1.1 The scope and concerns of public health

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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 biological sciences, 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, to evaluate their effectiveness. Public health is a global issue, and will become even more so in the 21st century, as the interconnectedness of nations increases through modern communication, resulting in the need to deal with epidemics of communicable and non-communicable diseases and environmental issues that require transnational solutions. Thus, public health must address the challenge of confronting health problems and political, social, and economic factors affecting health, not only at the community, state, and national levels, but at the global level as well.

In this chapter, we introduce the reader to the scope and current major concerns of public health as we enter the 21st century, giving examples of each. It is the goal of this chapter to assist the readers in understanding the conceptual framework of the field, which will help them in placing the subsequent more detailed chapters into the context of the entire field of public health (1).

Introduction

There have been many definitions and explanations of public health. The definition offered by the Acheson Report (1) 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 the mere 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

Public health is concerned with the process of mobilizing local, state/provincial, national and international resources to assure the conditions in which all people can be healthy (2). To successfully implement this process and to make health for all achievable public health must perform the functions listed in Table 1.1.1.

Table 1.1.1 Functions of public health

1. Prevent disease and its progression, 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)

Public health *identifies, measures*, and *monitors* community and global health needs through surveillance of disease and risk factor (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.

Comment [u1]: And global health needs and trends. See comment U2 above.

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 is an essential function of public health at the local, national, and global levels.

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*, coordinate, 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. 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.

Comment [u2]: And coordination, where necessary and possible, with relevant international programmes and initiatives (eg vaccine programmes)

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 locally and globally. 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, promote adoption of behaviours associated with good health outcomes, and stimulate the community* to take appropriate actions to ensure 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 and other natural disasters.

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 and anticipating health problems and the optimal strategies for confronting them. 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. The explosive growth in use of the internet and social media and the widespread use of mobile phones is generating massive amounts of new data that can give valuable insights pertinent to public health, but using these new tools effectively presents a challenge which will require formulation of new strategies and methodologies. 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.

A major problem in public health has been translating research advances into health practice and policy in a timely manner. A new area of research, *implementation science*, has been proposed to delineate barriers to and factors that facilitate rapid translation of scientific advances into improvements in health practice and development of more effective policies promoting health.

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.

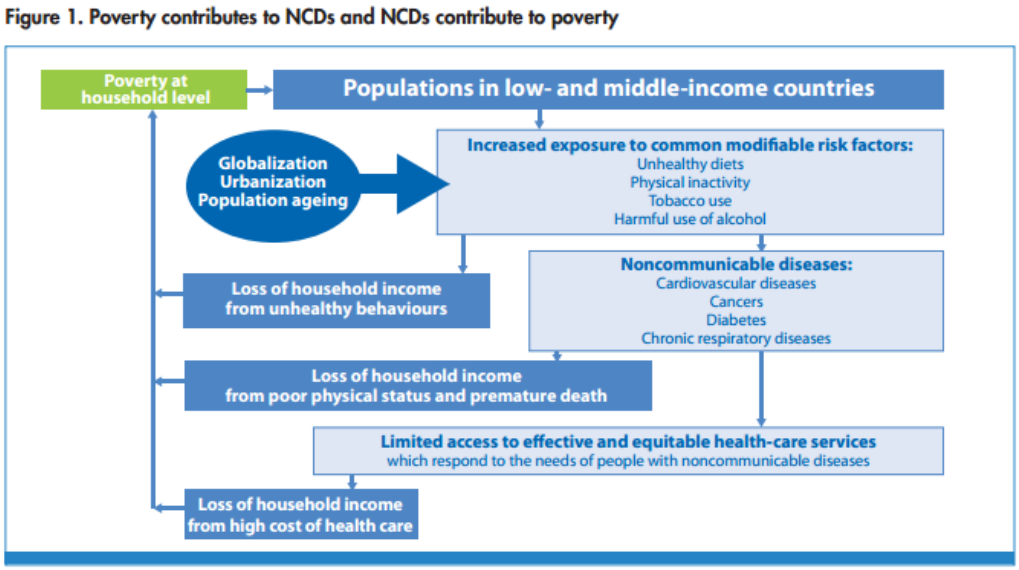
Contemporary health issues

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, and 22% of the population in developing countries lives on less than $1.25 per day (3). Although the majority of the world's poor live in developing countries, there are many poor living in the wealthiest countries of the world—

