

Part **One**

Summary and Cross-Cutting Themes

- Summary
- Cross-Cutting Themes

Chapter 1

Investing in Health



Dean T. Jamison

A girl born in Chile in 1910 could expect to live only to age 33. Since then, her life expectancy has more than doubled to its current level of 78 years. What has this increase meant for her? The probability that she will die before her fifth birthday has declined from 36 percent to less than 2 percent. Throughout middle age the likelihood that she will die is also far lower: death in childbearing or from tuberculosis (TB) as a young adult are no longer threats, and she is less likely to die in middle age from cancer. Mirroring this mortality reduction—but less easily quantified—are marked improvements in health-related quality of life. She will be able to choose to have fewer children and thus spend less time in pregnancy and child rearing. From an average of about 5.3 children at midcentury, Chilean women’s fertility rate has dropped to its current level of 2.3. She will have fewer infections, less anemia, greater strength and stature, and a quicker mind. Her life is not only much longer; it is much healthier as well.

Chile’s history of health improvements is unusually well documented but typifies changes that have occurred in much of the world. These dramatic improvements in health have, moreover, been possible without major increases in income. In the early 1900s, income levels in the United States were roughly the same as they are in Chile today, yet U.S. life expectancy then was 25 years shorter. New knowledge, new vaccines, and new drugs have inexpensively enabled major gains in health that were not possible before, even for those whose incomes were high. Although those gains are now *possible*, they do not occur unless health systems and policies effectively realize the available potential.

Although the magnitude of possible gains in health was clear by the early 1990s, it is even clearer today: focused attention by health systems on delivering powerful but often inexpensive interventions can lead to dramatic improvements in health at modest cost. Globalization has helped diffuse knowledge about what those interventions are and how health systems can deliver them. The pace of diffusion of such knowledge into a country—much more than its level of income—determines the pace of health improvement in that country. Our purpose in *Disease Control Priorities in Developing Countries*, 2nd edition (*DCP2*), is to help speed the diffusion of policy-relevant knowledge.

This introductory chapter to *DCP2* serves two purposes:

- First, it provides the context for the rest of the book by discussing broad trends in health conditions, by summarizing health conditions of the world at the dawn of the 21st century, and by pointing to recent research suggesting that the economic benefits from successful investments in health are likely to be exceptionally high.
- Second, it highlights some of the main messages for policy that emerge from the 37 chapters that deal with conditions and risk factors and the 21 chapters that deal with strengthening health systems. These highlights are deliberately brief because chapters 2 and 3 summarize the remainder of the book: chapter 2 summarizes findings about intervention cost-effectiveness from across the book, and chapter 3 synthesizes findings on strengthening health systems.

Box 1.1 summarizes the main messages of this chapter.

Box 1.1

Disease Control Priorities

Chapters in this volume convey compact distillations of current knowledge concerning interventions to improve health and the related delivery systems. Chapter 2 summarizes main messages of the chapters dealing with interventions, and chapter 3 summarizes the main messages concerning health systems. Chapter 1 provides context and conveys examples of the range of findings from across the volume. Here, in brief, are the main messages of chapter 1:

1. *Average life expectancy in low- and middle-income countries increased dramatically in the past half-century, while cross-country health inequalities decreased.* In the countries with the best health indicators, life expectancy increased a substantial two and one-half years per decade since 1960; low- and middle-income countries on average, with life expectancy gains of about five years per decade, have been converging toward the countries with the longest life expectancy. Improvement in average income and education levels contributed to these worldwide gains in health. Of much greater quantitative significance, however, have been the generation and diffusion of new knowledge and of low-cost, appropriate technologies. Increased access to knowledge and technology has accounted for perhaps as much as two-thirds of the impressive 2 percent per year rate of decline in under-five mortality rates.
 2. *Improved health has contributed significantly to economic welfare.* Per capita GNP rose rapidly in developing countries in the decades following 1960, and economic research suggests that health improvements led to perhaps 10 percent to 15 percent of that GNP growth. Although GNP includes the costs of providing medical care and reflects changes in health-related consumption, such as the quantity and quality of food, it omits altogether the value that mortality reduction represents for countries. Recent economic research has extended measurement to a broader indicator, known as *full income*, that reflects reasonable valuation of changes in mortality. For many countries, recent mortality changes exceed in value the growth of GNP. More widespread use of full-income measures to calculate the rate of return to investments in health—and health research—will almost certainly conclude that, today, most countries substantially undervalue those investments.
 3. *Although health improvements constituted an enormous success for human welfare in the 20th century, four critical challenges face developing countries (and the world) at the beginning of the 21st century:*
 - high levels and rapid growth (for mostly demographic reasons) of noncommunicable conditions in the disease profiles of developing countries
 - the still unchecked HIV/AIDS pandemic
 - the possibility of a successor to the influenza pandemic of 1918
 - the persistence in many countries and many population subgroups of high but preventable levels of mortality and disability from diseases such as malaria, TB, diarrhea, and pneumonia; from micronutrient malnutrition; and, for both mothers and infants, from childbirth.
- The main purpose of this volume is to facilitate diffusion of appropriate approaches for addressing those problems.
4. *The volume's conclusions concerning interventions include the following:*
 - Although 50 percent of deaths (including stillbirths) of children under age five occur at ages younger than 28 days, relatively little attention has been paid to this age group. Cost-effective interventions exist.
 - Treatment of HIV-positive mothers, treatment of sexually transmitted infections, free distribution of condoms, and other interventions can cost-effectively interrupt HIV transmission. These preventive interventions continue to receive inadequate attention from health systems and workers.
 - Controlling tobacco use, particularly through taxation, is feasible in developing countries and is the single most important intervention for reducing noncommunicable disease.
 - Lifelong medical management of risk factors in individuals at high risk for heart attacks or strokes, using aspirin and other drugs, is cost-effective and would benefit tens of millions of individuals.
 5. *This volume's findings concerning health services and systems include the following:*
 - Provider incentives matter. Financial or other recognition for timely, responsive service increases the likelihood of such services. Conversely, financial incentives for excessive or inappropriate use of

drugs or diagnostic tests is an all-too-common cause of high costs and poor health outcomes.

- Provider experience matters. Having providers do a few things frequently, rather than attempting to provide diverse services, facilitates quality improvement with potentially major improvements in health outcomes.
- Strengthening surgical capacity at district hospitals is likely to be cost-effective and would address broad needs.
- In low-income countries, targeting the very limited public sector resources for health to control of diseases—such as TB—that particularly affect the poor would be efficient.
- In middle-income countries, public finance—or publicly mandated finance—of a substantial package of clinical care for all would be not only equitable but also efficient in terms of meeting health needs, controlling costs, and providing financial protection to populations.

6. *The generation and diffusion of new knowledge and products underpinned the enormous improvements in*

Source: Author.

health in the 20th century. Every reason exists to believe that continued progress—meeting the challenges of noncommunicable disease, HIV/AIDS, potential pandemics, and neglected populations—will also rely heavily on new knowledge. The rapidly growing commitment of high-income countries to providing development assistance for health would be more effectively used if a larger share were devoted to research and development. Public-private partnerships provide a promising institutional mechanism for new product development. A particularly important—and much neglected—type of knowledge results from tight evaluations of interventions and systems.

This volume represents an attempt to learn systematically from the enormous successes of the past half-century in improving human health. Knowledge that has been gained—and that this volume pulls together—creates a platform for addressing the problems that remain.

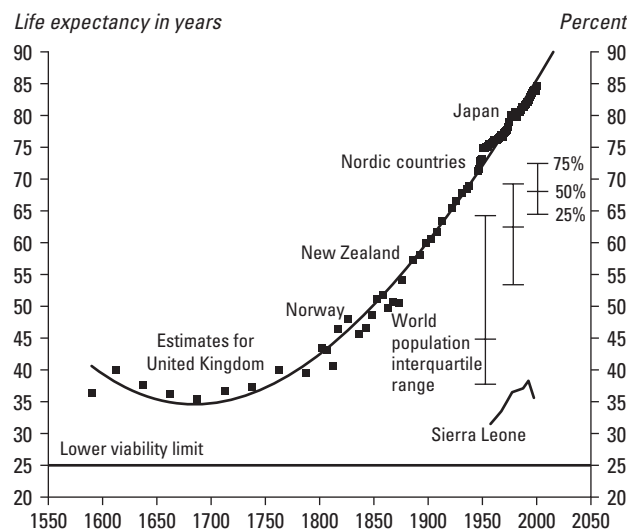
THE 20TH CENTURY TAKEOFF IN HUMAN HEALTH

The 20th century differed markedly from previous history in two critical domains:

- First, the rapid economic growth that had begun in the 19th century in countries of the North Atlantic diffused widely around the globe while continuing in the countries where it originated (DeLong 2000; Maddison 1999).
- Second, human mortality rates plummeted, and other dimensions of health improved dramatically. These changes also began in the North Atlantic countries in the 19th century but remained modest until the 20th century, during which the rate of improvement increased and spread to most of the rest of the world (Easterlin 1996, 1999; Oeppen and Vaupel 2002).

Improvements in Health

This section briefly documents the magnitude of health improvements and then points to the challenges that remain. For the past 160 years, life expectancy in the healthiest countries has increased steadily. At the same time, differences in life expectancy between those countries and much of the rest of the world have narrowed. Figure 1.1 depicts trends in female life expectancy in the country with the *highest* estimated level of



Source: Oeppen 1999.

Figure 1.1 Trends in Maximum Female Life Expectancy, 1600–2000

life expectancy. From about 1600 to about 1840, there is fluctuation but no clear trend; after 1840, the graph turns upward at a surprisingly uniform rate of improvement: maximum life expectancy increased by about two and one-half years per decade for 160 years.

Table 1.1 Levels and Changes in Life Expectancy, 1960–2002, by World Bank Region

Region	Life expectancy (years)			Rate of change (years per decade)	
	1960	1990	2002	1960–90	1990–2002
Low- and middle-income countries	44	63	65	6.3	1.7
East Asia and the Pacific	39	67	70	9.3	2.5
(China)	(36)	(69)	(71)	(11)	(1.7)
Europe and Central Asia	—	69	69	—	0.0
Latin America and the Caribbean	56	68	71	4.0	2.5
Middle East and North Africa	47	64	69	5.7	4.2
South Asia	44	58	63	4.7	4.2
(India)	(44)	(59)	(64)	(5)	(4.6)
Sub-Saharan Africa	40	50	46	3.3	–3.3
High-income countries	69	76	78	2.3	1.7
World	50	65	67	5.0	1.7

Source: World Bank 2004 (CD-ROM version).

— = not available.

Note: Entries are the average of male and female life expectancies.

Table 1.1 shows progress in life expectancy by World Bank region between 1960 and 2002. (Map 1 on the inside front cover depicts the World Bank regions.) For the first three decades of this period, progress was remarkably fast—a gain of 6.3 years in life expectancy per decade on average, albeit with substantial regional variation. Progress continued between 1990 and 2002 in the low- and middle-income countries but at a much slower pace. This slower pace is due, in great part, to mortality increases from HIV/AIDS. Sub-Saharan Africa actually lost more than four years of life expectancy.

Since 1950, life expectancy in the median country has steadily converged toward the maximum and cross-country differences have decreased markedly. This reduction in inequality in health contrasts with long-term *increases* in income inequality between and within countries. Despite the magnitude of global improvements, many countries and populations have failed to share in the overall gains or have even fallen behind. Some countries—for example, Sierra Leone—remain far behind (figure 1.1). China's interior provinces lag behind the more advantaged coastal regions. Indigenous people everywhere probably lead far less healthy lives than do others in their respective countries, although confirmatory data are scant.

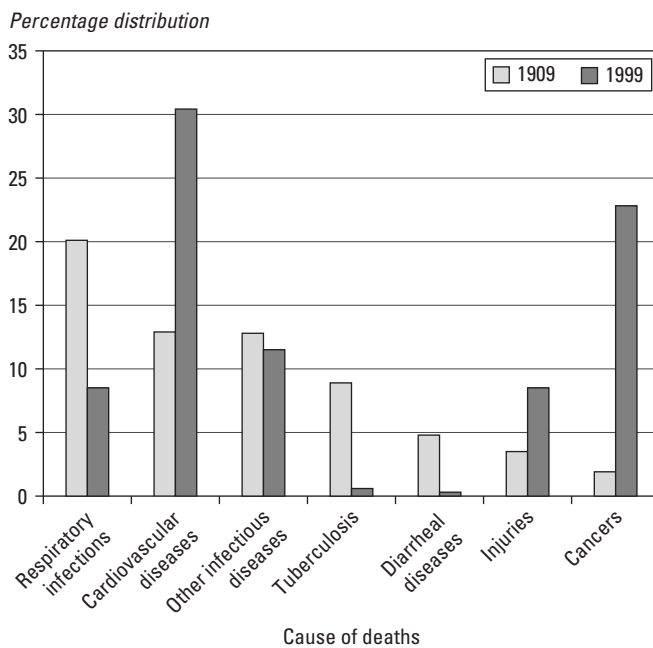
Reasons for remaining health inequalities lie only partially in income inequality: the experiences of China, Costa Rica, Cuba, Sri Lanka, and Kerala state in India, among many others, conclusively show that dramatic improvements in health can occur without high or rapidly growing incomes. The experiences of countries in Europe in the late 19th and early 20th centuries similarly show that health conditions can improve without prior or concomitant increases in income (Easterlin 1996). A recent review, undertaken in part as background for this volume,

identified many specific examples of low-cost interventions leading to large and carefully documented health improvements (Levine and others 2004). The public sector initiated and financed virtually all of these interventions. The goal of this book is to assist decision makers—particularly those in the public sector—to realize the potential for low-cost intervention to rapidly improve the health and welfare of their populations.

Remaining Challenges

Four central challenges for health policy ensue from the pace and unevenness of the progress just documented and from the evolving nature of microbial threats to human health.

Epidemiological Transition. First, the next two decades will see continuation of trends resulting from the dramatic mortality declines of recent decades. The key phenomenon is that the major noncommunicable diseases—circulatory system diseases, cancers, and major psychiatric disorders—are fast replacing (or adding to) the traditional scourges—particularly infectious diseases and undernutrition in children. This phenomenon results in substantial part from rapid relative population growth at the older ages, when noncommunicable diseases become manifest. Additionally, injuries resulting from road traffic are replacing more traditional forms of injury. Using data from Chile, figure 1.2 illustrates the huge increase in the relative importance of injuries, cancers, and cardiovascular disease between 1909 and 1999. Responding to this epidemiological transition with sharply constrained resources is a key challenge. Tables 1.A1 and 1.A2 (see annex 1.A) provide cause-specific summaries of death and disease burden, measured in DALYs, in 2001 for the world as a whole and for low- and



Source: WHO 1999, 13.

Note: For 1909, 35.1 percent of deaths were categorized as “other,” and for 1999, the corresponding percentage was 17.5. The cause-specific percentages shown in the figure are the number from the indicated cause as a percentage of the total number classified into a specific cause for that year.

