug treatment of the population between January 1988 and June 1989 virtually eliminated biting by infective mosquitoes, and the proportion of people infected by filariasis fell from 50 to 10 percent. By January 1993 the proportion of people infected had fallen to 3 percent. The polystyrene bead layers remained intact and effective for several years and were disrupted only by exceptional flooding.

In Zanzibar Town researchers are studying whether it is better to make beads freely available so that householders can apply them to their own pits or to have trained teams identify and treat all pits requiring treatment. In Dar es Salaam polystyrene beads are being used to control *Culex* nuisance biting and thereby increase public acceptance of house spraying against the *Anopheles* vectors of malaria. The effectiveness of the *Culex* control measures is evidenced by declining sales of mosquito coils in local shops. In Madras, India, polystyrene beads are being applied to water tanks to control the local vectors of malaria and dengue; the quality of the water is not affected.

An important policy issue, on which there is an apparent tension between health objectives and the demand-driven approach advocated here and in *World Development Report 1992*, concerns the sequencing and packaging of investments in water and sanitation. Given the patterns of household choice, a demand-driven approach will usually mean that provision of water supply services precedes that of sanitation services. It is frequently argued that this sequence would produce few health benefits because rapid increases in water use can overwhelm existing waste disposal capacity and because health benefits are maximized only when households utilize both better water and better sanitation services. These arguments are plausible, but experiences in many countries suggest that close adherence to the demand-driven approach remains appropriate in most places, including low-income settings. First, where rapid increase in water use is likely to cause environmental and health problems in the absence of household

sanitation services—as in urban areas—the demand for improved sanitation has invariably risen automatically as the demand for water services is satisfied. Second, where the demand-driven approach has not been followed, service provision has almost always been characterized by inefficiency and lack of accountability. For the provision of water supply and wastewater collection services, therefore, the demand-driven approach should be compromised only in rare circumstances.

Households are less willing to pay for the cost of trunk sewers and treatment of excreta and wastewater. Because these investments benefit the whole community and are important for environmental quality and health, there is potentially a case for using public funds to finance them. A few other situations may also justify direct government action or subsidies. Householders tend to undervalue such investments as areawide pollution abatement, vector control involving actions within

households (see Box 4.6), and research and development. There may thus be grounds for public subsidy or other interventions in these areas. It will often be difficult to disentangle environmental and health benefits, and judgments will be necessary concerning the use of public funds.

Large institutional and cultural shifts are needed to create an efficient system for allocating scarce public and private resources to improve the household environment. Many developing countries have inherited—and then elaborated on—the former colonial powers’ worst traditions of public sector inertia and professional inflexibility. Encouragingly, however, private sector involvement is increasing rapidly in both industrial and developing countries. SODECI, the privately run utility in Abidjan, is considered one of the best-run water companies in Africa. EMOS, the utility that serves Santiago, has used private sector contracts for such functions as meter reading, pipe maintenance, billing, and vehicle leasing and is one of the most efficient utilities in Latin America. The role of community organizations and NGOs may also be significant, particularly in drainage and sanitation improvements. In cities such as Karachi and São Paulo, community groups have significantly accelerated the provision of low-cost water supply and sanitation services to poor households, as well as helping to maintain and manage local services.

### *The occupational environment*

Many women work in the home and thus suffer disproportionately from the health risks in the household environment just described. Both men and women may also encounter health risks in workplaces outside the home. A burden of 36 million DALYs, or 3 percent of the global burden of disease, is caused each year by preventable injuries and deaths in high-risk occupations and by chronic illness stemming from exposure to toxic chemicals, noise, stress, and physically debilitating work patterns (Table 4.6).

The International Labour Office has estimated that the cost of occupational injuries and associated production losses in a sample of industrial countries is between 1 and 4 percent of GNP. In developing countries this proportion is likely to be greater because accident rates tend to be higher. Rates of fatal occupational injuries among construction workers, for example, are more than ten times higher in Kenya and Thailand than in Finland. Agriculture, which employs more than half of all adults in most developing countries, is among the world’s most dangerous occupations. Not only do agricultural workers suffer injuries, but they are also exposed to disease-carrying animals and to poisonous agrochemicals. Health risks are high in other sectors as well. Miners, construc-

**Table 4.6 Estimated global burden of disease from selected environmental threats, 1990, and potential worldwide reductions through environmental interventions**

<i>Type of environment and principal related diseases<sup>a</sup></i>	<i>Burden from these diseases (millions of DALYs per year)</i>	<i>Reduction achievable through feasible interventions<sup>b</sup> (percent)</i>	<i>Burden averted by feasible interventions (millions of DALYs per year)</i>	<i>Burden averted per 1,000 population (DALYs per year)</i>
Occupational	318	—	36	7.1
Cancers	79	5	4	0.8
Neuropsychiatric	93	5	5	0.9
Chronic respiratory	47	5	2	0.5
Musculoskeletal	18	50	9	1.8
Unintentional injury	81 <sup>c</sup>	20	16	3.1
Urban air	170	—	8	1.7
Respiratory infections	123	5	6	1.2
Chronic respiratory	47	5	2	0.5
Road transport (motor vehicle injuries)	32	20	6	1.2
All the above	473 <sup>d</sup>	—	50	10.0

a. The diseases shown are those for which there is substantial evidence of a relationship with the particular environment and which are listed in Appendix B.

b. Estimates derived from the product of the efficacy of the interventions and the proportion of the global burden of disease that occurs among the exposed. All estimates of efficacy are speculative and assume the implementation of known, feasible, and affordable interventions in the circumstances encountered in developing countries.

c. Computed by subtracting motor vehicle injuries (32 million DALYs) from all unintentional injuries (113 million DALYs).

d. Adjusted for double counting.

Source: Appendix tables B.2 and B.3 and authors’ calculations.

tion workers, migrant workers, and child laborers all suffer increased risk of disease because of their occupations. Small workplaces may have especially low standards of safety, yet such risks are often overlooked by government agencies and trade unions alike. A survey of companies in Samud Prakhon, Thailand, found that smaller plants, with fewer than fifty workers, had substantially lower levels of sanitation, health services, safety provisions, and environmental control measures than larger enterprises. Workers suffered more than twice as much noise and a third more lead fumes and vapors. And they experienced significant work-related health problems: 22 percent had lead poisoning or absorption, 27 percent had upper respiratory symptoms, and 6 percent had chronic obstructive pulmonary disease, even though most workers were below age 30.

