1.1

The scope and concerns of public health

Roger Detels

Abstract

Public health is the art and science of preventing disease, prolonging life, and promoting health through the organized efforts of society. The goal of public health is the biologic, physical, and mental well-being of all members of society. Thus, unlike medicine, which focuses on the health of the individual patient, public health focuses on the health of the public in the aggregate. To achieve this broad, challenging goal, public health professionals engage in a wide range of functions involving technology, social sciences, and politics. Public health professionals utilize these functions to anticipate and prevent future problems, identify current problems, identify appropriate strategies to resolve these problems, implement these strategies, and finally, evaluate their effectiveness.

In this chapter, we introduce the reader to the scope and current major concerns of public health as we enter the twenty-first century, giving examples of each. It is the goal of the chapter to assist the readers in understanding the conceptual framework of the field, which will help them in placing the subsequent more detailed chapters in the context of the entire field of public health.

Introduction

There have been many definitions and explanations of public health. The definition offered by the Acheson Report (Acheson 1988) has been widely accepted:

> *Public health is the science and art of preventing disease, prolonging life, and promoting health through the organized efforts of society.*

This definition underscores the broad scope of public health and the fact that public health is the result of society's efforts as a whole, rather than that of single individuals.

In 2003, Detels defined the goal of public health as:

> *The biologic, physical, and mental well-being of all members of society regardless of gender, wealth, ethnicity, sexual orientation, country, or political views.*

This definition or goal emphasizes equity and the range of public health interests as encompassing not just the physical and biologic, but also the mental well-being of society. Both the World Health Organization (WHO) and Detels' goals or definitions depict public health as being concerned with more than merely the elimination of disease.

To achieve the WHO goal of 'health for all', it is essential to bring to bear many diverse disciplines to the attainment of optimal health, including the physical, biologic, and social sciences. The field of public health has adapted and applied these disciplines for the elimination and control of disease, and the promotion of health.

Functions of public health

To accomplish its task of ensuring the well-being of the population, public health must perform a wide range of functions, which are listed in Table 1.1.1. The primary functions are to prevent disease and injuries and to promote healthy lifestyles and good health habits; but in order to succeed in these two objectives, public health must perform additional functions.

Public health *identifies*, *measures*, and *monitors* community health needs through surveillance of disease and risk factors (e.g. smoking) trends. Analysis of these trends and the existence of a functioning health information system provides the essential information for predicting or anticipating future community health needs.

In order to ensure the health of the population, it is necessary to *formulate*, *promote*, and *enforce* sound health policies to prevent and control disease and to reduce the prevalence of factors impairing the health of the community. These include policies requiring reporting of highly transmissible diseases and health threats to the community and control of environmental threats through the regulation of environmental hazards (e.g. water and air quality standards and smoking). It is important to recognize that influencing politics, particularly in a democracy, is an essential function of public health.

There are limited resources that can be devoted to public health and the assurance of high-quality health services. Thus, an essential function of public health is to effectively *plan*, *manage*, and *administer cost-effective health services*, and to ensure their availability to all segments of society.

In every society, there are *health inequalities* that limit the ability of some members to achieve their maximum ability to function.

Table 1.1.1 Functions of public health

1.	Prevent disease and injuries.
2.	Promote healthy lifestyles and good health habits.
3.	Identify, measure, monitor, and anticipate community health needs.
4.	Formulate, promote, and enforce essential health policies.
5.	Organize and ensure high-quality, cost-effective public health and health-care services.
6.	Reduce health disparities and ensure access to health care for all.
7.	Promote and protect a healthy environment.
8.	Disseminate health information and mobilize communities to take appropriate action.
9.	Plan and prepare for natural and man-made disasters.
10.	Reduce interpersonal violence and aggressive war.
11.	Conduct research and evaluate health-promoting/disease-preventing strategies.
12.	Develop new methodologies for research and evaluation.
13.	Train and ensure a competent public health workforce.

Source: Adapted from Office of the Director, National Public Health Performance Standards Program. *10 essential public health services.* [Online]. Centers for Disease Control; 1994. (Available from: http://www.cdc.gov/od/ocphp/nphpsp/EssentialPHServices.htm) and Pan American Health Organization. *Essential public health services.* [Online]. 2002. (Available from: http://www.sopha.cpha.ca/english/ephf_e.html)

Although these disparities primarily affect the poor, minority, rural, and remote populations and the vulnerable, they also impact on society as a whole, particularly in regard to infectious and/or transmissible diseases. Thus, there is not only an ethical imperative to reduce health disparities, but also a pragmatic rationale.

Technological advances and increasing commerce have done much to improve the quality of life, but these advances have come at a high cost to the environment. In many cities of both the developed and developing world, the poor quality of air—contaminated by industry and commerce—has affected the respiratory health of the population, and has threatened to change the climate, with disastrous consequences. We have only one world. If we do not take care of it, we will ultimately have difficulty living in it. Through education of the public, formulation of sound regulations, and influencing policy, public health must restore and monitor the environment to *ensure that the population can live in a healthy environment*.

To ensure that each individual in the population functions to his or her maximum capacity, public health needs to *educate the public and stimulate the community* to take appropriate actions towards the optimal conditions for the health of the public. Ultimately, public health cannot succeed without the support and active involvement of the community.

We cannot predict, and rarely can we prevent, the occurrence of natural and man-made disasters, but we can prepare for them to ensure that the resulting damage is minimized. Thus, *disaster preparedness* is an essential component of public health, whether the disaster is an epidemic such as influenza or the occurrence of typhoons.

Unfortunately, in the modern world, interpersonal *violence and war* have become common. In some segments of society (particularly among adolescent and young adult minority males), violence has become the leading cause of death and productive years of life lost. Public health cannot ignore that violence and wars are major factors dramatically reducing the quality of life for millions.

Many of the advances in public health have become possible through *research*. Research will continue to be essential for identifying health problems and the optimal strategies for confronting public health problems. Strategies that seem very logical may, in fact, not succeed for a variety of unforeseen reasons. Therefore, public health systems and programmes cannot be assumed to function cost-effectively without continuous monitoring and evaluation. Thus, it is essential that new public health strategies undergo rigorous evaluation before being scaled up, and once scaled up, periodically reviewed to ensure their continuing effectiveness.

Over the last century, the quality of research has been enhanced by the *development of new methodologies*, particularly in the fields of epidemiology, biostatistics, and laboratory sciences. The development of the computer has increased our ability to analyse massive amounts of data, and to use multiple strategies to aid in the interpretation of data. As new technologies continue to be developed, it is essential that public health continues to use these new technologies to develop more sophisticated research strategies in order to address public health issues.

The quality of public health is dependent on the competence and vision of the public health *workforce*. Thus, it is an essential function of public health to *ensure the continuing availability of a well-trained, competent workforce* at all levels, including leaders with the vision essential to ensure the continued well-being of society and the implementation of innovative, effective public health measures.

Contemporary health issues

Underlying almost all the pubic health problems of the world is the issue of poverty. More than half of the world's population lives below the internationally defined poverty line. Although the majority of the world's poor live in developing countries, there are many poor living in the wealthiest countries of the world—underscoring the disparity of wealth between developed and developing countries as well as between the poor and the rich in all countries. Unfortunately, the disparity between the rich and the poor is increasing, not only within countries, but also between rich and poor countries. It is incumbent on public health to reduce these disparities to ensure that all members of the global society share in a healthy quality of life.

The twentieth century witnessed the transition of major disease burdens, defined by death, from infectious and/or communicable diseases to chronic diseases (Table 1.1.2). In 1900, the leading cause of death in the United States and other developed countries was reported to be pneumonia and influenza. By the end of the century, diseases of the heart were the leading cause of death, and pneumonia and influenza dropped to the seventh place, primarily affecting the elderly. Commensurately, the average lifespan increased significantly, compounding the problems introduced by population growth. The reduction in communicable diseases was not primarily due to the development of better treatments, although vaccines played an important role in the second half of the twentieth century, but through public efforts to reduce crowding and improve housing, improve nutrition, and provide clean water and safe disposal of wastes.

By 1980, many leading public health figures felt that infectious diseases had been eliminated as a primary concern for public

Table 1.1.2 Leading causes of death in the United States (1900, 1950, 1990, 1997, 2001)

	1900	1950	1990	1997	2001
Diseases of the heart	167	307	152	131	248
Malignant neoplasms	81	125	135	126	196
Cerebrovascular disease	134	89	28	26	58
Chronic obstructive lung diseases	—	4	20	13	44
Motor vehicle injuries	—	23	19	16	15
Diabetes mellitus	13	14	12	13	25
Pneumonia and influenza	210	26	14	13	22
HIV infection	—	—	10	6	5
Suicide	11	11	12	11	10
Homicide and legal intervention	1	5	10	8	7

Values expressed as rates per 100 000, age-adjusted.
Source: Updated from McGinnis JM, Foege WH. Actual causes of death in the United States. *Journal of the American Medical Association* 1993; **270**:2007–12 and Department of Health and Human Services, National Center for Health Statistics *Health, United States, 1999*. Washington (DC): US Government Printing Office; 1999.

health; however, the discovery and expanding pandemic of acquired immunodeficiency syndrome (AIDS) caused by the human immunodeficiency virus (HIV) in the early 1980s, and subsequently, sudden acute respiratory syndrome (SARS) outbreaks in the late 1990s demonstrated the fallacy of their thinking. Although infectious and/or communicable diseases persist as a major public health concern, globally, even in poor, developing countries, chronic diseases have become a major health problem. In fact, 74 per cent of the deaths due to non-communicable or chronic diseases at the beginning of the twenty-first century occurred in developing countries. This, of course, reflects that the majority of the world's population lives in developing countries with limited resources and incomes. Communicable diseases, however, still accounted for 30 per cent of the deaths worldwide in 2005 (Fig. 1.1.1). This statistic is particularly disturbing, as the majority of the communicable diseases are now preventable through vaccines, improved sanitation, behavioural interventions, and better standards of living.

An essential step in defining health is to identify appropriate methods for measuring it. Traditionally, public health has defined disease in terms of mortality rates because they are relatively easy to obtain and death is indisputable. The use of mortality rates, however, places the greatest emphasis on diseases that end life, and tends to ignore those which compromise function and quality of life without causing death. Thus, the problems of mental illnesses, accidents, and disabling conditions are seriously underestimated if one uses only mortality to define health.