Figure 1.2 Distribution of Deaths by Cause in Chile, 1909 and 1999

middle-income countries as a group as well as for high-income countries. Those summaries indicate that noncommunicable disease already accounts for over half of all deaths in the low- and middle-income countries, although nearly 40 percent of deaths continue to be from infection, undernutrition, and maternal conditions, creating a “dual burden” that Julio Frenk and colleagues have pointed to (Bobadilla and others 1993).

HIV/AIDS Epidemic. A second key challenge is the HIV/AIDS epidemic. Control efforts and successes have been very real but, with only a few exceptions, limited to upper-middle-income and high-income countries. Poorer countries remain in the epidemic’s deadly path.

New Pandemics. The global influenza pandemic of 1918 resulted in more than 40 million human deaths, exceeding the 20th-century toll of HIV/AIDS or of World Wars I and II. Continued evolution of the influenza virus leaves the world at risk of another such pandemic—as has been much discussed in the press as this book goes to print. If the H5N1 strain of avian influenza, for example, evolved so that (like the human flu) it could be efficiently transmitted from human to human, a major pandemic would be likely. Preparing for such an eventuality is the third great challenge to global health.

Unequal Progress. A fourth key challenge results from continued high levels of inequality in health conditions across

and within countries. Bourguignon and Morrisson (2002) have stressed that global inequalities are declining if one properly accounts for convergence across countries in health conditions, which more than compensates for income divergence. However, in far too many countries health conditions remain unacceptably—and unnecessarily—poor. This factor is a source of grief and misery, and it is a sharp brake on economic growth and poverty reduction. From 1990 to 2001, for example, the under-five mortality rate remained stagnant or increased in 23 countries. In another 53 countries (including China), the rate of decline in under-five mortality in this period was less than half of the 4.3 percent per year required to reach the fourth Millennium Development Goal (MDG-4) (see map 2 on the inside back cover of this book). Meeting the MDG for under-five mortality reduction by 2015 is not remotely possible for these countries. Yet the examples of many other countries, often quite poor, show that with the right policies dramatic reductions in mortality are possible. A major goal of this volume is to identify strategies for implementing interventions that are known to be highly cost-effective for dealing with the health problems of countries remaining behind—for example, treatment for diarrhea, pneumonia, TB, and malaria; immunization; and other preventive measures against a large proportion of those diseases.

THE ECONOMIC BENEFITS OF BETTER HEALTH

The dramatic health improvements globally during the 20th century arguably contributed as much or more to improvements in overall well-being as did the equally dramatic innovation in and expansion of the availability of material goods and services. To the substantial extent that appropriate investments in health can contribute to continued reductions in morbidity and mortality, the economic welfare returns to health investments are likely to be exceptional and positive—with previously unrecognized implications for public sector resource allocation. These returns go far beyond the contribution better health makes to per capita income, which itself appears substantial (see Bloom, Canning, and Jamison 2004; Lopez-Casasnovas, Rivera, and Currais 2005). This section first summarizes the evidence concerning health’s effect on per capita income and then turns to more recent literature concerning the effect of health changes on a broader measure of economic well-being than per capita gross domestic product (GDP).

Health and Income

How does health influence GDP per person? Healthy workers are more productive than workers who are similar but not healthy. Supporting evidence for this plausible observation comes from studies that link investments in health and nutrition of the young to adult wages (Strauss and Thomas 1998). Better

health also raises per capita income through a number of other channels. One involves altering decisions about expenditures and savings over the life cycle. The idea of planning for retirement occurs only when mortality rates become low enough for retirement to be a realistic prospect. Rising longevity in developing countries has opened a new incentive for the current generation to save—an incentive that can dramatically affect national saving rates. Although this saving boom lasts for only one generation and is offset by the needs of the elderly after population aging occurs, it can substantially boost investment and economic growth rates while it lasts.

Encouraging foreign direct investment is another channel: investors shun environments in which the labor force suffers a heavy disease burden. Endemic diseases can also deny humans access to land or other natural resources, as occurred in much of West Africa before the successful control of river blindness.

Boosting education is yet another channel. Healthier children attend school and learn more while they are there. A longer life span increases the returns on investment in education.

Demographic channels also play an important role. Lower infant mortality initially creates a “baby-boom” cohort and leads to a subsequent reduction in the birth rates as families choose to have fewer children in the new low-mortality regime. A baby-boom cohort thereby affects the economy profoundly as its members enter the educational system, find employment, save for retirement, and finally leave the labor market. The cohorts before and after a baby boom are much smaller; hence, for a substantial transition period, this cohort creates a large labor force relative to overall population size and the potential for accelerated economic growth (Bloom, Canning, and Malaney 2000).

If better health improves the productive potential of individuals, good health should accompany higher levels of national income in the long run. Countries that have high levels of health but low levels of income tend to experience relatively faster economic growth as their income adjusts. How big an overall contribution does better health make to economic growth? Evidence from cross-country growth regressions suggests the contribution is consistently substantial. Indeed, the initial health of a population has been identified as one of the most robust and potent drivers of economic growth—among such well-established influences as the initial level of income per capita, geographic location, institutional environment, economic policy, initial level of education, and investments in education. Bloom, Canning, and Sevilla (2004) found that one extra year of life expectancy raises GDP per person by about 4 percent in the long run. Jamison, Lau, and Wang (2005) estimated that reductions in adult mortality explain 10 to 15 percent of the economic growth that occurred from 1960 to 1990. Not all countries benefit equally from this link. Bhargava and others (2001) found that better health matters more for

income growth in low-income countries than in high-income ones. Although attribution of causality is never unequivocal in analyses like these, different types of evidence point consistently to a likely causal effect of health on growth.

Health declines can precipitate downward spirals, setting off impoverishment and further ill health. For example, the effect of HIV/AIDS on per capita GDP could prove devastating in the long run. An enormous waste of human capital occurs as prime-age workers die. A high-mortality environment deters the next generation from investing in education and creating human capital. The creation of a generation of orphans means that children may be forced to work to survive and may not get the education they need. High rates of mortality may reduce investment. Saving rates are likely to fall, and retirement becomes less likely. A foreign company is less likely to invest in a country with a high HIV prevalence rate because of the threat to the firm’s own workers, the prospect of high labor turnover, and the loss of workers who have gained specific skills by working for the firm. The International Monetary Fund recently published a collection of important studies of the multiple mechanisms through which a major AIDS epidemic can be expected to affect national economies (Haacker 2004).

Health and Economic Welfare

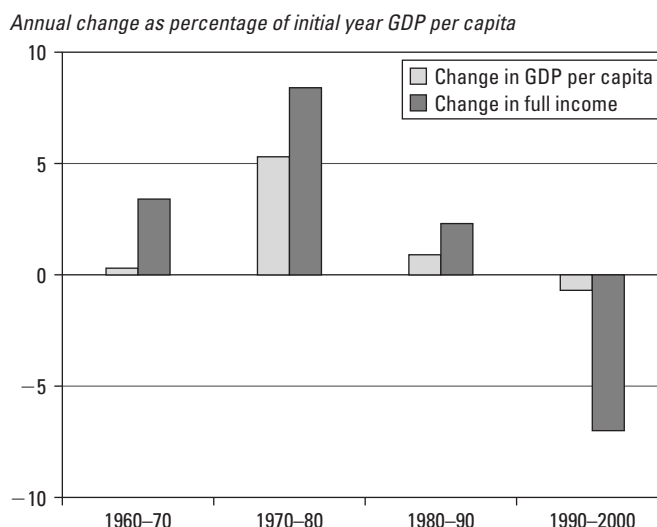
Judging countries’ economic performance by GDP per person fails to differentiate between situations in which health conditions differ: a country whose citizens enjoy long and healthy lives clearly outperforms another with the same GDP per person but whose citizens suffer much illness and die sooner. Individual willingness to forgo income to work in safer environments and social willingness to pay for health-enhancing safety and environmental regulations provide measures, albeit approximate, of the value of differences in mortality rates. Many such willingness-to-pay studies have been undertaken in recent decades, and their results are typically summarized as the *value of a statistical life* (VSL). Chapter 7 discusses these issues in the context of assessing the economic returns to investments in health research and development.

Although the national income and product accounts include the value of inputs into health care (such as drugs and physician time), standard procedures do not incorporate information on the value of changes in longevity. In a seminal paper, Usher (1973) first brought the value of mortality reduction into national income accounting. He did this by generating estimates of the growth in what Becker, Philipson, and Soares (2003) have called *full income*—a concept that captures the value of changes in life expectancy by including them in an assessment of economic welfare. Estimates of changes in full income are typically generated by adding the value of changes in annual mortality rates (calculated using VSL figures) to changes in annual GDP per person. These estimates of change

in full income are conservative in that they incorporate only the value of mortality changes and do not account for the total value of changes in health status. Valuation of changes in mortality, it should be noted, is only one element—albeit a quantitatively important one—of potentially feasible additions to national account to deal with nonmarket outcomes. The U.S. National Academy of Sciences has recently proposed broad changes for the United States that would include but go beyond valuation of mortality change (Abraham and Mackie 2005).

For many years, little further work was done on the effects of mortality change on full income although, as Viscusi and Aldy (2003) document, the number of carefully constructed estimates of VSLs increased enormously. Bourguignon and Morrisson (2002) address the long-term evolution of inequality among world citizens, starting from the premise that a “comprehensive definition of economic well-being would consider individuals over their lifetime.” Their conclusion is that rapid increases in life expectancy in poorer countries had resulted in declines in inequality (broadly defined) beginning sometime after 1950, even though income inequality had continued to rise. In another important paper, Nordhaus (2003) assessed the growth of full income per capita in the United States in the 20th century. He concludes that more than half of the growth in full income in the first half of the century—and less than half in the second half of the century—had resulted from mortality decline. In this period, real income in the United States increased sixfold and life expectancy increased by more than 25 years.

Three lines of more recent work extend those methods to the interpretation of the economic performance of developing countries. All reach conclusions that differ substantially from analyses based on GDP alone. Two of those studies—one undertaken for the Commission on Macroeconomics and Health (CMH) of the World Health Organization (WHO) (Jamison, Sachs, and Wang 2001) and the other at the International Monetary Fund (Crafts and Haacker 2004)—assessed the impact of the AIDS epidemic on full income. Both studies conclude that the AIDS epidemic in the 1990s had far more adverse economic consequences than previous estimates of effects on per person GDP growth would suggest. Accounting for mortality decline in Africa before the 1990s, on the other hand leads to estimates of much more favorable overall economic performance than does the trend in GDP per person. Figure 1.3 shows that in Kenya, for example, full income grew more rapidly in GDP per person before 1990 (and far more rapidly in the 1960s). After 1990 the mounting death toll from AIDS appears to have only a modest effect on GDP per person but a dramatically adverse impact on changes in full income. Becker, Philipson, and Soares (2003) extended the earlier work of Bourguignon and Morrisson (2002) in finding strong absolute convergence in full income across countries over time, in contrast to the standard finding of continued divergence (increased inequality) of GDP per person. Finally,



Source: Jamison, Sachs, and Wang 2001.

Figure 1.3 Changes in GDP and Full Income in Kenya, 1960–2000

Jamison, Jamison, and Sachs (2003) have adapted standard cross-country growth regressions to model determinants of full income (rather than GDP per person). Like Becker, Philipson, and Soares (2003), they conclude that inequalities have been decreasing.

The dramatic mortality declines of the past 150 years—and their reversal in Africa by AIDS subsequent to 1990—have had major economic consequences. The effect of health on GDP is substantial. The intrinsic value of mortality changes—measured in terms of VSL—is even more substantial. What are the implications of these findings for development strategy and for benefit-cost analyses of public sector investment options? Using full income in benefit-cost analyses of investments in health (and in health-related sectors such as education, water supply and sanitation, and targeted food transfers) would markedly increase estimates of net benefits or rates of return. A careful, quantitative reassessment of competing policies for improving a country’s living standards would probably conclude that development assistance and budgetary allocations to health deserve greater relative priority.

WHY HAS MORTALITY DECLINED AT SUCH DIFFERENT RATES IN DIFFERENT COUNTRIES?

This section explores some of the reasons mortality has declined so rapidly and at such different rates in different countries. It considers the question of whether income levels or growth rates play an important role in achieving better health or whether good policies can potentially lead to good health for low-income populations. The section concludes with a snapshot of health conditions in the world at the dawn of the 21st century.

The 20th century witnessed huge and unprecedented declines in mortality rates at all ages and in most parts of the world. Easterlin (1996) and Crafts (2000) place an emphasis on mortality transformation that is comparable to their emphasis on economic growth in their retrospectives on the unprecedented changes in the human condition during the 20th century. Understanding the sources of mortality changes is important for understanding one of the defining events of world history and also for devising policies to address the needs of the perhaps 25 percent of the world's population whose mortality rates remain far higher than those of the rest of humanity.

Several approaches shed light on the sources of mortality decline. Epidemiologists and demographers have carefully tracked specific communities for many years to assess levels of mortality and causes of death. In rural Senegal, rapid mortality decline followed introduction of interventions addressing specific conditions (Pison and others 1993).

Another approach is historical. Easterlin (1996, 1999) examined the interplay of economic growth, urbanization, and mortality in 19th- and 20th-century Europe. He concluded that although income growth in the 19th century probably did play a role in reducing mortality (through its influence on food availability and environmental conditions), the magnitude of the effect was small. Fogel (1997) stressed the importance of increases in food availability during this period. Positive effects of income growth were partially offset by increased infectious disease transmission resulting from urbanization. Easterlin (1999) concludes that 20th-century mortality decline, which was much more rapid than that of the 19th century, had its origin in technical progress, and Powles (2001) has pointed to the importance and nature of the institutional changes required to translate technical change and economic improvements into mortality reduction. Mosk and Johansson's (1986) assessment of the interplay between income and mortality in Japan illustrates the role that adoption of public health knowledge and institutional development played in mortality decline in the country that now has the world's lowest mortality rates.

Most analysts agree that advances in science and technology have underpinned the 20th-century transformations both of income and of mortality levels. Models of economic growth rely heavily on technological progress to account for economic change (Boskin and Lau 2000; Easterly and Levine 1997; Solow 1957). Preston (1975, 1980) and Fuchs (1974) provided early quantitative assessments of the central importance of technical progress in accounting for 20th-century increases in life expectancy. [Economists use the term *technical progress* to denote advances in knowledge that lead to new products, like vaccines, or that can inform behavior change, like knowledge of the germ theory of disease (Preston and Haines 1998).] Davis (1956) had already concluded that the unprecedented reduction in mortality in underdeveloped areas since 1940 is the result primarily of the discovery and dissemination of new

methods of disease treatment that can be applied at reasonable cost. The reduction was rapid because it did not depend on general economic development or social modernization (Davis 1956, 306–7, 314). Some strands of the literature, however, attribute the high correlation of income and life expectancy at any given time to a significant causal effect of income on health (see, for example, Pritchett and Summers 1996).

Background work for this volume (Jamison, Sandbu, and Wang 2004) attempted to provide a better sense of the importance of income as a determinant of mortality by exploring the relationships among income, technical progress (or diffusion), and mortality decline. Previous econometric research either has given little emphasis to technical progress—in part simply because much of the research is cross-sectional and therefore fails to address developments over time—or has assumed the rate of technical progress or technology adoption to be constant across countries. The background work for this volume relaxed the assumption that the rate of technology adoption is constant across countries. Allowing for cross-country variation in the rate of adapting new methods resulted in weaker estimated effects of income on infant mortality rates than previously found, although education's estimated effect was robust with respect to this change.