Alleviating occupational risk depends on safety education for workers and managers, use of appropriate equipment and technology, and sound management practices. Governments can encourage these initiatives through legislation and regulation, financial incentives, investment in education, and research and development. Where worker organizations are strong, they have played a major role in identifying and reducing occupational risks. Tripartite agreements between workers, employers, and governments can lead to speedy progress.

#### *The ambient environment*

Radiation and pollution of air and water are additional health hazards. Since there is no market for clean air and water, government action is frequently justified.

**AIR POLLUTION.** Many cities suffer from air pollution caused by industry, power plants, road transport, and domestic use of coal. About 1.3 billion urban residents worldwide are exposed to air pollution levels above recommended limits. Air quality in the established market economies has generally improved in the past two decades. But in many developing countries and in the formerly socialist economies, air quality has deteriorated because of rising industrial activity, increasing power generation, and the congestion of streets with poorly maintained motor vehicles that use leaded fuel.

Air pollution damages the human respiratory and cardiorespiratory systems in various ways. The elderly, children, smokers, and those with chronic respiratory difficulties are most vulner-

able. Under the assumption that achievable reductions in urban air pollution can prevent 5 percent of all infectious and chronic respiratory disease, these reductions could avert a burden of 8 million DALYs each year, or 0.6 percent of the global burden of disease (Table 4.6). Local impacts and the effects on especially vulnerable groups can be much greater (Box 4.7).

Lead poisons many systems in the body and is particularly dangerous to children's developing brains and nervous systems. Airborne lead concentrations are high in polluted urban environments, where lead comes mainly from the exhaust of vehicles burning leaded gasoline. Elevated lead levels in children have been associated with impaired neuropsychologic development as measured by loss of IQ, poor school performance, and behavioral difficulties.

**WATER POLLUTION.** Newly industrialized countries, as well as many industrial countries, have polluted or are polluting their rivers, lakes, and coastal waters with a variety of chemical and biological wastes of both industrial and domestic origin. The practice of letting raw wastewater from industry and residential areas flow into rivers or the sea is common but unwise. Investment in preventing it may be justified because of the possibly severe local health consequences (as illustrated in Box 4.8) and because generalized water pollution, by reducing the number of water sources available for domestic supply, can foreclose cost-effective options for responding to demand for domestic services.

**RADIATION.** Individuals are exposed to natural background ionizing radiation and to radiation used for medical and dental diagnosis. Only a tiny amount of additional radiation comes from safely operated nuclear power stations or other installations (roughly one-thousandth of the background dose for those living within 50 kilometers of a nuclear power station). Current evidence suggests that the health effects of this radiation on the general population are extremely small or nonexistent. Accidents and occupational risks to workers in nuclear industries and to miners of radioactive ores, however, are different matters. The consequences of the nuclear power plant accident at Chernobyl, Ukraine, in 1986 have yet to be fully documented but are undoubtedly large. (The risk of such accidents is particularly high in the formerly socialist economies because of their large number of poorly designed nuclear facilities.) Standards and safe-

### Box 4.7 Air pollution and health in Central Europe

Contrary to expectations, public ownership and centrally planned economies have neither controlled pollution nor brought health benefits to the populations of the formerly socialist economies. The countries of this region face a variety of serious environmental health threats, of which the greatest are particulates and gases in air, lead in air and soil, and nitrates and metals in water. A substantial gap in health status between these countries and those of Western Europe has opened up since the early 1960s: life expectancy is roughly five years shorter in the formerly socialist economies, and mortality rates in middle-aged males are roughly double. There has been considerable speculation among scientists and the public in Central Europe about how much of this health gap is attributable to environmental pollution.

Air pollution is the environmental factor that has had the greatest negative effect on health in Central Europe. Of the many air pollution "hotspots" throughout the region, the worst-affected area is the "Black Triangle," which covers northern Bohemia and Moravia, Silesia, and Saxony and has a population of roughly 6.5 million. In August 1991 the three governments involved—the Czech Republic, Germany, and Poland—and the Commission of the European Communities formed a Working Group for Neighbourly Cooperation on Environmental Issues to deal with the extremely high levels of air pollutants in the area.

The overall effect of air pollution on mortality in the Czech Republic has been estimated using data on the distribution of the population, the ambient levels of particulates and sulfur dioxide, and the relationship between excess mortality and pollution. This relationship is derived from studies in Canada, the United Kingdom, and the United States that indicate excess

mortality of 1 percent for every 10 micrograms per cubic meter of particulates and sulfur dioxide. These estimates suggest air pollution causes up to 3 percent of total mortality in the Czech Republic and is responsible for roughly 9 percent in the gap in mortality rates between the Czech Republic and Western Europe. Similar estimates have been obtained for Silesia in Poland.

The effect of air pollution on mortality is greater for certain causes of death in specific age groups. A recent study of postneonatal respiratory mortality showed a rate 2.4 times higher in the most polluted districts of the Czech Republic than in the least polluted, after adjusting for a battery of socioeconomic factors. An increase in particulates of 25 micrograms per cubic meter was associated with an increase in postneonatal respiratory mortality of 58 percent.

The contribution of air pollution to morbidity in the Czech Republic is likely to be considerably greater than the effect on mortality and to have larger economic consequences through health expenditures, lost schooling, and lost productivity. Children in heavily polluted areas may suffer twice the rates of respiratory morbidity of those in clean areas. Overall, air pollution may be responsible for up to one-quarter of all respiratory morbidity in Czech children.

"Hotspots" of lead exposure exist throughout the formerly socialist economies. Average blood levels of more than 25 micrograms per deciliter in children have been reported in, for example, Pribram, Czech Republic, and Katowice, Poland. In comparison with normal levels, these higher levels could double the proportion of children requiring special education and halve the proportion in the exceptionally gifted group (IQ greater than 130).

guards against accidents and occupational hazards have been greatly improved, but risks may remain, and continued research and vigilance are required. Putative links of certain cancers with exposure to radon in houses and with electromagnetic fields created by high-voltage cables are being investigated in several industrial countries.