Two other strategies to measure health that evolved in the last half of the twentieth century have been 'years of productive life lost' (YPLL) (Lopez *et al*. 2006) and 'disability-adjusted life years' (DALYs) (Murray & Lopez 1995). The former emphasizes those diseases that reduce the productive lifespan (currently arbitrarily defined as 75 years), whereas the latter emphasizes those diseases that compromise function but also includes a measure of premature mortality. Using either of these alternatives to define health results in very different orderings of diseases and/or health problems as public health priorities (Fig. 1.1.1).

Using death to identify disease priorities, the leading cause is chronic diseases, which account for 61 per cent of the diseases worldwide (Fig. 1.1.1). Among the chronic diseases, cardiovascular diseases account for almost half (49 per cent) of the deaths.

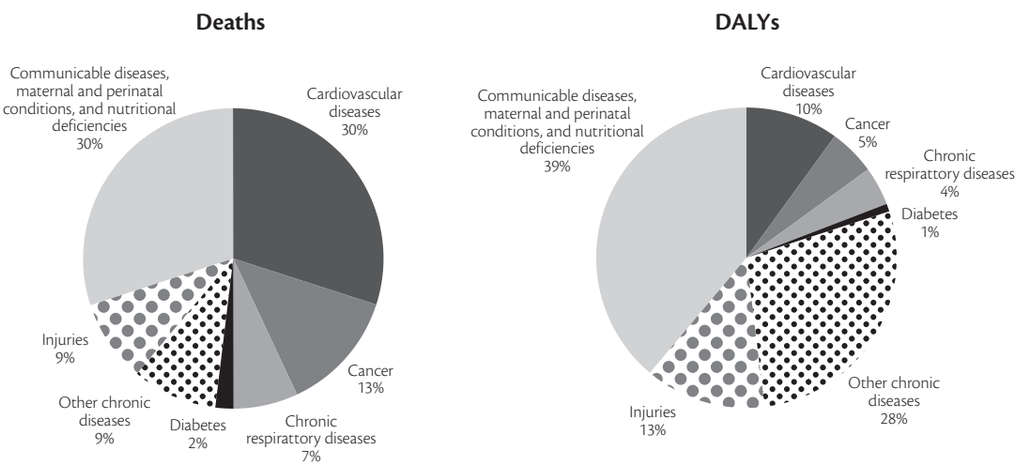

Fig. 1.1.1 Main causes of death and global burden of disease (DALYs) in the world for all ages, projections for 2005.
Source: World Health Organization. *Preventing chronic diseases: A vital investment.* [Online]. 2005. Available from: http://whqlibdoc.who.int/publications/2005/9241563001_eng.pdf.

The proportion, however, varies markedly by regions of the world and level of affluence of the countries. Communicable diseases remain the major cause of death only in Africa, although they account for a significant proportion of deaths in Southeast Asia and the eastern Mediterranean (Figs 1.1.2 A and B). The major victims of these communicable diseases are infants and children under five. The persistence of communicable diseases in these areas represents a major public health challenge.

DALYs and YPLL may be considered as better measures of the quality of life and functioning capacity of a country than mortality. Using DALYs to establish global disease priorities emphasizes communicable diseases and injuries, which tend to disproportionately affect the young, and reduces the relative importance of cardiovascular diseases and other chronic diseases that primarily affect the elderly (Fig. 1.1.1). The WHO has projected that the ranking of total DALYs for neuropsychiatric disorders, injuries, and noncommunicable and/or chronic diseases will increase by 2020, whereas the ranking for communicable diseases other than HIV/AIDS will decline (Figs 1.1.3A–D) (Mathers & Loncar 2006). Communicable diseases, which currently account for 40 per cent of the DALYS, are expected to decline to 30 per cent by 2030 (Mathers & Loncar 2006).

On the other hand, according to projections by the WHO, HIV, tuberculosis, and malaria (currently major communicable disease problems globally) will account for an even greater number of YPLL per 1000 population by 2030, whereas other communicable diseases will yield to intervention efforts and account for progressively fewer YPLL (Fig. 1.1.4). The YPLL per 1000 population due to chronic diseases that tend to affect older people, however, is projected to remain constant, perhaps reflecting the optimism regarding the development of strategies for earlier diagnosis and better drugs to sustain life with these conditions.

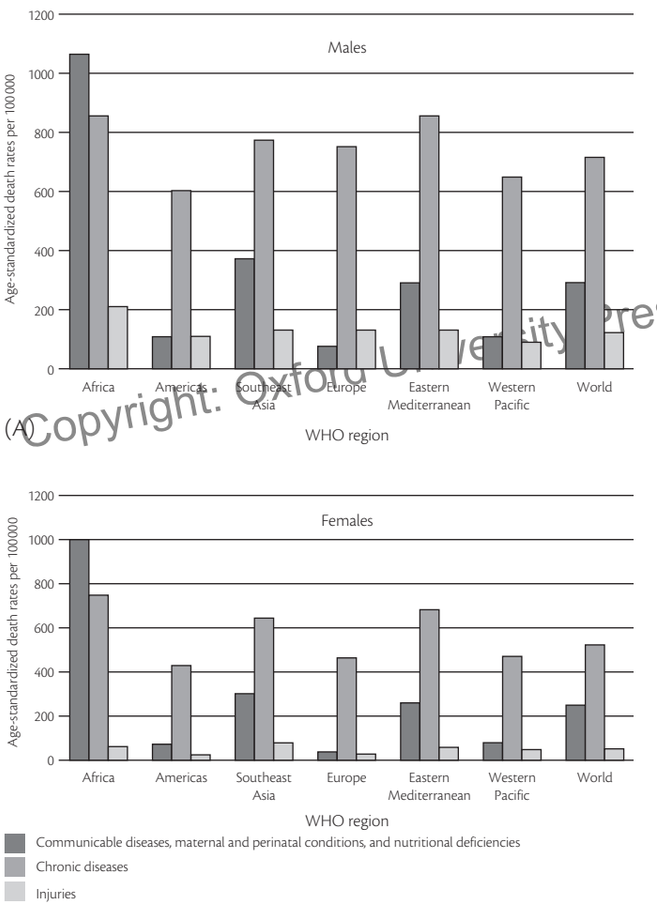

Fig. 1.1.2 Projected main caused of death by WHO region for all ages, 2005: (A) males and (B) females.
Source: World Health Organization. Main causes of death and global burden of disease (DALYs), world, all ages, projections for 2005. [Online]. Available from: http://www.who.int/chp/chronic_disease_report/contents/part2.pdf [accessed 2007 May].

Communicable diseases

The WHO's regional offices working with individual countries have conducted intensive immunization programmes against the major preventable infectious diseases of childhood, but there are significant barriers to complete coverage, including poverty, geographic obstacles, low levels of education, civil unrest and wars, and mistrust of governments. Poverty, weak governments, and misuse of funds have also prevented the control of disease vectors, provision of clean water, and safe disposal of sanitation, all essential for the control of communicable diseases. Another major factor in the rapid spread of communicable diseases has been the rapid growth in transportation. It is now possible for an individual with a communicable disease to circumnavigate the globe while still infectious and asymptomatic. Thus, cases of SARS were reported throughout Southeast Asia and as far as Canada within weeks of the recognition of the first cases in Hong Kong (Lee 2003).

Another source of communicable diseases is the continuing emergence of new infectious agents, many of them adapting to humans from animal sources. Figure 1.1.5 identifies new disease outbreaks from 1981 to 2003, including newly drug-resistant variants of new diseases occurring worldwide. Changes in food production, crowding of animals, mixing of live animal species in 'wet markets' in Asia and elsewhere, and the introduction of hormones and antibiotics into feed have all contributed to the emergence of these new diseases. Table 1.1.3 lists many of the new diseases that have been recognized since 1980. In addition to the diseases listed in this table, antibiotic-resistant strains of known agents have emerged rapidly due, in part, to the widespread inappropriate use of antibiotics. Thus, resistant strains of gonorrhoea, staphylococcus, tuberculosis, and malaria have become major problems. The latter two have now emerged as two of the three current major infectious disease problems globally. The development of drug-resistant malaria has been compounded by the emergence of vectors resistant to the commonly used chemical insecticides.

Approximately one billion people, one sixth of the world's population, suffer from one or more tropical disease, including Buruli ulcer, Chagas' disease, cholera, dengue, dracunculiasis, trypanosomiasis, leishmaniasis, leprosy, lymphatic filariasis, onchocerciasis, schistosomiasis, helminthiasis, and trachoma (World Health Organization 2006). The functional ability of those who suffer from one or more of these diseases is severely compromised, in turn affecting the ability of the poorest countries, which suffer the greatest burden of these tropical diseases, to compete in the

Income group	Rank	Disease or injury	Per cent of total deaths
Worldwide	1	Ischaemic heart disease	13.4
	2	Cerebrovascular disease	10.6
	3	HIV/AIDS	8.9
	4	COPD	7.8
	5	Lower respiratory infections	3.5
	6	Trachea, bronchus, lung cancers	3.1
	7	Diabetes mettitus	3.0
	8	Road traffic accidents	2.9
	9	Perinatal conditions	2.2
	10	Stomach cancer	1.9
High-income countries	1	Ischaemic heart disease	15.8
	2	Cerebrovascular disease	9.0
	3	Trachea, bronchus, lung cancers	5.1
	4	Diabetes mellitus	4.8
	5	COPD	4.1
	6	Lower respiratory infections	3.6
	7	Alzheimer's and other dementias	3.6
	8	Colon and rectum cancers	3.3
	9	Stomach cancer	1.9
	10	Prostate cancer	1.8
Middle-income countries	1	Cerebrovascular disease	14.4
	2	Ischaemic heart disease	12.7
	3	COPD	12.0
	4	HIV/AIDS	6.2
	5	Trachea, bronchus, lung cancers	4.3
	6	Diabetes mellitus	3.7
	7	Stomach cancer	3.4
	8	Hypertensive heart disease	2.7
	9	Road traffic accidents	2.5
	10	Liver cancers	2.2
Low-income countries	1	Ischaemic heart disease	13.4
	2	HIV/AIDS	13.2
	3	Cerebrovascular disease	8.2
	4	COPD	5.5
	5	Lower respiratory infections	5.1
	6	Perinatal conditions	3.9
	7	Road traffic accidents	3.7
	8	Diarrhoeal diseases	2.3
	9	Diabetes mellitus	2.2
	10	Malaria	1.8

Fig. 1.1.3A Ten leading causes of death by income group (baseline scenario), 2030.
Source: Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Medicine 2006*;**3**(11):e442. Available from: http://medicine.plosjournals.org/perlserv/?request=slideshow&type=table&doi=10.1371/journal.pmed.0030442&id=9665 [accessed 2007 May].

world marketplace. However, major strides have been achieved in reducing the burden of diseases such as leprosy, guinea worm disease, and lymphatic filariasis. Continuing efforts are needed to further reduce the burden of these and other tropical diseases.

