A Framework for Public Health Action: The Health Impact Pyramid

A 5-tier pyramid best describes the impact of different types of public health interventions and provides a framework to improve health. At the base of this pyramid, indicating interventions with the greatest potential impact, are efforts to address socioeconomic determinants of health. In ascending order are interventions that change the context to make individuals' default decisions healthy, clinical interventions that require limited contact but confer long-term protection, ongoing direct clinical care, and health education and counseling.

Interventions focusing on lower levels of the pyramid tend to be more effective because they reach broader segments of society and require less individual effort. Implementing interventions at each of the levels can achieve the maximum possible sustained public health benefit. (*Am J Public Health.* 2010;100:590–595. doi:10.2105/AJPH.2009.185652)

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LIFE EXPECTANCY IN DEVELOPED countries has increased from less than 50 years in 1900 to nearly 80 years today.[1] The greatest improvement occurred in the first half of the 20th century, when life expectancy in the United States and many parts of Europe increased by an average of 20 years,[2] largely because of universal availability of clean water and rapid declines in infectious disease,[3] as well as broad economic growth, rising living standards, and improved nutritional status.[4] Smaller gains in the latter half of the 20th century resulted primarily from advances in treatment of cardiovascular disease and control of its risk factors (i.e., smoking, high blood pressure, and high cholesterol).[5]

The traditional depiction of the potential impact of health care interventions is a four-tier pyramid, with the bottom level representing population-wide interventions that have the greatest impact and ascending levels with decreasing impact that represent primary, secondary, and tertiary care.[6] Other frameworks more specific to public health have been proposed. Grizzell's 6-tier intervention pyramid emphasizes policy change, environmental enhancement, and community and neighborhood collaboration.[7] Hamilton and Bhatti's 3-dimensional population health and health promotion cube incorporates 9 health determinants (e.g., healthy child development, biology and genetics, physical environments, working conditions, and social support networks) and evidence-based actions to address them (e.g., reorienting health services, creating supportive environments, enacting healthy public policy, and strengthening community action).[8] The maternal and child health pyramid of health services, developed by the US Health Resources and Services Administration, consists of 4 levels of services used by states to allocate resources for mothers and children.[6] Infrastructure building (e.g., monitoring, training, systems of care, and information systems) is at the bottom of the pyramid, followed by population-based services (e.g., newborn screening, immunization, and lead screening) and enabling services (e.g., transportation, translation, case management, and coordination with Medicaid), with direct health care services at the top.

All of these models, however, focus most of their attention on various aspects of clinical health services and their delivery and, to a lesser extent, health system infrastructure. Although these are of critical importance, public health involves far more than health care. The fundamental composition, organization, and operation of society form the underpinnings of the determinants of health, yet they are often overlooked in the development frameworks to

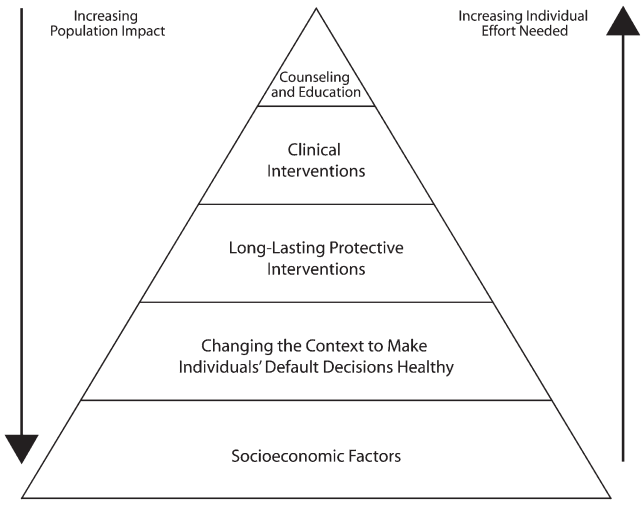

FIGURE 1—The health impact pyramid.

describe health system structures. As a result, existing frameworks accurately describe neither the constituent elements nor the role of public health.

A FIVE-TIER PYRAMID

An alternative conceptual framework for public health action is a 5-tier health impact pyramid (Figure 1). In this pyramid, efforts to address socioeconomic determinants are at the base, followed by public health interventions that change the context for health (e.g., clean water, safe roads), protective interventions with long-term benefits (e.g., immunizations), direct clinical care, and, at the top, counseling and education. In general, public action and interventions represented by the base of the pyramid require less individual effort and have the greatest population impact. However, because these actions may address social and economic structures of society, they can be more controversial, particularly if the public does not see such interventions as falling within the government's appropriate sphere of action.

