APPENDIX 2

The Evidence Base for the Prevention and Control of Noncommunicable Diseases

During the second half of the 20th century, most of the scientific research into noncommunicable diseases (NCDs) was oriented toward establishing causal relationships between potential contributory factors and disease. A large body of knowledge was generated concerning specific risk factors as well as broader determinants of health. This information has pointed toward areas of prevention and health promotion, yet knowledge, and even understanding, of causality does not immediately translate into a preventive strategy. The long lag time between the research that established that tobacco use was a major cause of morbidity and mortality in the 1950s and the enactment of preventive interventions in the 1980s and 1990s speaks to a complex pathway.

Preventive interventions for NCDs require more than deciphering the causal relationships and biological explanations of disease. They also require an understanding of human behavior and of relationships among political contexts, economic interests, and public health objectives. Perhaps the most crucial constraint to the effectiveness of prevention has been the lack of proper evaluation of interventions. Programs were often adopted on the basis of a simple cause-and-effect rationale, only for the adopters to find out,

after spending resources, that the programs did not work as expected. Examples of this are running school-based tobacco control programs to prevent the uptake of smoking and promoting early detection of breast cancer through breast self-examination among women. Impact evaluations demonstrated that both these approaches were ineffective after they had been widely adopted (Thomas and others 2002; Yach and Wipfli 2006).

In the case of biological interventions, such as drug treatments, chemoprevention, and immunoprevention, the intervention in question must compare favorably with usual care or no intervention. Therefore, comparison of groups that are as similar as possible with and without the intervention is a precondition for recommending use of the intervention. The key to comparability is similarity of the groups, which is achieved through randomization. Ideally, the same standards should be observed for behavioral and organizational prevention and control strategies. For the purpose of this work, evidence that a proposed intervention works was taken to be that for which several evaluation studies have consistently showed the same direction of the effect of a given intervention. Published reviews were searched systematically in various databases and additional studies not contained in the review or that would help answer the questions were also retrieved. The results are presented in a summary that can be understood by nonspecialists.

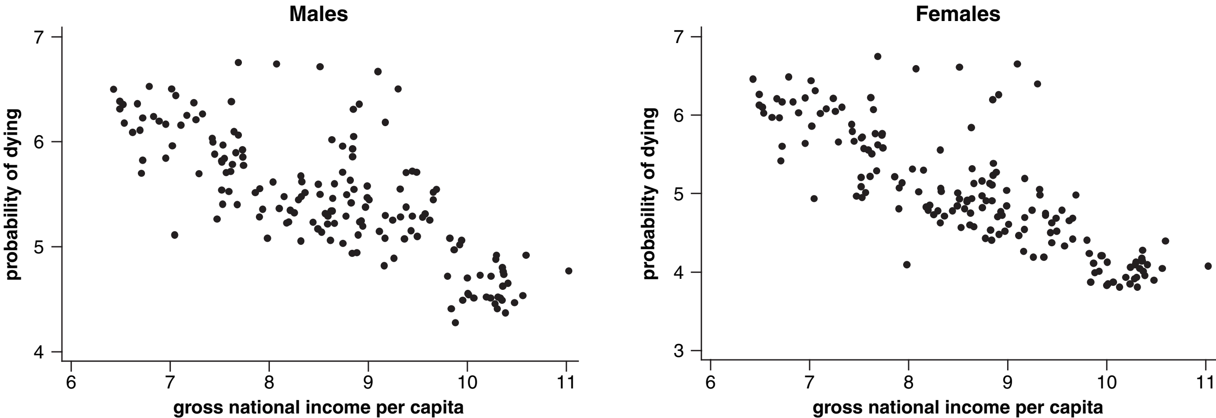
The evidence is presented at two different levels of action: intersectoral, in which public policies are developed, and intrasectoral, in which interventions occur within the health care system. To ensure transparency, consistency, and attention to developing countries, as much as possible, cost-effectiveness ratios used in this appendix were taken from Jamison and others (2006a), unless otherwise specified.

Premature Mortality

Mortality from NCDs increases with age, but the toll of premature mortality among adults has important consequences for the labor force. To avoid the variability that exists in registering the cause of deaths, figure A2.1 presents the probability that a 15-year-old will die before age 60 (premature mortality) according to gross national income per capita for 2004 in 162 countries. Not surprisingly, among both males and females, mortality is highest in low-income countries and decreases as income per capita increases.

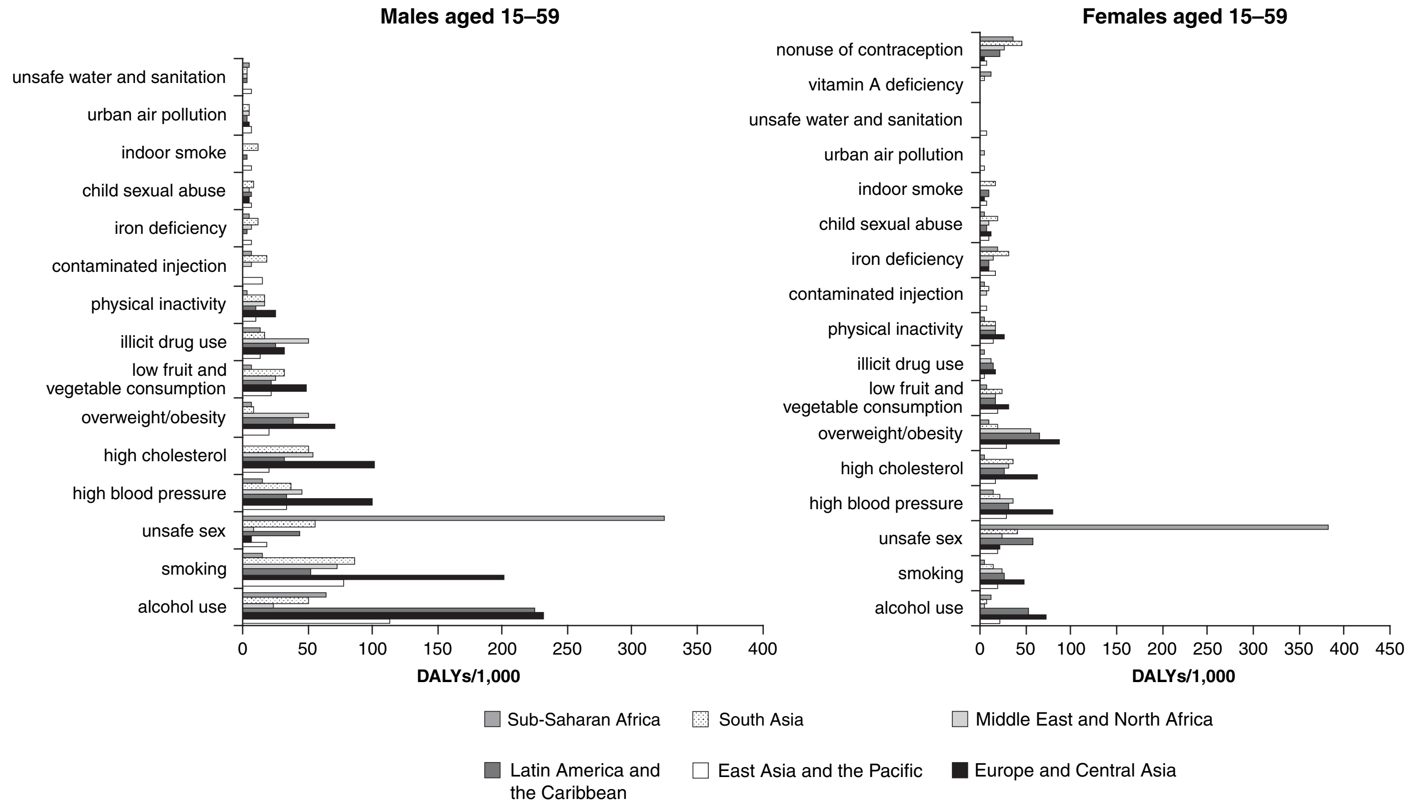
To better understand the causes of premature mortality, figure A2.2 presents estimates of unweighted, discounted (3 percent) disability-adjusted

Figure A2.1. Premature Mortality among Adults Aged 15–59 According to Gross National Income Per Capita in 162 Countries, 2004



Sources: WHO 2006a. "World Health Statistics 2006." WHO. http://www.who.int/whosis/whostat2006/en/index.html. Date consulted: November 15, 2006; World Bank 2006f.
Note: Gross national income per capita and the probability of dying are expressed as natural logarithms.

Figure A2.2. Premature Mortality: Disability-Adjusted Life Years (DALYs) Lost Attributable to the Most Frequent Risk Factors for Disease by World Bank Region, 2001



Source: Lopez and others 2006.

life years (DALYs) lost for males and females aged 15–59 attributable to leading risk factors by World Bank region. Worldwide, the most important cause of premature mortality is clearly unsafe sex among males and females in Sub-Saharan Africa, whereas alcohol use and other risk factors for NCDs appear to take a larger toll in other regions. Figure A2.3 presents the same information but excluding Sub-Saharan Africa, which allowed the unmasking of other conditions that present a high risk of premature deaths for adults.

Among males, the leading risk factor is hazardous consumption of alcohol in Europe and Central Asia followed closely by Latin America and the Caribbean. The high number of DALYs also attributable to smoking, high cholesterol, high blood pressure, and overweight and obesity among males and females in Europe and Central Asia speaks to a significant toll of NCDs. Elsewhere among females, these NCD risk factors are an important cause of DALYs, but in Latin America and the Caribbean and in South Asia, unsafe sex and lack of access to contraception are also significant causes of premature mortality. Mortality attributable to smoking is increasing in developing countries, where tobacco control policies have recently or not yet been enacted (box A2.1).

Public Policy

The populations of low- and middle-income countries are increasingly being exposed to the common risk factors, such as tobacco, hazardous use of alcohol, inadequate diet, and lack of physical activity, for the leading NCDs (WHO 2002b). As developed countries have implemented successful tobacco control policies, tobacco use has shifted to developing countries. In the last 20 years, the prevalence of smoking has increased from 30 to 50 percent among men in developing countries, whereas in developed countries the proportion of men who smoke has decreased from 50 to 34 percent (Guindon and Boisclair 2003).

As a consequence of rapid urbanization and concurrent social changes, such as the incorporation of women into the workforce, developing countries have shifted from a simple and monotonous diet to consuming more animal-source foods, fats, sugar, and processed foods (Popkin and Gordon-Larsen 2004). This process is bolstered by the global commercialization of food that is now possible though improvements in technology. The results are higher and increasing rates of high blood pressure, high cholesterol, obesity, and NCDs.