We now recognize that we will continue to see new human pathogens emerging in the future, and need to be prepared to contain them. Table 1.1.4 lists the factors that contribute to the emergence of these new agents and disease threats. Unless the world faces the consequences of changing the environment in which we live, newly emerging diseases will continue to plague us.

Chronic diseases

With the increasing control of communicable diseases and the increasing lifespan, chronic diseases have emerged as the major global health problem in both developed and developing countries. Even in developing countries, chronic diseases have assumed greater importance. The prevalence of type 2 diabetes in rural India is 13.2 per cent (Chow & Raju 2006). Cardiovascular diseases have become a major cause of death in China. Eighty-seven per cent of stroke deaths occur in low- and/or middle-income countries (Lopez *et al.* 2007).

The causes of chronic diseases are many and complex (Fig. 1.1.6). Although the immediate causes are factors such as increasing blood pressure, increasing blood glucose, abnormal lipids and fat deposition, and diabetes, the underlying causes are behavioural and social. These behavioural factors include unhealthy diets that substitute pre-packaged and fast foods high in fats for a balanced diet, physical inactivity, and tobacco use; these in turn are the products of social change, including globalization, urbanization, and aging. Some chronic diseases have been associated with infectious disease agents. For example, *Chlamydia pneumoniae* has been implicated in the development of atherosclerosis (Kuo & Campbell 2000), and hepatitis C as a leading cause of hepatocellular (liver) cancer.

Another aspect of chronic diseases is the increasing survival of compromised individuals who would not otherwise have survived, many of whom are handicapped. These individuals require modified environments to experience a reasonable quality of life and to realize their full potential in order to contribute to society.

Most chronic diseases can be reduced by a combination of healthy behaviours, including not smoking, moderate alcohol use, and exercise (Breslow & Breslow 1993). Many developed countries have been promoting healthy lifestyles, but there is need for greater

Group	Cause	Average annual change (per cent) in age-standardized death rate	
		Males	Females
All causes		−0.8	−1.1
Group I		−1.4	−1.9
	Tuberculosis	−5.4	−5.3
	HIV/AIDS	3.0	2.1
	Malaria	−1.3	−1.5
	Other infectious diseases	−3.4	−3.3
	Respiratory infections	−2.7	−3.4
	Perinatal conditions[a]	−1.7	−1.9
	Other Group I	−3.0	−3.6
Group II		0.0	−0.8
	Cancer	−0.2	−0.4
	Lung cancer	0.1	0.3
	Diabetes mellitus	1.1	1.3
	Cardiovascular diseases	−1.1	−1.2
	Respiratory diseases	0.3	−0.1
	Digestive diseases	−1.3	−1.7
	Other Group II	−0.7	−1.1
Group III		0.0	−0.2
	Unintentional injuries	−0.2	−0.2
	Road traffic accidents	1.1	1.1
	Intentional injuries	0.2	−0.2
	Self-inflicted injuries	−0.3	−0.4
	Violence	0.4	0.2

[a]Causes arising in the perinatal period as defined in the ICD, principally prematurity and birth asphyxiz, and does not include all deaths occurring in the neonatal period (under 1 mo).
DOI: 10.1371/journal.pmed.0030442.t001

Fig. 1.1.3B Projected global tobacco-caused deaths (baseline scenario), by cause, 2015.
Source: Mathers C.D., Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Medicine 2006*;**3**(11):e442. Available from: http://medicine.plosjournals.org/perlserv/?request=slideshow&type=table&doi=10.1371/journal.pmed.0030442&id=9667 [accessed May 2007].

Category	Disease or injury	2002 rank	2030 ranks	Change in rank
Within top 15	Perinatal conditions	1	5	−4
	Lower respiratory infections	2	8	−6
	HIV/AIDS	3	1	+2
	Unipolar depressive disorders	4	2	+2
	Diarrhoeal diseases	5	12	−7
	Ischaemic heart disease	6	3	+3
	Cerebrovascular disease	7	6	+1
	Road traffic accidents	8	4	+4
	Malaria	9	15	−6
	Tuberculosis	10	25	−15
	COPD	11	7	+4
	Congenital anomalies	12	20	−8
	Hearing loss, adult onset	13	9	+4
	Cataracts	14	10	+4
	Violence	15	13	+2
Outside top 15	Self-inflected injuries	17	14	+3
	Diabetes mellitus	20	11	+9

Fig. 1.1.3C Changes in rankings for 15 leading causes of DALYs (baseline scenario), 2002 and 2030.
Source: Mathers C.D., Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Medicine 2006*;**3**(11):e442. Available from: http://medicine.plosjournals.org/perlserv/?request=slideshow&type=table&doi=10.1371/journal.pmed.0030442&id=9669.

emphasis and development of these programmes in developing countries, where the major global burden of chronic diseases occurs.

Mental illness

Public health professionals have only relatively recently recognized the need to address the mental health needs of society on a global scale, partly due to the difficulties in defining it. It is now estimated that 10 per cent of the world's population suffers from mental illness at any given time, and that mental illness represents 12 per cent of the global burden of disease. Mortality rates seriously underestimate the burden of mental health on society. Mental illness accounts for 31 per cent of DALYs, a better measure of its impact on society (Murray & Lopez 1995). However, the true extent of mental illness is probably greater—only 73 per cent of the countries have a formal mental health reporting system, and only 57 per cent have done epidemiologic studies or have data collection systems for documenting mental illness (World Health Organization 2001).

Income group	Rank	Disease or injury	Per cent of total DALYs
Worldwide	1	HIV/AIDS	12.1
	2	Unipolar depressive disorders	5.7
	3	Ischaemic heart disease	4.7
	4	Road traffic accidents	4.2
	5	Perinatal conditions	4.0
	6	Cerebrovascular disease	3.9
	7	COPD	3.1
	8	Lower respiratory infections	3.0
	9	Hearing loss, adult onset	2.5
	10	Cataracts	2.5
High-income countries	1	Unipolar depressive disorders	9.8
	2	Ischaemic heart disease	5.9
	3	Alzheimer and other dementias	5.8
	4	Alcohol use disorders	4.7
	5	Diabetes mellitus	4.5
	6	Cerebrovascular disease	4.5
	7	Hearing loss, adult onset	4.1
	8	Trachea, bronchus, lung cancers	3.0
	9	Osteoarthritis	2.9
	10	COPD	2.5
Middle-income countries	1	HIV/AIDS	9.8
	2	Unipolar depressive disorders	6.7
	3	Cerebrovascular disease	6.0
	4	Ischaemic heart disease	4.7
	5	COPD	4.7
	6	Road traffic accidents	4.0
	7	Violence	2.9
	8	Vision disorders, age-related	2.9
	9	Hearing loss, adult onset	2.9
	10	Diabetes mellitus	2.6
Low-income countries	1	HIV/AIDS	14.6
	2	Perinatal conditions	5.8
	3	Unipolar depressive disorders	4.7
	4	Road traffic accidents	4.6
	5	Ischaemic heart disease	4.5
	6	Lower respiratory infections	4.4
	7	Diarrhoeal diseases	2.8
	8	Cerebrovascular disease	2.8
	9	Diabetes mellitus	2.8
	10	Malaria	2.5

Fig. 1.1.3D Ten leading causes of DALYs by income group and sex (baseline scenario), 2030.
Source: Mathers C.D., Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Medicine 2006*;**3**(11):e442. Available from: http://medicine.plosjournals.org/perlserv/?request=slideshow&type=table&doi=10.1371/journal.pmed.0030442&id=9671 [accessed 2007 May].

Global provisions for treatment of mental illness are still significantly below what is necessary to adequately address the problem. Although 87 per cent of the world's governments offer some mental health services at the primary-care level, 30 per cent of them have no relevant programme and 28 per cent have no budget specifically identified for mental health. Mental illness robs society of a significant number of potentially productive persons. With the diminishing proportion of productive people of working age and the increasing proportion of elderly dependants, it is important to assist those who are not productive because of mental illness to become healthy, productive members of society.

Population changes

Although the rate of growth of the world's population has slowed in the latter half of the twentieth century, the world's population, currently over 6.5 billion people, is estimated to grow to 9 billion by 2050 (Fig. 1.1.7) (United States Census Bureau 2006). The growth in the population will be mostly among the elderly and the old elderly (those over 80 years of age). By 2050, at least 30 per cent of the population in most developed countries and in China will be over 65 years of age (Fig. 1.1.8). In the United States, the number of elderly is expected to double over the next 30 years. Because women survive longer, the majority of the elderly will be women. The gender ratio (M:F) for the world's population was 101.4 in 2007, but is estimated to be 101.3 by 2010. However, among those 80 years and over, the ratio was 56.3 in 2007 and is estimated to be 57.3 by 2010.

Currently, one of the major problems facing the world is the deterioration of the environment caused by the increasing numbers of people and the accumulation of wastes produced by them, their vehicles, and the industries they support. Thus, the quality of the air that we breathe has declined, especially in developing countries, where increased economic output has come at the expense of the environment. The most polluted cities of the world are concentrated in developing countries, which have the least capacity and political will to reduce pollutants. Pollution of the world's oceans, which receive massive amounts of biological and chemical wastes annually, affects not only the quality of the water but also the ability of the ocean to sustain marine life, an important source of food.