**GLOBAL THREATS.** Depletion of the atmospheric ozone layer and global warming pose potential threats of unknown magnitude to health. International agreements are limiting or will limit the release of chlorine compounds that can harm the ozone layer and of the greenhouse gases that contribute to global warming. The societies that will suffer least from these global changes are those that are wealthier (and therefore able to invest in

appropriate coping strategies) and healthier. The best preparation at the national level for these uncertain future events is therefore to pursue sound economic and health policies in the medium term.

**IMPROVING THE AMBIENT ENVIRONMENT.** Improving health is only one of several reasons why societies may choose to invest in a cleaner environment. The policies and actions needed to clean up the air in a given city or area will depend on the origins of the pollution at that site. In most cities in developing countries motor vehicles are a significant source of air pollution and need to be specifically targeted. A few cities in the developing world, among them Bangkok and Mexico City, are pursuing systematic policies to reduce motor vehicle emissions, and their experience will be valuable

### Box 4.8 Pollution in Japan: prevention would have been better and cheaper than cure

In the 1950s and 1960s Japan experienced a period of rapid industrialization and economic growth, but little attention was paid to the environmental consequences. The result was high levels of pollutants in the air, water, and soil in some areas and several infamous outbreaks of disease. Strong corrective action was taken in the 1970s and 1980s to redress the severest problems. Three conclusions emerge from the examples given below: allowing the release of toxic substances into the environment can lead to serious health consequences and economic losses; prevention, as Japan is now doing, is less costly than cleaning up; and taking corrective action now is less costly than allowing problems to persist.

#### Case 1: sulfur dioxide in the air

Between 1956 and 1973 one of Japan's largest petrochemical complexes was constructed at Yokkaichi City. By 1960 air pollution was causing local concern, and by 1963 one-hour average sulfur dioxide levels exceeded 2,800 micrograms per cubic meter, far above WHO's suggested maximum of 350 micrograms per cubic meter. In 1967 local residents successfully sued six companies, claiming medical costs and compensation for lost income. Seven percent of the total population of the district were certified to have been medically affected by ambient air pollution. Increasingly stringent pollution measures were introduced starting in 1970, and by 1976 sulfur dioxide levels were in compliance with local standards.

Air pollution control costs since 1971—including technical installations and their operation, monitoring, and creation of environmental buffer zones—have been \$114 million a year. Without this investment, however, medical expenses and compensation would have been more than \$160 million a year.

#### Case 2: mercury in the water

At the turn of the century, Minamata was a scenic coastal town of 12,000 people who made their living from wood products, oranges, and fish. In 1908 a fertilizer plant was established that eventually became the Chisso Corporation, one of Japan's largest manufacturers of chemicals. By the 1920s compensation for damage to fisheries had already become an issue, and

in 1956 patients with a severe neurological affliction, later to be called Minamata disease, were observed. In 1968, following extensive research, the disease was linked to the ingestion of seafood containing high concentrations of methyl mercury, a compound discharged into Minamata Bay by the Chisso Corporation as a by-product of the manufacture of acetaldehyde. The discharge of methyl mercury peaked in 1959; it ended in 1968 when the company ceased production of acetaldehyde, but by then the floor of the bay and its aquatic life had become heavily contaminated. Starting in 1974, 1.5 million cubic meters of polluted sediment were dredged and removed.

By 1991, 2,248 people (1,004 of whom had died) had been certified as suffering from Minamata disease and were eligible for compensation. An additional 2,000 people are pursuing claims for compensation. Had discharge of mercury continued, the estimated annual costs of the damage, including patient treatment and compensation, sediment dredging, and losses to fisheries, would have been \$97 million a year. If acetaldehyde production had continued, pollution abatement through in-plant waste recycling would have cost only \$1 million a year.

#### Case 3: cadmium in the soil

In the late 1940s a disease characterized by extreme generalized pain, kidney damage, and loss of bone strength appeared in the Jinzu River Basin. The disease, which primarily afflicted women, was called *itai-itai* ("It hurts, it hurts!") after the cries of the sufferers. Two decades of research led, in 1968, to the conclusion that the cause was chronic cadmium poisoning, which was traced to the effluent from the Mitsui Mining and Smelting Company located in the upper reaches of the basin. The route for the cadmium poisoning was from river water to irrigation water to soil to rice. By 1991, 129 people had been certified as *itai-itai* sufferers, and 116 of them had died.

A major program of soil restoration was initiated in 1979. By 1992, 36 percent of the contaminated area of 1,500 hectares had been treated. Had the further release of cadmium not been prevented, the annual costs from medical compensation, agricultural losses, and soil restoration would have been \$19 million a year. The costs of prevention were \$5 million a year.

in designing the next generation of programs. Successful policies include incentives and regulations to improve fuel quality, enhance engine performance and maintenance, and reduce traffic volume. Most industrial countries and an increasing number of developing countries have set limits on

lead levels in gasoline and are using price differentials to encourage consumers to switch to lead-free products. Lead concentrations in the air have fallen by 50 percent or more in response to these measures, and average blood lead levels in urban areas have also declined substantially.

Clean technologies and practices can reduce local industrial pollution levels even as output expands. To encourage adoption of such technologies, governments need to pursue policies that improve the efficiency with which energy is used. Such policies include the elimination of subsidies for power generation and, in many countries, for vehicle fuels and coal. Efficient reforms help reduce pollution while raising a country's economic output. Policy options are described in full in *World Development Report 1992*.

### *The road transport environment*

Motor vehicle crashes are responsible for an increasing burden of injury and death in developing countries. Each year throughout the world road traffic injuries cause a loss of 32 million DALYs, or more than 2 percent of the global burden of disease (Table 4.6). Men suffer roughly twice the burden from road traffic injuries as women. The young and the old are particularly vulnerable, as are drivers of nonmotorized vehicles and pedestrians. The number of road fatalities and injuries in developing countries is rising rapidly with urbanization and growth in the volume of traffic. Road fatalities in Africa increased fourfold between 1968 and 1988, whereas in Europe they declined by more than 20 percent during the same period.