Much of the variation in country outcomes results from the very substantial cross-country variation in the rate of technical progress—from essentially no decline in infant mortality rate caused by technical progress to reductions of up to 5 percent per year from that source. Deaton (2004) provides a complementary and extended discussion of the importance of technological diffusion for improvements in health. Many factors from outside the health sector also affect the pace of health improvement; the education levels of populations are most important. Box 1.2 briefly discusses the multisectoral nature of health's determinants. The importance of technical progress and diffusion should be viewed in this larger context.

However technical progress or diffusion may be manifested, the large differences in its magnitude across countries suggest important effects of a country's health-related policies (Fuchs 1980; Oeppen 1999). This point bears reiterating in a slightly different way: income growth is neither necessary nor sufficient for sustained improvements in health. Today's tools for improving health are so powerful and inexpensive that health conditions can be reasonably good even in countries with low incomes.

CHILD HEALTH

A small number of conditions accounts for most of the (large) differences in health between the poor and the not so poor. Less than 1 percent of all deaths from AIDS, TB, and malaria, for example, occur in the high-income countries. Available technical options—exemplified by but going well beyond immunization—can address most of the conditions that affect

Box 1.2

The Multisectoral Determinants of Health

Malnourished children easily acquire diseases, and they easily die from the diseases that they acquire. Dwellings and neighborhoods without sanitation provide fertile environments for transmission of intestinal infections. Cooking with wood and coal results in air dense with particulates and gases, which destroy lungs and lives. Hopeless life circumstances thrust young girls (and boys) into commercial sex work with its attendant risks of violence and sexually transmitted infections, including HIV/AIDS. Manufacturers of tobacco and alcohol profit enormously from advertising and promotion that spread addiction. Rapid growth in vehicular traffic—often with untrained drivers on unsafe roads—generates a rising toll of injury. Poorly designed irrigation creates breeding grounds for vectors of disease. The point is clear: determinants of health are truly multisectoral.

WHO coordinated a group of more than 100 individuals to generate estimates of the percentage of deaths, by region and globally, associated with a range of 26 risk factors (Ezzati and others 2004). Those estimates were revised and updated for the Disease Control Priorities Project. The results give a sense of the extent to which multisectoral factors contributed to mortality and disease burden in low- and middle-income countries in 2001. The following, for example, are estimates of the percentage of disease burden (and, in parentheses, of deaths) in those countries attributable to the indicated risk factors:

- tobacco smoking—4.7 percent (8.5 percent)
- indoor air pollution—2.7 percent (3.2 percent)
- inadequate water and sanitation—3.4 percent (2.8 percent)

Source: Author.

Note: The estimates reported here of DALYs and deaths that are attributable to various risk factors come from Ezzati and others (2006).

- risky sexual activity—5.3 percent (5.1 percent)
- alcohol use—3.6 percent (3.4 percent).

Underlying most proximal risks are more general determinants of health, such as education and, to a lesser extent, income. The effects of income and education operate for the most part through influencing risk (and permitting effective use of health services). If an important fraction of ill health results from poverty and low educational levels—or from their consequences in inadequate food or sanitation or other specific risks—then ought the task of the health professional lie principally in addressing these underlying problems? In one sense, the answer is surely yes: the health community should measure the effects on health of actions outside the health sector. It should ensure that these findings are communicated and are considered by those making policy choices. The magnitude of the demonstrated effect of girls' education on health and fertility outcomes, for example, provides one powerful argument for investing in expansion of educational access to girls. Millions of premature deaths, to take another example, could be averted in Africa alone in the next quarter century with appropriate policies toward supply of energy for household use (Bailis, Ezzati, and Kammen 2005). It is essential that the health sector document and advocate opportunities such as these.

The health community has limited capacity for direct action outside the health sector, however. It will make more of a difference if it focuses its energy, expertise, and resources on ensuring that health systems efficiently deliver the powerful interventions provided by modern science.

children, and can do so with great efficacy and at modest cost. That short list of conditions, including undernutrition, relates directly to achieving the MDGs for health. Public expenditures to address those conditions have, in the past, benefited the relatively well off, albeit within poor countries (although global inequities have decreased because many poor countries have made much progress).

Under-Five Health Problems and Intervention Priorities

MDG-4 for under-five mortality (reducing its level in 2015 by two-thirds relative to what it was in 1990) is highly

ambitious. Yet its implication of an average 4.3 percent per year decline is well within recent experience. In the first half of the MDG period (1990–2002), 46 countries achieved rates of decline in under-five mortality greater than 4.3 percent per year. Figure 1.4 displays trends in the rate of decline in under-five mortality relative to the requisite 4.3 percent per year for China, India, Latin America and the Caribbean, and Sub-Saharan Africa. Africa's slowed progress probably stems mostly from HIV/AIDS and the spread of resistance to previously effective and widely used antimalarial drugs. Map 2 (on the inside back cover of this

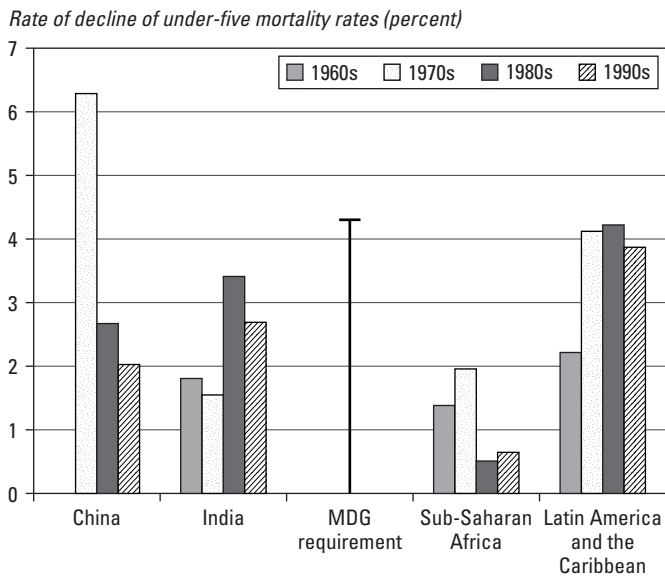


Figure 1.4 Rate of Progress in Reducing Under-Five Mortality, 1960–2000: China, India, Latin America and the Caribbean, and Sub-Saharan Africa

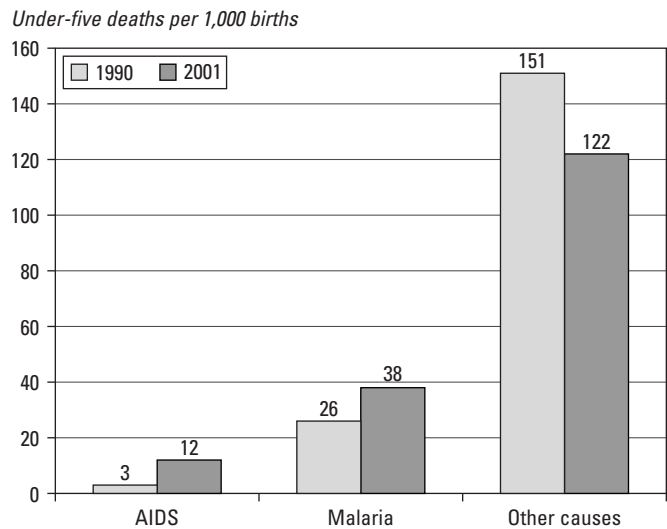
Source: Calculations based on data in World Bank 2004 (CD-ROM version).
 Note: The black bar in the center shows the 4.3 percent per year rate of decline required for the period 1990–2015 to meet MDG-4 of reducing under-five mortality by two-thirds.

Figure 1.4 Rate of Progress in Reducing Under-Five Mortality, 1960–2000: China, India, Latin America and the Caribbean, and Sub-Saharan Africa

book) shows country-specific progress in reducing under-five mortality:

- Countries colored in green experienced annual rates of decline greater than 4.3 percent in the first half of the MDG period (1990–2002).
- Countries colored in red saw no decrease (or an increase) in their under-five mortality.
- Countries colored in yellow and orange depict countries in between—with yellow indicating performance in the top half of the range between 0 and 4.3 percent, and orange indicating poorer performance in the bottom half of the range.

Basic knowledge about the cost-effectiveness of interventions to address maternal and child health has been available from the 1980s. *DCP2*'s work provides a reassessment with few surprises but some additions. It makes two important relatively new points. The first results from noting that half of under-five deaths occur at ages less than 28 days, when the substantial but usually neglected problem of stillbirth is considered. *DCP2* identifies some highly cost-effective approaches to intervention against stillbirth and neonatal death (chapter 27). The second new point results from the rapid spread of resistance of the malaria parasite to chloroquine and sulfadoxine-pyrimethamine (SP). These inexpensive, highly effective, widely available drugs provided an important partial check on the high levels of malaria mortality in Africa. Their loss is



Source: Lopez, Begg, and Bos 2006, table 2.4.

Figure 1.5 Under-Five Deaths from AIDS, Malaria, and Other Causes, per Thousand Births, 1990 and 2001, Sub-Saharan Africa

leading to an even greater rise in malaria mortality and morbidity that could be substantial. Figure 1.5 illustrates increases in malaria death rates in under-five children in Sub-Saharan Africa in the period from 1990 to 2001. The design of instruments for financing a rapid transition to effective new treatments—artemisinin combination therapies (ACTs)—is a high priority (chapter 21; Arrow, Gelband, and Jamison 2005).

The other intervention priorities for addressing under-five mortality are for the most part familiar:

- Expand immunization coverage.
- Expand the use of the simple and low cost but highly effective treatments for diarrhea and child pneumonia through integrated management of childhood illness or other mechanisms.
- Prevent transmission of and mortality from malaria by expanding coverage of insecticide-treated bednets, by expanding use of intermittent preventive treatment for pregnant women, and, particularly, by financing the adoption of ACTs to replace the now widely ineffective drugs chloroquine and SP.
- Ensure widespread distribution of key micronutrients.
- Expand the use of a package of measures to prevent mother-to-child transmission of HIV (further discussed in the next section on HIV/AIDS).

In addition to interventions to reduce under-five mortality, one other priority is clear. The world's most prevalent infections are intestinal helminth (worm) infections, and children of all ages are among the most heavily affected. Chapter 24 discusses these infections, which a low-cost drug (albendazole),

taken every six months to a year, can control effectively. Chapter 58 on school health services points to both the importance to children's school progress of taking albendazole where needed and the potential efficacy of school health programs as a vehicle for delivery. In the long run, improved sanitation and water supplies will prevent transmission. Use of albendazole is only an interim solution, but it is one that may be required for decades if the experience of the currently high-income countries is relevant.

Delivering Child Health Interventions

The list of potential interventions is far from exhaustive, and different regions, countries, and communities will face different mixes of the problems these interventions address. However, there can be little dispute that any short list of intervention priorities for under-five mortality in low- and middle-income countries would include many on the list in the preceding section. Why not, then, simply put money into scaling up these known interventions to a satisfactory level?

To greatly oversimplify—and these issues are discussed more substantially in chapter 3—two schools of thought exist. One line of thinking—often ascribed to macroeconomist Jeffrey Sachs and his work as chair of the WHO CMH—concludes that more money and focused effort *are* the solutions. Although acknowledging dual constraints—of money and of health system capacity—Sachs and his colleagues (WHO CMH 2001; Sachs 2005) contend that money can buy (or develop, or both) relevant system capacity even over a period as short as five years. Major gains are affordable and health system capacity constraints can be overcome. Immunization provides an example of where, even in the short term, money can substitute for system capacity. Adding antigens for *Haemophilus influenzae* type B (Hib) and hepatitis B (HepB) to the immunization schedule is costly (although still cost-effective). In some environments, however, it proves less demanding of system capacity than expanding coverage does. Money can be effectively spent by adding antigens at the same time as investing in the capacity to extend coverage.

A second school of thought acknowledges the need for more money but asserts that health system capacity is often a binding short- to medium-term constraint on substantial scaling up of interventions. Critical priorities are, therefore, system reform and strengthening while ensuring that such reforms focus clearly on achieving improved health outcomes and financial protection.

Chapter 3, as indicated, discusses these issues further in the context of all the problems facing a health system, and chapter 9 provides a thoughtful assessment of how to overcome the constraints facing achievement of the MDGs for health. From an individual country's perspective, however, if financial resources are available, the question is very much an empirical one: to what extent can those resources be effectively deployed

in buying interventions, in buying out of prevailing system constraints, and in investing in relevant system capacity for the future? What needs to be constantly borne in mind throughout this continued controversy is that *something* works: under-five mortality rates have plunged by more than half since 1960 in the low- and middle-income countries.

HIV/AIDS

For dozens of countries around the world—including several of the most populous—the AIDS epidemic threatens every aspect of development. No other threat comes close, with the possible exceptions of use of nuclear weapons in densely populated areas or a devastating global pandemic similar to the 1917–18 influenza episode. Most governments of affected low- and middle-income countries and most providers of development assistance have only recently begun to respond more than minimally. Creation of the Global Fund to Fight AIDS, Tuberculosis, and Malaria can be viewed as an attempt of the world's top political leaders to improve on the records of existing institutions. The Global Fund's initial years have seen substantial success, but that success is potentially undermined by sharp constraints on resource availability (Bezanson 2005).

Tools to Control the Epidemic

In contrast to the initially slow programmatic movement of most national leaders and international institutions, the research and development community—public and private—has made rapid progress in developing tools to control the HIV/AIDS epidemic, although both a vaccine and a curative drug remain distant objectives. Sensitive, specific, and inexpensive diagnostics are available; means of prevention have been developed and tested; modes of transmission are well understood; and increasingly powerful drugs for controlling viral load allow radical slowing of disease progression. Tools for dealing with HIV/AIDS are thus available: As emphasized in chapter 18, a number of countries show by example that those tools can be put to effective use. Most of the high-income countries have done so, and Brazil and Mexico provide examples of upper-middle-income countries that have forestalled potentially serious epidemics. Mexico succeeded, for example, with a policy of responding both early and forcefully to the epidemic (del Rio and Sepúlveda 2002). The major successes of Thailand and Uganda demonstrate that countries with fewer financial resources can also succeed—and succeed against more established epidemics that had already penetrated deeply into their populations.

Prevention and Management

Prevention underpins success. At the time the World Bank's *World Development Report: Investing in Health* (World Bank

1993) was being written in 1992 and 1993, the only tool for dealing with the epidemic was prevention. In collaboration with the then–Global Programme against AIDS at WHO, the *World Development Report* commissioned very approximate estimates of the consequence for the new infection rate of fully implementing available preventive measures (its optimistic case scenario) or of doing very little (worst case). Actual incidence numbers for 2000, unfortunately, fall very close to the worst-case projection, and chapter 18 points out that even by 2003 fewer than one in five people at high risk of infection had access to the most basic preventive services. In much of the world, little has been spent on prevention, and little has been achieved. In addition, the current U.S. administration may be partially responsible for discouraging condom use in some countries and in stigmatizing and alienating commercial sex workers who are particular priorities for prevention programs. Despite those problems, the potential for prevention is very real, and a number of successful countries have shown the possibility of using that potential well. Chapter 17 on sexually transmitted infections (STIs) and chapter 18 on AIDS discuss a broad menu of preventive measures and experiences with their implementation. Among them, treatment of STIs may be of particular salience both because the diseases are well worth treating in their own right and because the absence of STIs greatly reduces transmission of HIV.