Comment [u3]: Suggest to put this as a separate point and para with data to show the growing income disparity is one of the most severe issues experienced by most countries in the past decade. This could lead to reduced access to health services and poor health-behaviours, in some countries into the de facto creation of 2-tier health systems determined by affordability. [References]

underscoring the disparity of wealth between the poor and the rich in all countries. In the United States, 39.8 million Americans were living below the official poverty level in 2008. The proportion was highest among African-Americans (24.7%) and Hispanic-Americans (23.2%). Unfortunately, the disparity between the rich and the poor is increasing within countries (4). 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. Poverty causes a cascade of problems leading to poor health (Figure 1.1.1).

Figure 1.1.1. From poverty to disease



http://www.who.int/nmh/publications/ncd_report_full_en.pdf

The 20th century witnessed the transition of major disease burdens, defined by death, from infectious and/or communicable diseases to non-communicable diseases. In 1900, the leading cause of death in the United States and other developed countries was reported to be pneumonia and influenza. By the beginning of the 21st century diseases of the heart and other chronic diseases were the leading cause of death, pneumonia and influenza had dropped to seventh place, primarily affecting the elderly (Tables 1.1.2 and 1.1.3). 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 20th century; public efforts to reduce crowding and improve housing, improve nutrition, and provision of clean water and safe disposal of wastes were key to reducing communicable diseases.

healthy

Table 1.1.2. Leading causes of death in the United States (1900, 1950, 1990, 1997, 2001, 2011)

	1900	1950	1990	1997	2001	2011
Diseases of the heart	167	307	152	131	248	180

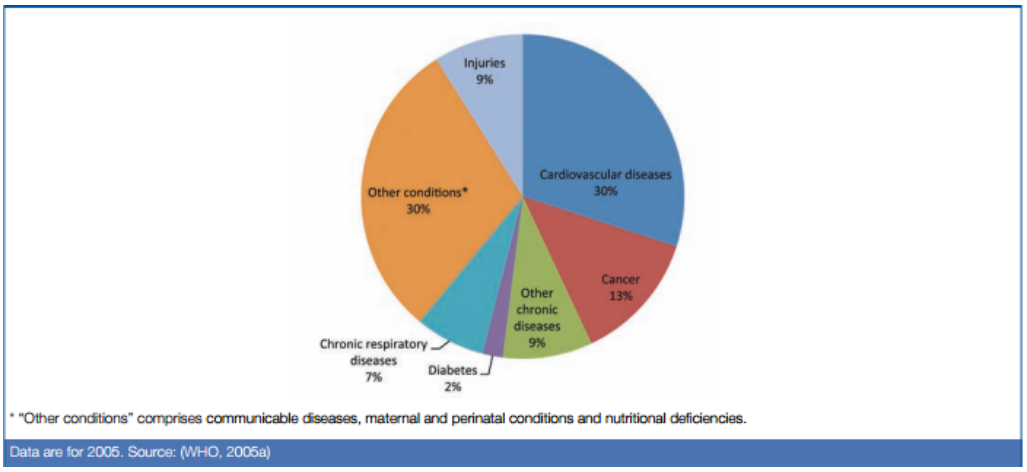
Malignant neoplasms	81	125	135	126	196	174
Cerebrovascular disease	134	89	28	26	58	39
Chronic obstructive lung diseases	—	4	20	13	44	42
Motor vehicle injuries	—	23	19	16	15	37
Diabetes mellitus	13	14	12	13	25	21
Pneumonia and influenza	210	26	14	13	22	16
HIV infection	—	—	10	6	5	3
Suicide	11	11	12	11	10	12
Homicide and legal intervention	1	5	10	8	7	6
Alzheimer's disease	--	--	--	--		23

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; U.S. Centers for Disease Control & Prevention.