A multipronged approach to road safety can reduce crashes at reasonable cost. Public investment in improved road infrastructure and highway operation systems, remedial action at known "black-spots" with high accident rates, and expanded public transport systems all make a difference. Legislation, financial incentives, and programs of road safety education can improve driver behavior, reduce traffic speeds, promote use of seat belts, improve vehicle safety, and reduce drunk driving. The insurance and legal liability systems may also offer powerful incentives for road safety. A carefully designed package of measures such as those mentioned above can, over time, reduce road fatalities and injuries by at least one-fifth, thus preventing the loss of at least 6 million DALYs a year worldwide (Table 4.6). Several countries, including Kenya and Malaysia, have set more ambitious targets for reductions in deaths and injuries over the next decade.

### **AIDS: a threat to development**

Historians will look back on the latter half of this century as having had one great medical triumph,

the eradication of smallpox, and one great medical tragedy, AIDS. Unknown prior to 1981, AIDS now dominates public health programs and health services in several countries and may come to dominate in many more. The human immunodeficiency virus (HIV) that causes AIDS is transmitted through sexual intercourse. Like other STDs, it can also be transmitted by contact with contaminated blood (notably from transfusions) and from mother to child during the perinatal period. Casual transmission from person to person does not occur. In developing countries more than 85 percent of infections occur through heterosexual intercourse. There is no cure, and discovery of a vaccine is unlikely before 2000. Action is needed now to combat the spread of the disease.

### *Why AIDS is a special case*

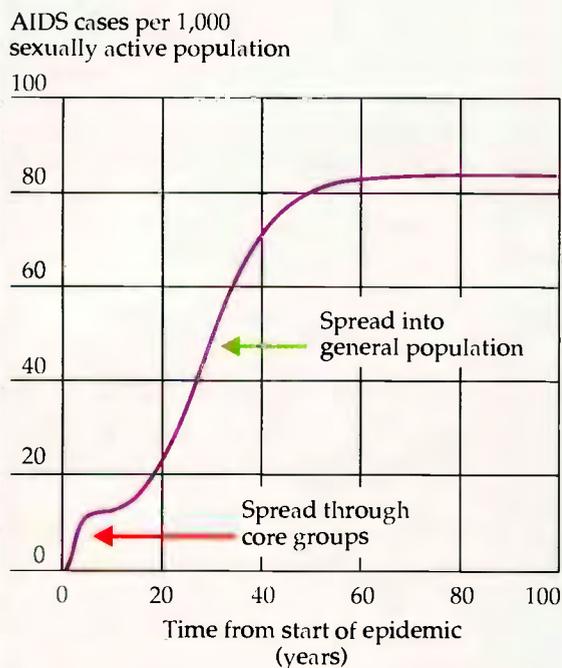
AIDS deserves special attention because failure to control the epidemic at an early stage will result in far more damaging and costly consequences in the future.

- *The HIV epidemic is bad and is getting worse.* An estimated 9 million people worldwide carried the HIV virus in 1990; as many as 26 million could be infected by 2000, according to WHO estimates (see Table 1.3 in Chapter 1). AIDS will then contribute about 3.3 percent to the global burden of disease, and 1.8 million people will die of AIDS each year. Given the short time it takes infection rates to double in many developing countries and the rapid spread of the disease to countries that previously had low numbers of infections, total figures in 2000 may be two or three times higher than the above projections.

More than 80 percent of those infected lived in developing countries in 1990; by 2000 this will increase to an estimated 95 percent. In Thailand one in fifty adults is infected. In Sub-Saharan Africa one in forty adults is already infected, and in certain cities of Africa the prevalence of infection is as high as one in three. In some of these high-prevalence communities AIDS is already starting to reverse long-term declines in child mortality.

- *The cost-effectiveness of interventions drops sharply when infections cross from high-risk groups to the general population.* Since there is no vaccine or cure for AIDS, primary prevention is the only way to fight the disease. In the absence of adequate preventive action, AIDS spreads rapidly in the "core" groups (such as sex workers and their clients), followed by a slower and then accelerating

**Figure 4.7 Simulated AIDS epidemic in a Sub-Saharan African country**



Source: Adapted from Potts, Anderson, and Boily 1991.

spread in the general population (Figure 4.7). Early and effective targeting of HIV interventions is critical because these interventions diminish in cost-effectiveness as the infection moves out of the high-risk, high-transmission core groups. The large number of new sexual contacts in the core groups means that each HIV case avoided in this group can avert more than ten times as many additional infections as can a case avoided in the general population.

- *AIDS has catastrophically costly consequences.* AIDS, affecting as it does mainly people in the economically productive adult years, has powerful negative economic effects on households, productive enterprises, and countries (see Box 1.2 in Chapter 1). Because so many of its victims are heads of households or parents, AIDS devastates families. Heavily infected countries have found their health systems burdened with costly cases of AIDS-related opportunistic infections. If the AIDS epidemic continues unchecked, the accelerated de-

mand for health care for AIDS patients will crowd out the needs of other patients. Furthermore, the number of tuberculosis cases is increasing dramatically as a direct result of HIV, and the presence of HIV worsens problems with other sexually transmitted diseases. (STDs both facilitate HIV transmission and are harder to treat in HIV-infected individuals.)

- *Prevention of AIDS involves sensitive and politically charged issues.* Preventing HIV infection often necessitates working with socially marginalized groups (including, in many cultures, homosexuals), and with people who pursue illegal activities such as drug use or prostitution. In addition, an effective preventive program must reach out to inform young people frankly about sexual practices and risks. These activities offer little political benefit and may be highly controversial. Strong government will and commitment are therefore essential to effective programs, the more so because the seven-to-ten-year lag between HIV infection and the development of AIDS makes it tempting for countries and individuals to put off dealing with AIDS issues until it is too late to avert a widespread epidemic.

#### *Prevention: an absolute necessity*

A combination of strategies, backed up with adequate resources, is required for stemming the spread of AIDS. Crucial elements in these strategies are providing information on how to avoid infection, promoting condom use, treating other sexually transmitted diseases, and reducing blood-borne transmission. These measures are especially cost-effective when targeted at the relatively few people in the core groups. Unless effective preventive action is taken, the number of new HIV infections can be expected to grow, especially in parts of Asia. But a comprehensive AIDS prevention program could check the growth of the disease (Figure 4.8).