In addition to prevention, better management of patients with AIDS could avert much misery, both by treating opportunistic infections and by ameliorating the often excruciating pain associated with many AIDS deaths. Medically inappropriate restrictions on the use of inexpensive but powerful opiates for pain control continue to deny dignity and comfort to millions of patients with AIDS and cancer in their final days (chapter 52).

Antiretroviral Treatment

Intensive research and development efforts have led in the past decade to the availability of well over a dozen antiretroviral drugs that can greatly reduce the quantity of HIV in an infected person. This reduction in viral load slows or halts progression of AIDS and can return individuals from serious illness to reasonable health. Available drugs leave a residual population of HIV in the body, however, and this population grows if the drugs are stopped. At present the drugs must be taken for life. Widespread use of these drugs in high-income (and some middle-income) countries has transformed the life prospects of HIV-infected individuals.

Early generation antiretroviral drugs suffered notable shortcomings: they were enormously costly; regimens for their use were complicated, making adherence difficult; their use generated unpleasant side effects; and rapid evolution of HIV led to

resistant mutants that undermined the efficacy of therapy. In a remarkably short time, scientific advances have substantially attenuated those problems, making feasible, at least in principle, antiretroviral therapy in low-income settings. WHO’s “3 by 5” program had as its objective, for example, to reach 3 million people in low- and middle-income countries with antiretroviral therapy by 2005. Although that goal was far from being met, the global effort to make treatment widely available is well under way.

Despite the indicated progress against the problems with antiretroviral drugs, challenges to their effective use in low-income environments remain formidable. The complexity of patient management is very real. Management requires high levels of human resources and other capacities in many of the countries where those capacities need to be most carefully rationed. Perhaps in consequence, achieving effective implementation has been difficult on even a limited scale. Chapter 18 reviews those problems and how they might be addressed.

Three points concerning widespread antiretroviral drug use are particularly noteworthy:

- Poor implementation (low adherence, development of resistance, interruptions in drug supplies) is likely to lead to very limited health gains, even for individuals on therapy. (This outcome is unlike that of a weak immunization program in which health gains still exist in the fraction of the population that is immunized.) Poorly implemented antiretroviral drug delivery programs could divert substantial resources from prevention or from other high-payoff activities in the health sector. Even worse, they could lead to a false sense of complacency in affected populations: evidence from some countries suggests that treatment availability has led to riskier sexual behavior and increased HIV transmission. The injunction to “do no harm” holds particular salience.
- Unless systematic efforts are made to acquire hard knowledge about which approaches work and which do not, the likelihood exists that unsuccessful implementation efforts will be continued without the appropriate reallocation of resources to successful approaches. Learning what works will require major variations in approach and careful evaluation of effects. Failing to learn will lead to large numbers of needless deaths. Most efforts to scale up antiretroviral therapy unconscionably fail to commit the substantial resources required for evaluation of effects. Such evaluations are essential if ineffective programs are to be halted or effective ones are to receive more resources.
- Many programs rely exclusively on the cheapest possible drugs, thereby risking problems with toxicity, adherence, and drug resistance. From the outset a broader range of drug regimens needs to be tested.

NONCOMMUNICABLE DISEASE AND INJURY

At the same time that most low- and middle-income countries need to address health problems that are now effectively controlled in high-income countries, they are increasingly sharing the high-income countries' heavy burdens of cardiovascular system disease (chapters 33, 44, and 45); cancers (chapter 29); psychiatric disorders (chapter 31); and automobile-related injuries (chapter 39). The public health research and policy community has been surprisingly silent about these epidemics even though, for example, cardiovascular disease (CVD) in low- and middle-income countries killed over twice as many people in 2001 as did AIDS, malaria, and TB combined (table 1.A1). An important early exception is Feachem and others (1992), who indicated approaches to treatment and prevention of these conditions that can be adapted to the tighter budget constraints of developing countries. The World Health Organization provides a valuable and more up-to-date discussion that emphasizes prevention (WHO 2005). In addition, low-cost but effective approaches to long-term management of chronic conditions need to be developed and implemented.

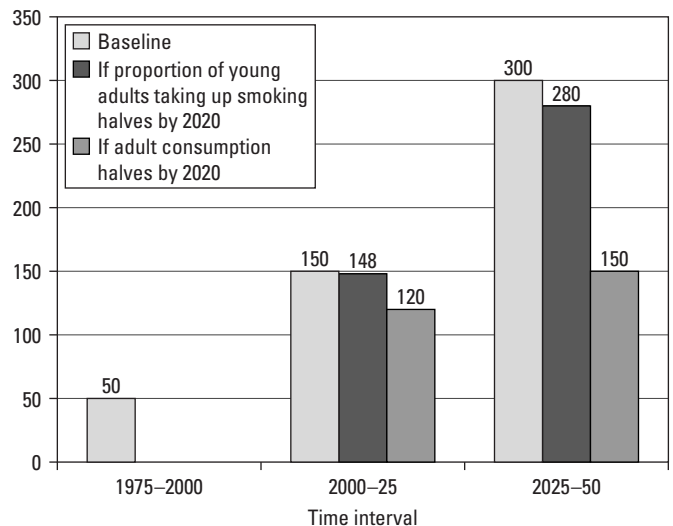
The remainder of this section briefly discusses, as examples, the prevention and management of cardiovascular diseases, psychiatric disorders, and injuries.

Cardiovascular Disease

Cardiovascular diseases in low- and middle-income countries result in about 13 million deaths each year, over a quarter of all deaths in those countries. Most cardiovascular deaths result from ischemic heart disease (5.7 million) or cerebrovascular disease (4.6 million). Because such deaths occur at older ages, they account for a substantially smaller fraction of total disease burden in disability-adjusted life years (DALYs)—12.9 percent—than they do of deaths (table 1.A2).

Growing tobacco use accounts for a substantial and avoidable fraction of CVD and of cancers. Reasonable projections show the number of tobacco-related deaths to be not only large but also growing, particularly in developing countries. In 2000, the number of tobacco-related deaths in developing countries about equaled the number in high-income countries; projections suggest that by 2030 developing countries will have more than twice as many. For those reasons, controlling smoking is a key element of any national strategy for preventing CVD or for promoting health more generally. Preventing the initiation of smoking is important because addiction to tobacco makes smoking cessation very difficult, even for the numerous individuals who would like to do so. However, helping people quit smoking is at least as important as preventing initiation. Figure 1.6 portrays estimates showing that far more lives could be saved between now and 2050 with successful efforts to help people stop smoking than with efforts to keep them from

Tobacco deaths worldwide in the indicated quarter century (millions)



Source: Chapter 46, figure 46.2. Adapted from Jha and Chaloupka 2000; Peto and Lopez 2001.

Figure 1.6 Increase in Tobacco-Related Deaths as Populations Age

starting. Reducing smoking levels is well demonstrated to be within the control of public policy. The principal instrument is through taxation: Complementary measures discussed in chapter 46 are important as well.

The main risk factors for CVD account for very large fractions of the deaths (and even more of the burden) from those diseases. For ischemic heart disease, they collectively account for 78 percent of deaths in low- and middle-income countries; for stroke, they account for 61 percent (Ezzati and others 2006). Measures to reduce the levels of those risk factors—high blood pressure, high cholesterol, smoking, obesity, excessive alcohol use, physical inactivity, and low fruit and vegetable consumption—are the goals for prevention. Unlike the favorable experience with controlling tobacco use, attempts to change the behaviors leading to obesity, hypertension, high cholesterol, or physical activity appear to have had little success at a population level. However, as chapter 44 documents, many promising approaches remain to be tried. Common sense suggests that they should be initiated even while more systematic efforts to develop and evaluate behavior-change packages are ramped up.

Pharmaceutical interventions to manage two major components of cardiovascular risk—hypertension and high cholesterol levels—are well established and are highly cost-effective for individuals at high risk of a stroke or heart attack. From at least the time of publication of *Disease Control Priorities in Developing Countries*, 1st edition (DCPI), researchers have recognized that the low cost and high effectiveness of drugs to prevent the reoccurrence of a cardiovascular event made their long-term use potentially cost-effective in low-income

environments (Pearson, Jamison, and Trejo-Gutierrez 1993). Even if sustained behavior change proves difficult to achieve, medications have the potential to reduce CVD risks by 50 percent or more. Chapters 33 and 45 develop the current evidence on that point. A key problem, however, concerns the health care personnel and systems requirements associated with the need for lifelong medication use, a problem also faced with antiretroviral therapy for AIDS and the use of medications to target several major psychiatric disorders. How to achieve effective long-term management of lifesaving drugs is a key delivery and research challenge for health system reformers.

In contrast to the lifelong requirement for drug use associated with CVD risk reduction in high-risk individuals, treatment of acute heart attacks with inexpensive drugs is both less demanding of system resources and highly cost-effective (chapter 45). Given the high incidence of these problems, systemwide efforts to achieve high rates of appropriate drug use in response to acute heart disease are a high priority.

Psychiatric Disorders

Although neurological and psychiatric disorders lead to only about 1.4 percent of deaths in low- and middle-income countries (1.8 percent in high-income countries), they cause suffering and disability far beyond what the mortality numbers suggest. About 10 percent of disease burden in DALYs in low- and middle-income countries results from these conditions; three major psychiatric diseases—unipolar major depression (3.1 percent of DALYs), bipolar disorder (0.6 percent), and schizophrenia (0.8 percent)—account for much of it (table 1.A2).

Chapter 31 provides a concise overview of advances made in recent years in treating these conditions (as well as panic disorder), summarizes information on their burden, and develops estimates of the cost-effectiveness of drug-based and cognitive behavioral therapies in different settings (hospital based and community based). Although the cost-effectiveness estimates reported in chapter 31 suggest interventions are only moderately cost-effective, the authors suggest that a fuller analysis of benefits than is captured by a health metric such as the DALY would justify substantial investments. They analyze a basic package of mental health services that could provide a practical vehicle for providing these interventions in environments with tightly constrained financial and implementation resources. A continuing theme in this volume—and one of particular relevance here—is that without careful evaluations of the effects of alternative approaches to large-scale intervention against psychiatric disorders, the world will fail to develop hard knowledge of what does—and does not—work. Without that knowledge, far less health and financial security will be gained than is potentially possible from the inevitably limited resources available.

Injuries

Injuries constitute an additional major and neglected component of disease burden in developing countries. This volume's chapters on injury (chapters 39 and 40) emphasize prevention. Timely treatment is also important, and chapters 67 (on surgery) and 68 (on emergency medical services) point to the potential, at low cost, for much better treatment of injury victims than is typical today.

The great diversity of both causes and consequences of injury precludes an attempt in this chapter to do more than highlight their importance. Chapter 2 and the injury-related chapters just mentioned provide a rich menu of practical options. It is worth pointing out here the central importance of two specific categories of injury—road-traffic injuries (1.07 million deaths in 2001 in low- and middle-income countries) and suicides (0.75 million deaths). Safer roads, safer driving, safer vehicles, and better emergency care have sharply reduced the toll from road-traffic injuries in high-income countries, but unless dramatic action is taken in developing countries, the toll will surely rise. Although there has been less success in reducing suicide rates, the improved treatments now available for psychiatric disorders are proving to be one important approach in suicide prevention.

This discussion of noncommunicable diseases and injury highlights the huge and growing burden from those conditions and conveys a consistent message that constructive action is feasible at relatively modest cost. No attempt has been made to be comprehensive (chapters 29 through 38 all deal with noncommunicable diseases); rather the discussion points to the need for health systems to systematically incorporate effective responses to noncommunicable diseases and injuries as their capacities grow.

HEALTH SYSTEM DEVELOPMENT AND FINANCE

DCPI focused principally on intervention priority. What mix of public health and clinical interventions would best respond to important disease conditions in highly resource constrained environments? Given the results of those assessments, where were the most important overall best buys? Where were resource commitments likely to be of low value? *DCP2* returns to those questions but goes beyond them in assessing the steps required for strengthening of health services and systems in ways that will allow the appropriate mix of interventions to be delivered equitably and well. De Savigny and others (2004) describe a specific example from Tanzania that links system reform to intervention selection.

Part 3 of the volume addresses strengthening of health systems. For valuable discussions of the goals of health systems, see WHO's *World Health Reports* for 1999 and 2000 (WHO 1999, 32–33; 2000, 23–25) and Roberts and others (2003).

Part 3 first reviews options for public health services with chapters on surveillance and information (chapters 53 and 54), drug resistance (chapter 55), community health and nutrition programs (chapter 56), contraception (chapter 57), school-based health (chapter 58), adolescent health (chapter 59), occupational health (chapter 60), natural disaster relief (chapter 61), and disease elimination and eradication (chapter 62). A major point implied by the simple number of chapters devoted to public health is that health system strengthening and reform efforts need to commit substantial financial resources and political and managerial attention to public health.

A second cluster of chapters in part 3 deals with strengthening personal health services. The first of those chapters deals with an important facet of community-level health services, the integrated management of the sick child (chapter 63). Chapters 64 to 66 deal with levels of care: general primary care, the district hospital, and the referral hospital, respectively. Three chapters address services offered at multiple levels of the system: surgery (chapter 67), emergency medical services (chapter 68), and complementary and alternative medicine (chapter 69). The final cluster of four chapters addresses capacity strengthening and management reform: quality of care (chapter 70), the health workforce (chapter 71), supplies of drugs and vaccines (chapter 72), and management of clinical services (chapter 73).

This overview of the topics on health systems provides a sense of the breadth of the issues considered. Chapter 3 provides a concise and integrated statement of the main findings. The remainder of this section deals briefly with assessing the performance of health systems and with the key issue of finance. Before we turn to those topics, however, it is worth highlighting several particular points.

First, in low-income countries, limited health system capacity has sometimes led governments (and development assistance agencies) to focus their capacity on a few high-priority items—such as immunization or control of HIV/AIDS. The objective may be a reasonable one: a greater reduction in disease burden in the population and more financial protection for it are likely to be achieved by doing a few important things well than by doing many things poorly. Yet if this focused effort is undertaken by establishing vertical structures outside the health system, then important opportunities for increasing capacity may be missed. Chapter 3 stresses a critical point: a focused program should be designed so that it contributes to, rather than detracts from, long-term system strengthening. Second, quality of care is important; it can be measured, and it can be improved (box 1.3). Third, providing basic surgical services, particularly at the district hospital level appears to offer major but neglected opportunities for addressing

Box 1.3

Tangible Approaches to Improving Quality of Care

A 2001 report from the Institute of Medicine of the U.S. National Academy of Sciences (Institute of Medicine 2001b) highlights great variation in the quality of clinical care in the United States. Its publication catalyzed reform efforts. In a recent evaluation, Leape and Berwick (2005) found that those reform efforts had a major effect on professional attitudes and organizational culture, although less effect, so far, on mortality. Chapter 70 on quality of care documents the similarly large variation in quality in low- and middle-income countries and the associated cost in lives and money. Improving quality of care amplifies the effect of investments in health. Promising approaches in improving the quality of care include the following:

- Invest in measuring quality and feeding that information back into the system. This approach has been shown to be possible (for example, clinical vignettes) and effective.