Figure A2.3. Premature Mortality: Disability-Adjusted Life Years (DALYs) Lost Attributable to Most Frequent Risk Factor for Disease, by World Bank Regions excluding Sub-Saharan Africa, 2001

Males aged 15–59

unsafe water and sanitation
urban air pollution
indoor smoke
child sexual abuse
iron deficiency
contaminated injection
physical inactivity
illicit drug use
low fruit and vegetable consumption
overweight/obesity
high cholesterol
high blood pressure
unsafe sex
smoking
alcohol use

0 50 100 150 200 250

DALYs/1,000

Females aged 15–59

nonuse of contraception
vitamin A deficiency
unsafe water and sanitation
urban air pollution
indoor smoke
child sexual abuse
iron deficiency
contaminated injection
physical inactivity
illicit drug use
low fruit and vegetable consumption
overweight/obesity
high cholesterol
high blood pressure
unsafe sex
smoking
alcohol use

0 10 20 30 40 50 60 70 80 90 100

DALYs/1,000

Sub-Saharan Africa
South Asia
Middle East and North Africa
Latin America and the Caribbean
East Asia and the Pacific
Europe and Central Asia

Source: Lopez and others 2006.

Box A2.1

Trends in Mortality Attributable to Smoking

In those high-income and former socialist economies with more complete and reliable mortality statistics than those elsewhere, one can measure the effects of increased smoking prevalence and subsequent decreases that have been observed among large numbers of adults. The changes are best documented by examining lung cancer mortality among young adults, because lung cancer is rarely misclassified with other causes of death at young ages and is almost entirely attributable to smoking, and is an indicator of the trend in mortality of all smoking-related causes.

In the United Kingdom, the age-standardized lung cancer mortality rate among males aged 35–44 per 100,000 fell from 18 in 1950 to 4 by 2000. In contrast, comparable male lung cancer rates in France show the reverse pattern. In France, the increase in smoking occurred some decades later than in the United Kingdom, and declines in smoking began only after 1990. Similarly, a large increase in female lung cancer at young ages was avoided in the United Kingdom, but female lung cancer at young ages continues to rise in France.

Source: Jamison and others 2006a.

Behaviors leading to tobacco use, hazardous use of alcohol, inadequate diet, and lack of physical activity are not only a matter of rational individual choice, but a more complex process whereby the social environment can induce choices (Emmons 2000). The following sections discuss public policies to reduce the behavioral risk factors. The information is organized according to the main types policy levers, where appropriate:[1] (a) economic incentives and disincentives, (b) informational environments, (c) direct regulation, (d) indirect regulation, and (e) deregulation. These are policy instruments for government intervention that are consistent with a population-based approach.

Tobacco Control

No other legal consumer product is as dangerous as tobacco. Evidence of the health hazards of tobacco use has long been established (Doll and Hill 1954; U.S. Surgeon General's Advisory Committee on Smoking and Health 1964). Cigarettes are the most widely used tobacco product, but tobacco use also includes pipe smoking, tobacco chewing, hand-rolled

cigarettes, and local forms of tobacco consumption that vary across cultures. According to the World Health Organization (WHO), 4.9 million deaths in 2000 can be attributed to tobacco (WHO 2002b). The figure is increasing in developing countries, which currently account for 56 percent of the tobacco diseases burden (WHO 2002b).

In 1999, a World Bank (1999, p. 34) report addressed the economics of tobacco control. One of its main conclusions was that "it appears unlikely . . . that smokers either know their full risk or bear the full cost of their choice. Governments may consider that intervention is therefore justified, primarily to deter children and adolescents from smoking and to protect nonsmokers, but also to give adults all the information they need to make an informed choice." The report specified that interventions to control demand are more effective than supply-side interventions.[2]

Economic disincentive: increasing the price of tobacco products through excise taxation—Increasing the unit price of tobacco products through excise taxation is the most cost-effective intervention for tobacco control (Ranson and others 2000; Shibuya and others 2003). The World Bank originally estimated a price elasticity of –0.4 for developed countries and –0.8 for developing countries. A systematic review (Hopkins and others 2001) of evaluations of such interventions, mostly in developed countries, reported a median price elasticity for prevalence of tobacco use of –0.15. For tobacco consumption among those who continued to smoke, the median price elasticity was –0.19. Gallus and others (2006) estimated price elasticities for countries in the European Union of –0.43 and for countries not in the European Union of –0.87, closer to the World Bank's original estimates.

Following the publication of the World Bank report and working toward the Framework Convention on Tobacco Control sponsored by WHO, investigators undertook several World Bank–sponsored studies on the economics of tobacco control in developing countries using data from household surveys. All the studies used the same methodology (Wilkins, Yurekli, and Hu 2003) and consistently reported a significant decrease in consumption with a 10 percent rise in real price, but with a wider variation than the original World Bank (1999) estimates (table A2.1).

Studies that analyzed data by socioeconomic group document that responsiveness to price increase is higher among poor smokers (Hu and others 2006; Townsend, Roderick, and Cooper 1994; Van Walbeek 2005). Subsequent to tax increases, those of lower socioeconomic status smoke fewer cigarettes per day and cheaper brands than affluent smokers.

Table A2.1. Expected Decrease in Cigarette Consumption per 10 Percent Rise in the Real Price of Cigarettes, Selected Developing Countries, Circa 2000

Country	*Expected decrease (%)*
Asia	
Bangladesh	2.7
China	5.4
Indonesia	3.4
Nepal	8.8
Sri Lanka	5.3
Thailand	3.9
Eastern Europe	
Bulgaria	8.0
Estonia	3.4
Turkey	1.9
Latin America	
Argentina	2.7
Bolivia	8.5
Brazil	2.5
Chile	2.2
Uruguay	4.9
Middle East	
Egypt	4.0
Morocco	5.1

Sources: Adioetomo, Djutaharta, and Hendratno 2005; Alcaraz 2005; Ali, Rahman, and Rahman 2003; Aloui 2003; Arunatilake and Opatha 2003; Debrott Sanchez 2005; Gonzales-Rozada 2005; Hu and Mao 2002; Iglesias and Nicolau 2005; Karki, Pant, and Pande 2003; Nassar 2003; Onder 2002; Ramos and Curti 2005; Sayginsoy 2002; Taal 2004. These reports are available on line at http://www.worldbank.org and for Latin America at http://www.paho.org.

Adolescents and young adults are particularly sensitive to price increases (Lewit and others 1997; Liang and Chaloupka 2002). This is important, because most smokers initiate tobacco use before age 25 and become addicted during the first few years of use (Clark and others 2005). In the United States, expenditure on tobacco marketing exceeds US$15.5 billion per year, 71.4 percent of it through price discounts,[3] which speaks to the importance of price interventions.

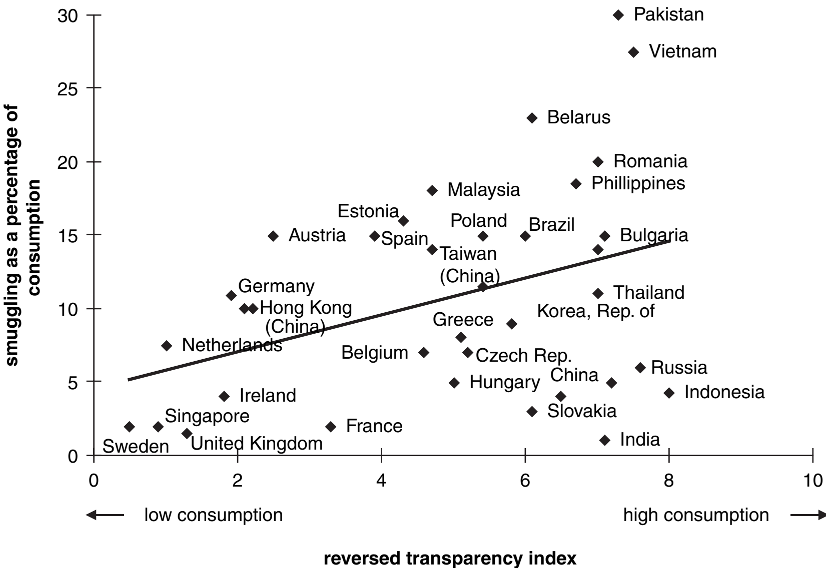
Policy makers are concerned that by increasing tobacco taxes, and hence the price of tobacco, illicit trade in tobacco could increase, and this argument is widely used. At the same time, this is a practice condoned by tobacco companies, as shown in court records of proceedings during which tobacco company executives were found guilty of complicity in smuggling operations (Warner 2000). The level of illicit tobacco trade has been correlated with the corruption perception index, also known as the transparency index,[4] indicating that smuggling is more likely to

occur in those countries where corruption is high (Merriman, Yurekli, and Chaloupka 2000). Figure A2.4 shows the relationship between the reverse transparency index and cigarette smuggling. According to Merriman, Yurekli, and Chaloupka, the level of transparency explains the amount of smuggling that occurs as much as price and taxes.

Several countries have significantly reduced illicit trade. Spain, for example, reduced illicit trade from 16 to 2 percent in five years (1996–2001) by strengthening law enforcement, which included seizing smuggled tobacco products and levying a fine covering the costs of the seizure (Wilkins, Yurekli, and Hu 2003). Malaysia and the United Kingdom have taken a proactive approach by marking domestic cigarettes packages with information and special ink to identify smuggled and counterfeit products (Joossens and Raw 2000).

Smuggling is an important problem, but rather than forgoing the well-established public health and fiscal benefits of high tobacco prices by lowering the price of tobacco in an attempt to reduce smuggling, it should be addressed as a law enforcement issue. Canada learned this from experience. In the 1990s, the Canadian government reduced the

Figure A2.4. Reverse Transparency Index and Estimated Smuggling as a Share of Tobacco Consumption, Selected Countries, 2000



Source: Merriman, Yurekli, and Chaloupka 2000.

Note: $R^2 = 0.2723$. The reverse transparency index explains 27.23 percent of the variations in smuggling as a percentage of consumption.

tobacco taxes to control illicit trade as advocated by the tobacco companies. As a consequence, the year after the tax cuts the government's revenues fell by Can$1.2 billion and smoking among children increased (Hamilton and others 1997).

A country's institutional capacity to control illicit tobacco trade needs to be considered when increasing the price of tobacco products. At least in part, the control of illicit trade could be self-financed through fines. In addition, data show that despite smuggling, tax increases do have an effect on tobacco consumption and do increase revenues (Gruber, Sen, and Stabile 2003).

Informational environment—The informational environment for tobacco control at the population level is mainly shaped through antitobacco mass media campaigns, advertisements against tobacco use, advertising bans, and warning labels on tobacco products. Evaluation of these interventions poses several methodological challenges, such as assessing the exposure and intensity of the campaign, determining whether the control group has been contaminated, and separating the campaign's effects from those of other interventions. Three out of five published experimental studies that met quality criteria for a systematic review reported a reduction in smoking prevalence following a media campaign (Farrelly, Niederdeppe, and Yarsevich 2003). Two review papers state that media campaigns can improve outcomes when used in conjunction with other interventions (Hopkins and others 2001; Sowden and Arblaster 2000). Antitobacco media campaigns that have documented reductions in the prevalence of tobacco use have been carefully planned, adequately funded, and based on solid theoretical grounds and formative research (Farrelly, Niederdeppe, and Yarsevich 2003; Hopkins and others 2001).