Current annual worldwide expenditure on AIDS prevention is about \$1.5 billion a year. Perhaps less than \$200 million of this is spent in developing countries, where 85 percent of all infections occur. Among developing countries Thailand spends the most for AIDS prevention, with 1992 spending of \$45 million, more than 75 percent of which was from government funds. Total AIDS spending on prevention in all Sub-Saharan Africa was only twice this amount, with a mere 10 percent from government funds. A recent study for WHO's Global Program on AIDS suggested that

comprehensive AIDS and STD prevention services for all developing countries would cost \$1.5 billion to \$2.9 billion a year. This is ten to fifteen times current spending, but it would yield enormous benefits. The estimated number of new adult HIV infections averted by such spending between 1993 and 2000 would be about 9.5 million—4.2 million in Africa, 4.2 million in Asia, and 1.1 million in Latin America.

*Groups to be targeted*

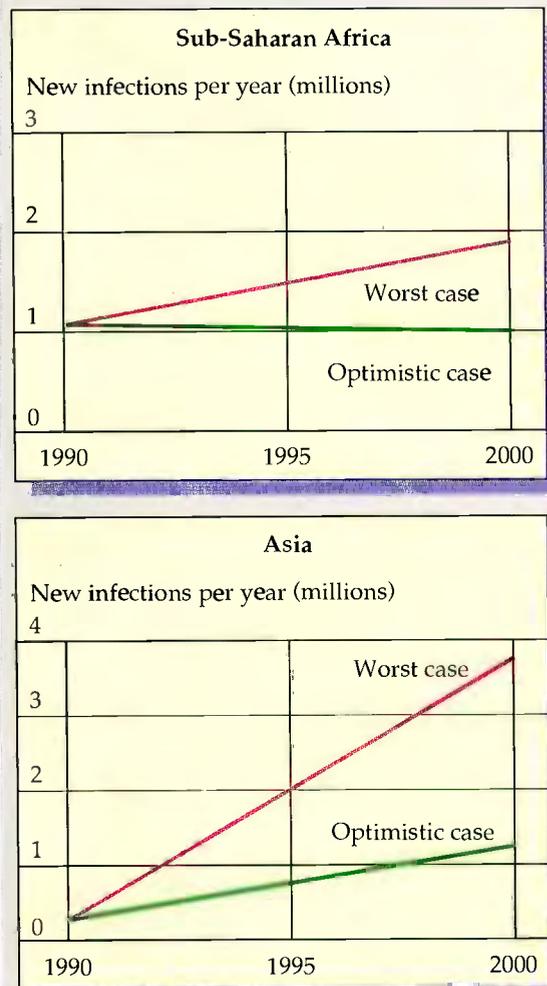
Preventive efforts must reach populations with diverse needs: people at particularly high risk of acquiring and transmitting HIV infection (core groups), young people, and women. Preventive programs for the population at large are less cost-effective than targeted programs but are needed to increase awareness and understanding of AIDS and STDs, reduce discrimination against infected persons, and prepare the way for subsequent interventions when levels of infection rise. Monogamy might be encouraged as part of public information efforts to curb the spread of HIV, but it cannot be the only strategy; even where it is the societal norm, not all individuals adhere.

*High-risk groups* may include sex workers, migrants, members of the military, truck drivers, and drug users who share needles. For these groups, prevention of sexual transmission essentially means education on safer sex, promotion of condom use, and prevention and treatment of STDs. It is important not simply to provide information on condoms but also to ensure their availability and to empower members of the core group, especially female sex workers, to use them. Brothel managers and clients must also be persuaded of the need to change their behavior; experience from Zaire and other countries shows that promotion of condoms to male clients substantially improves the success of programs targeted at sex workers. Areas of high STD prevalence warrant aggressive attempts to control STDs through condom promotion, case management and counseling, notification of partners, and surveillance. These can be provided through a wide spectrum of health institutions such as family planning clinics and primary health centers.

*Young people*, both in and out of school, need comprehensive education on reproduction and reproductive health issues. To be most effective, education must begin before the onset of sexual activity (ages 12–14 in many countries) and must be targeted at boys as well as girls. Reaching boys is

*Effective prevention can markedly slow the rate of new infection with HIV.*

**Figure 4.8 Trends in new HIV infections under alternative assumptions, 1990–2000: Sub-Saharan Africa and Asia**



Note: Asia includes China, India, and Other Asia and islands.  
Source: World Health Organization and World Bank data.

particularly important because men so often dominate the sexual relationship. The curriculum should be sensitive to local cultural conditions but should provide explicit, honest explanations of sexuality, gender issues, safe sexual practices, STDs and HIV, safe motherhood, and family planning. All potential behavioral choices, including

abstinence and condom use, should be presented. There is no evidence to support the objection that providing sex education encourages promiscuity. In societies in which it is unacceptable for teachers to provide sex education, the task can be delegated to qualified voluntary groups.

Women are biologically more susceptible to acquiring HIV infection through heterosexual intercourse than are men, and social factors often add to the risks. In Uganda, for example, more than 60 percent of infected persons are women. Preventive efforts addressed to women, especially those of childbearing age, can protect both maternal and child health. In many African countries AIDS and HIV-related illnesses are already among the top ten causes of childhood mortality. At present there is no way to prevent HIV transmission from an infected woman to her fetus; about 30 percent of the babies of infected women are born with the infection. Most such babies survive their first year but succumb to opportunistic infections during their second or third year. The uninfected children of infected mothers are also at increased risk of dying because they are likely to lose one or both of their parents. The only strategy for fighting childhood AIDS is to target preventive efforts to women of childbearing age.

Babies can contract HIV through breast milk, creating difficult tradeoffs between the risk of infection and the benefits of breastfeeding for child health. Recent studies suggest that the risk is substantial (about 30 percent) for babies breastfed by mothers who develop an HIV infection after childbirth; the risk for babies of women who are infected prenatally is smaller, although still significant. Randomized controlled studies are under way in Haiti, Kenya, and Rwanda to determine the risks more accurately. In the meantime, in areas where the primary causes of infant deaths are infectious diseases and malnutrition, breastfeeding should probably continue to be recommended. In areas where a safe alternative to breastfeeding exists, testing of pregnant women would provide an opportunity to advise those infected about the health risk of breastfeeding for their babies.