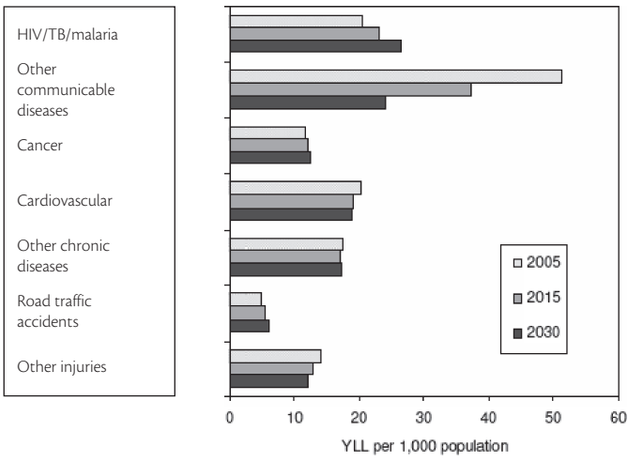

Fig. 1.1.4 Trends in global years of life lost (YLL) per 1000 population, by broad cause group and income group, 2002–2030 (2005).
Source: Mathers C.D., Loncar D. *Updated projections of global mortality and burden of disease, 2002–2030: data sources, methods and results*. Geneva: World Health Organization; 2005. Available from: http://www.who.int/healthinfo/statistics/bodprojections2030/en/index.html [accessed 2007 May].

As the population grows, there is increasing pressure to provide food, water, and other necessities to maintain a high quality of life. Fertile farmlands are increasingly being converted to residential areas. Thus, more people need to be supported on less land. Will agricultural efficiency grow at a rate commensurate with population growth? Will we be able to find alternative fuel sources when oil and other natural resources are depleted? Will we be able to provide sufficient water to sustain populations and agriculture, currently a major global problem?

The well-being of society is dependent on the ratio of those who produce to those who are dependent. The fact that the majority of the population growth in the coming decades will be among the old and old elderly, not through increasing birth rates, will result in a diminishing proportion of producers and an increasing proportion of dependants. In 2000, the proportion of the world's population who were 60 years and over was 10 per cent; by 2050, it will be 50 per cent. This will be further exacerbated because the majority of the oldest elderly will be single women who traditionally have more limited resources and lower levels of education, particularly in developing countries. Thus, the productivity and efficiency of those who produce must increase if we are to sustain or improve the quality of life for all. Improved technology and strategies will be required to increase worker productivity.

The occurrence of disease in old age is directly correlated with unhealthy behaviours developed in early life. Unfortunately, concurrent with population growth, there has been a worldwide epidemic of obesity and decreased physical activity, which has increased the proportion of elderly who suffer from chronic debilitating diseases in both the developed and developing world. Thus, unless efforts to promote health lifestyles are successful, not only will there be an increase in the proportion of elderly, but also an increasing proportion of them will require supportive care, placing a further economic burden on society.

Other public health issues

Oral health

Good dental health is essential for maintaining adequate nutrition and a healthy quality of life. However, it was estimated that in 2004 there was an average of 1.6 decayed, missing, or filled teeth (DMFT) among children 12 years old globally (WHO Oral Health Program 2004). The number of DMFT ranged from a low of 0.3 in Togo and Rwanda to 6.3 per 12-year-old in Martinique. The percentage of

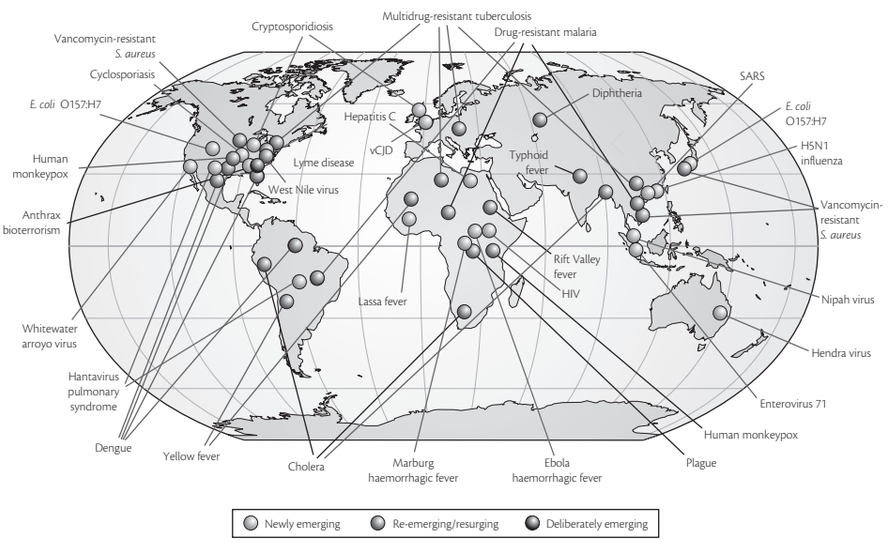

Fig. 1.1.5 Emerging and re-emerging disease worldwide, 1981–2003.
Source: Morens D.M., Folkers G.K., Fauci A.S. *Nature* 2004; **430**:242–9. Updated and reproduced with permission of A. Fauci [2007 June].

Table 1.1.3 Newly identified infectious diseases and pathogens

Year	Disease/pathogen
2004	Avian influenza (human cases)
2003	SARS
1999	Nipah virus
1997	H5N1 (avian influenza A virus)
1996	New variant Creutzfelt-Jacob disease; Australian bat lyssavirus
1995	Human herpes virus 8 (Kaposi's sarcoma virus)
1994	Savia virus; Hendra virus
1993	Hanta virus pulmonary syndrome (Sin Nombre virus)
1992	*Vibrio cholerae* O139
1991	Guanarito virus
1989	Hepatitis C
1988	Hepatitis E; human herpes virus 6
1983	HIV
1982	*Escherichia coli* O157:H7; Lyme borreliosis; human T-lymphotropic virus type 2
1980	Human T-lymphotropic virus

Source: World Health Organization. Workshop presentation by David Heymann. Geneva: World Health Organization; 1999.

adults in the United Kingdom with total tooth loss in 1998 was 13 per cent, and increased with decreasing social class (Table 1.1.5) and education (Fig. 1.1.9). These high rates of DMFT and tooth loss reflect poor dental hygiene and preventive care (Pine & Harris 2007). Unfortunately, many people believe that dental care is an expendable luxury, and that visits to dentists are only necessary when there is a problem. Poor dental hygiene is probably a major reason for the 119 730 cases of oral cancer worldwide in 2000, and why the five-year prevalence of oral cancer is estimated to be 6.8 per cent globally (WHO Oral Health Program 2004). Even in Western Europe, the five-year prevalence of oral cancer was estimated at almost 50 000 cases (WHO Oral Health Program 2004). Clearly the public health message regarding the importance of good dental hygiene, regular tooth brushing, and regular dental check ups is not reaching the majority of the people.

Injuries

Injuries and violence caused 9 per cent of all deaths and 12 per cent of the global burden of diseases in 2002, accounting for 5.2 million deaths (World Health Organization 2004). Deaths due to injuries are almost three times greater in developing than in developed countries. However, most of the injuries do not cause death, but may result in disability. Furthermore, they occur more commonly among younger persons and children.

Injuries can be broadly categorized in the following groups: motor vehicle accidents, suicide, homicide, and other unintentional injuries, including occupational injuries and falls. Motor vehicle accidents account for the largest proportion of deaths due to injury (Fig. 1.1.10); globally, they were the sixth leading cause of death in 2001, and the third leading cause of YPLL lost in the United States in 2000. The WHO projects that motor vehicle accidents will become the third highest cause of DALYs globally by 2020. Falls, particularly among the elderly, are a major cause of DALYs, and ranked thirteenth globally in 1999 according to the WHO.

Occupational injuries are another major cause of death and DALYs. Globally, over 350 000 deaths and 270 million injuries are currently attributable to occupation-related factors annually. The burden is greater in developing countries, where the drive to produce goods cheaply has been given greater importance than providing a safe work environment.

Homicide, violence, and suicide

Homicide, violence, and suicide represent a growing problem, particularly among the young. Homicide and suicide are among the top ten leading causes of death in the United States. In some minority groups in the United States, homicide and violence are the leading cause of death of youth, followed by suicide. In China, suicide remains the leading cause of death among women in rural areas. Globally, the WHO predicts that homicide and suicide will account for an increasing proportion of deaths. Unfortunately, the WHO predicts that by 2020, war will become the sixth leading cause of DALYs, violence the twelfth, and self-inflicted injuries the fourteenth.

Unintentional injuries are largely preventable through community and governmental intervention. Thus, improved roads, separation of different modes of transportation, enactment, and enforcement of seat belt and helmet laws, and improved designs of ladders and other equipment and tools have all been shown to significantly reduce injuries and deaths due to accidents. Stronger emphasis on a safer work environment, especially in developing countries, will significantly reduce both injuries and the severity of injuries that occur in the workplace.

Vulnerable populations

Public health has always been concerned with the health and well-being of vulnerable groups who require special attention. The definition of a vulnerable population and who constitute a vulnerable population varies by time, situation, and culture, but the common characteristic across all vulnerable groups is their susceptibility to adverse health and poor quality of life. Often, they live at the margins of society and have difficulty accomplishing the basic functions of living and accessing healthcare. Thus, they require assistance. In many societies, particularly in developing countries, the family acts as the safety net for these groups; but if the family itself is vulnerable, this safety net is absent. Societies with resources have developed social support programmes that assist the vulnerable, but these programmes seldom cover the full range of vulnerable groups, and may not adequately support those whom they target. Universal healthcare is one component of assisting the vulnerable, but presently, even in rich, developed countries such as the United States, healthcare is not available to all, and strategies to fund universal healthcare are difficult to implement.

The list of vulnerable groups includes the poor, minorities, women, children, the elderly, the handicapped, the illiterate, orphans and street children, immigrants, refugees and displaced people, the homeless, and the mentally ill. In certain situations, other groups may be considered vulnerable. For example, in the face of epidemics such as HIV/AIDS, one could also consider adolescents to be a vulnerable group.

