The field of public health aims to improve the health of as many people as possible as rapidly as possible. Since 1900, the average life span in the United States has increased by more than 30 years; 25 years of this gain have been attributed to public health advances.1,2 Globally, life expectancy doubled during the 20th century,3 largely as a result of reductions in child mortality attributable to expanded immunization coverage, clean water, sanitation, and other child-survival programs.4

Public health focuses on denominators — what proportion of all people who can benefit from an intervention actually benefit. Maximizing health requires contributions from many sectors of society, including broad social, economic, environmental, transportation, and other policies in which government plays key roles; involvement of civil society; innovation by the public and private sectors; and health care and public health action. Although there has sometimes been distrust and disrespect between the health care and public health fields,5 they are inevitably and increasingly interdependent; maximizing potential health gains is a defining challenge for both fields.

Building a Public Health Pyramid

To maximize impact, public health works at five levels (Fig. 1). At the first level — the base of the pyramid — are socioeconomic factors such as income, education, housing, and race. Although these factors are not diseases, both public health efforts and health care can have some effect on them — for example, through health insurance coverage that reduces poverty or through prevention of teen pregnancy to reduce the perpetuation of poverty. Immediately above the socioeconomic factors are traditional public health interventions that change the context to make default decisions the healthy choices (e.g., by providing clean drinking water). At the next level are long-lasting protective interventions, such as immunizations, that require only intermittent action by the health care system. Next are clinical interventions requiring long-term, daily care, such as blood-pressure control. The last level includes counseling and education, such as exhorting people to eat healthy food and be physically active. Each level is important, but interventions at the pyramid’s base generally improve health for more people, at lower unit cost, than those at the top.6

To increase the impact of clinical care on population health, improvements in the third and fourth levels need to be implemented more effectively. Blood-pressure control, which can save more lives than any other clinical intervention,7 is successful in only about half of Americans; nearly 90% of patients with uncontrolled hypertension have both health insurance and a regular source of care, and more than 80% have multiple contacts with the health system each year.8

To maximize health overall, both communicable and noncommunicable dis-
ease threats need to be addressed in the United States and globally. There are important connections between infectious and noninfectious diseases: most cases of cervical cancer and many cases of liver cancer can now be prevented through vaccination; diabetes, obesity, and tobacco and alcohol use increase risks of both cancer and infections. U.S. and global health are also inextricably connected, as outbreaks of Ebola virus disease and the Middle East respiratory syndrome (MERS) and the spread of drug resistance make clear. Nevertheless, it is useful to give separate consideration to ways of addressing infectious and noninfectious conditions.

**Infectious Diseases in the United States**

Despite progress over the past century, the United States continues to face substantial infectious disease challenges. Human immunodeficiency virus (HIV) infection, hepatitis C virus infection, drug-resistant bacteria, health care–associated infections, and preventable influenza and pneumonia continue to kill more than 100,000 people in the United States each year.9-11 The increase in drug resistance, higher prevalence of risk factors such as diabetes and obesity, aging of the population, and greater complexity of medical interventions make infectious-disease control increasingly important and challenging. Addressing these challenges requires a combination of technological advances, more effective clinical and administrative systems, and political commitment to invest in prevention and control.

From a public health perspective, an effective clinical system has five essential characteristics: consistency, patient-centeredness, team-based care, registry-based information systems, and continuous improvement in treatments and delivery. These core features can help clinical systems address infectious-disease threats through standardization of care, interventions that increase patient adherence, team-based approaches to care (including hospital stewardship programs),12 rigorous monitoring of outcomes, and continuous improvement in detection, treatment, and prevention. Standardization and team-based care can increase vaccination rates and reduce prescription of unnecessary or overly broad-spectrum antibiotics. Registry-based approaches have the potential to increase the proportion of patients with HIV infection who are effectively treated from the current rate of 40% or less in the United States.13 Coordination among health care facilities and public health departments can substantially reduce the spread of drug resistance.14 Technological advances present new opportunities for infectious-disease control. These include large-scale, real-time whole-genome sequencing, which can improve identification of organisms, resistance, and infection clusters and elucidate the effects of the microbiome on health. New technologies complement and enhance but do not replace core epidemiologic functions.

**Infectious Diseases Around the World**

Recent decades have seen substantial progress in addressing some infectious diseases globally. Rates of death from the acquired immunodeficiency syndrome (AIDS),15 tuberculosis,16 and malaria17 have decreased substantially. Tropical diseases such as filariasis are being controlled.18 Polio and guinea worm disease are nearly eradicated.19,20 Vaccination programs prevent more than 2 million deaths each year among children.
under 5 years of age, although at least another 1.5 million deaths could be averted if current programs were expanded and new vaccines developed.21

The Ebola epidemic that began in West Africa in 2014 revealed once again how a weak link in disease detection and control anywhere can be a vulnerability everywhere. In theory, control of Ebola is simple. Programs must find, isolate, and safely care for infected people, track contacts, and safely bury patients who die. The challenge in West Africa has been to undertake these tasks in communities with no electricity or running water, no Internet or cell-phone coverage, large segments of society that are nonliterate and trust neither the government nor modern medicine, and a near complete lack of core public health infrastructure.