#### *Specific preventive interventions*

Widespread experience with national AIDS control programs in industrial and developing countries is already on hand. It suggests some areas in which action needs to be taken and provides important lessons for programs to control AIDS.

**PROVIDING INFORMATION.** Informing people about the steps they can take to protect themselves against HIV infection is central to any strategy for combating AIDS. Individuals need to know that the risk of infection can be minimized by reducing the number of new sexual partners they have, by choosing partners of lowest risk, by avoiding contact with contaminated blood, by using condoms and refraining from risky sexual practices such as anal sex, and by avoiding or seeking treatment for cofactors such as STDs. Intravenous drug users can lower their risks by using clean needles. In communities where the HIV virus is present, people should be aware that unprotected sex is safe only with a person known unequivocally to be uninfected—for example, someone who has not yet been sexually active and has no other risk factors (such as intravenous drug use or transfusion) or who has recently undergone HIV testing and has been found to be uninfected.

**ENCOURAGING CONDOM USE.** Condom use is effective in slowing the spread of both HIV and STDs and needs to be encouraged in all risky sexual encounters. Programs to promote condom use in highly vulnerable groups such as clients of sex workers are cost-effective. One such program targeted to low-income sex workers in Nairobi reduced the mean annual incidence of gonorrhea from 2.8 episodes per woman in 1986 to 0.7 episode in 1989. The program averted an estimated 6,000 to 10,000 new HIV infections a year at an approximate cost of \$0.50 per DALY gained. Community-wide interventions are also being tried with success. In Zimbabwe a community intervention estimated to cost \$85,000 successfully reached more than 1 million persons, distributed more than 5.7 million condoms, and reduced STDs in the general population by 6 to 50 percent in different areas. The intervention also changed behavior among sex workers: the proportion reporting condom use with their last client rose to 72 percent, from only 18 percent before the intervention.

Social marketing is another strategy for promoting condom use. In Zaire distribution outlets—from pharmacies to traditional healers and from nightclubs to street vendors—were saturated with condoms. Condom sales rose from 20,000 in 1987 to 18.3 million in 1991. Consumer research indicates that 90 percent of the condoms were bought by men and that about 60 percent were intended for casual sex. Estimates suggest that the program averted about 25,000 HIV infections in 1991 alone.

**REDUCING BLOOD-BORNE TRANSMISSION.** Blood transfusions account for less than 5 percent of HIV transmission worldwide, but transfusion with infected blood almost always leads to infection. Measures for preventing transmission of HIV through blood transfusions include reducing the need for transfusions, eliminating payments for donated blood (because paid donors tend to have a higher risk of HIV), and screening donors. Effective early treatment of health problems, combined with education for health care providers about the proper indications for transfusion, can cut the need for transfusions by more than 50 percent. Public health programs such as helminth control in schools, iron supplementation, prenatal care, and malaria control can reduce the severity of existing anemia and thus diminish the need for transfusions. When transfusion is unavoidable, blood donors can be screened to ensure a supply of uninfected blood. The cost-effectiveness of blood screening varies dramatically depending on the prevalence of HIV. To maintain the population's overall confidence in the medical community, however, blood screening has been advocated even where HIV prevalence is low. When blood banks exist, screening adds only about 5 percent to the total cost of each unit of transfused blood.

**INTEGRATING AIDS PREVENTION AND STD SERVICES.** Wide availability of STD services is crucial for fighting AIDS because HIV transmission is facilitated by the genital lesions and inflammation associated with STDs. Treatment of STDs is often highly cost-effective in its own right. It becomes even more cost-effective when the benefits of reduced HIV transmission are added. Curing each case of gonorrhea in a core group saves 120 DALYs, at a cost well below \$1 per DALY gained if the benefits of fewer secondary cases and reduced risk of HIV transmission are included.

Because many STDs are asymptomatic (especially in women), infected individuals may have little motivation to be tested and treated. Even for those with symptoms, charges for clinical services may reduce access to treatment and therefore increase the spread of STDs. In Nairobi, for example, the introduction of fees at the main STD clinic reduced attendance by 60 percent among men and 35 percent among women. Subsidizing STD services therefore makes sense as part of an AIDS control program. Another good strategy is to combine STD and family planning services; screening for asymptomatic STD infections in family plan-

ning clinics has revealed infection rates as high as 20 percent.

**TESTING AND SCREENING.** Voluntary HIV testing provides individuals with useful information about themselves and their partners. Studies suggest that counseling and testing can help individuals and couples adopt safer sexual behavior. The once-prohibitive cost of testing has been declining sharply; a couple can now be screened for less than \$2 (excluding the cost of counseling). The test, however, is not always reliable because there is a short period during which HIV may not be detected in a newly infected person; furthermore, a negative test result is no guarantee of continuing risk-free behavior. As a result, testing is currently most useful for couples within or planning a long-term relationship. Governments need to ensure that testing remains voluntary and anonymous, meets quality standards, and is accompanied by appropriate counseling or information.

**SURVEILLANCE.** Public health surveillance for HIV is critical in areas where extensive spread of the virus has not yet occurred. Countries that establish a timely and reliable system of surveillance are able to give policymakers early warning of an impending spread of the virus. Useful activities include regular surveillance for HIV and syphilis in a few prenatal clinics and in centers serving clients at high risk of infection, such as sex workers and patients with STDs.

Several of the preventive interventions discussed above have been incorporated in the Indian government's National AIDS Control Project, launched in 1992 with the assistance of the World Bank and WHO. The Indian program emphasizes promoting public awareness about AIDS, promoting health in core groups through NGOs, controlling STDs, improving the safety of blood supplies, strengthening surveillance and institutional capabilities for control of HIV-AIDS, and encouraging the humane treatment of people with AIDS or HIV infections.