Interventions at the top tiers are designed to help individuals rather than entire populations, but they could theoretically have a large population impact if universally and effectively applied. In practice, however, even the best programs at the pyramid's higher levels achieve limited public health impact, largely because of their dependence on long-term individual behavior change.[9] As Rose writes,

> Personal life-style is socially conditioned. . . . Individuals are unlikely to eat very differently from the rest of their families and social circle. . . . It makes little sense to expect individuals to behave differently than their peers; it is more appropriate to seek a general change in behavioural norms and in the circumstances which facilitate their adoption.[10(p135)]

Socioeconomic Factors

The bottom tier of the health impact pyramid represents changes in socioeconomic factors (e.g., poverty reduction, improved education), often referred to as social determinants of health, that help form the basic foundation of a society.[11,12] Socioeconomic status is a strong determinant of health, both within and across countries.[13] Although the exact mechanisms by which socioeconomic status exerts its effects are not always apparent, poverty, low educational attainment, relative deprivation, and lack of access to sanitation increase exposure to environmental hazards.[14] Educational status is also tightly correlated with cardiovascular risk factors, including smoking.[15,16]

Although poverty increases ill health within a society, economic development can also increase illness and death from noncommunicable disease. As living standards and life expectancy improve, risk for cardiovascular disease and some cancers increases.[17] Much of this increase results from modifiable risk factors related to overconsumption of tobacco, unhealthy food, and alcohol, with a concurrent decrease in physical activity. Greater wealth can also lead to more roads and an increase in motor vehicle use, which can result in increased outdoor air pollution and more injury and death from traffic crashes.

A third of the world's urban population lives in slums.[18] Substantial health improvements in high-poverty areas will require improved economic opportunities and infrastructure, including reliable electric power, sanitation, transport, and other basic services.[19] Clean water and improved sanitation introduced in the United States in the late 19th and early 20th centuries may have been primarily responsible for reducing mortality rates by about half and child mortality rates by nearly two thirds in major cities.[20] Still, more than 900 million people worldwide have no access to clean drinking water and about 2.5 billion have no access to adequate sanitation.[21] As the World Health Organization's Commission on Social Determinants of Health reported, "Social injustice is killing people on a grand scale."[11(p26)]

Changing the Context to Encourage Healthy Decisions

The second tier of the pyramid represents interventions that change the environmental context to make healthy options the default choice, regardless of education, income, service provision, or other societal factors. The defining characteristic of this tier of intervention is that individuals would have to expend significant effort not to benefit from them. For example, fluoridated water—which is difficult to avoid when it is the public supply—not only improves individual health by reducing tooth decay,[22] but also provides economic benefits by reducing health spending and productivity losses. In countries without either adequate natural or added fluoridation, health authorities are limited to counseling interventions, such as encouraging toothbrushing.

Other contextual changes that create healthier defaults include clean water, air, and food; improvements in road and vehicle design; elimination of lead and asbestos exposures; and iodization of salt.[22] The potential societal impact of decreasing cardiovascular risk factors by changing from saturated to unsaturated cooking oils was demonstrated in Mauritius[23]; eliminating artificial *trans* fat in food is another way to prevent cardiovascular disease.[24] Strategies to create healthier environmental contexts also include

designing communities to promote increased physical activity; enacting policies that encourage public transit, bicycling, and walking instead of driving; designing buildings to promote stair use; passing smoke-free laws; and taxing tobacco, alcohol, and unhealthy foods such as soda and other sugar-sweetened beverages.

Cardiovascular disease risk factors (e.g., hypertension) are currently addressed at the individual level through screening and medication. But even assuming perfect treatment, this approach fails to prevent almost half of the disease burden caused by elevated blood pressure; cardiovascular risk increases with systolic blood pressure above 115 mm Hg, a level at which medical treatment is not recommended currently.[25,26] Changing the environmental context so that individuals can easily take heart-healthy actions in the normal course of their lives can have a greater population impact than clinical interventions that treat individuals.

For example, modern diets contain many times the minimum daily requirement of sodium—mostly from packaged foods and restaurant meals—making it difficult for individuals to control their intake.[27] Reducing dietary sodium can reduce hypertension at the population level.[28,29] A healthier food environment can be created by decreasing salt in packaged foods. This is happening in the United Kingdom, which introduced four-year sodium reduction targets,[30] and in Finland, where dietary sodium intake decreased approximately 25% in the past 30 years.[31]

Long-Lasting Protective Interventions

The third level of the pyramid represents 1-time or infrequent protective interventions that do not require ongoing clinical care; these generally have less impact than interventions represented by the bottom 2 tiers because they necessitate reaching people as individuals rather than collectively. Historic examples include immunization, which prevents 2.5 million deaths per year among children globally.[32] Another example is colonoscopy, which can significantly reduce colon cancer and is only needed every 5 to 10 years for most people. Smoking cessation programs increase quit rates; life expectancy among men who quit at age 35 is almost 7 years longer than for those who continue to smoke.[33]