The Ebola outbreak offers three essential lessons. First, every country must have the core public health functionality to identify a threat when it emerges, stop it promptly, and prevent it wherever possible. The goal of the Global Health Security Agenda is to strengthen every country’s capacity, including trained epidemiologists, high-quality laboratories, timely and accurate disease-surveillance systems, and rapid response teams.22,23

Second, when national capacity is overwhelmed, the world must be able to move immediately and decisively. Epidemics are global problems. The World Health Organization (WHO) and its Global Outbreak Alert and Response Network need to strengthen global response capacity in epidemiology, laboratory science, clinical care, logistics, anthropology, and other disciplines essential for disease control. The responses in individual countries can be quicker, more efficient, and more cost-effective than a global effort but only if systems in daily use can be rapidly scaled up in emergencies.

Third, the lack of effective infection prevention and control in hospitals and other health care facilities is a key vulnerability. Because Ebola infections, MERS, and the severe acute respiratory syndrome (SARS) usually result in severe illness or death within weeks after exposure, the presence and spread of these infections are readily apparent. But tuberculosis,24,25 diseases caused by drug-resistant organisms,26 Clostridium difficile infection,27 measles,28 and many other conditions are routinely spread in health care facilities. Every country needs a strong system to support, coordinate, and monitor infection control in health facilities. Such facilities need full-time staff dedicated to monitoring and improving infection control, and facility leadership needs to fully support these staff.

### Chronic Diseases in the United States

Tobacco use is still the leading underlying cause of death in the United States and worldwide. Smoking prevalence in the United States is declining, albeit slowly. Smoking-cessation counseling and treatment are effective clinical interventions, but public health interventions, including raising tobacco taxes, expanding smoke-free public places, running hard-hitting antitobacco advertising campaigns, reducing images of smoking in movies and television, and increasing the purchase age to 21 years, can reduce smoking rates much more. In its first 3 years, the “Tips from Former Smokers” advertising campaign from the Centers for Disease Control and Prevention helped at least 300,000 smokers quit and saved at least 50,000 lives, at a cost of less than $500 per smoker who quit, less than $400 per year of life saved, and less than $3,000 per life saved.29 Regulation of the toxicity and addictiveness of combustible tobacco holds promise for reducing the harms of tobacco but faces certain opposition from the tobacco industry.

Improved cardiovascular care, particularly better blood-pressure control, can save far more lives than any other clinical intervention but will require substantial improvement at the fourth level of the pyramid. Better implementation of the “ABCS” — daily aspirin use for people at high risk, blood-pressure control, cholesterol management, and smoking cessation — could save 100,000 lives yearly in the United States if rates of clinical service utilization increase to those achieved by high-performing systems.7 Every 10% increase in the number of people effectively treated for hypertension would lead to prevention of an additional 14,000 deaths — a greater impact than that of any other intervention studied.7 Nationally, just over half of adults with hypertension have it under control, up from slightly over 40% 15 years ago.30,31 But health systems such as Kaiser Permanente Northern California32 and communities such as Minneapolis–St. Paul33 have increased control rates to 70 to 80%.

Some of the highest-performing U.S. health systems — Geisinger,34 North Shore,35 and oth-
ers — examined data from electronic health records and found that nearly a third of people with multiple elevated readings were never told that they had high blood pressure, much less had it treated. Investigators identified and treated patients with elevated blood-pressure readings and created automated reminders to find and treat patients who would not otherwise be included in the denominator for clinical quality measures.

High sodium intake is a leading contributor to hypertension, and Americans consume an average of 3500 mg of sodium per day, far more than recommended. Reducing average sodium intake by a third could save up to half a million lives and nearly $100 billion in health care costs over the next 10 years. Because the sodium content of most processed and restaurant foods puts reducing intake beyond personal or clinical reach, action is needed at the societal level, such as working with food manufacturers and restaurants to steadily reduce sodium content.

In the United Kingdom, industry initially resisted government calls to voluntarily reduce sodium content but then reduced sodium levels in many food categories by 14 to 36% in 2 to 3 years — achieving a 20% reduction in bread between 2001 and 2011 and a 57% reduction in breakfast cereals between 2004 and 2011. Average British sodium intake fell by 15% between 2003 and 2011, and there was a substantial reduction in average blood pressure, a 40% drop in the number of deaths from heart attacks, and a 42% decrease in deaths from stroke, with reduced sodium intake estimated to account for a quarter to a third of the mortality reduction.