#### *Care of AIDS patients*

In 1992 developing countries spent about \$340 million to care for AIDS patients. Although this is only a small fraction of the \$4.7 billion spent by industrial countries to care for their AIDS patients, it is still nearly twice the amount spent on AIDS prevention in the developing world. If spending

per patient remains constant, the amount spent on the care of AIDS patients in developing countries will more than triple, to \$1.1 billion in 2000. To date, many AIDS control programs have not developed guidelines for the cost-effective provision of care for AIDS patients. Antiviral drugs such as azidothymidine (AZT) are enormously expensive, have severe side effects, and may, at best, delay the onset of AIDS and prolong life to some extent. One year of AZT costs more than \$3,000, a prohibitively high figure. Treatment options in many low-income nations are therefore limited to alleviation of pain and management of the opportunistic infections—most commonly, tuberculosis, diarrhea, and candidiasis—that afflict HIV-infected persons. Strategic planning can greatly reduce costs through the use of a small number of less-expensive drugs and outpatient or community treatment where possible. Basic care, including outpatient treatment of opportunistic infections, can cost \$200 to \$400 per DALY gained, a substan-

tial sum. Palliative home care, by contrast, costs between \$30 and \$75 per DALY gained, but it may be a substantial burden to the family. Uganda's innovative activities have made it possible to provide caring responses, at modest cost, to those afflicted (Box 4.9).

#### *The need for national and international action*

At present, most national AIDS programs are inadequate, despite international attention and the significant effort by WHO to help design and implement plans for controlling AIDS. Most programs use only the resources available to ministries of health, are too standardized, and neglect the control of STDs. AIDS has to be approached as a national development issue. National leadership is crucial; the most effective programs, such as Thailand's, pursue strategies that involve many agencies, in and outside government, in an atmosphere of openness and frankness (Box 4.10).

#### **Box 4.9 Coping with AIDS in Uganda**

By June 1992 Uganda had reported 33,971 AIDS cases; the true number may be between 100,000 and 300,000, and it is estimated that 1 million to 1.5 million Ugandans are infected with HIV. In Kampala more than 30 percent of all pregnant women are infected, and in many parts of the country AIDS is the most common cause of admission and death among hospitalized adults. With this immense burden, care of infected individuals and management of the social consequences of infection are perceived to be as important as prevention of further cases of HIV.

In response, a variety of innovative activities have been undertaken. In 1987 the first AIDS clinic was opened, with a small staff, a few drugs, and little outside support. The clinic recently enrolled its 8,000th patient. Patients regard the care they get there as much higher in quality than that available elsewhere. The founder of the clinic, Dr. Ely Katabira, and another physician at the national teaching hospital have produced a 104-page manual on AIDS care that recommends simple diagnostic and treatment strategies for AIDS; for example, nine relatively inexpensive drugs used in combination with tuberculosis therapy can achieve a high degree of relief for patients with AIDS.

Also in 1987 sixteen Ugandans who were personally affected by AIDS (because of their own infection or that of a family member) set up a new voluntary organization, The AIDS Support Organization (TASO), to provide emotional support for AIDS sufferers. Twelve of the founding members have since died of AIDS, but

TASO has grown to include ninety-seven counselors, three supervisors, and six trainers in eight locations. Services, which reach more than 30,000 people a year, include counseling, condom education and distribution, home care, income-generating activities, feeding programs, and payment of orphans' school fees.

In 1990, to address the demand for personal testing, Uganda's first anonymous HIV testing and counseling center was established. The enormous demand has made individual pretest counseling impossible, but group counseling has become popular. Individual post-test counseling continues to be offered, and HIV-positive patients are referred to TASO for further support. AIDS awareness in Uganda is so high that many people assume they are infected. Couples who are tested and found to be negative report they are more motivated to be monogamous, and a small follow-up study found that such clients have fewer casual sex partners and use condoms regularly. Additional centers have been established in other areas, as well as an executive testing center for businessmen and parliamentarians uncomfortable about being served in the busy public clinic. High demand indicates that Ugandans want to know whether they are infected, particularly before embarking on important life events such as marriage. Uganda's experience demonstrates that an AIDS-testing program in a country with a high prevalence of heterosexual transmission can have a more positive influence on behavior than results from the industrial world would indicate.

#### **Box 4.10 HIV in Thailand: from disaster toward containment**

As late as 1988 Thailand and the rest of Asia were considered to be relatively free of HIV infection, leading senior Thai health experts to conjecture that Asians might be less susceptible to the disease. That year, however, an explosive HIV epidemic started its march through Thailand, affecting all levels of society. Today it is estimated that 2 percent of sexually active adults, or 400,000 to 600,000 people, are infected. Without effective prevention, by 2000 the number infected may be as high as 2 million to 4 million.

Faced with the HIV epidemic, Thai officials have moved quickly from complacency to action. Thailand, they realized, could not sustain its 10 percent annual growth of GNP in the presence of a huge AIDS epidemic. Indeed, in 1991 researchers projected that the aggregate direct and indirect cost of AIDS could be as high as \$8 billion over the next decade and that AIDS could have negative effects on tourism, foreign investment, and labor remittances from abroad. They argued, however, that a major preventive effort, with the goals of reducing numbers of sexual partners by at least one-half, doubling condom use, and treating STDs, could mean 3.5 million fewer infections and more than \$5 billion in savings by 2000.

AIDS prevention is now being accorded the highest priority in Thailand, and a national AIDS prevention and control committee chaired by the prime minister has been formed. In 1992 the cabinet approved the establishment of the AIDS Policy and Planning Coordination

Bureau in the office of the permanent secretary of the prime minister. The multisectoral bureau coordinates the planning and budgeting of AIDS activities among fourteen ministries, international funding agencies, and local sources of support. The bureau also facilitates the planning of joint activities with private businesses and NGOs.

Thailand's strategy has led to a broad consensus within the country on the importance of taking action. Spending for AIDS prevention was \$28 million in 1991 and \$45 million in 1992. To monitor the epidemic, Thailand has established the world's most comprehensive national HIV surveillance system, which reports twice a year on HIV prevalence in all risk groups in all provinces of the country. Acknowledging that commercial sex is ingrained in Thai society and will remain so in the short run, the government has decided to mandate and enforce a policy of 100 percent condom use at the brothels. This ensures that brothels cannot compete for customers seeking condom-free sex. Preliminary evidence shows very high rates of condom use, with demand increasing from 10 million a year to about 120 million a year and reductions in the incidence of STDs.