Table 1.1.4 Factors contributing to the emergence or re-emergence of infectious diseases

1.	Human 'demographic change' by which persons begin to live in previously uninhabited remote areas of the world and are exposed to new environmental sources of infectious agents, insects, and animals.
2.	Breakdowns of sanitary and other public health measures in overcrowded cities and in situations of civil unrest and war.
3.	Economic development and changes in the use of land, including deforestation, reforestation, and urbanization.
4.	Climate changes cause changes in geography of agents and vectors.
5.	Changing human behaviours, such as increased use of child-care facilities, sexual and drug-use behaviours, and patterns of outdoor recreation.
6.	Social inequality.
7.	International travel and commerce that quickly transport people and goods vast distances.
8.	Changes in food processing and handling, including foods prepared from many different animals and transported great distances.
9.	Evolution of pathogenic infectious agents by which they may infect new hosts, produce toxins, or adapt by responding to changes in the host immunity (e.g. influenza, HIV).
10.	Development of resistance of infectious agents such as *Mycobacterium tuberculosis* and *Neisseria gonorrhoeae* to chemoprophylactic or chemotherapeutic medicines.
11.	Resistance of the vectors of vector-borne infectious diseases to pesticides.
12.	Immunosuppression of persons due to medical treatments or new diseases that result in infectious diseases caused by agents not usually pathogenic in healthy hosts (e.g. leukaemia patients).
13.	Deterioration in surveillance systems for infectious diseases, including laboratory support, to detect new or emerging disease problems at an early stage.
14.	Illiteracy limits knowledge of prevention strategies.
15.	Lack of political will—corruption, other priorities.
16.	Biowarfare/bioterrorism—an unfortunate potential source of new or emerging disease threats (e.g. anthrax and letters).
17.	War, civil unrest—creates refugees, food and housing shortages, increased density of living, etc.
18.	Famine.

In almost every country, developed or developing, there are homeless people, many of whom suffer from multiple problems, including mental illness. Complicating the ability of many vulnerable groups, including the homeless, mentally ill, alcoholics, and drug addicts, to achieve good health and to function adequately are poverty, prejudice, and stigmatization by society. Thus, we not only need programmes to assist the vulnerable, but also to encourage society to take action to assist them in realizing their maximum potential.

Complicating the issue of vulnerable groups is the fact that the specific problems and needs of each of these groups are different, and thus require differing specific public health action. For some of these groups, such as mothers and children and the handicapped, there are well-established programmes, although coverage is far from complete and the quality of these programmes varies widely. For others, such as the illiterate and migrants, there are fewer established programmes. If we are to meet the public health goal of 'Health for All', we need to identify and assist the vulnerable groups within societies to achieve their maximum possible health and function.

The environment

> *Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial processes in the environment.* (WHO)

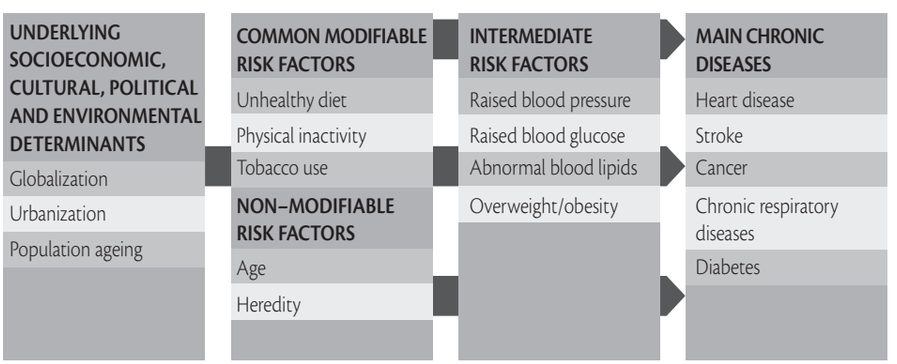

Fig. 1.1.6 Causes of chronic diseases. *Source*: World Health Organization. Main causes of death and global burden of disease (DALYs), world, all ages, projections for 2005. [Online]. Available from: http://www.who.int/chp/chronic_disease_report/contents/part2.pdf [accessed 2007 May].

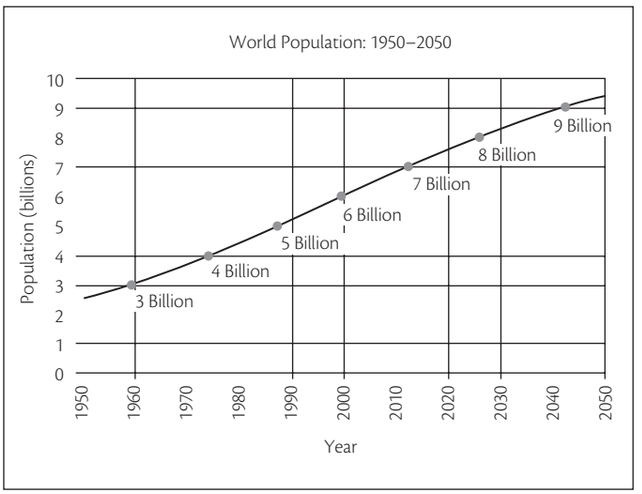

Fig. 1.1.7 World population, 1950–2050.
Source: United States Census Bureau. *International database.* [Online]. 2006 Aug. Available from: http://www.census.gov/ipc/www/idbnew.html [accessed 2007 May].

The number of known chemicals globally exceeds 14 million, of which over 60 000 are commonly used. All of these ultimately end up in the environment. They are the result of the huge proliferation of industry, technology, and automobiles in the twentieth century. Murray and Lopez (1996) have estimated that 1 379 238 DALYs are caused annually by environmental exposures. As we enter the twenty-first century, the number of pollutants will continue to increase.

Problems of the environment occur at the personal level (at home and the workplace), the community level (air and water pollution), and globally (global warming, hazardous and radioactive waste). Although these problems may be viewed separately, they are in fact all global issues affecting both local and remote populations. Thus, air pollution caused by slash-and-burn cultures in Sumatra severely affects the health of residents of Singapore and Malaysia. Industrial pollutants released in the industrial states of Northeastern United States cause acid rain, which adversely affects crops and people in the Midwestern United States and southern Canada. Pollution of rivers upstream can adversely affect communities and countries downstream, as happened in 2005 when nitrobenzene was released into the Songhua River in Heilongjiang, China, contaminating drinking water downriver in both China and Siberia, Russia.

Air pollution

The rapid increase in automobiles and industry has caused widespread air pollution in most urban areas of the world, the worst occurring in the developing countries, which have rapidly industrialized at the expense of their environment. Now, in the early part of the twenty-first century, many of these countries are realizing the need to protect the environment. Unfortunately, reversal of decades of pollution is far more difficult and costly than prevention.

The harmful effects of air pollution extend beyond the environment. Many members of society, including asthmatics and persons with chronic respiratory disease, are vulnerable to even relatively low levels of pollutants. Studies of the urban air in Southern California have demonstrated that children chronically exposed to high levels of both primary pollutants and photochemical oxidants have decreased lung function (Detels *et al.* 1979). Recent studies have demonstrated that children living near freeways in Southern California also suffer long-term lung damage (Gauderman *et al.* 2007). Levels of pollutants observed in many developing countries, especially in China and India, are considerably higher than in developed countries, but few studies have documented the cost of these high levels of pollutants to the health of children, as well as adults, in these countries. Thus, the true cost of uncontrolled industrialization in these countries is not known.

Water pollution

Those who live in developed countries take the provision of safe drinking water for granted, but 40 per cent of the world's population does not have access to clean drinking water, a basic necessity of life. As the world population expands, the production of waste increases, and the problem of protecting water supplies also increases. Approximately 60 per cent of the world does not have adequate facilities for waste disposal. Even in leading cities in developed countries, pollution of the water supply occurs, as happened in Milwaukee, Wisconsin, when cryptosporidia contaminated the water supply, causing severe illness and death, especially in vulnerable populations compromised by immune deficiency disorders (MacKenzie *et al.* 1994). The increased rate of upper respiratory infections and gastrointestinal disorders among surfers and others using the ocean for recreational purposes has been well documented. Beaches in most urban areas are frequently closed when the sewage disposal systems become overwhelmed. Acid rain from industrialization has caused acidification of lakes, making them inhospitable for fish and other marine life, thus compromising the food supply. Recently there has been discussion about whether the benefits of omega-3 fatty acids found in fish outweigh the risk of mercury poisoning among those who eat large quantities of fish. Ensuring a safe, adequate water supply for people in both developed and developing countries must become a public health priority.

Other pollutants

As the population of the world rapidly increases and technology produces new substances and processes, not only the amount of pollutants, but also the varieties of pollutants increases. As new substances are developed, their use should not be permitted until plans and provisions have been developed and implemented for their safe disposal. This seldom happens!

Biodegradable pollutants have a limited lifespan in the environment, but we are increasingly producing non-biodegradable substances such as plastics, which are now ubiquitous, and hazardous materials such as radioactive wastes that persist for generations. It is likely that the amount of these hazardous substances will increase as natural energy sources are exhausted by the burgeoning and increasingly affluent population. The problem of discarding these waste products safely has become a major public health issue. Developed countries are now paying developing countries to accept their hazardous waste products. This strategy does not solve the problem, but shifts it to those countries that have fewer resources with which to deal with the problem, thus solving a local problem but creating a global problem! A major public health issue of the twenty-first century will be global warming due to the release of carbon dioxide and other 'greenhouse gases'.