- Use evidence-based criteria to link quality of care to outcomes. This approach can be implemented by training and creating incentives for adapting clinical guidelines or by using the collaborative improvement model.
- Improve system-level and provider incentives. Minimally, do no harm with the structure of financial incentives facing providers, for example, by establishing a legal and ethical environment where care providers do not profit personally from sale of drugs, diagnostic procedures, or referrals to expensive specialized care.
- Emphasize high-volume care for selected surgical procedures and prevalent medical conditions. Such an approach can lead to higher quality and lower cost even while, in some cases (for example, cataract removal), allowing lower-level workers to substitute for more expensive and scarcer physicians.

Source: This box was prepared with input from John Peabody.

significant sources of disease burden. An important substantive component of health sector reforms should often involve strengthening surgical capacity.

Health System Performance

Since about 1940, the publication of economic performance indicators in national income and product accounts has made it possible to hold political leaders accountable for economic management. Additionally, measures of economic performance—such as GDP growth rates and unemployment rates—have allowed economists to move toward evidence-based assessments of which policies facilitate good economic performance and which do not.

In many ways, unfortunately, the assessment of health system performance remains where economic performance measures were before the development of national income and product accounts in the United Kingdom in the late 1930s. Chapter 3 observes, for example, that “The body of knowledge [on health systems] represents a largely ad hoc and disjointed collection of facts, figures, and points of view. Making confident recommendations relevant to strengthening health system capacity is thus difficult.” In its 2000 *World Health Report*, WHO made an ambitious effort to provide the performance measures for health systems that would enable progress toward more systematic knowledge of the policies to improve health systems (WHO 2000). Such knowledge could replace what is now frequently simply ideology and opinion. The 2000 *World Health Report* proved to be highly controversial, and its ranking of health system performance may in the end be judged as more of a first attempt than an initial approximation (Jamison and Sandbu 2001). WHO set an agenda that will certainly continue to be advanced.

Despite current inability to judge health system performance and the consequently ad hoc character of knowledge, much is in fact known that bears on health policy. Chapters 2 and 3 of this volume summarize very specific knowledge about intervention characteristics and system design that can inform policy. Although broad prescriptions may still elude us, particular knowledge is still important. Additionally, the perform-

ance of countries is better understood even though relating country performance to performance of its health systems may remain only judgmental for the moment. For example, Brazil and China had under-five mortality rates that were quite close in 2002: 37 per 1,000 for Brazil and 38 per 1,000 for China. In 1990, however, Brazil’s rate was 60 per 1,000 and China’s was 49 per 1,000: the rate of improvement in Brazil was far more rapid than in China. This measure is only one dimension of outcome, and many explanations are possible. Yet hard numbers on country perform do exist to initiate discussions of policy.

Financing Health Services

Chapters 12 and 13 in this volume discuss domestic and external financing of health systems. Different issues arise in low-income countries than in middle-income ones, and the discussion that follows is so divided. Table 1.2 provides context by conveying the level of health expenditures in 2001 in different income groupings of countries, the fraction of GDP spent on health, and the extent to which those expenditures are publicly financed. Almost 10 percent of the total product of the world pays for health services. In the low-income countries, about three-quarters of expenditures are from private, out-of-pocket payment. In the high-income European countries, only about one-quarter of expenditures is private. Middle-income countries spend about 5 times as much per capita on health services as do low-income ones and over 10 times as much through the public sector. Although available data sets (for example, from the World Bank or WHO) provide no direct evidence on trends over time in health expenditures (for more than very short periods), current levels of expenditure are likely to substantially exceed those of several decades ago, even as a percentage of growing incomes. The availability of physicians provides one indicator: in a large sample of countries the number of physicians per 100,000 population increased from 54 in the mid 1960s to 116 in the early 1990s, an annual rate of increase of 2.8 percent.

Before we turn to questions of financing health services (or insurance), briefly discussing related issues concerning the public sector’s financial role is worthwhile. Those issues address

Table 1.2 Health Expenditures by Country Income Level, Public and Total, 2001

Country group	Health expenditure per capita (2001 US\$)	Health expenditure (percentage of GDP)	Public sector expenditures (percentage of total health expenditures)
Low income	23	4.4	26.3
Middle income	118	6.0	51.1
High income (Countries in the European Monetary Union)	2,841 (1,856)	10.8 (9.3)	62.1 (73.5)
World	500	9.8	59.2

Source: World Bank 2004, table 2.14.

what chapter 11 calls “healthy fiscal policy and fiscal policy for health.” An example of unhealthy fiscal policy was the Polish government’s subsidy of fatty animal products. Elimination of that subsidy was a gain for the treasury and resulted in improved diets and health. Minimally, a healthy fiscal policy identifies and corrects such inappropriate subsidies. Fiscal policy for health is exemplified by tobacco taxation, which chapter 46 deals with at length and chapter 11 deals with more briefly. Fiscal policy for health involves taxes whose principal purposes lie more in changing health-related behaviors than in generating revenue (although the latter can be important as well).

Financing Health in Middle-Income Countries. A major cause of poverty (and economic insecurity more generally) results from highly uneven and unpredictable needs to finance health expenditures. In consequence, most societies have moved toward prepaid care as income rises. The current high-income countries, with only two exceptions, have decided in favor of universal public financing (rather than private voluntary insurance) as the principal means of meeting the demand for prepaid care. Taiwan (China) and the Republic of Korea, several years ago, and Mexico and Thailand more recently, have also taken the path toward universal public financing. The health sector is exceptional: no one in the mature capitalist democracies would contemplate substantial public financing for food or housing, and public subsidies and protection for agriculture result from unusually powerful interest groups.

Public financing for health, including for clinical services for well-off individuals, has been the result of the democratic process in all the major capitalist countries except Switzerland and the United States. (Public financing is, of course, consistent with private provision of services, and the countries of the Organisation for Economic Co-operation and Development (OECD) display substantial diversity in this regard.) Efficiency as well as equity concerns underlie this pattern. Barr (2001) examines in detail the efficiency rationales that have underpinned major public sector financial involvement in health, education, and social protection in the high-income countries.

Why do market economies choose public sector financing (either public spending or publicly mandated social insurance) for many of their personal clinical services? The case for publicly financing interventions that are shared by all (for example, antitobacco advertising or water fluoridation) or where significant externalities exist (such as interruption of transmission of TB by treatment of infections) is widely accepted. Providing personal clinical services, like hernia repair, has none of those attributes. Nonetheless, as Arrow (1963) articulated in a now-classic article, the pervasiveness of incomplete information for decision makers (patients, providers, insurers) dominates private health insurance and delivery of clinical services. These personal clinical services account for the bulk of health expenditure. The evidence is

increasingly clear that a strong government presence in finance is the least bad way of dealing with these problems. Such a presence is necessary to achieve universal access to health care and makes it easier to impose the hard budget constraints that impose discipline in resource allocation. Additional evidence indicates that introducing universal mandatory health coverage favorably affects both wages and employment levels. Gruber and Hanratty (1995) provide thorough documentation of these effects in Canada. Some combination of these factors likely underpins the choices of the high-income democracies to fund a large fraction of private clinical services with public resources.

Public financing of services for all does not imply that all services can be provided. Indeed, given their resource constraints, countries face hard choices about what to include (and exclude) in the universal benefits package—choices that this volume seeks to inform.

Middle-income countries vary substantially in the extent to which health care providers are financed on a fee-for-service basis—that is, by direct payment for specific services. Although that is traditionally the chief way to pay for *private* care, it is worth clarifying that *government* providers can also be financed (legally or illegally) on a fee-for-service basis—as is increasingly the case in China, for example. Similarly, providers are sometimes compensated through other means, such as capitation, and individual physicians in the private sector are sometimes on salary or a combination of salary plus capitation. Out-of-pocket payments to a public sector provider are usually called *user fees*, but they differ little from fee-for-service compensation of private providers.

What is the OECD experience with user fees? Basically, it is that both providers and patients respond strongly to the incentive environment. Indeed, a problem exists of providers being too responsive: much low-value or useless surgery, diagnosis, and drug use is, in some systems, highly profitable to the provider, and often the provider must, as agent for the patient, decide what to do. This conflict of interest has led to cost escalation and to inappropriate care. A case may be made for divorcing provider compensation from the delivery of individual services, drugs, or diagnostic tests unless a need exists to accelerate coverage of critical services by giving bonuses to providers for providing them, as the United Kingdom’s National Health Service has done with immunization.

If fee-for-service financing can generate a perverse incentive environment, does that imply that a system must forgo charging beneficiaries for services they receive? Not at all: other ways exist to ensure that funds are adequate for costs—ways that may be more effective. Earmarking payroll taxes to finance health care for workers and their dependents (usually called *social insurance*) is one approach for recovering costs that is consistent with provider compensation mechanisms relying principally on salaries or capitation rather than fee-for-service. It has been argued that cost recovery through payroll taxes

will generate more economic distortions than do income, consumption, or sin taxes—although recent evidence suggests that may not be true (Blanchard and Katz 1997). Nonetheless, when general revenue mechanisms are incapable of financing the nationally defined basic package of services for all, the option of cost recovery through payroll taxes for the privileged workers in the formal sector is clearly desirable on equity grounds. This form of taxation also links contributions to a specific service, which increases its acceptability.

Financing Health in Low-Income Countries. Approximately 2.5 billion people live in countries the World Bank classifies as low-income—that is, with a per capita gross national income in 2002 of less than US\$735 per year. These countries include India but not China. Table 1.2 reflects that the estimated average per capita health expenditure for these 2.5 billion people is about US\$23 per year, of which US\$5 or US\$6 comes from public sources. Chapter 12, on financing health systems, points to the severe challenges in setting priorities that these resource limitations imply. Not only are expenditure levels currently very low, but also the fiscal space needed to increase them is, in most low-income countries, sharply constrained. Fiscal space results from an excess of potential government revenues, including reasonable projections of official development assistance (ODA), over public expenditures. The concept of fiscal space combines both short-term fiscal balance and long-term debt sustainability. Grant ODA can help with short-term balance, and soft loans (such as International Development Association credits from the World Bank) can reduce the repayment burden from a given level of incurred debt. Health financing policy for low-income countries must focus heavily on mobilizing public sector resources and concentrating resources on true priorities (although the broader range of issues just discussed that middle-income countries must address is relevant to low-income countries with large formal sectors).

The chapters in this volume make clear that incremental resources for health, well spent, could have an enormous effect: resource mobilization is important. Increasing public sector expenditures in health by 0.5 percent or more of GDP will be possible in some countries, but not in all, and even where it is possible other investment priorities will also be pressing. However, increases of as much as 1 percent of GDP may be possible where the political will exists, as is now being attempted in India. Cost estimates for meeting just the health-related MDGs, as reported in chapter 9, can exceed that amount, and other estimates have run higher. Development assistance for health, discussed in chapter 13 and here, can expand the available resource envelope, but even multiples of current levels of development assistance would likely prove insufficient to finance attainment of the MDGs in some countries.

Achieving gains for health (and frequently concomitant gains in financial protection) requires that critical decisions be

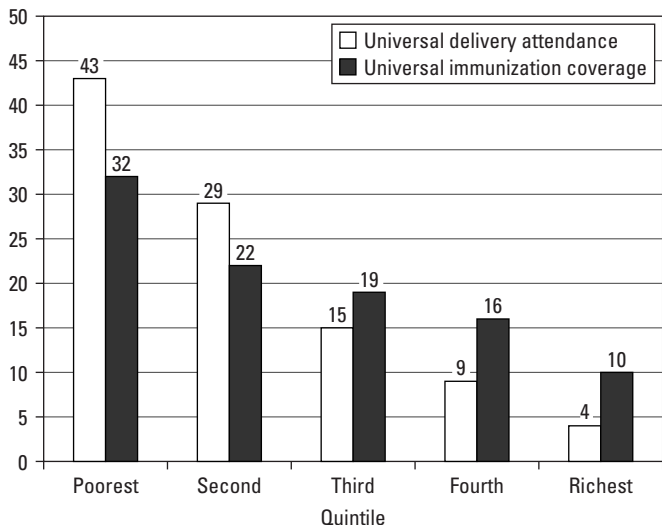
made on how to allocate highly limited public sector resources. Much of this volume deals with resource allocation across interventions. Public finance must address an additional set of decisions. Do interventions with substantial positive externalities have a particular claim on public resources—beyond the amount of health and financial protection they buy per million dollars spent? Should public resources be spent only on individuals with low income? Or should health systems provide universal public finance for the very limited range of interventions that can be afforded? Should public finance emphasize providing interventions that maximize financial protection or improvements in health? What patterns of public sector resource allocation are likely to prove politically sustainable? Fewer tradeoffs may exist among these criteria than at first seems to be the case.

A starting point for thinking about these criteria is the availability of an increasing number of good benefit incidence studies—that is, studies of how the benefits of a public intervention distribute across income (or asset) quintiles of the population. Those studies find that in a great majority of countries wealthier people are more likely to benefit from public programs than are the poor, at least where benefits are measured in expenditures. The World Bank's 1993 *World Development Report* pointed to that pattern some time ago (although noting a number of important exceptions), and more recent studies add support to that conclusion. The caveat “measured in expenditures” is important and insufficiently noted. The value or welfare benefit to the poor of a given level of transfer may well exceed the value received by the well off from the same level of transfer. A landmark benefit incidence study of the U.S. Medicare program, a mandatory health insurance for the elderly, found it to be regressive in dollar terms but pro-poor in welfare outcomes (McClellan and Skinner 1997).

Public programs that are not universal appear to systematically benefit the better off, and that pattern is understandable from a political perspective. It follows that if an immunization program, for example, is differentially benefiting the well off, then making immunization universal would be pro-poor in terms of incremental public expenditures. Figure 1.7 uses data from a careful benefit incidence assessment in the Philippines (Gwatkin and others 2000) to illustrate this point for immunization and for attended deliveries.

Making coverage universal for cost-effective interventions *for conditions important to the poor* is thus likely to prove to be an efficient way of both improving health outcomes and enhancing equity. Many of these interventions address infectious disease where control has significant externalities, and implementing universal coverage is likely to prove more politically sustainable than targeting population subgroups. Lindert (2004) extensively discusses the experience in high-income countries with universalization of public financing of education, health, and old-age pensions and concludes not only that

Percentage of incremental benefit received by each quintile



Source: Calculations based on data reprinted in Gwatkin and others (2000).

Notes: *Universal immunization coverage* means complete coverage with the standard immunization schedule. The Philippines achieved 75 percent coverage overall in 1998, and Gwatkin and others (2000) show the coverage level by quintile. The black bar shows what the percentage distribution of benefits by population quintile would be of moving from the 1998 status quo to universal coverage. *Universal delivery attendance* means that all births would be attended by a doctor, nurse, or nurse-midwife. The Philippines achieved 63 percent coverage overall, and the white bar shows what the percentage distribution of benefits by population quintile would be of moving from the current pattern of coverage to universal coverage.