The prime minister's office is launching national campaigns through the mass media in 1993-94 to promote changes in the sexual culture and the sexual norms of the population. Only time will determine whether intervention has been prompt and effective enough to halt the further spread of HIV.

No single strategy in the fight against AIDS will meet the needs of every country. Three main criteria can guide the choice of priorities from the range of HIV-AIDS interventions listed above. These criteria are current HIV prevalence, risk of future spread, and existing AIDS burden. Strategies for different countries and regions within countries fall into four main groups.

- Areas with little HIV and few STDs (for example, rural areas of northern China and North Africa) should emphasize comprehensive reproductive health education for youth, with some attention to AIDS prevention among high-risk groups, and should establish a sensitive HIV surveillance system.

- Areas at high risk of an epidemic from early spread of HIV or having a high rate of STDs (for example, Yunnan Province in China and Surabaya, Indonesia) should undertake massive, targeted preventive activities for high-risk groups, including sex workers, supplemented by general education and by testing of the blood supply.

- Areas with an HIV epidemic but as yet little disease (for example, Thailand, and urban areas of India) need to develop AIDS prevention programs for the entire population while continuing to target high-risk groups. Voluntary HIV testing and counseling and preparation for the care of AIDS patients should also begin.

- Finally, areas with a major epidemic and a high disease burden (for example, Uganda and Zambia) have to combine a broadly based preventive strategy with attention to care for AIDS patients (see Box 4.9).

Nongovernmental organizations can play a vital role in prevention, care, and community support programs, using their credibility and access to reach those at highest risk, such as intravenous drug users and sex workers. Such groups have been highly effective in using social marketing to reach individuals at the grass-roots level, particularly by initiating peer education and media programs that reinforce behavior change and work to modify the perceived social norms. A recent

**Table 4.7 Costs and health benefits of public health packages in low- and middle-income countries, 1990**

Country group and component of package	Annual cost (dollars)			Disease burden averted (percent) <sup>a</sup>
	Per participant	Per capita	Per DALY	
<i>Low-income (income per capita = \$350)</i>				
EPI Plus	14.6	0.5	12-17	6.0
School health program	3.6	0.3	20-25	0.1
Other public health programs (including family planning, health, and nutrition information) <sup>b</sup>	2.4	1.4	— <sup>c</sup>	— <sup>c</sup>
Tobacco and alcohol control program	0.3	0.3	35-50	0.1 <sup>d</sup>
AIDS prevention program <sup>e</sup>	112.2	1.7	3-5	2.0
Total	—	4.2 (1.2)	—	8.2
<i>Middle-income (income per capita = \$2,500)</i>				
EPI Plus	28.6	0.8	25-30	1.0
School health program	6.5	0.6	38-43	0.4
Other public health programs (including family planning, health, and nutrition information) <sup>b</sup>	5.2	3.1	— <sup>c</sup>	— <sup>c</sup>
Tobacco and alcohol control program	0.3	0.3	45-55	0.3 <sup>d</sup>
AIDS prevention program <sup>e</sup>	132.3	2.0	13-18	2.3
Total	—	6.8 (0.3)	—	4.0

Note: Numbers in parentheses refer to per capita cost as a percentage of income per capita.

a. Although costs are estimated for 100 percent coverage, the health benefits are based on 95 percent coverage for EPI Plus and 80 percent coverage for the school health, AIDS prevention, and tobacco and alcohol programs.

b. Includes information, communication, and education on selected risk factors and health behaviors, plus vector control and disease surveillance and monitoring.

c. The health benefits from information and communication and from disease surveillance are counted in the other public and clinical services in the health package. The health benefits from vector control are unknown.

d. Calculation of the potential disease burden averted through this program assumes no change in the prevalence of smoking and alcohol consumption; if such prevalence were to rise, the potential benefits would be larger.

e. Excludes treatment of STDs, which are in the clinical services package; see Table 5.3.

Source: Authors' calculations.

needs-assessment study conducted in a number of developing countries showed that the full potential of NGOs was not being realized for lack of financial, managerial, and technical support. Planning is under way for a program to provide innovative mechanisms for simple and flexible assistance to nongovernmental groups working on AIDS.

The world must do more to deal with the global challenge of AIDS. No country is immune from a future HIV epidemic, and the costs of delay are high. A global coalition is needed that will encourage and assist governments to take bold action before it is too late. Without a substantial increase in political commitment and leadership—as well as additional resources to support the \$1.5 billion to \$2.9 billion needed annually for effective prevention of AIDS—the HIV epidemic could cause a health disaster and an enormous setback for development.

### The essential public health package

Public health programs that address the problems described above can produce substantial health

gains at modest cost. Local conditions vary, but an essential public health package is likely to include:

- The Expanded Programme on Immunization, including micronutrient supplementation
- School health programs to treat worm infections and micronutrient deficiencies and to provide health education
- Programs to increase public knowledge about family planning and nutrition, about self-cure or indications for seeking care, and about vector control and disease surveillance activities
- Programs to reduce consumption of tobacco, alcohol, and other drugs
- AIDS prevention programs with a strong STD component.

This public health package would yield large benefits at low cost (Table 4.7). In low-income countries it would avert more than 8 percent of the burden of disease at a cost of just \$4 per capita (1.2 percent of income per capita), while in middle-income countries it might avert 4 percent of the burden of disease at a cost of \$7 per capita (0.3 percent of income per capita). Because it is difficult to quan-

tify the health gains from the activities under "Other public health programs," the corresponding cost per DALY is not estimated.

Provision of information is needed in every aspect of the program. Information should cover the benefits of healthy eating, contraceptive use, and hygienic practices in the household; the health effects of smoking and of alcohol and drug abuse; and prevention of HIV infections. Some public health measures will involve providing services in clinics, including family planning and STD-related

services. These are included in the essential package of clinical measures discussed in the next chapter. Health will also be served if governments do less in a number of areas—if they avoid intervening in food markets, cut indiscriminate subsidies for water and sanitation, remove most restrictions on contraceptive services, and abolish subsidies on fuels. Appropriate government regulatory action on the ambient environment, occupational conditions, and road safety can also safeguard people's health.