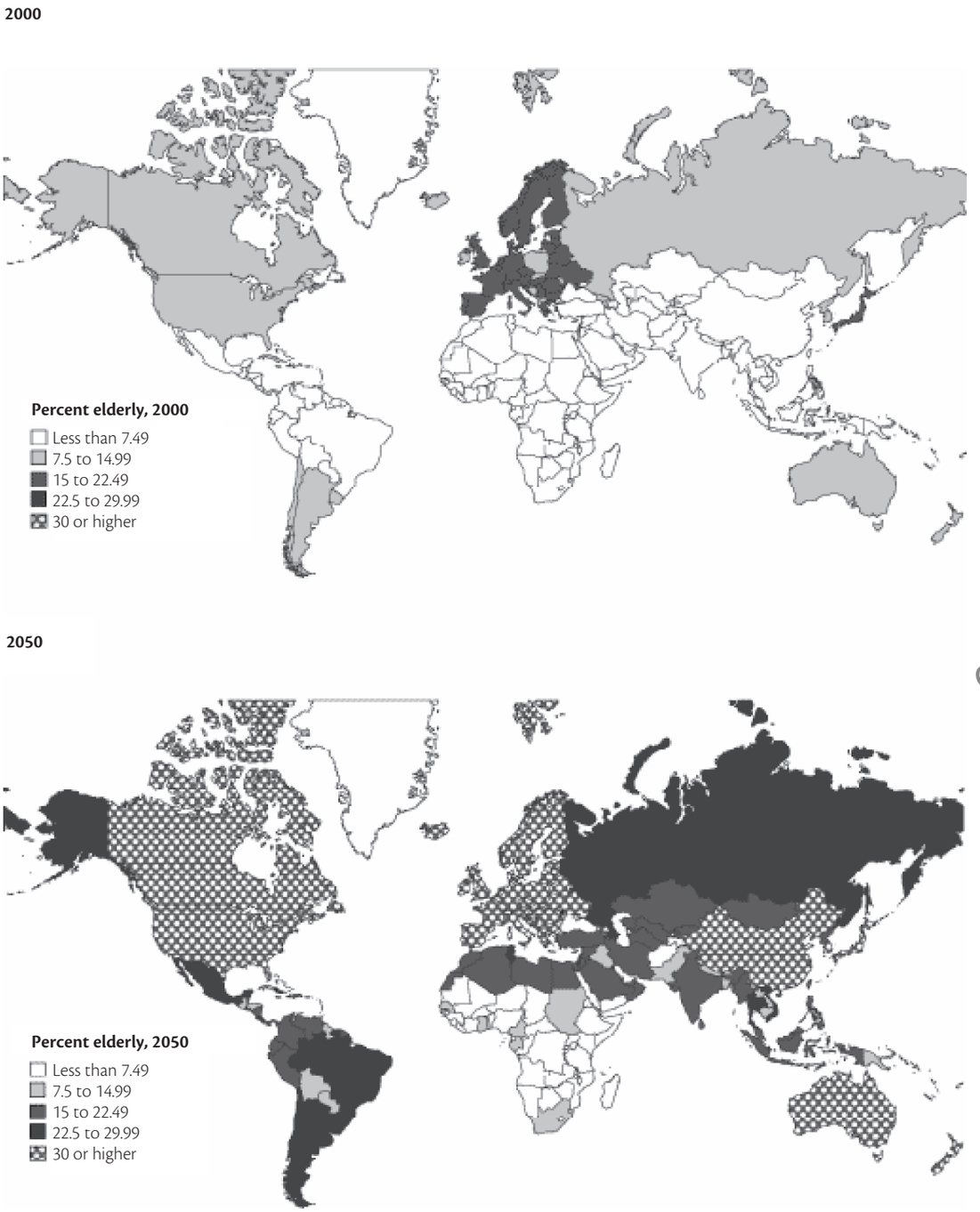

Fig. 1.1.8 Percentage of elderly (age 65 and over) by country, 2000 and 2050.
Source: Kaneda T. Percentage of elderly (ages 65 and over) by country, 2000 and 2050. [Online]. Population Reference Bureau. Available from: http://www.prb.org/Articles/2006/iticalWindowforPolicymakingonPopulationAginginDevelopingCountries.aspx [accessed 2007 May].
United Nations Population Division, *World Population Prospects: The 2004 Revision* (New York: United Nations, 2005).

Rescuing the environment

The key to rescuing the environment is to induce the political will of the countries of the world to take steps towards reversing and preventing further degradation of the environment. Global warming represents an example of these problems. The United States is the major producer of carbon dioxide and other greenhouse gases responsible for global warming, yet it is one of the few countries unwilling to sign the treaty on global warming! In order to induce the political will to protect the environment and public health globally, political leaders will need to collaborate with other countries

Table 1.1.5 Percentages of adults with total tooth loss in the United Kingdom for different age, gender, and social class groups in 1978, 1988, and 1998

	1978	1988	1998
Age (years)			
25–34	4	1	0
35–44	13	4	1
45–54	32	17	6
55–64	50	37	20
65 and over	79	67	45
All ages	30	21	13
Gender			
Male	25	16	10
Female	33	25	15
Both	30	21	13
Social class of head of household			
I, II, III NM (skilled non-manual)	22	15	8
III M (skilled manual)	29	24	15
IV, V (unskilled)	38	32	22
All	30	21	13

Source: Walker and Cooper (eds), 2000; Todd and Lader, 1991
Petersen PE. Inequalities in oral health: the social context for oral health. In: *Community oral health*. 2nd ed. London: Quintessence Publishing; 2007. p. 38.

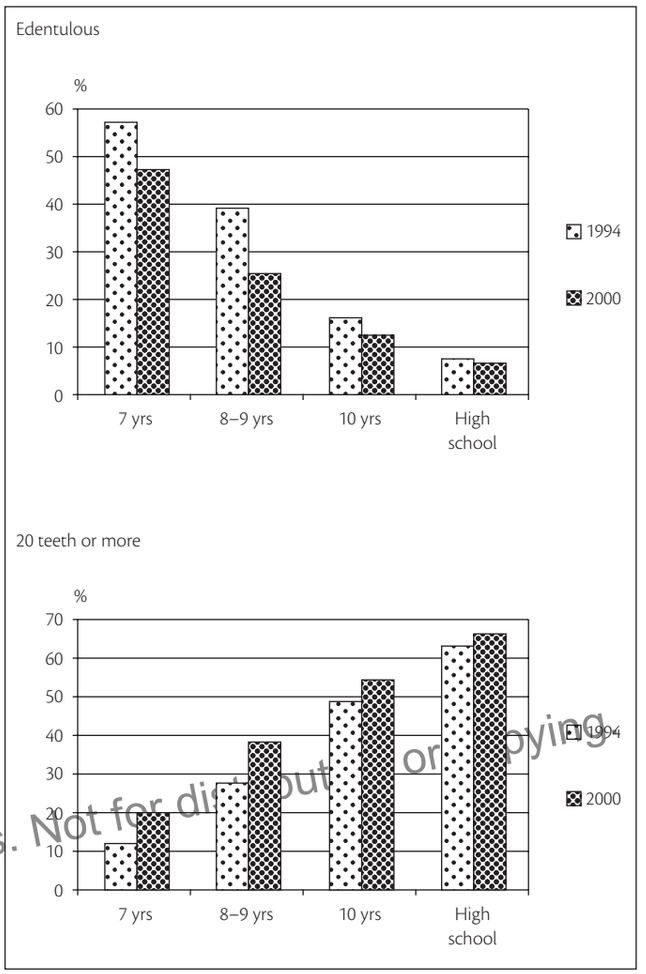

Fig. 1.1.9 Percentages of interviewed elderly (65 years or more) who reported being edentulous or having at least 20 teeth present in relation to number of years having attended school and year of study.
Source: Petersen PE. Inequalities in oral health: the social context for oral health. In: *Community oral health*. 2nd ed. London: Quintessence Publishing; 2007. p. 39.

to confront cultural norms, strong economic interests (e.g. industry), and current attitudes of much of the world's population. Regulations will need to be promulgated and implemented, which, out of necessity, will compromise the current lifestyle of much of the world's population. It is unlikely that risk from environmental pollution and hazardous waste can be reduced to zero. Thus, the concept of 'acceptable risk' will be a part of the process. Determining the level of acceptable risk might not be a scientific process, but a political one in which public health must play a strong role.

Occupational health

Occupational diseases are different from other diseases, not biologically, but socially. (Henry Sigerist 1958)

In 1999, Dr. Jukke Takala, Chief of the International Labour Organization's Health and Safety Programme, estimated that there were 1.1 million work-related deaths, 250 million work-related injuries, and 160 million cases of occupational disease annually worldwide (International Labour Organization 1999). Twelve million of these serious injuries occurred among young workers. This is more people than those who have myocardial infarcts (heart attacks), strokes, or newly diagnosed malignancies annually. A significant proportion of these deaths and injuries are preventable by improving safety in the workplace. However, safeguarding the worker is often given less priority than the need to produce cheap goods, especially in developing countries.

The nature of the workplace is constantly changing, with increasing proportions of workers being involved in communications and services rather than production of goods. Increasingly, the production of goods is moving from developed countries to developing countries, where labour costs are cheaper and safety regulations are fewer. Increasingly, women are entering the workforce and must juggle work and family. Because the costs of healthcare are rising more rapidly than the cost of living, industry is seeking relief from providing healthcare benefits, and healthcare is increasingly not provided as part of the employment package. Shifting from a formal full-time workforce to an informal part-time workforce is one strategy for reducing labour costs. Thus, the informal part-time workforce, not usually able to receive work-related benefits, now represents 50 per cent or more of the workforce globally. This segment of the workforce is particularly vulnerable to injury and limited access to healthcare.

As noted earlier, the population is aging, and the proportion of the population that produces is diminishing. In response to this

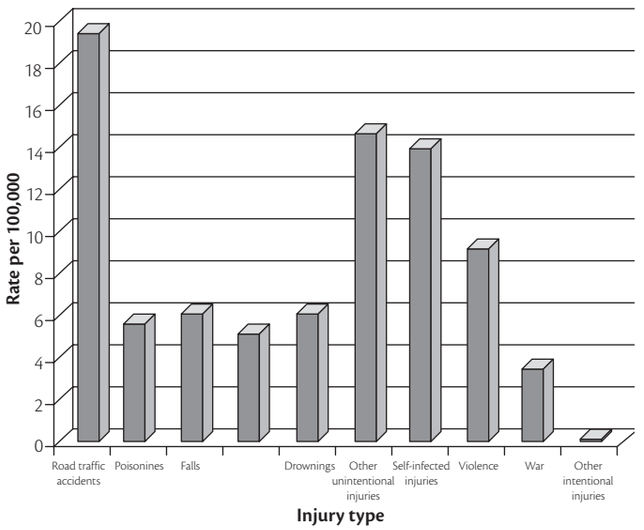

Fig. 1.1.10 Global injury DALY rates per 1 000 000 population, 2001.
Source: Merson M.H., Black R.E., Mills J.E., editors. *International public health*. 2nd ed. Sudsbury [MA]: Jones & Bartlett; 2006. p. 326.

change, the age of eligibility for social security benefits in the United States is increasing, and mandatory retirement is being phased out. It is now projected that the proportion of workers over the age of 60 will increase to 20 per cent in Japan and 10 per cent in the United States by 2030 (Population Projections 2000). The needs of older workers are different from those of younger workers. Thus, the changing nature of the workforce will require changes in work safety regulations and health benefits to ensure a healthy, productive workforce.