Despite some controversy about the methods used to evaluate the effect of bans on advertising tobacco, it continues to be one of the most heavily advertised products in the world. In the United States before the advertising ban in 1970, most of the advertising budget was spent on television and radio. Since then, newspapers and magazines have been the preferred advertising channel, and the total marketing budget has continued to increase. A study with data from 22 high-income countries (Saffer and Chaloupka 2000) estimated that a total advertising ban could reduce smoking among adults by 6.3 percent.

Another information strategy is the placement of warning labels on cigarette packages, advertisements, and points of sale. Most evaluations have shown positive results in terms of people reading, recalling, and understanding the messages (Strahan and others 2002). A study

conducted in Canada at the time when warning labels were increased to cover 50 percent of the package, front and back, and included vivid images and clear messages, demonstrated a positive relationship between the depth of cognitive processing of the messages and the intention to quit or actual quitting of tobacco use among adults (Hammond and others 2003).

***Regulation to reduce harm to others: secondhand smoke*—**Regulations restricting or banning smoking in the workplace have decreased the number of cigarettes smoked, increased attempts to quit among smokers, and reduced the prevalence of tobacco use (Farrelly, Evans, and Sfekas 1999; Fichtenberg and Glantz 2002). An analysis of the 50 states and the District of Columbia in the United States (McMullen and others 2005) found that the extent of legislation related to exposure to clean indoor air had a positive association with the proportion of indoor workers reporting a smoke-free workplace and an inverse association with the prevalence of smoking among 12- to 17-year-olds. A large body of evidence indicates that eliminating involuntary exposure to tobacco smoke is an effective component of tobacco control policies (Department of Health and Human Services 2006).

Around the world, the hospitality industry has raised concerns about the potential loss of income to its businesses if it adopts a smoke-free policy. In reviews of the studies evaluating the effect of smoke-free policies, none of the studies that met the quality criteria found a decrease in revenue for bars and restaurants (Jossens 2005; Scollo and others 2003). The studies that found a negative effect did not measure objective outcomes, were based on opinions, and most were funded by the tobacco industry. Empirical evidence (Bartosch and Pope 2002), including an analysis of the long-term effects in California (Cowling and Bond 2005), which put smoking bans into effect in restaurants in 1992 and in bars in 1995, showed that taking existing trends into account, revenues for bars and restaurants actually increased after a ban on smoking.

***Deregulation: over-the-counter nicotine replacement therapy*—**Several analyses demonstrate the effectiveness of nicotine replacement therapy, physician's advice, and use of the antidepressant bupropion on smoking cessation (Hughes, Stead, and Lancaster 2004; Silagy and others 2004). Individual interventions such as these tend to have lower population impact and be less cost-effective than public policy (table A2.2).

Table A2.2. Cost-Effectiveness of Interventions to Control Tobacco Addiction
(US$/DALY)

Intervention	*Cost-effectiveness ratio*	*Comments*
33 percent price increase by means of tobacco taxes	22	These estimates are based on a price elasticity of demand of 8 percent (p. 875)
Interventions in the information environment, restrictions to reduce smoking in the workplace and public places, and interventions to reduce smuggling of tobacco products	353	There is evidence of effectiveness for each of these interventions (p. 876)
Nicotine replacement therapy for smoking cessation	396	Individual approach, with the potential to avert only 23 percent of the deaths averted by tax increases (p. 76)

Source: Jamison and others 2006a.

Nonetheless, if affordable, deregulation of nicotine replacement therapy to be sold over the counter and efforts to reduce its price can be useful for smoking cessation programs (Hughes and others 2003).

International treaty—Since its initial stages when WHO convened the parties involved, the World Bank has supported the international treaty known as the Framework Convention for Tobacco Control. The World Bank has worked with countries on economic analyses for tobacco control and made the information from this work widely available.[5] The treaty came into force in February 2005, and countries that have ratified the convention are obligated under international law to enact its provisions. All signatories participate in the conference of parties, which meets regularly to monitor the progress of the treaty's provisions and facilitate their implementation. The challenge now is to bridge the gap between ratification and implementation by gaining a better understanding of the political economy of the development of policies for tobacco control and helping countries execute the convention.

Hazardous Use of Alcohol

Hazardous alcohol use constitutes an important risk factor for premature mortality in many developing countries. Among men aged 15 to 59,

it accounts for 23.1 percent of DALYs in Europe and Central Asia, 22.5 percent in Latin America and the Caribbean, and 11.3 percent in East Asia. The alcohol-related burden of disease is much lower for women: 7.3 percent in Europe and Central Asia, 5.3 percent in Latin America and the Caribbean, and 2.2 percent in East Asia. Hazardous use is defined as an average rate of consumption of alcohol of more than 20 grams daily for women and 40 grams daily for men (Lopez and others 2006; Room, Babor, and Rehm 2005). Even though this is a significant quantity of alcohol, it does not account for the various patterns of drinking, nor does it reflect that even small quantities of alcohol can impair neurological functions and reasoning enough to cause harm. Examples of this are motor vehicle accidents and injuries from violence caused while under the influence of alcohol (Room, Babor, and Rehm 2005).

Patterns of drinking are cultural and context specific and vary greatly across societies, as does the type of alcohol that people prefer. For example, among drinkers in southern Europe, where social drinking frequently takes place in conjunction with meals, 41 percent prefer wine and another 41 percent prefer beer, whereas in Eastern Europe, 68 percent of drinkers prefer spirits and the predominant pattern is binge drinking (Chisholm and others 2004; Nicholson and others 2005). In some areas, alcohol drinking is more clearly linked to festivities, such as the carnivals in Brazil and in Trinidad and Tobago, whereas in others it is predominant in specific population groups, for example, indigenous populations in Canada and the United States (Room, Babor, and Rehm 2005). In the Americas, more than 50 percent of drinkers prefer beer (Chisholm and others 2004). Therefore, interventions need to vary according to the context and estimates of cost-effectiveness can only point toward potential areas of action, particularly when these estimates rely on mathematical modeling rather than on empirical data.

Economic disincentives—Alcohol consumption is sensitive to price increases. In general, younger people are most responsive, but hazardous drinkers also decrease their alcohol consumption. The price elasticity of demand, however, varies substantially according to prevailing drinking patterns in the population (Babor and Caetano 2005). Unintended consequences of price increases are home production of alcoholic drinks and illicit trade, yet various econometric studies conclude that the benefits of increasing alcohol prices far outweigh the costs (Osterberg 2004). The effect of excise taxation is not as important if the prevalence of alcohol use is low, but it contributes to government revenues if the revenue collection system is efficient.

Informational environment**—**Although many countries frequently provide information to the public on the hazards of alcohol use (Babor and Caetano 2005), this has not been found to influence consumption patterns. Other information strategies for which evidence of effectiveness is inconclusive include public service announcements, advertisement restrictions, advertisements against alcohol consumption, warning labels, and school-based programs. Nevertheless, communication strategies can be useful for gaining popular support for regulations (Osterberg 2004).

Regulations**—**Several regulations aimed at decreasing the availability of alcohol have shown some level of effectiveness, while others have been counterproductive. Total prohibition has been enforced in several countries and is an established practice in Islamic countries, but in the absence of social acceptance of prohibition, illegal alcohol production and smuggling have meant that the harm has been greater than the benefits (Jernigan and others 2000).

Evidence with regard to restrictions on the number of outlets and their location is inconclusive (Osterberg 2004), but restrictions on the hours and days of operation have been shown to decrease alcohol consumption and related injuries in Sweden (Norstrom and Skog 2005). Alcohol strikes—defined in Finland as the restriction of sales during popular games or festivities—have been shown to reduce drinking among heavy drinkers, public disturbances, violent crimes, and alcohol-related hospital admissions (Cook and Moore 2002). These findings need to be further evaluated, but could be applicable in many circumstances.

The minimum drinking age in many countries coincides with the legal age of adulthood, except in the United States, where setting the minimum drinking age at 21 while the legal age of adulthood remained at 18 had an effect on consumption and alcohol-related injuries. Studies in several states show that increasing the drinking age from 18 to 21 reduced motor vehicle crashes by 10 percent (Shults and others 2001).

Licensing places that can sell alcohol, such as bars and restaurants, has been an important policy in the industrial countries, in particular to enforce restrictions of sales to minors and to intoxicated individuals. Some indications suggest that holding both owners and patrons legally liable for infringing the law and risking the alcohol sales license may limit hazardous drinking in public places (Babor and Caetano 2005).

Indirect regulation**—**Because one of the main causes of death from alcohol is motor vehicle accidents, legislation that discourages drunk driving is critical to alcohol control. In the United States, as states reduced the

legal alcohol level allowed for drivers from 0.10 grams per deciliter (g/dl) to 0.08 g/dl, fatalities decreased by 7 percent (Jernigan and others 2000). The level of blood alcohol concentration at which driving is against the law varies by country and jurisdiction, ranging from 0.08 g/dl in most industrial countries to zero in Japan. Young motorists, motorcycle drivers, and commercial drivers are at higher risk for motor vehicle accidents in general. A recent report by WHO and the World Bank recommended setting the limit for blood alcohol concentration at 0.05 g/dl in general and 0.02 g/dl for young people and motorcycle drivers (WHO and World Bank 2004). The level at which alcohol affects an individual's motor skills, sense of balance, visual acuity, and reasoning varies from person to person. WHO and the World Bank (2004) have documented that the relative risk for involvement in a crash increases significantly at 0.04 g/dl and above.

The effectiveness of drunk driving legislation is directly related to the level of enforcement. Taking random breath samples from motorists has been found to decrease fatalities by 6 to 10 percent (Chisholm and others 2004). Several economic evaluations have reported that random breath testing is the most effective strategy to decrease fatalities from drunk driving. Severe penalties also contribute to decreased drunk driving, of which the most effective have been found to be suspension of the driver's license (Osterberg 2004).

***Deregulation*—**Considerable evidence indicates that when government-owned alcohol monopolies are privatized, alcohol consumption increases (Osterberg 2004). This is likely to occur because government-owned outlets tend to be few, have shorter operating hours, and are more likely to control sales to minors (Babor and Caetano 2005). A review of cost-effective interventions to reduce high-risk alcohol use is presented in table A2.3.