Figure 1.7 Equity Implications of Providing Universal Coverage for Immunization and Attended Delivery in the Philippines, 1998

it is politically sustainable but also that no evidence indicates that the resulting higher taxes have harmed economic growth.

Two final points are worth stating about making coverage universal:

- First, early adoption of universalization of coverage for publicly financed interventions—even if only a few can be financed—sets the stage for expansion, in a middle-income environment, to universal public financing of health care, the overwhelming choice of the democratic process in high-income countries.
- Second, the implementation capacity of health systems in low-income countries will often be highly constrained. Capacity is likely to grow most rapidly by building on a base of doing a few things well rather than many things poorly. Universal coverage implies tight focus in highly resource-constrained environments.

RESEARCH AND DEVELOPMENT

Why has health improved so dramatically after controlling for income and, hence, the availability of commodities that, like food, are essential for health? Although no unambiguous

answer to this question exists, an important factor has been advance in scientific knowledge and its application both in creating powerful interventions and in guiding behavior. Acquisition and use of health research and development or its products becomes, then, an essential function of a country's health system. Moreover, it is important that research extend beyond development of new products to encompass knowledge generation on health system financing and performance.

Much knowledge is embodied in global public goods: once a vaccine against hepatitis B has been developed anywhere, it becomes, in some sense, available everywhere. Although monopoly pricing made possible by patents may slow the diffusion of some innovations, the temporary nature of patent-induced monopoly pricing limits that effect. However, an innovation's being cheap, powerful, and globally available in no way assures its global use. The implication is clear: globally available knowledge and products offer enormous opportunities to countries, but national policies and national health systems determine whether that knowledge is put to local use. Additionally, although some information for improving outcomes is principally local and must be locally produced, making the results available contributes to a growing evidence base. Chapter 4 on health research stresses the value of contributing to a global evidence base and summarizes with the observation that "all health care is national" and "all health research is global."

What are the implications for policy? One is that if knowledge gains prove even partially as important for future health improvements as they have in the past century—and chapters in this volume point to a number of reasons for expecting this to be so—then investments in health research and development will continue to have high payoffs in health status and economic productivity. Chapter 7 points to the potential for enormous economic returns. Ensuring an adequate level of research and development investment, therefore, holds strong claim on health budgets—a claim for more than the approximately 3 percent now committed. Equally important—or more important—is that the investments be efficient in generating useful new knowledge and products. Fauci (2005) discusses the need for greater efficiency in conducting research and development in an environment of tightening budgets in U.S. agencies, and he points to a number of specific directions for doing so.

In some cases, additional resources (probably from growth within national health budgets or health aid budgets) will be required to meet these research and development needs adequately. In many cases, institutional change will be necessary to create the information and incentives required for efficient resource allocation. At the international level, resource allocation has often lacked focus, failing to bring results to the point of application, and has neglected important conditions and issues while providing, often generously, for less important ones. Reform is needed. Successful models of competitively

driven international funding and experience-sharing networks should be applied to currently neglected clusters of conditions.

Just as the quality and productivity of research efforts vary dramatically from one institution to another within the high-income countries, they vary in the low- and middle-income countries. Exemplary work is done in a number of institutions and countries; but in general, the obstacles to high quality are greater when countries' incomes are lower. Inadequate training, insufficient staff motivation, and lack of competition prevent many institutions from attaining their potential. The instability of short-term funding, isolation from peers, and poor access to the research literature all compound the problem and prevent researchers from responding rapidly to ever-changing demands. Given the shortage of good researchers, an argument exists for the talent to move to countries (including low- and middle-income countries) whose policies are likely to facilitate productive research (WHO 1996). Donor funding should reflect this possibility.

Institutions are more likely to succeed not only if they receive stable core funding but also if a proportion of their work is funded competitively. Some institutions, such as the Oswaldo Cruz Foundation in Brazil, have already moved in these directions with great success—for example, by freeing up intramural resources for competitive allocation between groups and within the institution, with assessments being made by an external review group. Notable successes have occurred in assisting with capacity strengthening, such as the Special Programme for Research and Training in Tropical Diseases collaboratively supported by WHO, the World Bank, and the United Nations Development Programme.

The failure of current incentive structures, essentially the patent system, to produce health products for the lowest income groups demands remedial action (chapter 5). In essence, either the public sector must harness the skills, energy, and capacity of the private sector to develop and bring promptly to market products for the lowest income groups, or it must take responsibility for doing so itself. In reality, a combination of the two is likely, as is exemplified in successful public-private partnerships such as the Medicines for Malaria Venture or the International AIDS Vaccine Initiative. Recently proposed pre-commitments by the public sector to purchase specific new products are an additional potential instrument to generate incentives for private sector investment (Kremer and Glennerster 2004). Developing countries that participate in private sector innovation will be positioned to more quickly learn of and have access to the technical progress that is critical in driving health improvements.

Global challenges demand, in some sense, a global response. All nations share the fruits of research and development. Even though each country may invest a relatively modest sum toward collective goals, the aggregate effort potentially benefits all substantially. Collective action is the economically rational

approach to public goods such as research and development; here, responsibility for catalyzing collective action lies principally in the hands of the global community. Far from overshadowing action at the national level, global efforts help both to make national research and development efforts more productive and to lead to a global result that exceeds the sum of national ones. Thus, among the many competing demands on the funds allocated to international assistance for health, those contributing to generation of new knowledge, products, and interventions that can be shared by all have special merit.

DEVELOPMENT ASSISTANCE FOR HEALTH

Development assistance, wisely focused, has the potential for unusual effect. First, because health gains for the poor can be relatively inexpensive (compared to the cost of achieving significant effect in other sectors), development assistance itself can achieve much, particularly if it serves as a channel for diffusion of new technologies and best practices. Second, evidence suggests that development assistance in health can be more effective than other development assistance in poor policy and weak institutional environments. Third, the economic benefits of investing in health can be exceptionally high. Finally, because research and development have had high impact (chapter 7) and are an international public good, development assistance has a particular comparative advantage in ensuring their finance.

Those conclusions point to a proactive strategy within development assistance agencies and governments for achieving major shifts in staffing and budgetary allocations toward specific high-payoff investments in health. They also point to the need, in order to achieve the potential benefits, for a focused concentration of health system development on a limited set of priority health goals—for example, controlling AIDS, controlling smoking, meeting the health-related MDGs, and—for middle-income countries—implementing finance reforms that lead toward universal public financing. The section argues that although financial fungibility—the capacity to redirect government resources away from areas supported by external financing—can dilute the effect of development assistance in health, as in other sectors, designing development assistance for health that minimizes the fungibility problem is possible. Performance-based budget support will be one instrument.

In 2003, the world committed to ODA of almost US\$100 billion, and news reports in May 2005 suggested the possibility of substantial increases by European donors. Approximately 10 percent of ODA is spent for health, a percentage that has grown rapidly. Table 13.1 in chapter 13 shows recent trends in external financing for health, of which ODA (that is, grant or highly concessionary loans) is only a part: these numbers are

for commitments, not actual disbursements, which are smaller and lag behind commitments. (The Global Fund to Fight AIDS, Tuberculosis, and Malaria is one of the few providers of developmental finance that reports disbursements as well as commitments.) External financing for health has grown from about US\$6.7 billion in 1998 to US\$9.3 billion in 2002 (Michaud 2003). For some countries, development assistance constitutes a significant and growing fraction of health expenditures. Economists have recently returned to the question of the returns to expenditures on development assistance, and several recent trends have important potential implications for health.

Aid Effectiveness

Recent work has been reassessing aid effectiveness and has focused on the following questions: Is there any evidence that infusions of development assistance have affected economic growth rates? Is there any evidence that infusions of economic assistance have affected mortality rates or levels of poverty? These questions are clearly not easy to answer. Nonetheless, some data provide insights. Burnside and Dollar (2000) conclude, for example, that development assistance does seem to work in countries where a good policy environment and a good institutional environment exist, but not in countries lacking those elements. Recent work focuses on aid directed to economic development and greatly strengthens the inclusiveness of the conclusion that aid boosts growth (Clemens, Radelet, and Bhavnani 2004). The effect of development assistance on growth is quantitatively important even in countries with poor policies and institutions, although the effect is stronger in countries with better policies. Interestingly, aid's effect appears larger in countries with higher life expectancy. That development assistance contributes broadly to growth does not, of course, imply that development assistance for health will accelerate health improvements. However, it is certainly suggestive of the potential in health to know that development assistance works for growth.

Even if development assistance is viewed as working better in strong institutional and policy environments, a dilemma exists in that the countries that most need aid are often ones that have weak policies and weak institutions (Radelet 2003, 194). Experiences with ODA in health complement the recent research on aid for growth in suggesting that ODA can pay off despite limited institutional or absorptive capacity. Polio has certainly been eliminated in countries with good health systems, but it has also been eliminated from most countries with weak ones. No smallpox exists today in countries with bad policies and bad institutions. A number of those countries have immunization rates of 60 or 70 percent, or as high as in the United States. An important question concerns the extent to which other development assistance for health, particularly

highly targeted development assistance, can be as successfully implemented as immunization programs where health systems are weak.

Project Support versus Budget Support

Development assistance is tending to move away from project support—for example, of an immunization program, an AIDS control program, or an extension of a road network—and toward general budgetary support, often to be provided through pooling of donor assistance. There are many reasons for this tendency, some of which are good (Kanbur and Sandler 1999, 106). The usefulness (and even propriety) of budget support is contingent, however, on adequacy of the policy and institutional environments. Chapter 3 points to arguments that as health systems evolve, development assistance should move from project assistance toward program assistance. The Global Alliance for Vaccines and Immunization (GAVI) is pointing to ways that support for immunization programs can be advanced within the context of this tendency to move toward general budget support. GAVI's innovation is to support immunization programs based on performance—US\$20 for a fully immunized child. The country gets the US\$20 for immunizing the child in whatever way it decides; thus, GAVI provides general budget support that is conditioned on performance. GAVI's concern has been with transitional financing (rather than with sustained assistance), but its approach points the way for designing long-term budget support conditioned on measurable performance with respect to specific health goals. Jamison (2004) outlined design of long-term development assistance for health that could meet this objective, maintaining incentives for countries to increase coverage (or performance) while scaling back the volume of aid as a country's income increased. Adequate measurement underpins assessment of performance and can be difficult even for immunization coverage. Measurement requires resources that must be planned for and budgeted.

Macroeconomic Consequences of Aid

Another concern in the aid community—particularly in the International Monetary Fund—is that development assistance could have adverse domestic macroeconomic consequences—essentially inflationary consequences (see WHO 2002, chapter 8). This argument needs to be taken seriously. It is in essence an argument about the generation of domestic inflationary pressures—of projects chasing after those few good engineers or doctors with an increasing amount of foreign money and creating an inflationary spiral in that way. However, if the principal proposed use for the money is for drugs or vaccines—for example, the US\$10 increment for adding Hib and HepB vaccines to the Expanded Program on Immunization

schedule—that money is almost all foreign exchange, and the macroeconomic arguments about inflationary consequences simply would not apply. Careful project design can respond to what on the whole are serious concerns from the macroeconomic part of the development assistance community. Economic analysis can provide information—such as this volume attempts to provide—on getting the maximum health and financial protection outcomes from the development assistance available and for designing interventions (tradable and commodity intensive) that will minimize potentially adverse macroeconomic consequences.

The Millennium Development Goals

An additional and significant direction in thinking about ODA concerns achievement of the MDGs (chapter 9). The MDGs are very specific targets for improvement in education, health, and income-related poverty. Interestingly, focusing development assistance on achieving the MDGs stands in at least partial opposition to the move toward budget support.

These considerations point to several directions for the design of development assistance for health. Radelet (2003, 194) provides detailed quantitative examples to show that, even under very favorable circumstances, in a lower-middle-income country development assistance is likely to be needed for decades. Some conclusions follow that are drawn from the preceding discussion and from the need for predictability and long time horizons in donor behavior. ODA should move toward the following:

- providing aid over long-term perspectives (10 or more years)
- ensuring predictability in assistance commitments
- emphasizing demand-side support (with concomitant country control of resources)
- providing incentives for countries to maintain high coverage for cost-effective programs
- avoiding perverse incentives
- including a transparent exit strategy (for example, reduced grant support with per capita GDP growth).

There is a strong analogy to within-country programs like Mexico's *Progresa*, which provides cash transfers to poor households contingent on getting children immunized or into school. Gertler (2004) has reported evaluation results indicating a high degree of effectiveness. The effectiveness of coverage incentives is well exemplified by the Bill & Melinda Gates Foundation in its work on polio with both GAVI and the World Bank in providing a financial incentive for enhanced coverage (chapter 13). Although donors increasingly state a commitment to providing aid predictably and over long periods, the reality for many countries is that aid flows will be volatile and

of uncertain duration. Jamison and Radelet (2005) point to ways of using such aid that can be minimally disruptive.

CONCLUSIONS

A volume as large as this one can provide only a sampling of opportunities and potential pitfalls for investments in health. Indeed, the *International Statistical Classification of Diseases* (WHO 2003a) takes more than 1,500 pages simply to list the conditions that a health system must address. Yet the diseases accounting for most of the burden can be listed in perhaps half a dozen pages, and the diseases that account for most of the differences in outcome between high- and low-mortality countries can be listed on a page. Chapters in this volume assess 115 population interventions and 204 personal interventions that address most conditions of importance. The conclusions listed in this final section of the chapter simply highlight important conclusions for policy without attempting to summarize the volume as a whole. Chapters 2 and 3 complement this one with a fuller summary.

Table 1.3 provides a sense of the nature of the findings in much of the book, and box 1.4 provides a brief description of the methods. The table shows the number of DALYs that we estimate could be averted (or years of healthy life that could be bought) by spending a million dollars on a few of the interventions addressing major sources of disease burden. If we think of these numbers as the prices for buying health by different means, the price variation is enormous, ranging from one or two DALYs per million dollars up to well over 100,000. All the standard caveats more than apply to these numbers. Nonetheless, they do convey information relevant for policy. Expanding coverage of the currently used mix of vaccines, for example, appears more attractive than does adding new vaccines (except when the lower demands on system capacity of adding new vaccines are considered). Bypass surgery used even in the most appropriate circumstances is an expensive way to buy a year of healthy life, but for many common indications it is inordinately expensive. Findings from table 1.3 exemplify findings of the cost-effectiveness analyses from throughout the book that are summarized in chapter 2.

A general conclusion follows from the preceding discussion. There are many inexpensive ways to reduce mortality rates and improve health. A country that focuses on those interventions can expect to achieve major improvements—even with very limited resources. There are also ways to spend money on health that can dissipate even a substantial budget with almost no return—either for better health or for the financial protection of populations. Intervention selection matters. Many of the good and bad buys are now well known. Some are not, and our main purpose in this volume has been to assemble the evidence based on what is known.