Provision of and access to healthcare

Access to preventive and curative care is a requirement for health in every society, whether rich or poor. Access to healthcare has long been a problem for the poor and for rural residents, especially in developing countries. However, in the United States, access to healthcare is even a problem for the middle class. Health insurance is prohibitively expensive and beyond the reach of many in the middle class, unless it is subsidized by the employers. Increasingly, employers are attempting to free themselves from the cost of health insurance for their employees through a variety of strategies. Thus, the proportion of those without healthcare is likely to increase. The elderly also have problems with healthcare; because healthcare costs increase with age, insurance companies are less willing to cover the elderly, and many governments, even in developed countries, do not provide adequate support for the elderly. In developing countries, the rural poor are particularly at risk. Few health professionals are willing to work in rural areas, and the cost of providing care in less populated areas is greater than in urban areas. Innovative strategies are needed to ensure that the rural poor and elderly have access to reasonable healthcare.

Bioterrorism and war

Bioterrorism has been used as a weapon for hundreds of years. In the middle ages, corpses of plague victims were catapulted into castles under siege. Recently, anthrax was used to contaminate the US postal system, resulting in several deaths. There has been a sharp increase in terrorist activities in this century. The WHO and public health agencies of individual countries have developed plans to quickly diagnose and control bioterrorist incidents. These threats to the health of the public will continue until we address the underlying causes of terrorism and bioterrorism.

Few actions can have the magnitude of negative impact on the health of the public that war has. Men, women, and children are killed, homes are destroyed, major segments of the population become displaced refugees, and the social and/or economic fabric of the countries involved is destroyed. Recovery usually takes years to decades. The outside world, particularly those countries adjacent to warring nations, must cope with the huge influx of displaced persons, and action needs to be implemented to help those still in the country suffering from the impact of the war. In many cases, the so-called rationale for the aggressive action is spurious. One suspects that had the billions of dollars that were spent on the wars in Iraq, Vietnam, and Afghanistan been put into humanitarian and public health support, it would probably have achieved a greater goal and more goodwill, not only on the part of the nations involved, but globally. The world must find a better way to resolve international conflicts.

Ethics in public health

Although ethics is implicit in the delivery of public health, it was only after the Second World War and the recognition that 'scientific experiments' in Nazi Germany violated human rights that an emphasis was placed on recognizing the ethics of public health actions, particularly research. The Declaration of Helsinki (World Medical Association 2002), the Belmont Report (US National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1978), and the Council for International Organizations of Medical Science (CIOMS 2002) have promulgated ethical guidelines for research and the establishment of institutional review boards worldwide to ensure that medical and/or public health research is conducted ethically and does not violate human rights. However, there are inherent ethical conflicts in many public health actions. For example, the human rights of 'typhoid Mary', a typhoid carrier who insisted on working as a cook, were violated when she was incarcerated to prevent her from preparing food that initiated epidemics. Protecting the human rights of a man to refuse testing for HIV may result in his unknowingly infecting his wife, yet-to-be-born children, and other sexual contacts. By protecting his human rights, the human rights of his wife or partner and future family will be violated.

Implementing public health programmes and research often results in ethical conflicts and the need to balance the good of society against potential harm to the individual. It is usually necessary to inform society, particularly those who will be involved in the public programme or research, about the nature of the ethical conflicts inherent in action. For example, a trial evaluating the effectiveness of prophylactic treatment to prevent HIV infection in sex workers in Cambodia was stopped by the prime minister, who felt that the prevention trial exploited Cambodian sex workers. A more intense effort on the part of the researchers to inform the public and politicians about the nature of the study and the potential benefit to sex workers, not only in Cambodia but everywhere, might have averted this unfortunate outcome.

Public health interventions

One important task of public health professionals is to raise the level of anxiety of the public about public health problems to the level at which they will be willing to take an appropriate action. Raising the level of anxiety efficiently will result in inadequate or no action. On the other hand, raising the level too high will promote a fatalistic attitude and, as in the case of the recent HIV/AIDS epidemic, may promote stigmatization and isolation of affected individuals, seriously complicating the task of intervention. The difficulty for the public health professional is creating the level of anxiety that results in the required action.

Public health interventions can be divided into four categories: social/biologic/environmental, behavioural, political, and structural. The public health professional must use strategies in all four categories to achieve the maximum health of the public.

Social, biologic, and/or environmental interventions

The strategy that has had the greatest impact on improving the health of the public has been an improved standard of living, including provision of clean water and safe disposal of wastes. Unfortunately, these interventions have not reached much of the world where crowding, unsafe and insufficient water, and accumulation of wastes, and a lack of economic development persist.

The most cost-effective biologic intervention strategy is immunization, in part because it requires minimal behavioural change and usually only a single action. The WHO has taken the lead in promoting vaccine coverage worldwide through its Expanded Programme on Immunization. The appropriate use of vaccines has virtually eliminated the majority of childhood infections from the developed countries and significantly reduced them in most developing countries. Smallpox, a major infectious disease problem until the latter half of the twentieth century, has now been eliminated. We are well on our way to eliminating polio, but more challenges, such as hepatitis and tuberculosis, remain. Next may be measles. However, it is important to realize that development and production of a vaccine is only the first step. An effective vaccine against smallpox was available for over 150 years before smallpox was eliminated. The key was the strategy of vaccine coverage, 'search and contain', that permitted global elimination of the disease. Thus, the strategy for utilizing the vaccine is perhaps equally important as the efficacy of the vaccine itself.

Another biologic strategy is to eliminate the vectors of disease, the major approach currently in use for the control of dengue, arboviral diseases, and many of the parasitic diseases. However, overzealous use of pesticides can also create problems. For example, dichloro-diphenyl-trichloroethane (DDT), used widely in the twentieth century as an insecticide, still contaminates the food supply, creating other health problems, including the risk of malignancy.

Treatment can also be considered a biologic intervention strategy. To confront tuberculosis, one of the major infectious diseases of the twenty-first century, directly observed treatment short course (DOTS) has been successfully implemented in countries where the disease persists. Treatment of sexually transmitted infections and contacts is a major strategy for control of transmission, but has yet to prove effective in stopping the current epidemic.

Behavioural interventions

Most public health interventions depend ultimately on behaviour, whether it is personal or community behaviour. At the personal or individual level, promotion of good health habits and avoidance of smoking, excess alcohol use, and other dependency disorders are important interventions that have a major impact on health. At the community level, attitudes towards acceptable sexual behaviour and persons with dependency disorders and stigmatizing diseases are key to establishing community 'norms' that promote a healthy lifestyle and include all segments of society. However, modifying individual behaviour and community norms is difficult; it is even more difficult to ensure persistence of the modified behaviour. Yet, the majority of the public health interventions will not be successful unless they are embraced and sustained by the community at the local, national, and international levels. The success of the antismoking campaigns in the United States and Britain and population control in China (the one-child policy) affirm that it is possible to change community norms.

Many theories identifying strategies to modify behaviour have been proposed. One of the most interesting is the Popular Opinion Leader model proposed by Jeffrey Kelly (2004), which utilizes the natural leaders found in any social group as agents of change. In the United States, this strategy has been demonstrated to change behaviour in groups of men who have sex with men, and is now being evaluated in other populations worldwide.

Political interventions

Public health *is* politics. Any process that involves obtaining the support of the public will involve politics and differing points of view. For example, the campaign to stop smoking was strongly opposed by the tobacco industry, which spent millions of dollars trying to counter the many reports on the adverse health effects of smoking. Countering the efforts of the tobacco industry required obtaining the political support of the public in order to pass laws and regulations limiting smoking, placing health warnings on cigarette packages, and raising taxes on cigarettes.

If we are to succeed in safeguarding the oceans, inland waters, and the air we breathe, it will be through the political process. This process has already begun in many of the developed countries, which have passed strong laws regulating the emissions from automobiles and factories. Now this process must be expanded to the developing countries, where the worst pollution is currently occurring.

One of the most urgent issues before the public today is the battle over emission of 'greenhouse gases', which are causing a rise in temperatures globally. This temperature rise will adversely affect the quality of life of our children, grandchildren, and their grandchildren. Unfortunately, we have not yet achieved the political will to take the necessary steps to reverse this detrimental warming trend. The United States, the richest, most politically powerful nation in the world, even refuses to sign an international treaty signed by many other nations to address this problem.

It is important that the political process to improve the health of the public be based on sound scientific evidence. Pushing agendas not based on sound scientific evidence will undermine the credibility of public health professionals and our ability to accomplish our legitimate goals. Obtaining this evidence is not always easy. For example, accumulating evidence on the long-term (induction period of years to decades) impact of adverse exposures is not

easily established, and often requires extrapolation from data on the impact of acute high-dose exposures to lower doses. This often requires relying on models, which are difficult for the public to understand, and are often subject to debate within the scientific community.

Structural interventions

The end result of the political process is the passage of laws and regulations. This action, if implemented, can have a very significant impact on the improvement of the health of the public. For example, the law reducing the maximum speed in California from 65 to 55 miles per hour had a significant impact on lowering the automobile fatality rate; unfortunately, this lower speed limit has been reversed. The passage and enforcement of helmet laws for motorcycles in Indonesia has reduced the incidence of associated brain injuries and deaths. The incidence of lung cancer and heart disease among men in California has been significantly reduced, probably due to the laws regulating smoking and the high taxes imposed on cigarettes. Many of the current public health problems of the world, particularly those involving protection of the environment, can be addressed through structural changes requiring passage and implementation of laws and regulations. To accomplish this will require changing the attitudes and behaviour of the public.

Private support of public health

Private support has played an important role in the development of public health, especially in the twentieth century. The Rockefeller Foundation supported the first school of public health in the United States at Johns Hopkins University; set up the International Health Commission in 1913; established the China Medical Board in 1914, which established the first public health university in China, the Peking Union Medical College, in 1921; and has continued to contribute to global health since its founding in 1913 (Berman 1983; Brown 1979). Other foundations, including the Ford Foundation, the Carnegie Foundation, and the Robert Wood Johnson Foundation, have made similar significant contributions to public health.