Food and Nutrition

Substantial evidence exists that high consumption of energy-dense food and low consumption of fruits and vegetables increase the risk for chronic diseases (International Agency for Research on Cancer 2002b; WHO 2002b). Worldwide, low intake of fruits and vegetables accounts for 26.7 million DALYs and obesity accounts for 33.4 million DALYs, and together are comparable to the burden of disease of undernutrition-related deficiencies. Iron deficiency accounts for 35.1 million DALYs, vitamin A deficiency for 26.6 million DALYs, and zinc deficiency for 28.0 million DALYs. Although undernutrition-related deficiencies

Table A2.3. Cost-Effectiveness of Interventions to Reduce High-Risk Alcohol Use by World Bank Region

Intervention	*Coverage (%)*[a]	*Europe and Central Asia*	*Latin America and the Caribbean*	*Sub-Saharan Africa*	*East Asia and the Pacific*	*South Asia*
Cost-effectiveness relative to no intervention (US$/DALY averted)						
Excise tax on alcoholic beverages (current situation)	0.95	141	225	104	516	2,671
Excise tax on alcoholic beverages (25 percent increase)	0.95	127	202	100	447	3,654
Excise tax on alcoholic beverages (50 percent increase)	0.95	**116**	**184**	**95**	394	4,641
Reduced access to alcoholic beverage retail outlets	0.95	216	340	152	146	827
Comprehensive advertising ban on alcohol	0.95	185	380	134	**123**	1,123
Random breath testing of motor vehicle drivers	0.80	1,856	1,542	973	984	531
Brief advice to heavy drinkers by a primary care physician	0.50	270	502	204	224	**462**
Combination: highest tax + brief advice	n.a.	216	350	143	269	845
Combination: highest tax + advertising ban + random breath testing + brief advice	n.a.	381	546	229	383	707
DALYs averted/US$ million expenditure						
Excise tax on alcoholic beverages (current situation)	0.95	7,107	4,435	9,633	1,937	374
Excise tax on alcoholic beverages (25 percent increase)	0.95	7,847	4,953	10,007	2,239	274
Excise tax on alcoholic beverages (50 percent increase)	0.95	**8,590**	**5,442**	**10,553**	2,536	215
Reduced access to alcoholic beverage retail outlets	0.95	4,638	2,940	6,580	6,856	1,209
Comprehensive advertising ban on alcohol	0.95	5,417	2,631	7,442	**8,139**	891
Random breath testing of motor vehicle drivers	0.80	539	648	1,027	1,016	1,882
Brief advice to heavy drinkers by a primary care physician	0.50	3,705	1,992	4,891	4,460	**2,163**

(*continued*)

Table A2.3. Cost-Effectiveness of Interventions to Reduce High-Risk Alcohol Use by World Bank Region *(Continued)*

Intervention	*Coverage (%)*[a]	*Europe and Central Asia*	*Latin America and the Caribbean*	*Sub-Saharan Africa*	*East Asia and the Pacific*	*South Asia*
Combination: highest tax + brief advice	n a.	4,627	2,859	7,016	3,718	1,184
Combination: highest tax + advertising ban + random breath testing + brief advice	n.a.	2,621	1,833	4,364	2,612	1,415

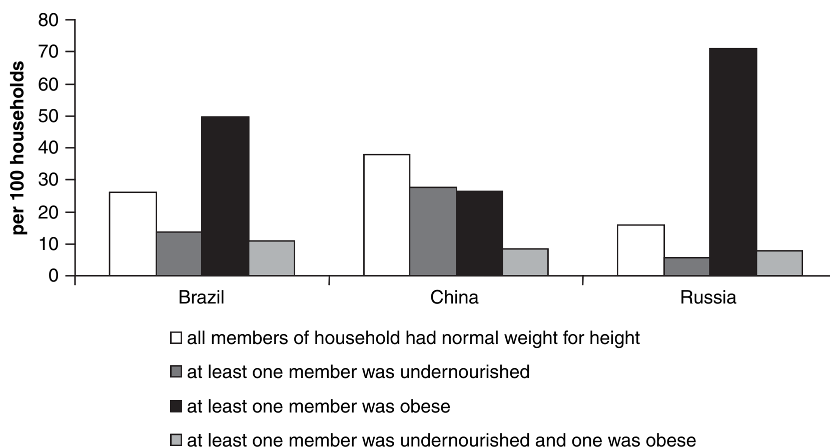
Source: Jamison and others 2006a.
Note: n.a. = not applicable. Bold figures indicate the most cost-effective strategy for reducing high-risk alcohol use based on the model for the region.
[a] Refers to the modeled percentage of all high-risk drinkers exposed to the intervention.

account for 10 times the number of DALYs than overnutrition-related risk factors in low-income African countries, the relationship starts to reverse in middle-income countries. In middle-income countries, DALYs attributable to vitamin A and zinc deficiencies are nearly one-seventh of those attributable to obesity and low intake of fruits and vegetables.[6]

Two features that present policy challenges characterize changes in the patterns of overweight and obesity in developing countries. The first is that the obesity epidemic in developing countries is occurring at a faster pace than economic development (Monteiro and others 2004; Popkin 2002; Popkin and Gordon-Larsen 2004), finding countries unprepared. The second characteristic, and possibly a consequence of the first, is that overnutrition and undernutrition may occur in the same household (Doak and others 2000).

Figure A2.5 shows the nutritional status per 100 households in three large countries: Brazil, China, and Russia. Overweight and obesity represent the largest proportion of the nutritional problem in Brazil and Russia,[7] whereas in China, 38 percent of the households were classified as normal. Although in China this does not necessarily represent a lower risk, as Asian populations have higher risk at lower levels of body mass index (WHO Expert Consultation 2004). In all three countries, between 8 and 11 percent of households had at least one overweight or obese member and at least one underweight member. A study of 27 developing countries (Garrett and Ruel 2005) reported a similar proportion of pairs of stunted children and overweight mothers. The authors report that this phenomenon was higher in Latin America and correlated positively with gross domestic product, but not with urban

Figure A2.5. Prevalence of Overweight and Obesity and Underweight by Household in Three Large Countries: Evidence of the Double Burden of Disease



Source: Doak and others 2000.

residence. Originally, obesity in low-income countries was interpreted as being more prevalent among higher socioeconomic groups. More recently, a trend analysis of survey data in Brazil (Monteiro, Conde, and Popkin 2004) showed that undernutrition among women declined by half during 1975–89, both in the poorest 25 percent of the population and in the richest 25 percent. During 1989–97, undernutrition did not change in either group, but obesity increased by 59 percent among the poorest 25 percent of women and decreased by 23 percent among the richest 25 percent of women.

The rapid changes in the prevalence of obesity across different socioeconomic groups can be understood by looking at the agro-food system as a whole and not only through the lens of nutrition and individual behaviors and their biological consequences. Over the past 20 years, food production and distribution have changed significantly. Technology has permitted the development of specialized agro-industry on a large scale. The biological adaptation of crops; the reduction of production costs; and the improvement of conditions for trade, such as transportation and removal of trade barriers, have given way to the globalization of food markets (Hawkes 2006). Countries often set most of their regulatory measures to comply with trade agreements and to facilitate exports of agricultural products. In most countries, fruits and vegetables remain mostly for local consumption, hence governments have had few incentives to regulate, support, or set standards for these

products. In contrast, grains and oilseeds have dominated agricultural trade, and processed foods and beverages are also important. These goods are traded in international markets and represent a larger share of retail than fruits and vegetables, yet the availability of low-priced processed foods, usually energy dense, is precisely what spearheads the increasing rates of overweight and obesity, particularly in urban environments. Prepared foods are an attractive option for busy working adults, even those in lower socioeconomic groups (Cutler, Glaeser, and Shapiro 2003; Popkin and Gordon-Larsen 2004). Although open produce markets still exist in most developing countries, cities are increasingly limiting the locations and hours of operation of such markets, which decreases access, especially for people with no means of transportation.

Globally, the lead in food distribution has been taken by large supermarket chains, which in turn have changed procurement and retail practices, moving toward centralized purchase and distribution with sophisticated logistic systems (Reardon and others 2003). Although fruits and vegetables represent a small share of the total food retailed by supermarkets, the produce section is key to marketing and to the store's competitive position (Cacho 2003). Large distributors, usually owned by the same supermarket company, set their own standards for purchasing fruits and vegetables, thus small farmers, who cannot meet the standards and compete, are driven out of the market (Reardon and Berdegue 2002).

For distributors, selling to small-scale stores is too costly, and for such stores stocking perishable goods is costly as well. At the same time, the location of large-scale stores or supermarkets is not random. Supermarkets are more profitable in high-income neighborhoods, which leave small food stores to serve poor neighborhoods. In areas with no supermarkets, the consumer has limited choices consisting mainly of dense-energy foods and few fruits and vegetables (Rex and Blair 2003). This may explain the findings of a large study in the United States that reported higher prevalence of overweight and obesity in urban areas with no supermarkets (Morland, Diez Roux, and Wing 2006). In this study, individuals living in neighborhoods that only had grocery or convenience stores (or both) had a 14 to 18 percent higher prevalence of overweight and a 48 to 60 percent higher prevalence of obesity than those living in urban areas with supermarkets after adjusting for individual-level variables related to obesity. The results of economic research are consistent with those of epidemiological studies and further suggest that people's food choices are constrained by availability and price

(Andrieu, Darmon, and Drewnowski 2006; Chou, Grossman, and Saffer 2004; Cutler, Glaeser, and Shapiro 2003; Drewnowski and Darmon 2005; French 2003; Glanz and others 1998; Khan and others 2004; Mancino 2003).

Economic incentives and disincentives: searching for balance— Analyses from developed countries have pointed toward increased consumption of energy-dense snacks as a factor in the causal chain of obesity (Cutler, Glaeser, and Shapiro 2003; Nielsen and Popkin 2004). Public health advocates have proposed taxing these snacks, among other price interventions (Nestle and Jacobson 2000). An economic analysis assessing the effects of taxing snack foods in the United States found that an excise tax of 1 percent per pound or a 1 percent price increase would not appreciably alter consumption, but it would generate US$40 million to US$100 million per year in tax revenues (Kuchler, Tegene, and Harris 2004). An analysis by the Food and Agriculture Organization of the United Nations (Schmidhuber 2004) predicted low demand elasticity for snacks in high-income groups and high demand elasticity in low-income groups. A study in China (Guo and others 1999) documented consumers' reaction to changes in the price of various foods items. It showed that pork consumers in the lowest income strata were three times more responsive to a price increase than consumers in the highest income strata. Thus subsequently, consumption of vegetable oils and unsaturated fats increased only among the rich as the poor did not have other alternatives and suffered the undesired consequence of decreased protein intake. In places that have concurrent overnutrition and undernutrition, taxing specific food items requires careful analysis, otherwise it may have little effect on obesity and may increase undernutrition.

Goodman and Anise's (2006, p. 20) review of economic instruments to reduce consumption of foods high in saturated fats and other energy-dense foods concluded that "the price inelasticity of foods may dampen the effect of economic instruments." The authors reported that they did not find empirical evaluations, only limited observational studies, such as the Guo and others (1999) study. Modeling exercises in Europe, however, suggest that increasing the price of nutrients could have a much larger effect than increasing the price of certain food items. One study stated that putting a tax on sugar would have a much larger effect than taxes on fat or subsidies on dietary fiber, particularly among younger and older consumers and those belonging to low socioeconomic groups. A report

commissioned in the United Kingdom agrees with these findings and warns of the potential regressivity of a fat tax, as total energy intake would not be significantly modified.

The market is responding differently to the externalities of the obesity epidemic: insurance companies offer discounts for people with normal body weight, employers provide access to exercise facilities to prevent obesity and NCDs, car insurers and airlines have instituted special policies for the obese, and even the U.S. Internal Revenue Service reimburses taxpayers for treatment of obesity if not covered by health insurance.[8] The question is whether taxing risk, directly or indirectly through insurance premiums or use of private services, would be more effective and efficient than taxes on specific food items or nutrients. A caveat is that such a tax may be regressive, as excess weight results from a diet of poor nutritional value, which is more prevalent among the poor, but it could provide an incentive if young adults of normal weight committed to maintaining a healthy weight in exchange for long-term lower health insurance premiums.