Male circumcision, a minor outpatient surgical procedure, can decrease female-to-male HIV transmission by as much as 60%.[34] Scale-up could potentially prevent millions of HIV infections in sub-Saharan Africa.[35,36] A single dose of azithromycin or ivermectin can reduce the prevalence of onchocerciasis, a major cause of blindness.[37]

Clinical Interventions

The fourth level of the pyramid represents ongoing clinical interventions, of which interventions to prevent cardiovascular disease have the greatest potential health impact. Although evidence-based clinical care can reduce disability and prolong life, the aggregate impact of these interventions is limited by lack of access, erratic and unpredictable adherence, and imperfect effectiveness. Access can be limited even in systems that guarantee health coverage for all[38] and is a much greater problem in the United States and other countries without universal health care coverage.[39,40] Nonadherence is especially problematic for chronic conditions that are usually asymptomatic, such as hypertension, hyperlipidemia, and diabetes. At least a third of patients do not take medications as advised, and nonadherence cannot be predicted from socioeconomic or demographic characteristics.[41,42]

Rigorous accountability, incentives for meaningful outcomes (e.g., blood pressure and cholesterol control), and systems to enable improved performance are all essential to improve health care system performance. Electronic health records have the potential—if and only if they are implemented with prevention and accountability as guiding principles—to facilitate greatly improved preventive and chronic care.[43] This goal is more likely to be attained if electronic record keeping is implemented along with changes in both financial incentives and physician practices to proactively support preventive care and control of chronic diseases.[44]

Counseling and Educational Interventions

The pyramid's fifth tier represents health education (education provided during clinical encounters as well as education in other settings), which is perceived by some as the essence of public health action but is generally the least effective type of intervention.[9] The need to urge behavioral change is symptomatic of failure to establish contexts in which healthy choices are default actions. For example, counterbalances to our obesogenic environment include exhortations to increase physical activity and improve diet, which have little or no effect. More than one third of US adults, or 72 million people, were obese in 2006, a dramatic increase over 1980.[45] Two thirds of these individuals were counseled by a health care provider to lose weight,[46] yet daily calorie and fat intake continues to rise.

Counseling, either within or outside the clinical context, is generally less effective than other interventions; successfully inducing individual behavioral change is the exception rather than the rule. For example, although clear, strong, and personalized smoking cessation advice, even in the absence of pharmacological treatment, doubles quit rates among smokers who want to stop and should be the norm in medical care, it still fails to help 90% of those who are motivated to quit.[47,48]

Nevertheless, educational interventions are often the only ones available, and when applied consistently and repeatedly may have considerable impact. An example of a successful evidence-based educational intervention is trained peer counselors advising men who have sex with men about reducing HIV risk.[49]

PROGRAM IMPLEMENTATION

Comprehensive tobacco control programs, which contain elements that work at all levels of the pyramid, illustrate the potential application of this paradigm and the synergies among different levels of intervention. People with low incomes and low educational attainment have higher rates of smoking than do people with higher incomes and education.[50] Interventions that address social determinants of health, such as increasing a population's educational and economic status, should therefore reduce smoking rates. However, because these changes often require fundamental social

TABLE 1—Structural Approaches to Health Promotion for Communicable Disease, Noncommunicable Disease, and Injury Prevention

Approaches to Prevention	Communicable Disease	Noncommunicable Disease	Injuries
Counseling and educational interventions	Behavioral counseling to reduce sexually transmitted infections	Dietary counseling Counseling to increase levels of physical activity Public education about avoiding lifestyle-mediated disease	Counseling and public education to avoid drinking and driving and encourage compliance with traffic laws School-based programs to prevent or reduce violent behavior
Clinical interventions	HIV treatment to decrease viral load and reduce transmission Treatment of tuberculosis, resulting in decreased spread of infection	Treatment of hypertension and hyperlipidemia Aspirin therapy for people with coronary heart disease	Methadone and buprenorphine treatment to decrease opiate overdose Screening and treatment of women older than 65 years for osteoporosis to reduce fractures
Long-lasting protective interventions	Immunizations Male circumcision in countries with high HIV prevalence and significant female-to-male transmission Mass antibiotics to prevent or treat tropical diseases (e.g., onchocerciasis)	Colonoscopy Treatment of tobacco addiction Surgical sterilization, intrauterine device insertion, or other long-acting contraception to reduce maternal mortality Dental sealants	Brief behavioral counseling to reduce alcohol consumption Home modification, such as installation of grab bars and handrails, to prevent falls among the elderly
Changing the context	Clean water Reduced indoor smoke pollution from biomass cooking Ubiquitous condom availability	*Trans* fat elimination in processed food to reduce cardiovascular disease Sodium reduction in packaged foods and food served in restaurants to reduce cardiovascular disease Fluoridation of water to prevent dental cavities Elimination of lead paint and asbestos exposures Increased unit price for tobacco, alcohol, and sugar-sweetened beverages Smoke-free workplaces Community and transit design to promote greater physical activity	Road and vehicle design requirements to reduce crashes and protect pedestrians and bicyclists Laws prohibiting the sale of alcohol to minors and increased alcohol price Laws prohibiting driving at even low blood alcohol levels Effectively implementing laws to mandate helmet use by motorcyclists and motorcycle passengers Occupational safety requirements
Socioeconomic factors	Reduced poverty to improve immunity, decreased crowding and environmental exposure to communicable microbes, and improved nutrition, sanitation, and housing	Reduced poverty, increased education levels, and more nutritional options to reduce cardiovascular disease, some cancers, and diabetes	Reduced poverty levels to reduce drug use and violence, improved housing options, and lowered vulnerability to extreme weather conditions