We now turn to more specific conclusions. Different items on the list are relevant in different countries. (Chapter 2

Table 1.3 How Much Health Will a Million Dollars Buy?

Service or intervention	Cost per DALY (US\$)	Estimated DALYs averted per million US\$ spent
<i>Reducing under-five mortality</i>		
Improving care of children under 28 days old (including resuscitation of newborns)	10–400	2,500–100,000
Expanding immunization coverage with standard child vaccines	2–20	50,000–500,000
Adding vaccines against additional diseases to the standard child immunization program (particularly Hib and HepB)	40–250	4,000–24,000
Switching to the use of combination drugs (ACTs) against malaria where resistance exists to current inexpensive and previously highly effective drugs (Sub-Saharan Africa)	8–20	50,000–125,000
<i>Preventing and treating HIV/AIDS</i>		
Preventing mother-to-child transmission (antiretroviral-nevirapine prophylaxis of the mother; breastfeeding substitutes)	50–200	5,000–20,000
Treating STIs to interrupt HIV transmission	10–100	10,000–100,000
Using antiretroviral therapy that achieves high adherence for a large percentage of patients	350–500	2,000–3,000
Using antiretroviral therapy that achieves high adherence for only a small percentage of patients		Because of very limited gains by individual patients and the potential for adverse changes in population behavior, it is possible that more life years would be lost than saved.
<i>Preventing and treating noncommunicable disease</i>		
Taxing tobacco products	3–50	24,000–330,000
Treating AMI (heart attacks) with an inexpensive set of drugs	10–25	40,000–100,000
Treating AMI with inexpensive drugs plus streptokinase (costs and DALYs for this intervention are in addition to what would have occurred with inexpensive drugs only)	600–750	1,300–1,600
Treating heart attack and stroke survivors for life with a daily polypill combining four or five off-patent preventive medications	700–1,000	1,000–1,400
Performing coronary artery bypass grafting (bypass surgery) in specific identifiable high-risk cases—for example, disease of the left main coronary artery (incremental to treatment with polypill)	>25,000	<40
Using bypass surgery for less severe coronary artery disease (incremental to treatment with polypill)	Very high	Very small
<i>Other</i>		
Detecting and treating cervical cancer	15–50	20,000–60,000
Operating a basic surgical ward at the district hospital level that focuses on trauma, high-risk pregnancy, and other common surgically treatable conditions	70–250	4,000–15,000

Source: Authors.

AMI = acute myocardial infarction.

suggests, for example, major differences between the priorities for South Asia and those for Sub-Saharan Africa.) Many interventions or policy changes that are important are not on this list, but they are included in the more extensive discussions in chapters 2 and 3, which synthesize messages from the rest of the book on setting intervention priorities and strengthening health system capacity. Given often quite limited availability of

money or political leadership or health system capacity, it will often be necessary to focus the available resources on a few key priorities. Chapter 12 makes it disappointingly clear that, for the low-income countries, not only are financial resources sharply limited now, but prospects for more than modest increases seem unlikely for many years. (Financial constraints in the middle-income countries, although real, are less

Box 1.4

Cost-Effectiveness Analysis in This Volume

A starting point for cost-effectiveness analysis is to observe that health systems have two objectives: (a) to improve the level and distribution of health outcomes in the population and (b) to protect individuals from financial risks that are often very substantial and that are frequent causes of poverty. Financial risk results from illness-related loss of income as well as expenditures on care; the loss can be ameliorated by preventing illness or its progression and by using appropriate financial architecture for the system.

For the purposes of this book, we consider two classes of resources to be available: financial resources and health system capacity. To implement an intervention in a population, the system uses some of each resource. Just as some interventions have higher dollar costs than others, some interventions are more demanding of system capacity than others. In countries with limited health system capacity, it is clearly important to select interventions that require relatively little of such capacity. Human resource capacity constitutes a particularly important aspect of system capacity, discussed in chapter 71 and in a recent report of the Joint Learning Initiative (2004).

Although in the very short run little tradeoff may exist between dollars and human resources or system capacity more generally, investing in the development of such capacity can help make more of that resource available in the future. Chapter 3 discusses different types of health system capacity and intervention complexity, and it points to the importance of and potential for responding to low capacity by selecting interventions that are less demanding of capacity and by simplifying interventions. Chapter 3 also explores the extent to which financial resources can

Source: Author.

substitute for different aspects of system capacity (see also Gericke and others 2003). An important mechanism for strengthening capacity, inherent in highly outcome-oriented programs, may simply be to use it successfully—learning by doing. Several chapters discuss capacity strengthening at different levels of the clinical system, in public health, and in health research and development.

The literature on economic evaluation of health projects typically reports the cost per unit of achieving some measure of health outcome—quality-adjusted life years (QALYs) or DALYs or deaths averted—and at times addresses how that cost varies with the level of intervention and other factors. Pritchard (2004) provides a valuable introduction to this literature. *DCP1* reported such cost-effectiveness findings for a broad range of interventions; *DCP2* does so as well. *DCP2* authors were asked to use methods described in Jamison (2003); chapter 15 discusses actual implementation. Cost-effectiveness calculations provide important insights into the economic attractiveness of an intervention, but other considerations—such as consequences for financial protection and demands on health system capacity—are also relevant.

DCP2 also makes a preliminary attempt to accumulate information about the extent to which interventions place demands on health system capacity; this information is qualitative. *DCP2* provides only an initial effort, but qualitative information does provide helpful input to policy. Kim (2005) develops a more quantitative approach in an analysis dealing with cervical cancer. Much less has been done on the extent to which specific interventions provide financial protection for patients and their families.

binding.) Selecting priorities will be hard. This section provides a starting point for discussing which activities should be high priorities. The conclusions are grouped under four headings: interventions; health services, systems, and financing; research and development; and development assistance.

Interventions

1. Standard interventions for reducing under-five mortality have long been known to be highly cost-effective. The challenge is to scale up while conserving and strengthening scarce health system capacity. These interventions include immunization; micronutrient supplement delivery;
2. Cost-effective interventions exist to address the 50 percent of under-five deaths that occur under 28 days of age, including stillbirths. These are underused relative to interventions for older children, and correcting this neglect is a priority.

treatment for diarrhea, malaria, and acute respiratory infections; and improved prenatal and delivery care. In cases of sharply limited resources—financial or health system capacity—often the single highest priority will be expansion of immunization coverage with the basic antigens: poliomyelitis, measles, diphtheria, tetanus, pertussis, and perhaps BCG.

3. Standard interventions to treat TB are also known to be highly cost-effective, although probably more demanding of health system capacity than are some of the child health interventions. Scaling up by using already developed models for strengthening relevant health system capacity is a priority.
4. Many well-tested preventive interventions for AIDS are effective and cost-effective. Such interventions include treating STIs, promoting condom use, providing voluntary counseling and testing, promoting peer intervention, using antiretroviral therapies to prevent mother-to-child transmission, ensuring safe blood supplies, and encouraging the use of breast milk alternatives by HIV-positive mothers. Scaling up treatment for STIs may prove particularly important. Much more rapid implementation of these interventions is of highest priority and needs to be accompanied by effective mechanisms of surveillance and evaluation. The appropriate mix and distribution of interventions depends on the stage of the epidemic. In particular, limited financial and institutional resources imply focusing effort on populations at high risk early in an epidemic.
5. Antiretroviral drugs have been successful on a wide scale in high-income countries (and in some upper-middle-income countries—notably Brazil and Mexico) in sharply reducing viral load and extending the life expectancy of patients who are HIV positive. Health system capacity for achieving durable benefits from antiretroviral drug use at scale in resource-constrained environments, however, remains to be demonstrated. Failure to achieve good adherence in such an environment would provide minimal benefits to the patient, increase risks of drug resistance, and incur substantial costs: the financial and human losses could be enormous. Multiple approaches to successful maintenance on antiretroviral drugs should be tried and evaluated in large-scale pilots or as part of implementation scale-up. Given the magnitude of the AIDS problem, undertaking and evaluating variations in implementation (including possible variation in the choice of first-line drugs) in parallel rather than serially is important. This approach is not now being used. Similarly important is being rigorous in dropping unsuccessful implementation models before they consume substantial resources that could otherwise have greatly affected AIDS prevention or other priorities in the health sector.
6. Control of tobacco use is the cornerstone of proven approaches to primary prevention of heart disease, stroke, chronic pulmonary disease, and many types of cancer. Instruments for control of tobacco use centering on taxation and improved public information are well established.
7. A range of potential approaches to changing dietary and exercise patterns of populations would, if successful,

reduce problems of obesity, hypertension, and dyslipidemia and their consequences for vascular disease. Successes are rare but suggestive that large-scale efforts could be worthwhile. Careful impact evaluation will be essential to ascertain whether these investments deliver value for money.

8. Lifetime medical management—eventually using variants of the polypill—of individuals at high risk for stroke or ischemic heart disease is cost-effective and important for tens of millions of individuals. The clearest indications of high risk are a previous vascular event or diabetes.

Health Services, Systems, and Financing

9. Focused funding for particular diseases or programs—for example, TB or immunization—is a fact of life in many low-income countries. Using such funding to build health system capacity is feasible as well as desirable, but it is far from automatic. As capacity grows, the potential advantages of categorical programs are likely to fade while a more integrated (but still outcome-oriented) health system assumes responsibility for dealing with the relevant conditions.
10. Quality of clinical care makes an enormous difference, both to the cost of care and to health outcomes. Tangible actions can be taken to improve quality: important among them is having each provider do a few things well rather than many things poorly.
11. Strengthening capacity for surgery at the district hospital level is a frequently neglected priority. Major important uses of this capacity will be to deal with injuries and obstetrical emergencies.
12. In low-income countries public funding for health will remain highly constrained as a percentage of GDP for the foreseeable future. Targeting these funds to provide universal access to a limited number of interventions that are high priority for poor people is both efficient and equity enhancing, but it will require clear setting of priorities, particularly for incremental resources as they become available.
13. Middle-income countries can learn from the OECD experience that universal public financing of a substantial package of clinical care is both efficient and equity enhancing.

Research and Development

14. Impact evaluation of interventions in many domains is an essential priority and should be done around planned variations in implementation. One specific area of importance is evaluation of effective ways to manage lifelong drug use—for example, for AIDS, secondary prevention of vascular disease, diabetes, and major psychiatric disorders.
15. Public-private partnerships such as the Medicines for Malaria Venture and the International AIDS Vaccine

Initiative provide promising models for developing important new drugs, vaccines, and diagnostic products to deal with the major diseases of poverty as well as the problem of drug resistance and microbial evolution more generally.

Development Assistance

16. Development assistance for health has begun to become performance based, and this trend should accelerate, along with making development assistance more stable and long term (contingent on performance). This change may involve at least a partial shift away from the sectorwide approaches to development assistance that recent evidence suggests may lead to neglect of focus on outcomes. It will require renewed attention to outcome measurement.
17. Resistance of the malaria parasite that is responsible for most deaths to chloroquine and SP is now widespread and rapidly increasing. A particular challenge is overcoming financial and institutional barriers to virtually complete replacement of those drugs with ACTs, which minimize resistance and can decrease transmission. Absent such an effort, malaria mortality is likely to continue rising. A centralized procurement mechanism receiving subsidies from development assistance agencies and making low-cost ACTs available to public and private supply chains globally would address this problem.
18. Investing in global capacity to respond effectively to a new influenza pandemic, particularly within the resource constraints of low-income countries, is a priority for the international system. Such capacity would include effective surveillance, surge manufacturing capacity for drugs and vaccines, stockpiles of drugs that could be used to attempt to contain epidemics, and mass media messages and public policies prepared in advance to be deployed if needed.
19. Because research and development is so important for health and because it is a classic international public good, a substantial fraction of incremental development assistance for health should go to research and development.

The content of these specific recommendations, and of recommendations throughout this volume, point to the enormous potential we now have to reduce further the human and financial burden of ill health. Scientific advance created this potential. Its more widespread realization requires the focused attention of health systems to finance and deliver priority interventions.

ANNEX 1.A: THE BURDEN OF DISEASE IN 2001

This annex provides estimates of the burden of different diseases and injuries in 2001. Alan Lopez, Colin Mathers, Christopher Murray, and their colleagues at WHO generated the estimates, aggregated them by World Bank regions, and provided final updates. A companion volume (Lopez and

others 2006) will provide more comprehensive tables of results for a much finer disaggregation of conditions, a full exposition of methods and data sources, and sensitivity analyses (including assessments of the sensitivity of results to including stillbirth). All numbers in this annex are consistent with those in the companion volume.

This annex first provides a brief background on assessments of deaths by cause and disease burden and then an overview of the uses of such measures for health policy. It concludes with aggregated tables on deaths and on disability-adjusted life years (DALYs) by selected causes or groups of causes. The tables present estimates both with and without stillbirths, which constituted approximately 5.5 percent of deaths globally in 2001. Estimates are provided separately for high-income countries and for the low- and middle-income countries as a group.

Background

Many countries, including all high-income ones, maintain vital registration systems that provide data (usually annual) on the number of deaths by cause, age, sex, and sometimes race. Some countries additionally compute years of life lost (or YLL) by cause, which assigns a number of years of life lost attributable to each cause that depends on the age of death and some relevant measure of life expectancy. As of the early 1990s, no similar estimates existed for many developing countries or for regional groupings of them. Experts on individual conditions or the relevant disease program at WHO generated estimates for the diseases of interest to them. When added up across diseases, however, such estimates exceeded, often by a factor of 2 or more, any plausible estimate of the total number of deaths occurring in each age group. *DCPI* and the *World Development Report 1993* (Lopez 1993 and World Bank 1993) generated estimates of the number of deaths by cause that were consistent with demographically determined death totals for eight regional groupings of countries. WHO collaborated closely on this work. The number of deaths from a disease is one measure of the magnitude of its burden, and YLL constitutes for many purposes a better measure. Neither takes account of the disability or suffering associated with a nonfatal disease.

The 1993 *World Development Report* also developed a variant of the quality-adjusted life year (QALY) from the health economics literature to add a disability dimension to YLLs in order to generate a more comprehensive measure of burden. The result, called a *disability-adjusted life year*, measures burden from a specific cause as the sum of years of life lost from that cause and the equivalent years of life lost (in a sense that is made quite specific) from the disability caused by the condition. Original publications on disease burden included estimates that discounted future events at 0 percent or at 3 percent per year. They also included estimates that weighted the value of a year of life uniformly across all age groups and estimates

that placed greater value on middle-aged groups. These are labeled DALYs (r,k) with the first number indicating the discount rate in percent per year and the second indicating whether uniform or nonuniform age weights were used. The most widely reported variant on the DALY is the DALY (3,1)—that is, one that uses a 3 percent discount rate and nonuniform age weighting. This chapter and the companion volume report DALYs (3,0)—that is, with discounting but uniform age weighting.