***Informational environment*—**Three strategies can be effective in shaping the informational environment toward a quality diet: the provision of information and education to the population at large, the provision of information at the point of purchase and food labeling, and the restriction of advertising and of health claims. According to several systematic reviews (Ammerman and others 2002; Pignone and others 2003; Pomerleau and others 2005), direct education, delivered either by telephone or in person, is the most effective intervention; however, individual interventions can be resource intensive, have a lower population impact, and are not always feasible in low- and middle-income countries.

Research has shown the benefits of point-of-purchase information, such as labeling healthier food selections in supermarkets and providing information about low calorie and low fat meals in restaurants, cafeterias, and vending machines (Matson-Koffman and others 2005). Nutrition labels on food packages have become widespread, but these are voluntary, and in most countries are not subject to standards. Ten countries where nutrition labels are mandatory based their decision on cost-benefit analyses. Their studies concluded that under the assumption that food labels contribute to consumers' choices, the savings in health care costs outweigh the cost of labeling (Hawkes 2004). However, the predominant users of nutrition labels to inform choices are young women and people with higher levels of education. Two systematic

reviews found that consumers regarded labels as complex (Baines and Lata 2004; Cowburn and Stockley 2005). These results suggest that labeling is insufficient and that additional educational interventions are needed. In addition, in countries with low literacy rates, some form of graphical representation may be more useful.

Several developed countries are undertaking measures to regulate advertising to children. Food advertising to children has been banned in Quebec, Canada, since 1980; in Sweden since 1991; and in Norway since 1992. Although no formal evaluation of the impact of these bans has been published (Hawkes 2004), an extensive review of the literature on children's preferences concluded that children aged 2 to 11 were highly influenced by television advertising, but that older children were less affected (Committee on Food Marketing and the Diets of Children and Youth and others 2006).

***Direct regulation*—**The Codex Alimentarius Commission of the Joint Food and Agricultural Organization of the United Nations and WHO Food Standards Program addresses food labeling and health claims. The Codex Alimentarius is a set of international standards, guidelines, and texts pertaining to food products developed to protect the consumer. The World Trade Organization recognizes the Codex Alimentarius as a reference for international trade and trade disputes. The Codex Alimentarius does not bind countries to a mandatory food label and is enforced only if a nutrition claim arises. European Union countries base their regulations on the European Commission's regulation on nutrition labeling (Council Directive 90/496/EEC as amended by Commission Directive 2003/120/EC).[9]

Based on results from etiologic research and on experience in the United States and Europe, academics and advocacy groups proposed that legislation to replace saturated fats with unsaturated fats, including sources of omega-3 fatty acids, would reduce the risk of ischemic heart disease by reducing low-density lipoprotein cholesterol. Table A2.4 presents the potential cost-effectiveness of such measure under two assumptions of cost. European manufacturers have already altered production methods to eliminate trans-fatty acids. and in the United States, the requirement to label trans-fatty acid content has led food manufacturers to follow suit. Given the biological rationale, such modification is sensible if it includes oils used for cooking, but additional evaluations are necessary to assess whether it actually leads to significant reductions in ischemic heart disease and diabetes. Conservative cost-effective estimates derived from modeling

Table A2.4. Incremental Cost-Effectiveness Ratios for Legislation Substituting 2 Percent of Energy from Trans Fat with Polyunsaturated Fat by World Bank Region
(US$/DALY averted)

	Intervention cost	
Region	*US$0.50/adult*	*US$6/adult*
East Asia and the Pacific	73	1,583
Europe and Central Asia	65	1,670
Latin America and the Caribbean	40	1,865
Middle East and North Africa	25	2,259
South Asia	38	1,014
Sub-Saharan Africa	53	1,344

Source: Jamison and others 2006a.

assume a 7 percent reduction in ischemic heart disease at a cost as low as US$38 per DALY if the intervention is a low-cost one.

Researchers have proposed the reduction of salt content in foods, which could be beneficial in places where consumption of processed foods is high. Such regulations could have important economic consequences for trade, food production, and agricultural policies. In general, regulatory mechanisms, whether on their own or attached to legislation, tend to be politically difficult, because stakeholders resist them (Hawkes 2006). Even though industry may already have the technology, modifying a product has a cost, thus it is more conservative to err on the side of higher costs for the intervention when estimating cost-effectiveness.

Deregulation—An example of deregulation, while not planned, took place in Poland. In the 1990s, as part of its economic reforms, the country eliminated subsidies for dairy products and other animal fats. At the same time, the market was opened to imports of fruits and vegetables. Zatonski, McMichael, and Powles (1998) reported a significant decrease in mortality from ischemic heart disease following this period and attributed the decrease to dietary changes following the deregulation. Zatonski and Willett (2005) further compared the relationship between an increased ratio of dietary polyunsaturated fat to saturated fat and the risk of ischemic heart disease in a U.S. cohort study and reported remarkably similar trends through 2002; however, their results have been questioned on the basis of a lack of consistency of this association across studies that assessed individual risk (Ravnskov 2005). The data from Poland show that reducing cardiovascular disease (CVD) is feasible over a short period of time. The inconsistency with individual-level data highlights the methodological

difficulties of establishing relationships that occur at different levels of social organizations, from agricultural policy to individual risks.

Physical Activity

Solid scientific evidence of the health benefits of regular physical activity is available (Department of Health and Human Services 1996). Increasing and sustaining regular physical activity in adults at any age increases disability-free life expectancy and reduces the risk of CVD, diabetes, colon cancer, and osteoporosis. Moderate physical activity has therapeutic effects on high blood pressure and depression and increases cognitive functions in middle-aged adults (Kahn and others 2002; Singh-Manoux and others 2005; Whelton and others 2002).

Experimental and quasi-experimental studies in communities and workplaces have shown that using prompts at points of decision, such as stairs, increases the odds of physical activity (Matson-Koffman and others 2005). Randomized trials indicate that direct intervention and supervision improve physical activity in previously sedentary individuals (Hillsdon, Foster, and Thorogood 2005). Research on work site promotion of physical activity has shown inconsistent results (Dishman and others 1998; Matson-Koffman and others 2005), yet the inconsistency appears to be more an issue of the actual intervention than of the work setting. Note that these are all individual-level interventions with a low population effect.

Population surveys report that only 25 to 30 percent of adults in developed countries and in urban areas of middle-income countries engage in regular physical activity (WHO 2005b). Encouraging physical activity should be a major public health intervention, yet worldwide, population policies to promote physical activity are scarce, and if present are rarely evaluated. In an extensive literature review, Sallis, Bauman, and Pratt (1998) stated that environmental interventions that facilitated physical activity should be in place before other informational and behavioral programs were attempted. A facilitating environment includes urban designs in which people can walk or bike, access to exercise facilities, transportation policies that encourage use of public transport and nonmotorized forms of transit, and neighborhood safety. Overall, quasi-experimental studies that have evaluated enhanced access to places for physical activities combined with educational interventions have reported increased physical activity in the target population (Kahn and others 2002). Outcome measurements across these studies varied, so

obtaining an average estimate of the effect is difficult. An assessment conducted in eight European cities in developed and emerging economies (Shenassa, Liebhaber, and Ezeamama 2006) found that perceived neighborhood safety was associated with 40 percent higher odds of occasional and frequent physical activity among women and 39 percent increased odds of occasional physical activity among men. Consistent with data from elsewhere, in these European cities men reported being more physically active than women.

The approach to physical activity may differ in developed and developing countries. In low- and middle-income countries, the predominant modes of transport are walking, cycling, motorcycling, and using public transport. WHO and World Bank (2004) reported that while the industrialized countries average two or three people per car, countries such as China and India average 220 to 280 people per car. Those of lower socioeconomic status are more likely to walk to work and walk longer distances (World Bank 2006e). The caveat, however, is that the urban environment is not pedestrian oriented and that public transportation is deficient. As a consequence, people may have to walk distances that are too far under unsafe conditions. Motor vehicle accidents are the second leading cause of death for 5- to 29-year-olds worldwide. The risk of fatal road traffic injury is higher for pedestrians, cyclists, and motorcyclists than for car occupants (WHO and World Bank 2004). Therefore efforts to increase physical activity must be introduced in connection with urban and transport interventions.

Research attempting to understand the factors that influence physical activity and how it can be stimulated is beginning to emerge. It includes examination of the environmental changes necessary to induce physical activity, particularly in urban settings; of the use of leisure time; of occupation and conditions at the workplace; of transportation; and of home-based activities. Along these lines, Pratt and others (2004) have proposed an economic framework for understanding what influences physical activity and identifying potential interventions.

Key Messages

The main conclusions of the review on public policies that affect the occurrence of chronic NCDs are as follows:

- The harmful effects of tobacco are well known and what works for tobacco control is well established. Despite worldwide, country-by-country epidemiological and economic analyses and an international

treaty, implementation is absent or weak in most countries. Increasing the price of tobacco products through taxes remains the most cost-effective intervention, yet a better understanding of the political economy is necessary to develop policies for tobacco control.
- Increasing the price of alcohol via excise taxation has been found to be a highly cost-effective strategy. In many countries, however, enormous benefits could be derived from legislation to prevent driving while under the influence of alcohol.
- The situation for food and nutrition policies is complex in developing countries, and consideration must be given to both overnutrition and undernutrition. The issue has to be addressed from the perspective of the agro-food system. Economic instruments such as price and subsidies are unlikely to have a significant effect. Information-based strategies, such as food labeling and point-of-purchase information, can support behavior change, but are insufficient. Legislation to reduce the content of trans-fatty acids in processed foods is a promising strategy that is already taking place in the industrial countries.
- The evidence on the enormous health benefits of regular physical activity is increasing, but understanding of how to bring about substantial increases in physical activity in the population is limited, although the importance of the urban environment is undeniable. Pedestrian-oriented cities and appropriate transport policies would mostly benefit the poor.

Despite the large body of evidence on the causal relationship of tobacco consumption, alcohol consumption, diet, and physical activity to the incidence of and mortality from NCDs, this review found empirical evidence of effective policy-level interventions mostly for tobacco control and hazardous use of alcohol. A publication bias may be possible, as the review was based on published literature. Perhaps many experiences, particularly in developing countries, are either not published or are published as descriptive accounts, as impact evaluation is infrequent. Therefore, most of the evidence presented here comes from developed countries.

The applicability of developed country evidence to developing countries could be questionable, yet many of the processes are of global scope, such as those influencing agro-food systems that lead to limited availability of food for a healthy diet to the urban poor or those pertaining to the effectiveness of price increases to reduce tobacco use. Not all the policy issues described are limited to health; indeed, most of the

solutions come from other sectors. Accordingly, the next steps require collaborative work to assess the effect of various policies on health in low- and middle-income settings.