change, they are generally not within the traditional purview of tobacco control or public health programs.

Context-changing interventions, such as increasing tobacco taxes, establishing smoke-free workplaces, and changing the social norms regarding smoking through hard-hitting antitobacco campaigns and elimination of advertising and promotional cues to smoke, are highly effective in reducing tobacco use.[51] Hard-hitting ad campaigns, particularly as part of a comprehensive tobacco control program, not only reduce tobacco use by changing the social context of smoking[52] but also provide in effect a social immunization against smoking that persists over time. Clinical care that includes cessation medications can triple quit rates in individual smokers, but even the best systems treat only a small proportion of smokers, and only one third of those who are motivated to quit and are treated will succeed.[48] Education about the harms of smoking provides people with information to help them change their behavior. Other examples of this 5-tiered framework applied to communicable disease, chronic disease, and injury prevention are given in Table 1. Inevitably, some programs blur the distinctions between tiers. For example, mass media campaigns for tobacco control could be viewed as an educational intervention (tier 5), but if done effectively, such actions can change the context by altering the social norms related to tobacco use (tier 2).

PRACTICAL APPLICATION OF THE HEALTH IMPACT PYRAMID

The health impact pyramid, a framework for public health action, postulates that addressing socioeconomic factors (tier 1, or

the base of the pyramid) has the greatest potential to improve health. Interventions that change the context for individual behavior (tier 2) are generally the most effective public health actions; 1-time clinical interventions (tier 3), such as immunizations, can be more effectively applied than those requiring ongoing care; and clinical interventions (tier 4) are generally, although not inevitably, more effective than counseling and education (tier 5).

Although the effectiveness of interventions tends to decrease at higher levels of the pyramid, those at the top often require the least political commitment. Achieving social and economic change might require fundamental societal transformation. Contextual change is often controversial, as evidenced by disputes over smoke-free laws, restrictions on artificial *trans* fat, and water fluoridation.[53,54] One-time interventions tend to be less controversial, although immunization programs that attempt to reach all members of a society often meet resistance arising from suspicion and disbelief.[55]

Although the structure and financing of health care systems can be controversial, clinical care itself rarely is. While exceptions exist, health education usually requires minimal political backing. Hence the greater popularity of school-based antismoking programs (despite consistent evidence they provide little to no benefit[56]) than of proven tobacco control interventions such as taxation, smoke-free environments, and comprehensive marketing bans. Similarly, exhorting people to exercise more and eat less is politically popular, but taxation of soda and other sugar-sweetened beverages,[57] bans on marketing junk food to children, and community redesign to encourage walking and bicycling, although far more effective, are also politically more difficult.

Interventions that address social determinants of health have the greatest potential public health benefit. Action on these issues needs the support of government and civil society if it is to be successful.[58] The biggest obstacle to making fundamental societal changes is often not shortage of funds but lack of political will; the health sector is well positioned to build the support and develop the partnerships required for change.[59]

To say that social and contextual changes are more effective at improving public health is not to imply that other interventions should be ignored. For different public health problems, different interventions may be the most effective or feasible in any given context. Education to encourage condom use, although of only limited effectiveness, can reduce HIV transmission and save lives. Changing the context to make condoms ubiquitously available and acceptable makes education about their use more effective. Comprehensive public health programs should generally attempt to implement measures at each level of intervention to maximize synergy and the likelihood of long-term success. ■

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This article was accepted December 8, 2009.

Acknowledgments

The author thanks Kelly Henning for valuable insight and input and Drew Blakeman, Cheryl de Jong Lambert, Leslie Laurence, and Karen Resha for assistance with article preparation and research.

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