Private support of public health has been implemented through three strategies: establishment of charitable foundations by industry; development of international, national, and local non-governmental organizations (NGOs); and direct contributions by industry. Each makes and can continue to make a significant contribution to the health of the public.

Foundations have contributed enormously to the advancement of public health, but most often identify their own priorities for funding. Usually they provide support for important public health needs, but foundations and public health leaders do not always agree on what the most important priorities are. Thus, massive infusions of money into public health by organizations such as the Gates Foundation, which makes contributions to fight HIV, malaria, and tuberculosis, can have a significant positive impact, but they also tend to influence public health priorities. Some argue that developing strong public health infrastructures in developing countries will have a much greater impact on improving health than focusing funds on specific health issues (Garrett 2007).

NGOs tend to focus on specific health problems (e.g. American Cancer Society), specific health issues such as refugee health or medical care for the underserved (e.g. Doctors without Borders), and specific populations (e.g. drug users and sex workers). Often they can be more effective in reaching vulnerable populations and specific health problems and issues because they are closer to the problem than health professionals who must confront a broad range of concerns. Public health programmes can increase their cost-effectiveness by cooperating with NGOs in addressing specific issues, health problems, and populations.

Industry is often viewed as part of the problem. Certainly, industry is frequently the source of public health problems (e.g. air and water pollution). On the other hand, economic development can lead to an improved economic situation that reduces poverty and benefits all of society. However, industry, particularly the advertising industry, has clearly demonstrated that they are better at creating demand and influencing lifestyles than public health. Thus, it would behoove public health to learn from industry and to work with industry to develop and implement healthy economic growth, while safeguarding the environment and benefiting the public.

Private support has greatly benefited public health in the twentieth century. The challenge for the twenty-first century is for public health and private support to agree on the most effective use of private funds for achieving public health goals.

The future of public health

Public health does not lack challenges requiring solutions; emerging infections will continue to present new problems. Public health professionals recognize the threat that H5N1 influenza may mutate to cause human-to-human transmission, but given a virus as labile as influenza, other pandemics are also likely to occur. Early recognition of new strains by genetic monitoring of circulating influenza viruses will help.

An increasing proportion of the world's population will live to be old. We have been successful at adding 'years to life', but chronic diseases such as Alzheimer's have reduced the quality of life of the years of life added. We must now concentrate on adding 'life to years', helping older people to continue to be productive.

We cannot afford to continue to ignore the quality of the environment. Continuing contamination of the air and water will not only cause and/or exacerbate chronic and infectious diseases, but will rob us of important sources of food. Addressing these problems will require eliciting the political will and commitment of the public and changes in lifestyle. Unchecked population growth will further exacerbate the problem of protecting the environment.

Despite the economic and health advances of the past century, disparities between the rich and the poor are widening. This gap must be narrowed if not eliminated, not at the expense of those who are better-off, but by improving the economic situation and health of the poor and disadvantaged.

Injuries and violence are robbing an increasing number of people of their ability to function and to enjoy a reasonable quality of life. Injuries can be easily prevented through a variety of preventive strategies, including better design of the workplace and tools such as ladders, but also include implementing behavioural and structural strategies. Violence and war represent greater challenges, and will most likely require new strategies not hitherto widely used in public health.

We in public health know what needs to be done to significantly reduce chronic diseases such as cardiovascular diseases, stroke, and

cancer, but we need to develop more effective ways to change behaviour and promote healthy lifestyles.

We have made tremendous strides to improve the health of the public, but the challenge to do better remains. In subsequent chapters, public health experts discuss the challenges and potential solutions in detail.

References

Acheson E.D. On the state of the public health [the fourth Duncan lecture]. *Public Health* 1988;**102**(5):431–437.

Berman E.H. *The ideology of philanthropy: the influence of the Carnegie, Ford, and Rockefeller foundations on American foreign policy*. New York (NY): University of New York Press; 1983.

Breslow L., Breslow N. Health practices and disability: some evidence from Alameda County. *Preventive Medicine* 1993;**22**:86–95.

Brown E.R. *Rockefeller medicine men: medicine and capitalism in America*. Berkeley (CA): University of California Press; 1979.

Chow C.K, Raju R. The prevalence and management of type 2 diabetes in India. *Diabetes Care* 2006;**29**:1717–1718.

Council for International Organization of Medical Sciences (CIOMS). *International ethical guidelines for biomedical research involving human subjects*. Geneva: World Health Organization; 2002.

Department of Health and Human Services, National Center for Health Statistics, *Health, United States, 1999*. Washington (DC): US Government Printing Office; 1999.

Detels R., Rokaw S.N., Coulson A.H. *et al*. The UCLA population studies of chronic obstructive respiratory disease: I. Methodology and comparison of lung function in areas of high and low pollution. *American Journal of Epidemiology* 1979;**109**(1):33–58.

Garrett L. The challenge of public health. *Foreign Affairs;* 2007 Jan/Feb.

Gauderman W.J., Vora H., McConnell K. *et al*. Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study. *Lancet* 2007;**369**:571–577.

Sigerist H.E. *A History of Medicine*. Oxford and New York: Oxford University Press, 1958–1961.

International Labour Organization. Report of the 15th World Congress on Occupational Safety and Health. [Online]. 1999. Available from: http://www.ilo.org/public/english/bureau/inf/pr/1999/9.htm [accessed 2007 May].

Kaneda T. Percentage of elderly (ages 65 and over) by country, 2000 and 2050. [Online]. Population Reference Bureau. Available from: http://www.prb.org/Articles/2006/ACriticalWindowforPolicymakingonPopulationAgingin DevelopingCountries.aspx [accessed 2007 May].

Kelly J.A. Popular opinion leaders and HIV prevention peer education: resolving discrepant findings, and implications for the development of effective community programmes. *AIDS Care* 2004;**16**(2):139–50.

Kuo C.C, Campbell L.A. Detection of Chlamydia pneumoniae in arterial tissues. *Journal of Infectious Diseases* 2000;**181**:S432–S436.

Lopez A., Mathers C., Ezzati M., Jamison D., Murray C. Global and regional burden of disease and risk factors, 2001: a systematic analysis of population health data. *Lancet* **367**(9524):1747–1757, 2007.

Lee S.H. The SARS epidemic in Hong Kong. *Journal of Epidemiology and Community Health* 2003;**57**(9):652–4.

Lopez A.D, Mathers C.D, Ezzati M. *et al*. Global burden of disease and risk factors. In: *Disease control priorities project*. Oxford: Oxford University Press; 2006.

MacKenzie W.R., Hoxie N.J., Proctor M.E. *et al*. A massive outbreak in Milwaukee of cryptosporidium infection transmitted through the public water supply. *New England Journal of Medicine* 1994;**331**:161–7.

Mathers C.D., Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. [Online]. *PLoS Medicine* 2006;**3**(11):e442.

McGinnis J.M., Foege W.H. Actual causes of death in the United States. *Journal of the American Medical Association* 1993;**270**:2007–2012.

Merson M.H., Black R.E., Mills J.E., eds. *International public health*. 2nd edn. Sudsbury (MA): Jones & Bartlett; 2006. p. 326.

Murray C.J.L., Lopez A.D. A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990, and projected to 2020. In: *The global burden of disease*. Cambridge (MA): Harvard University Press; 1995. vol 1.

Murray C.J.L., Lopez A.D. (eds). The global burden of disease. In: *The global burden of disease*. Cambridge (MA): Harvard University Press; 1996. (Global burden of disease and injury series; vol 1).

Office of the Director, National Public Health Performance Standards Program. *10 essential public health services*. [Online]. Centers for Disease Control; 1994. Available from: http://www.cdc.gov/od/ocphp/nphpsp/EssentialPHServices.htm

Pan American Health Organization. *Essential public health services*. [Online]. 2002. Available from: http://www.sopha.cpha.ca/english/ephf_e.html

Petersen P.E. Inequalities in oral health: the social context for oral health. In: *Community oral health*. 2nd edn. London: Quintessence Publishing; 2007. p. 38–39.

Pine C., Harris R. *Community oral health*. London: Quintessence Books; 2007.

Population Projections. *Health Affairs;* 2000 May/June.

United States Census Bureau. *International database.* [Online]. 2006. Available from: http://www.census.gov/ipc/www/idbnew.html [accessed 2007 May].

US National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. *The Belmont report*. Washington (DC): US National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research; 1978.

WHO Oral Health Program. [Online]. Sweden: Malmo University; 2004. Available from: http://www.whocollab.od.mah.se/index.html [accessed 2007 May].

World Health Organization. *Atlas mental health resources in the world, 2001*. [Online]. 2001. Available from: http://whqlibdoc.who.int/whr/2001/WHR_2001.pdf [accessed 2007 May].

World Health Organization. Causes of chronic diseases. [Online]. 2005. Available from: http://www.who.int/chp/chronic_disease_report/contents/part2.pdf [accessed 2007 May].

World Health Organization. Indicators for Policy and Decision Making in Environmental Health. Geneva, Switzerland: WHO; 1997.

World Health Organization. *Injury Report.* [Online]. 2004. Available from: http://www.wpro.who.int/internet/templates/HLT_Topic.aspx?NRMODE=Published&NRORIGINALURL=%2Fhealth_topics%2Finjuries_and_violence_prevention%2F&NRNODEGUID=%7BF17BB93C-267E-49F1-B089-F4C4710AED39%7D&NRCACHEHINT=NoModifyGuest [accessed 2007 May].

World Health Organization. Main causes of death and global burden of disease (DALYs), world, all ages, projections for 2005. [Online]. Available from: http://www.who.int/chp/chronic_disease_report/contents/part2.pdf [accessed 2007 May].

World Health Organization. Neglected tropical diseases—hidden successes, emerging opportunities. [Online]. 2006. Available from: http://whqlibdoc.who.int/hq/2006/WHO_CDS_NTD_2006.2_eng.pdf [accessed 2007 May].

World Health Organization. Trends in global years of life lost (YLL) per 1,000 population, by broad cause group and income group, 2002–2030. [Online]. 2005. Available from: http://www.who.int/healthinfo/statistics/bodprojectionspaper.pdf [accessed 2007 May].

World Health Organization. *World Health Report, 2001*. Geneva: World Health Organization; 2001.

World Medical Association. *Declaration of Helsinki*. 5th revision. Washington (DC): World Medical Association; 2002.