Incorporating Prevention into Primary Care

Health care plays an important role in preventing and reducing premature mortality from NCDs. Analyses from developed countries estimate that health care accounts for 35 to 60 percent of the reduction in ischemic heart disease mortality that has taken place over the last 30 years (Bennett and others 2006; Capewell and others 2000; Capewell, Morrison, and McMurray 1999; Goldman 2004; Hunink and others 1997; Kuulasmaa and others 2000; Laatikainen and others 2005; Park, Safdar, and Schmidt 2002; Peeters and others 2003; Tunstall-Pedoe and others 1999) and all of the 30 to 80 percent reduction in mortality from cancer brought about by cancer screening and treatment (International Agency for Research on Cancer 2002a, 2005). Therefore, individuals who cannot access these services die from preventable causes.

Demographic changes currently under way in low- and middle-income countries lead to an absolute increase in the adult population and rapid growth of urban areas; hence, an increase in the number of people with chronic diseases is practically inevitable. What tools are currently available to deal with the imminent burden of chronic diseases? This section discusses the evidence for effective interventions against two major disease categories not on the basis of the actual diseases, but on the basis of the challenges that they present to health systems. The last two sections deal with cross-cutting issues regarding health care delivery and the need for stewardship within the health sector.

The Continuum of Care: Cardiovascular Prevention

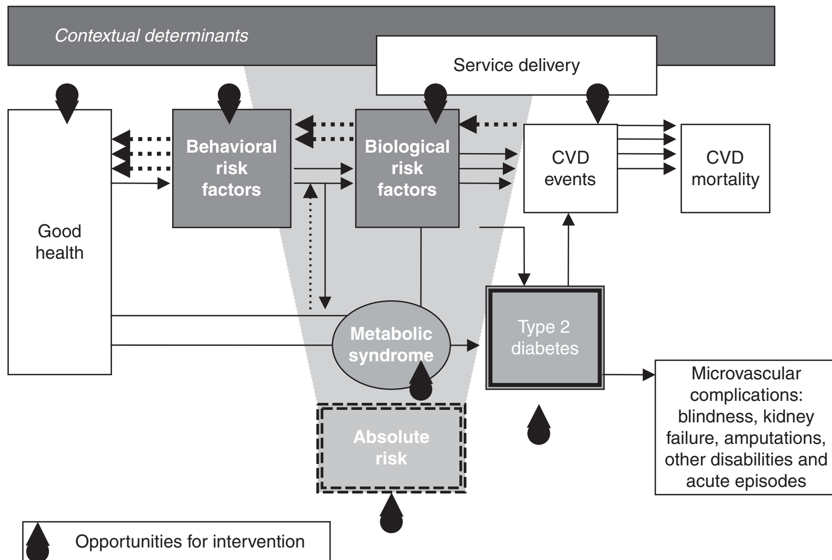
Cardiovascular risk is a continuum of interdependent factors that cumulatively increase the probability of having a fatal or nonfatal cardiovascular event. The most frequent events are myocardial infarction and angina (ischemic heart disease) and stroke (cerebrovascular disease) (WHO 2002b). With the exception of age, risk factors can be prevented, reduced, or eliminated. Biological risk factors are initially asymptomatic. Many individuals do not know they have them and learn of their condition when it has advanced and disease is already likely to have caused damage.

The main biological risk factors are hypertension; hypercholesterolemia (the most common form of hyperlipidemia); age; and a condition known

as metabolic syndrome, which is characterized by the presence of abdominal obesity (Grundy and others 2005). The various interrelationships of the cardiovascular risk complex are depicted in figure A2.6. Tobacco use also contributes independently to cardiovascular risk. Diet and physical activity are behaviors that lead to the development or prevention of biological risk factors. Although genetics also play an etiologic role, the exact mechanisms and interrelations with external risk factors are not yet clear. An individual's level of risk is conditioned by the presence and intensity of independent risk factors and is expressed as absolute risk or the probability of having a cardiovascular event in the following 10 years (Anderson and others 1991).

Hypertension—Potentially, one of the most effective ways to decrease mortality from CVD is to control high blood pressure. Clinical trials have estimated that adequate treatment of hypertension can decrease deaths from stroke by 30 percent, deaths from ischemic heart disease by 20 percent, and overall cardiovascular mortality by 19 percent

Figure A2.6. Pathways to Cardiovascular Risk



Source: Authors.
Note: This is a graphical representation of the natural history of CVD, interrelationships between causes or risk factors and potential points of intervention. The progression toward cardiovascular mortality is shown by continuous arrows; the regression is shown by dashed arrows. When people are in good health or with only one risk factor, then contextual determinants are critical. Primary care interventions become the cornerstone of risk management when progression occurs, yet contextual determinants continue to exert influence.

(Neal and others 2000; Psaty and others 2003). An accepted value for defining hypertension is having systolic blood pressure of 140 millimeters of mercury or above and diastolic blood pressure of 90 millimeters of mercury or above (Department of Health and Human Services; National Institutes of Health; and National Heart, Lung, and Blood Institute 2003). Research during the last decade has revealed that "the relationship between blood pressure and risk of cardiovascular (CVD) events is continuous, consistent, and independent of other risk factors. The higher the blood pressure, the greatest the chance of heart attacks, heart failure, stroke, and kidney disease" (Department of Health and Human Services; National Institutes of Health; and National Heart, Lung, and Blood Institute 2003, p. 2). Blood pressure increases with age and this trend is more pronounced after age 55 (Port and others 2000). Given the continuous nature of hypertension and its interrelationship with age and other risk factors, health professionals now recommend that it be managed not as an isolated condition, but as part of cardiovascular risk as a whole, based on absolute risk (Giles and others 2005).

Worldwide, more than 20 percent of adults have high blood pressure. In developed countries, reported prevalence ranges from 27.6 percent in North America to 55.3 percent in Germany (Wolf-Maier and others 2003). As reliable data from developing countries become available, most reports estimate prevalence among adults as between 15 and 40 percent (Ordunez and others 2001; WHO 2005b), which makes hypertension one of the most frequent risk factors for CVD in the developing world.

Population-based surveys that have measured blood pressure report that in North America, nearly 70 percent of people with hypertension are aware of their condition, but that only 60 percent of those with diagnosed hypertension are treated (Hajjar and Kotchen 2003; Wolf-Maier and others 2003). An analysis of studies in six European countries reported that, on average, 26.8 percent of those with hypertension receive treatment (Wolf-Maier and others 2003). In China, India, and low- and middle-income countries of Europe and Latin America, awareness of having hypertension ranges between 35 and 46 percent, and among those diagnosed with hypertension, 20 to 40 percent receive treatment (Gu and others 2002; Macedo and others 2005; Ordunez and others 2001; Panagiotakos and others 2003; Reynolds and others 2003; Zachariah and others 2003).

Lifestyle factors such as diet and physical activity play a larger role in blood pressure control than previously thought. In China, those people who introduced lifestyle modifications to their treatment regime had

59 percent higher control rates than those who did not (Gu and others 2002; Li and others 2003). In Greece, control rates for people with hypertension who followed a Mediterranean diet were 39 percent higher than for those with other diets (Panagiotakos and others 2003). An important benefit is derived from physical activity, in particular, aerobic exercise. A meta-analysis that included 53 randomized trials where the only difference between intervention and control groups was aerobic exercise showed significant reductions in systolic and diastolic blood pressure regardless of weight loss (Whelton and others 2002). Evidence also indicates that physical activity reduces insulin resistance and the serum concentration of total cholesterol in people with hypertension (Brett, Ritter, and Chowienczyk 2000; Brown and others 1997).

Hyperlipidemias—People with hyperlipidemias (most often high cholesterol) are at increased risk of ischemic heart disease, stroke, and other vascular diseases. Estimates indicate that worldwide, hyperlipidemias account for 47 percent of ischemic heart disease and 26 percent of strokes. Data from clinical trials indicate that by reducing a subtype of cholesterol (measured through low-density lipoprotein) by 1 millimole per liter (39 milligrams per deciliter) through treatment with statins, first coronary events (myocardial infarction or angina) can be reduced by 23 percent, stroke can be reduced by 17 percent, and major vascular events can be reduced by 21 percent (Baigent and others 2005).

Hypertension and hypercholesterolemia are independent risk factors for CVD, but they are often both present in the same person. The presence of behavioral risk factors, a diet low in fruits and vegetables, and a lack of physical activity usually precede this comorbidity.

Absolute risk—The concept of absolute risk evolved from the Framingham study of CVD. For more than 30 years, this study has followed a random sample of individuals residing in Framingham, Massachusetts, to identify risk factors for CVD (Anderson and others 1991). Based on the findings of this study, researchers developed a score to predict a person's risk of ischemic heart disease over the next 10 years (referred to as the 10-year absolute risk). While the risk score may be specific to this study, it has been adjusted or modified to account for local and current prevalence of risk factors and cardiovascular mortality in various settings (Bhopal and others 2005; Brindle and others 2003; Conroy and others 2003; Giampaoli and others 2005; Hense and others 2003; Liu and others 2004; Thomsen and others 2002).

In light of increasing knowledge about cardiovascular risk and out of concern for the increasing prevalence of cardiovascular risk factors, discussions about feasible and potentially effective approaches to primary prevention are emerging. In the United Kingdom, an ex ante evaluation assessed various strategies for managing risk factors among men using data from the British Regional Heart Study (Emberson and others 2004). The researchers found that treating 10-year absolute risk of 30 percent and above would reduce cardiovascular events by 11 percent, whereas if the treatment threshold were reduced to 20 percent, cardiovascular events could be reduced by 34 percent. Although the study did not calculate costs, the researchers did analyze the option of avoiding laboratory costs and providing the four first-line drugs (a diuretic, a beta-blocker, aspirin, and a statin) to all men aged 55 and over. In this case, CVD events over the next 10 years would have been reduced by 45 percent, and by 60 percent if the threshold were set at age 50.

Another ex ante analysis using the estimated costs from low-, middle-, and high-income countries showed that treating a 10-year absolute risk of 35 percent or more was a cost-effective primary care intervention measured as unit cost per DALY averted (Murray and others 2003). Estimates of the cost-effectiveness ratio ranged from US$42 per DALY in Sub-Saharan Africa to US$423 per DALY in South and East Asia.

A bolder proposition based on indirect data called for the development of a multicomponent oral preparation to be administered as chemoprophylaxis for CVD (Wald and Law 2003). The preparation would contain a low dose of aspirin, a beta-blocker, a statin, and a diuretic. Pilot trials of the use of this kind of drug combination for secondary prevention of CVD are under way. Table A2.5 presents estimated cost-effectiveness ratios and the expected number of DALYs averted along with estimates for other primary care–based CVD interventions. While the cost-effectiveness of treating absolute risk is still high, when compared with secondary prevention, the effect in terms of DALYs averted is considerably higher.