Estimates of DALYs by cause for 1990 first appeared as appendix B of the 1993 *World Development Report* and, in expanded form, in Murray, Lopez, and Jamison (1994). Christopher Murray, Alan Lopez, and colleagues later produced updated estimates for 1990 and a fuller account of the methods used (Murray and Lopez 1996a, 1996b). The relative burden of different conditions as measured by numbers of deaths correlates highly with DALYs, but important exceptions exist. The massive burden of major psychiatric conditions, for example, is captured by DALYs but missed in estimates of deaths by cause or YLLs. Table 1.A1 summarizes the current estimates of deaths by cause in 2001 from Mathers, Murray, and Lopez (2006). Table 1.A2 shows disease burden in DALYs. Additional columns in these tables show the effect of including stillbirths on the percentage distribution of burden across conditions while leaving unchanged the other numbers (see Jamison and others 2006).

Disease burden can be assessed by risk factor as well as by disease or condition. An initial assessment of risk factor burden appeared in the 1993 *World Development Report* and later in Murray and Lopez (1997) and WHO (1996). WHO published a much fuller set of estimates in its 2003 *World Health Report* (WHO 2003b). Ezzati and others (2006) provided a substantial update adjusted to the same methodological assumptions as for deaths and DALYs, including use of DALYs (3,0).

Uses of Disease Burden Measures

DALYs are useful for informing health policy in at least six ways. Estimates of deaths by cause or YLL serve these same purposes, but for some uses less well.

1. *Assessing performance.* A country-specific (or regional) assessment of the burden of disease provides an outcome indicator that can be used over time to judge progress or across countries or regions to judge relative performance. The most natural comparison is to the development of national income and product accounts (NIPAs) by Simon Kuznets and others in the 1930s, which culminated in 1939 with a complete NIPA for the United Kingdom prepared by James Meade and Richard Stone at the request of the U.K. Treasury. NIPAs have, in the subsequent decades, transformed the empirical underpinnings of economic policy analysis. One leading scholar has put it this way:

The national income and product accounts for the United States (NIPAs), and kindred accounts in other nations, have been among the major contributions to economic knowledge over the past half century. . . . Several generations of economists and practitioners have now been able to tie theoretical constructs of income, output, investment, consumption, and savings to the actual numbers of these remarkable accounts with all their fine detail and soundly meshed interrelations. (Eisner 1989, 1)
2. *Generating a forum for informed debate of values and priorities.* The assessment of disease burden in a country in practice involves participation of a broad range of national disease specialists, epidemiologists, and, often, policy makers. Debating the appropriate values, say, for disability weights or for years of life lost at different ages helps clarify values and objectives for national health policy. Discussing the interrelations among diseases and their risk factors in the light of local conditions sharpens consideration of priorities.
3. *Identifying national control priorities.* Many countries now identify a relatively short list of interventions, the full implementation of which becomes an explicit priority for national political and administrative attention. Examples include interventions to control TB, poliomyelitis, HIV infection, smoking, and specific micronutrient deficiencies. Because political attention and high-level administrative capacity are in relatively fixed and short supply, the benefits from using those resources will be maximized if they are directed to interventions that are both cost-effective and aimed at problems associated with a high burden. Thus, national assessments of disease burden are one input in establishing a potential short list of control priorities. In the summary of the cost-effectiveness analyses reported in this volume, chapter 2 pays particular attention to identifying cost-effective interventions capable of averting a large disease burden.
4. *Allocating training time for clinical and public health practitioners.* Medical schools offer a fixed number of instructional hours; training programs for other levels and types of practitioners are likewise limited. A major instrument for implementing policy priorities is allocating this fixed-time resource well. Again that means allocation of time to training in cost-effective interventions in which disease burden is high.
5. *Allocating research and development resources.* Whenever a fixed effort will have a benefit proportional not only to the size of the effort but also to the size of the problem being addressed, estimates of disease burden become essential for formulating policy. Developing a vaccine for a broad range

Table 1.A1 Causes of Deaths in Low- and Middle-Income and High-Income Countries and the World, 2001
(percent)

	Low- and Middle-Income		High-Income		World	
	Stillbirths excluded	Stillbirths included	Stillbirths excluded	Stillbirths included	Stillbirths excluded	Stillbirths included
Population (thousands)	5,221,572		928,660		6,150,233	
Births (thousands)	118,505	121,733	11,371	11,416	129,878	133,150
Total deaths (thousands)	48,377	51,605	7,936	7,981	56,268	59,542
Causes of death (percent)						
I. COMMUNICABLE DISEASES, PREGNANCY OUTCOMES, AND NUTRITIONAL DEFICIENCIES	36.4	34.1	7.0	6.9	32.3	30.5
A Infectious and parasitic diseases	22.1	20.7	1.9	1.9	19.3	18.2
1 Tuberculosis	3.3	3.1	0.2	0.2	2.9	2.7
2 STIs excluding HIV	0.4	0.3	0.0	0.0	0.3	0.3
3 HIV/AIDS	5.3	4.9	0.3	0.3	4.6	4.3
4 Diarrheal diseases	3.7	3.4	0.1	0.1	3.2	3.0
5 Childhood diseases	2.8	2.6	0.0	0.0	2.4	2.3
a Pertussis	0.6	0.6	0.0	0.0	0.5	0.5
b Poliomyelitis	0.0	0.0	0.0	0.0	0.0	0.0
c Diphtheria	0.0	0.0	0.0	0.0	0.0	0.0
d Measles	1.6	1.5	0.0	0.0	1.4	1.3
e Tetanus	0.6	0.6	0.0	0.0	0.5	0.5
6 Meningitis	0.3	0.3	0.1	0.1	0.3	0.3
8 Malaria	2.5	2.3	0.0	0.0	2.1	2.0
Other I.A. (7, 9–15)	3.8	3.6	1.3	1.3	3.5	3.3
B Respiratory infections	7.2	6.7	4.4	4.4	6.8	6.4
C Maternal conditions	1.0	1.0	0.0	0.0	0.9	0.9
D Perinatal conditions	5.1	4.8	0.4	0.4	4.5	4.2
1 Low birth weight	2.7	2.5	0.1	0.1	2.3	2.2
2 Birth asphyxia and birth trauma	1.5	1.4	0.1	0.1	1.3	1.2
3 Other perinatal conditions	1.0	0.9	0.1	0.1	0.9	0.8
E Nutritional deficiencies	0.9	0.9	0.2	0.2	0.8	0.8
II. NONCOMMUNICABLE CONDITIONS	53.8	50.5	86.5	86.0	58.5	55.3
A Malignant neoplasms	10.2	9.6	26.0	25.9	12.5	11.8
C Diabetes mellitus	1.6	1.5	2.6	2.5	1.7	1.6
E Neuropsychiatric disorders	1.4	1.4	4.8	4.7	1.9	1.8
1 Unipolar major depression	0.0	0.0	0.0	0.0	0.0	0.0
2 Bipolar disorder	0.0	0.0	0.0	0.0	0.0	0.0
3 Schizophrenia	0.0	0.0	0.0	0.0	0.0	0.0
Other II.E. (4–16)	1.4	1.3	4.7	4.7	1.9	1.8
G Cardiovascular disease	27.6	25.9	38.3	38.1	29.1	27.5
3 Ischaemic heart disease	11.8	11.0	17.2	17.1	12.6	11.9
4 Cerebrovascular disease	9.5	8.9	9.8	9.8	9.6	9.1
Other II.G. (1, 2, 5, 6)	6.3	5.9	11.3	11.2	7.0	6.6
H Respiratory diseases	6.5	6.1	6.0	6.0	6.4	6.1
I Digestive diseases	3.3	3.1	4.2	4.2	3.4	3.3
M Congenital anomalies	1.0	0.9	0.4	0.4	0.9	0.9
Other II. (B, D, F, J–L, N)	2.2	2.0	4.3	4.3	2.5	2.3
III. INJURIES	9.8	9.1	5.9	5.9	9.2	8.7
A Unintentional	6.6	6.2	4.0	4.0	6.3	5.9
1 Road traffic accidents	2.2	2.1	1.5	1.5	2.1	2.0
Other III. A. (2–6)	4.4	4.2	2.5	2.5	4.2	3.9
B Intentional	3.1	2.9	1.9	1.9	2.9	2.8
1 Self-inflicted	1.5	1.5	1.6	1.6	1.6	1.5
Other III.B. (2–4)	1.6	1.5	0.3	0.3	1.4	1.3

Sources: Estimates in the columns excluding stillbirths come from Mathers, Lopez, and Murray (2006). Estimates in the columns including stillbirths come from Jamison and others (2006), which uses the estimates from Mathers, Lopez, and Murray (2006) while adding in stillbirths.

Table 1.A2 The Burden of Disease in Low- and Middle-Income and High-Income Countries and the World, 2001
(percent)

	Low- and Middle-Income		High-Income		World	
	DALYs ^a	DALYs _{SB} ^b	DALYs ^a	DALYs _{SB} ^b	DALYs ^a	DALYs _{SB} ^b
Total DALYs (thousands)	1,387,426	1,260,643	149,161	148,316	1,536,587	1,412,600
Causes of death (percent)						
I. COMMUNICABLE DISEASES, PREGNANCY OUTCOMES, AND NUTRITIONAL DEFICIENCIES	39.8	33.6	5.7	5.4	36.5	30.5
A Infectious and parasitic diseases	23.1	21.0	2.3	2.2	21.1	18.9
1 Tuberculosis	2.6	2.8	0.1	0.1	2.3	2.5
2 STIs excluding HIV	0.7	0.7	0.1	0.1	0.6	0.6
3 HIV/AIDS	5.1	5.3	0.4	0.4	4.7	4.8
4 Diarrheal diseases	4.2	2.6	0.3	0.3	3.9	2.6
5 Childhood diseases	3.1	2.4	0.1	0.1	2.8	2.4
a Pertussis	0.8	0.7	0.1	0.1	0.8	0.6
b Poliomyelitis	0.0	0.0	0.0	0.0	0.0	0.0
c Diphtheria	0.0	0.0	0.0	0.0	0.0	0.0
d Measles	1.7	1.5	0.0	0.0	1.5	1.4
e Tetanus	0.6	0.5	0.0	0.0	0.5	0.4
6 Meningitis	0.4	0.4	0.1	0.1	0.4	0.3
8 Malaria	2.9	2.1	0.0	0.0	2.6	1.8
Other I.A. (7, 9–15)	4.1	4.2	1.1	1.1	3.8	4.2
B Respiratory infections	6.3	4.6	1.7	1.7	5.8	4.3
C Maternal conditions	1.9	2.1	0.3	0.3	1.7	1.9
D Perinatal conditions	6.4	3.7	0.9	0.6	5.9	3.4
1 Low birth weight	3.1	1.4	0.3	0.2	2.8	1.5
2 Birth asphyxia and birth trauma	2.3	1.5	0.4	0.4	2.1	1.4
3 Other perinatal conditions	1.1	0.6	0.3	0.3	1.0	0.5
E Nutritional deficiencies	2.1	2.2	0.6	0.6	2.0	2.0
II. NONCOMMUNICABLE CONDITIONS	48.9	52.4	86.7	87.2	52.6	56.4
A Malignant neoplasms	5.4	5.9	17.4	17.4	6.6	7.1
C Diabetes mellitus	1.1	1.3	2.8	2.8	1.3	1.4
E Neuropsychiatric disorders	9.9	10.8	20.9	21.0	11.0	11.9
1 Unipolar major depression	3.1	3.4	5.6	5.7	3.4	3.7
2 Bipolar disorder	0.6	0.7	0.7	0.7	0.6	0.7
3 Schizophrenia	0.8	0.8	0.7	0.8	0.8	0.8
Other II.E. (4–16)	5.4	5.9	13.8	13.9	6.2	6.7
G Cardiovascular disease	12.9	14.2	20.0	20.1	13.6	14.7
3 Ischaemic heart disease	5.2	5.7	8.3	8.4	5.5	6.0
4 Cerebrovascular disease	4.5	5.0	6.3	6.3	4.7	5.1
Other II.G. (1, 2, 5, 6)	3.2	3.5	5.4	5.5	3.4	3.7
H Respiratory diseases	4.2	4.5	6.6	6.6	4.4	4.7
I Digestive diseases	3.8	4.0	4.4	4.4	3.8	4.1
M Congenital anomalies	1.7	1.3	1.0	0.8	1.6	1.3
Other II. (B, D, F, J–L, N)	9.9	10.9	13.7	13.8	10.3	11.2
III. INJURIES	11.2	12.1	7.5	7.5	10.9	11.6
A Unintentional	8.2	8.8	5.3	5.3	7.9	8.4
1 Road traffic accidents	2.3	2.5	2.0	2.0	2.3	2.5
Other III. A. (2–6)	5.9	6.3	3.2	3.3	5.6	6.1
B Intentional	3.1	3.4	2.3	2.3	3.0	3.2
1 Self-inflicted	1.3	1.4	1.7	1.7	1.3	1.4
Other III.B. (2–4)	1.8	2.0	0.5	0.5	1.7	1.8

Sources: Mathers, Lopez, and Murray (2006) provide the reported estimates of DALYs. Jamison and others (2006) provide the estimates for DALYs_{SB}.

a. The burden of disease is measured in DALYs. DALYs form a class of measures that aggregate years of life lost from premature mortality with years of life lost due to disability. The DALYs reported here are calculated at a 3 percent per year discount rate with no age-weights, i.e. a year of life at any age is valued the same. These are referred to as DALYs (3,0) in the accompanying volume on burden of disease and risk factors (Lopez and others, 2006).

b. The DALYs_{SB} is analogous to the DALY except that it includes stillbirths in the estimates of burden and assumes a gradual “acquisition of life potential” that allows the burden associated with a death near the time of birth to grow gradually with age rather than instantaneously increasing from 0 to a high value at birth or some earlier time. Jamison and others (2006) provide the estimates used here, which they label DALYs_{SB} (3,0,0.54).

of viral pneumonias, for example, would have perhaps hundreds of times the effect of a vaccine against Hanta virus infection. Thus, information on disease or risk factor burden is one vital input (of several) to inform research and development resource allocation, as discussed in chapters 4 and 5.

6. *Allocating resources across health interventions.* Here disease burden assessment often plays a minor role; the task is to shift resources to interventions, which, at the margin, will generate the greatest reduction in DALY loss. When there are major fixed costs in mounting an intervention, as is the case with political and managerial attention for national control priorities, burden estimates are required to improve resource allocation. Likewise, major fixed costs may be associated with making the use of an intervention universal (or expanding it to cover a major percentage of the population), and if so, the cost-effectiveness of the expansion will depend in part on the size of the burden.

Results

Tables 1.A1 and 1.A2 convey summaries of deaths by cause and burden of disease in 2001, respectively.

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In the early 1990s, the World Bank initiated efforts to understand and disseminate policies to address the remaining large burden of disease affecting the world's poor. The World Bank's (1993) *World Development Report: Investing in Health* reported the results of that assessment, which drew on a second publication, *Disease Control Priorities in Developing Countries*, 1st edition (*DCP1*) (Jamison and others 1993). Enormous changes both in the world and in our knowledge base occurred during the subsequent decade, leading to the conclusion that a major revision, update, and expansion of *DCP1* would be of value. In a collaborative undertaking, the World Bank, the World Health Organization, and the Fogarty International Center of the U.S. National Institutes of Health sponsored this new effort (*DCP2*) with substantial financial support from the Bill & Melinda Gates Foundation. This book results from that collaboration.

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