Although the rapid increases seen in obesity since the 1970s appear to have leveled off, obesity and overweight continue to be serious problems in the United States. Increasing physical activity and improving nutrition are keys to obesity prevention and control, and policies that change the environment to make healthful eating and regular physical activity easier, safer, and more attractive are likely to be most effective.

**CHRONIC DISEASES AROUND THE WORLD**

Even in low-income countries, chronic diseases and injuries now kill twice as many people as infectious diseases, and rates are higher than those in high-income countries. The only exception is sub-Saharan Africa, although chronic diseases are increasing there as well. Healthier populations will increase economic stability and growth, and effective collaboration to implement programs that address these diseases can provide important lessons on how to tackle the leading causes of preventable disability and premature death.

Tobacco use kills more than 6 million people per year — more deaths than HIV, tuberculosis, and malaria combined, and nearly 80% of these deaths occur in low- and middle-income countries. Without urgent action, tobacco use will kill more than 1 billion people in this century. Bloomberg Philanthropies, joined by the Bill and Melinda Gates Foundation and supporting WHO and individual countries, have expanded the WHO-recommended MPOWER strategy in recent years (Table 1). These efforts are expected to prevent more than 7 million deaths in the 41 countries that fully implemented at least one MPOWER policy between 2007 and 2010, and that impact is expected to increase dramatically in the future. Nevertheless, much more must be done to reduce tobacco use.

Hypertension is the only condition that kills more people globally than tobacco use — more than 9 million per year. Blood pressure does not necessarily increase with age if sodium intake, physical activity, and other factors remain in the healthy range. However, even with effective community-wide interventions, there will be substantial need for treatment of hypertension. Currently, only about one in seven people with hypertension has it under control. Improved functioning at the fourth level of the pyramid, including through standardized protocols that simplify availability, delivery, and use of core blood-pressure medications and allow tasks to be delegated to nursing and nonmedical staff, could save a million or more lives worldwide each year; a reduction of sodium intake in conjunction with treatment could save even more.

In much of the world, motor vehicle crashes are now the leading cause of death among people 15 to 29 years of age. Public health interventions at the lower levels of the pyramid are effective, inexpensive, and highly cost-effective. Such interventions include lowering allowable blood alcohol levels for drivers and implementing random traffic stops to reduce drunk driving; increasing the use of seat belts, child restraints, and helmets; promoting increased taxation of...
alcohol; and reducing and enforcing speed limits. Better-engineered roads and vehicles also increase safety and reduce crash injuries and deaths. Policies require effective enforcement, which is lacking in many parts of the world.

THE ROLE OF GOVERNMENT

A responsive government can maintain that people are responsible for their own health while also taking public health action that changes default choices to make it easier for people to stay healthy. Key public health actions do one of three things, all of which are now well accepted but were initially controversial. The first is to promote free and open information — such as truth-in-advertising laws and nutrition-facts panels. The second is to protect people from harm caused by others — for example, by detecting adulterated food, prohibiting alcohol-impaired driving, and protecting workers and the public from second-hand smoke. Legal and policy changes in this area often both reflect and accelerate changes in social norms. The third is to implement societal interventions when individuals cannot efficiently or effectively protect their own health through such policies as vaccination mandates, clean air regulations, water fluoridation, micronutrient fortification of food, and elimination of lead in paint and gasoline — interventions that have all greatly improved the health of Americans.

THE FUTURE

In the future, clinical medicine could see costs increase without substantial improvement in health outcomes. Alternatively, new delivery
models and technology could substantially increase healthy life expectancy. The public health field, for its part, may not be able to keep pace with changing risks and increased opposition to core public health actions that promote healthy living — or it could expand past successes to further reduce tobacco and alcohol use, control persistent infectious diseases, increase physical activity, improve nutrition, and reduce harms from injuries and other environmental risks.

By working more closely together, clinical medicine and public health can help each other improve health maximally — and emphasize society’s responsibility to promote both healthy environments and consistent, high-quality care. Public health organizations can publicize information on health outcomes and risks that clarifies the need for, or achievement of, substantial progress. Clinical experts can identify and validate preventable harms and effective interventions to protect patients.

The involvement of many parts of society, including government agencies, health organizations, nongovernmental organizations, clinicians, the private sector, and communities, is increasingly important for success. Everyone benefits when people are healthier.

Accountability for outcomes is essential — public health’s obsession with denominators can reduce the number of people missed by interventions that improve health and save lives. Working together, clinical medicine and public health can ensure that people live active and productive lives far longer than was ever thought possible.

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