Screening for and Early Detection of Cancer

Cancer is not necessarily a fatal disease any more. For several types of cancer, medical interventions allow patients to return to a disease-free state and the same probability of dying as the rest of their birth cohort (Coleman and others 2003; Gatta and others 2005; Sant and others 2003; Surveillance Epidemiology and End Results 2002). Detecting cancer early in its natural history, with the hope of obtaining better results, is intuitively appealing to many clinicians and public health

Table A2.5. Cost-Effectiveness Ratios for Interventions Aimed at Preventing Cardiovascular Conditions Compared with No Treatment

Condition to be prevented and intervention	*Cost-effectiveness ratio (US$/DALY)*	*DALYs averted (hundreds)*
Stroke, ischemic heart disease, and hypertensive heart disease		
Combination treatment based on absolute Risk[a]	2,128	61.65
Combination treatment after diagnosed ischemic heart disease[a]	409	—
Ischemic heart disease		
Aspirin and beta-blocker (optional angiotensin-converting enzyme inhibitor)	688	8.40
Plus statin	2,028	3.54
Acute myocardial infarction		
Aspirin	14	1.04
Plus beta-blocker	15	1.04
Plus streptokinase	671	1.04
Plus tissue plasminogen activator	15,869	0.42
Stroke		
Aspirin within 48 hours of acute stroke	149	1.62
Heparin within 48 hours of onset of acute stroke or thrombolytic therapy using recombinant tissue plasminogen activator within 3 hours of onset of acute stroke	1,977	1.22
Recurrent stroke		
Aspirin or combination of aspirin and extended-release dipyridamole	81	1.77
Carotid endarterectomy to remove harmful plaque from carotid arteries	1,458	4.93

Source: Jamison and others 2006a.
Note: — = not available.
a. Data used for these estimates were not based on empirical trials.

professionals. This perspective implies three basic assumptions: first, that accurate and well-tolerated methods to detect and diagnose cancer at early stages are available; second, that detecting cancer at an earlier stage has an advantage over waiting until it is symptomatic; and third, that effective treatments are available.

The accuracy of a screening method and the efficiency of the health service in which the program takes place determine the potential effectiveness of early detection and of a screening program (Zapka and others 2003). Box A2.2 enumerates the basic inputs for a screening program. The accuracy of the screening method is measured by sensitivity, that is, the test's ability to detect those who have the disease, and by

Box A2.2

Basic Inputs for an Organized Cancer Screening Program

Basic inputs are as follows:

- an explicit policy, with specified age categories, method, and screening interval, as well as clinical practice guidelines
- a defined target population
- a management team responsible for implementing and supporting an information system
- a health care team for evidence-based care
- a quality assurance structure
- method for identifying cancer occurrence in the target population independent of the screening program.

Source: Adapted from International Agency for Research on Cancer 2002a, 2005.

specificity, namely, the test's ability to label as negative those people who do not have the disease. Trade-offs between sensitivity and specificity always exist, as do variations across different providers. In addition, the progression of cancer is not always predictable, and often cancers that occur in the interval between screening rounds and are diagnosed by means other than screening progress more rapidly than cancers detected by screening.

The health profession has undertaken many attempts to screen various cancer sites, but the only sites for which evidence of reduction in mortality from screening exists are cancer of the cervix uteri, breast, and colon. In developing countries, external aid agencies introduced cervical cytology as a component of family planning programs in the 1960s and 1970s, yet no decline in mortality from cervical cancer was observed over the next 30 years (Robles, White, and Peruga 1996; Sankaranarayanan, Budukh, and Rajkuma 2001). In some middle-income countries where the indications were that cytology screening may have been working, no information on outputs or outcomes was available that could account for this, and whether the modest mortality declines observed were due to cervical cancer screening or to overall increased access to health services is not clear. In developing countries with a large primary care infrastructure and high coverage of cytology, the lack of quality assurance and low reliability of cytology, as well as the screening of young populations at low risk, can

partly explain why screening is not successful (Aristizabal and others 1984; Fernández Garrote and others 1996; Herrero and others 1992; Sepulveda and Prado 2005; Taucher, Albala, and Icaza 1994). In addition, in low-resourced settings, fewer than 25 percent of women screened positive are followed up for additional diagnosis and treatment (Gage and others 2003). This indicates a dissociation between the provision of primary care services and of secondary support services.

Three other screening tests for cervical cancer offer promising results: using liquid-based cytology, undertaking visual inspection with acetic acid or with iodine solution, and testing for high-risk human papillomavirus (HPV) through hybrid capture. A cost-effectiveness analysis conducted with data from five developing countries, two in Africa, two in Asia, and one in Latin America (table A2.6), showed that screening either with HPV tests or using visual inspection could be much more cost-effective than screening using conventional cytology (Goldie and others 2005). The results suggest that the optimal age for screening would be at 35 to 45 years of age. Studies in Brazil, Madagascar, and Zimbabwe reached similar conclusions (Brown and others 2006). However, the effectiveness of visual inspection has not yet been confirmed.

A vaccine for HPV is now available. As vaccine programs are introduced, screening will still be necessary to prevent cervical cancer in women already infected or infected by high-risk HPV types not contained in the vaccines. The screening strategy would, however, need to

Table A2.6. Cost-Effectiveness Ratios for Different Cervical Cancer Screening Tests, Selected Developing Countries

(2000 US$/year of life saved)

Country	*Conventional cytology (3 visits)*	*HPV testing (2 visits)*	*Visual inspection with acetic acid [a] (1 visit)*
Brazil	589	122	56
India	n.e.	+	10
Kenya	n.e.	+	+
Madagascar	379	167	54
Peru	n.e.	152	124
South Africa	n.e.	467	+
Thailand	n.e.	170	109
Zimbabwe	331	117	43

Source: Brazil, Madagascar, and Zimbabwe: Brown and others 2006; India, Kenya, Peru, Thailand, and South Africa: Goldie and others 2005.

Note: + = incremental cost-effectiveness is significantly higher; n.e. = not estimated (in this analysis cost-effectiveness ratios were not calculated for strategies that had low accuracy).

a. Effectiveness still under evaluation (trial in India), but thus far this test has demonstrated high accuracy.

change to achieve community effectiveness and provide the basis for HPV surveillance. An important question for countries seeking to introduce HPV vaccine is the cost-effectiveness of maintaining their screening program versus reorienting their screening strategy or, if screening is inefficient, whether to maintain the screening program at all. If adequate vaccine coverage can be achieved, then screening could start much later and occur less often, perhaps only once in a lifetime, thereby increasing the cost-effectiveness of the overall strategy to prevent cervical cancer (Goldie and others 2005; Goldie and others 2004).

Multiple factors can constrain the successful introduction of new vaccines, principally costs, acceptability, and capacity of local health services to deliver the vaccines; other limitations are related to the vaccine itself. Analysis of the distribution of HPV types worldwide indicates that current vaccines would prevent approximately 71 percent of cervical cancer, but the impact would be primarily in Asia, Europe, and North America (Munoz and others 2004). The duration of immunity is unknown, but measurements of antibody titers in young, vaccinated women indicate that these fall from peak levels soon after immunization and remain stable for at least 48 months (Mao and others 2006). Future reports from ongoing trials will be able to address the need for booster immunizations in older women. As the optimum vaccination age should be before starting sexual activity, minors will need their parents' consent. Given that HPV is a sexually transmitted disease, consent may prove difficult to obtain in many cultures.

Health Care for Chronic Conditions

Several features specific to NCDs can be construed from the conditions examined earlier. Morbidity builds over time and risk of disease and death is cumulative, yet reversible. At earlier stages of the risk-disease process, the probability of reversal is likely to be higher, which provides various opportunities for intervention. In the case of cardiovascular risk, if hypertension and absolute risk are effectively treated, in the context of a low-risk lifestyle, the probability of having a cardiovascular event decreases significantly (Psaty and others 2003), but the management of absolute risk relies on pharmacological therapy over a lifetime. New technologies, such as vaccines, tests, and ambulatory treatment, have the potential to make NCD prevention and management more accessible. The caveat is that early stages of NCDs are asymptomatic and the perception of risk is likely to be low (Slovic and others 2005), hence the difficulty of achieving high coverage of preventive services.

Even if preventive interventions are widely adopted, a proportion of people will still develop severe conditions because of biological or other unknown causes. The evolution of disease is almost never linear, thus continuity of care is necessary. Morbidity is not restricted to one condition. Indeed, as risks and disease evolve or as the person ages, comorbidity is more frequent, thus the need for comprehensive care. In the process of care, one intervention may lead to another, for example, if a patient screens positive for cancer, additional tests and specialized treatment are required, thus the need for coordination of care. Continuity, comprehensiveness, and coordination of care are three features that health care delivery must achieve to provide effective care for chronic conditions (Rothman and Wagner 2003).

The delivery of care for chronic NCDs is transaction intensive and highly discretionary (this is the terminology used by the World Bank 2003). Providers require support to make informed (evidence-based) recommendations that are acceptable to patients. In addition, the process of care occurs not only through visits or encounters with the health care system, but is permanent, as the person lives with the condition. Thus, it is the client who constantly makes decisions about his or her management. Self-management support is the fourth pillar for effectively addressing chronic conditions.

Ample evidence indicates that mortality from preventable chronic NCDs is lower in areas with strong primary care services (Starfield, Shi, and Macinko 2005). In an extensive and rigorous review, Renders and others (2001) concluded that interventions that improved the outcome of diseases such as diabetes were complex and included several concurrent interventions, such as the presence of a clinical information system that allows follow-up of patients; of decision support in the form of clinical guidelines; and of a team approach that shifts responsibilities to nonphysicians, such as nurses, nutritionists, and social workers. To bring about such changes in primary care, many countries may need considerable new resources or make efforts to shift those that are being used for inefficient services.

The Need for Stewardship

The role of the government is not necessarily that of providing, or even purchasing, health care services, but ensuring that if services are available that they are efficient and that the poor can benefit from them. However, the need for an effective primary care approach calls for strong stewardship and regulatory functions exercised by public institutions.

It entails defining a strategic policy framework; generating information for decision making at all levels; ensuring the availability of tools for implementation; building coalitions and partnerships; ensuring a fit between policy objectives, organizational structure, and culture; and ensuring accountability (Travis and others 2003). While these functions are not exclusive to NCDs, undertaking health technology assessments; ensuring drug availability and affordability; and generating intelligence, in which surveillance or the monitoring of health outcomes is a key feature, are critical for NCDs.

Health technology assessment—The high costs of NCD care are among the main concerns of policy makers. Technological developments, such as those described for cervical cancer, and also pressures by advocacy groups, can drive costs upward. Studies in the United States have shown that high costs are correlated with more visits to physicians, particularly specialists; more hospitalizations; and frequent tests, but no relationship is apparent between higher costs and better health outcomes, even after controlling for case mix (Fisher and others 2003a, 2003b). Even though high-income countries are early adopters of new technologies, differences among countries tend to level out over time (Slade and Anderson 2001). In many countries, health technology assessments may play a role in slowing the diffusion of technology, but are not the only mechanism doing so, and by themselves do not necessarily decrease costs (Packer and others 2006). However, health technology assessments are likely to play a role in regulating practice and in providing a framework for more cost-effective use of technological innovations in health care.

The field of health technology assessment has expanded significantly during the past three decades. Its beginnings can be traced to two different milestones leading to pathways that would eventually converge. In 1972, the U.S. Congress established the Office of Technology Assessment in the interests of integrating the evaluation of new technologies into the policy-making process. Even though this office no longer exists, it was instrumental in initially defining the field (Banta 2003).

The second milestone, also in 1972, was the publication of a book by A. L. Cochrane that emphatically called for the use of randomized trials to evaluate the efficacy of medical interventions (Cochrane 1999). This gave birth to evidence-based medicine, which has had an enormous influence on the practice of medicine in developed countries. Evidence-based medicine's main objective is to link evidence to clinical practice,

with the aim of improving the quality and effectiveness of individual patient care (Sackett and others 1996).

While originally the objectives of these two disciplines, health technology assessment and evidence-based medicine, may seem different, their respective methodological developments have led to a convergence and to the expansion of a field that continues to evolve. It is no longer restricted to concerns about safety and the efficacy of health care devices and interventions, but now also focuses on effectiveness and cost-effectiveness (Maynard and McDaid 2003). Health technology assessment is a decision support tool that can span from basic provider and client decision making to public policy development. Most important, it is a tool to improve resource allocation.

In many countries, these disciplines have now been institutionalized through the creation of agencies for health technology assessment that serve both clinical patient care and preventive activities. Several agencies in developed countries maintain permanent reviews of evidence pertaining to the effectiveness of preventive services, for example, the Public Health Agency of Canada; the National Institute of Clinical Evidence in the United Kingdom; the United States Preventive Task Force; and health technology assessment agencies in Australia, New Zealand, and Sweden. Increasingly, several of the agencies are incorporating public health services, either by commissioning a different agency, such as the Community Services Task Force in the United States, or by integrating efforts, as the National Institute of Clinical Evidence does in the United Kingdom. Most of the reviews and recommendations are available online.

The appropriate use of technology and the monitoring of its effectiveness can contribute to improved efficiency, client-provider accountability as well as provider-payer accountability. The challenge for low- and middle-income countries is twofold: first, to ensure the availability of local capacity and institutional support to use evidence in decision making within the health system; and second, to establish links with decision makers so that relevant information is made available on time and in a way that can be used and accessed easily. Producing all assessments locally is unnecessary, but it is important to be critical users of the information and to deliver specific recommendations for a particular setting.

Drug policy—One of the main limitations for the management of NCDs is the availability of drugs. Research in the industrial countries strongly

suggests that drug coverage is a major driver of patient outcomes, and also a major driver of health care costs. Survey data indicate that adherence is directly linked to costs and drug coverage (Goldman and others 2004; Tseng and others 2003). A recent study in the United States compared the costs and clinical outcomes of two drug plans, one with a US$1,000 cap and another with no cap, among people aged 65 and older affiliated with the same health care provider (Hsu and others 2006). The study found that people enrolled in the plan with a cap had lower treatment adherence, worse clinical outcomes, and higher death rates than those with no caps. In addition, the group with drug caps had higher rates of nonelective hospitalizations and emergency room visits that offset the savings in the drug plan.

WHO analyzed the availability and affordability of 14 pharmacological treatment schedules for five chronic conditions in 24 countries (Gelders and others 2006). A low availability of drugs in the public sector, where they are usually free of charge, forced patients to pay private sector prices, which were at least 3 to 100 times higher than the international reference price. Taxes and duties levied on medicines and markups often contributed more to the final price than the manufacturer's price. The study developed a methodology for assessing affordability based on the lowest monthly salary of a government employee and for monitoring availability. Although any policy approach needs to be country specific, monitoring tools can help evaluate and identify the optimal drug benefit scheme, particularly to ensure affordability and quality, while avoiding the distribution of counterfeit products.

Monitoring and evaluation: surveillance—The process of implementing planned interventions should ideally rely on a monitoring system, including for inputs, processes, outputs, and outcomes (for a more comprehensive discussion of monitoring and evaluation, see World Bank 2005d). Surveillance is a term originally from the field of infectious diseases that referred to monitoring the occurrence of disease to identify outbreaks. It is now more broadly applied to the process of monitoring health outcomes and is defined as the ongoing (continuous or periodic) collection and analysis of population-based data to measure the magnitude of a problem and of trends over time (Last 2001). In a public health context, surveillance is not limited to data collection and analysis, but also implies the dissemination of information about a health-related event for use in public health action to reduce morbidity and mortality and to improve health (Centers for Disease Control and Prevention 2001). Surveillance serves at

least seven public health functions: (a) supporting case detection and public health interventions, (b) estimating the impact of a disease or injury, (c) portraying the natural history of a health condition, (d) determining the distribution and spread of illness, (e) generating hypotheses and stimulating research, (f) evaluating prevention and control measures, and (g) facilitating planning (Teutsch 2000). The strength of surveillance as an instrument is its ability to detect changes in health outcomes over time.

A government must have the capabilities needed to make use of data at the analytic level and to disseminate information to various audiences. The use of existing data sources, such as mortality databases, needs to be maximized. Although the selection of monitoring strategies is of a technical nature, cost-benefit analysis of the use of various information systems is useful when deciding in which systems to invest. The following can be considered: (a) tracking mortality trends to evaluate impact; (b) requiring morbidity registration, such as cancer and stroke registries, to monitor survival as a measure of treatment effectiveness and timely diagnosis; (c) undertaking risk factor surveillance; and (d) monitoring health outcomes and health outputs from health service interventions at the local level.

In 2002 and 2003, the World Bank evaluated the epidemiological surveillance systems in Eastern Europe and Central Asia (Miller and Ryskulova 2004). The review included birth registration, death registration, infectious disease surveillance, NCD risk factor surveillance, and morbidity surveillance. The report concluded that the surveillance systems were overly complex, with duplicate and parallel reporting. A large amount of data is collected, but with no clear purposes, and it is often not used at all. In particular, collection of morbidity data consumes a large amount of human resources. In addition, no quality assurance systems were in operation. Many countries had conducted a census in 2000, but no data were available two to three years later when the evaluation took place. At least 17 countries had conducted a survey of risk factors for NCDs. Although probabilistic sampling methods were used, various problems were detected in the data collection instruments and in the analytical techniques used, such as failure to correct for sampling design effects when reporting prevalence rates.

In Latin America and the Caribbean, a capacity assessment for NCDs conducted in 2000 and repeated in 2005 found that in many countries, health information systems were tailored exclusively for maternal and child health (Pan American Health Organization 2006). The number of surveys of NCD risk factors published has increased fivefold since 1955,

and as of 2005, at least five countries had conducted national surveys. An analysis of the quality of the data in those surveys found that nearly 75 percent were well designed and data collection was reliable, but only 26 percent provided prevalence estimates correcting for sample design effects (Corber and others 2003).

Middle-income countries of Central Asia, Eastern Europe, and Latin America and the Caribbean are spending resources on monitoring and evaluation systems, but require additional investment to streamline data collection and build capacity to analyze and use information.

Key Messages

The main findings of the review are as follows:

- Evidence indicates that NCDs can be prevented by managing risk in primary care. The challenges include reaching the poor, making drugs available, ensuring adherence to drug regimens, and introducing support for lifestyle changes within and outside health services.
- Evidence supports the potential effectiveness of a primary care–based cancer screening program, but the availability and quality of treatment need to be ensured in advance.
- Effective primary care for chronic conditions requires continuity, comprehensiveness, and coordination of care as well as self-management support for the patient.
- Effective changes cannot occur without ensuring that public institutions exercise their stewardship function.

Conclusion

According to available evidence, countries that are facing the problem of premature mortality from NCDs have several choices: they can decide to concentrate their efforts on preventing risk factors through public policies that can reach large segments of the population, they may choose to incorporate prevention and management in the delivery of health services, or they may implement a combination of both. Making the distinction is important, however, because actions for the development of public policies take place mostly outside the health sector and encompass different stakeholders from actions that occur within the health system itself.

The evidence for implementing tobacco control policies is strong, and government intervention is not only justified, but is endorsed through an

international treaty to which countries have agreed. Excise taxation on alcohol has been proved to reduce consumption, and random testing of blood alcohol levels has been found to be effective in preventing driving under the influence of alcohol. Food and nutrition policies offer various options but require further evaluation, with the goal being to guarantee equal opportunity of access to a balanced diet by way of providing information, introducing regulations, or ensuring affordable products. Subnational governments, particularly municipalities, are key players in improving the urban environment for physical activity. The benefits of physical activity are so large that supporting further research to better understand how to facilitate this behavior in various population groups is important for public health.

Several effective interventions to reduce the risk of and premature mortality from NCDs can be implemented by health services. In practice, however, implementation encompasses sets of interventions to address specific health conditions, sometimes several health conditions concurrently. The challenge is to ensure that those who need them, particularly the poor, receive the interventions that are most likely to deliver optimum outcomes. The government is not necessarily responsible for financing the delivery of the interventions, but on the grounds of equity, the government is accountable for ensuring equal opportunity of access and quality. Instruments such as health technology assessments, surveillance, and monitoring and evaluation are important for the government to exercise its stewardship and bridge the gap between evidence of the efficacy of interventions and community effectiveness.

Notes

1. This is a legal framework used by Gostin (2000). This approach has the potential to facilitate further analysis of stakeholders and of institutional capacity to conduct policy changes.
2. Supply-side interventions include restrictions on youth access to tobacco, crop substitution and diversification, and subsidies and price support to local tobacco farmers, along with restricted imports, which may artificially raise the world price of tobacco. All of these are either too difficult to implement or have not shown any effect on tobacco consumption. However, the critical supply-side intervention that requires strong action is illicit trade or smuggling.
3. U.S. Federal Trade Commission. "Cigarette Report for 2003." U. S. Federal Trade Commission. http://www.ftc.gov/reports/cigarette05/050809cigrpt.pdf. Date consulted: September 20, 2006.

4. The corruption perception or transparency index is estimated by a nonprofit organization, Transparency International. This index ranks countries in terms of the degree to which corruption is perceived to exist among public officials and politicians. It is a composite index, drawing on corruption-related data in expert surveys carried out by a variety of reputable institutions. It reflects the views of businesspeople and analysts from around the world, including experts who are resident in the countries evaluated. The choice of the inverse of the index to present these data is done for ease of interpretation. The higher the inverse index, the higher the perceived level of corruption.
5. For additional information, discussion papers, and tools for economic analyses of tobacco control, see http://www.worldbank.org/hnp.
6. In-middle income countries, DALYs attributable to vitamin A deficiency amount to 0.7 million for males and 0.8 million for females, to zinc deficiency are 5.9 million for males and 5.4 million for females, to obesity are 5.1 million for males and 6.0 million for females, and to low intake of fruits and vegetables are 4.6 million for males and 3.3 million for females (WHO 2002b).
7. This survey measured overweight and obesity using body mass index.
8. For updates on policies affecting obese people, see http://www.obesity.org.
9. European directives on food labeling can be found at http://ec.europa.eu/food/food/labellingnutrition/nutritionlabel/index_en.htm.