By 1980, many leading public health figures felt that infectious diseases had been eliminated as a primary concern for public 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, the sudden acute respiratory syndrome (SARS) outbreaks in the early 2000s, demonstrated the fallacy of their thinking, as do the persisting high rates of infectious diseases in Africa. Although infectious and/or communicable diseases persist as a major public health concern, globally, even in poor, developing countries, chronic diseases have become the major health problem, accounting for 70% of deaths globally (Table 1.1.3). Nearly 80% of the deaths due to non-communicable or chronic diseases in 2008 occurred in developing countries, in part because many more people live in low- and middle-income countries than in high-income countries (5). The age-standardized death rate due to non-communicable diseases among males in low- and middle-income countries was 65% higher, and among females, 85% higher than for men and women in high-income countries. This figure is particularly disturbing because low- and middle-income countries have far fewer resources and capacity for confronting the epidemic of non-communicable diseases. Communicable diseases, however, still accounted for 30% of the burden of disease worldwide (Fig.1.1.2), but caused a majority of deaths only in Africa. The majority of communicable diseases are now preventable through vaccines, improved sanitation, behavioural interventions, and better standards of living.

Comment [u4]: Global burden of NCDs shifting rapidly to developing world, particularly Asia.

Figure 1.1.2



Bloom, D.E., et al. The Global Economic Burden of Noncommunicable Diseases. Geneva: World Economic Forum, 2011.

Table 1.1.3. Top ten causes of death worldwide, 2008

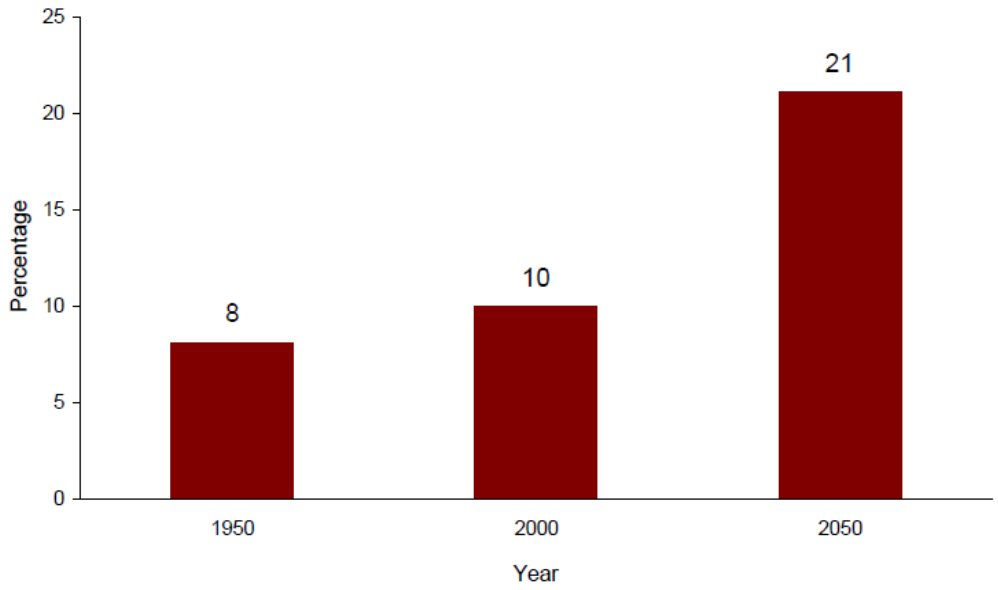
World	Deaths in millions	% of deaths
Ischaemic heart disease	7.25	12.8%
Stroke and other cerebrovascular disease	6.15	10.8%
Lower respiratory infections	3.46	6.1%
Chronic obstructive pulmonary disease	3.28	5.8%
Diarrhoeal diseases	2.46	4.3%
HIV/AIDS	1.78	3.1%
Trachea, bronchus, lung cancers	1.39	2.4%
Tuberculosis	1.34	2.4%
Diabetes mellitus	1.26	2.2%
Road traffic accidents	1.21	2.1%

http://www.who.int/mediacentre/factsheets/fs310/en/index.html

Compounding the global shift to non-communicable diseases is the rapidly rising age of populations in many countries due to increased longevity and dramatically decreased birth rates (Figure 1.1.3) (6). Population growth is already below replacement in many countries, including China, Japan, and Italy. This demographic shift will increase the burden of chronic disease in these countries and place increasing demand on the resources needed to maintain the health of the population. Further, the proportion of the population in the productive ages will decrease as the need for resources to treat the elderly increases. The low- and

middle-income countries in particular will be affected by the aging of their populations.

Figure 1.1.3. Proportion of population 60 years or older: world, 1950-2050



http://www.un.org/esa/population/publications/worldageing19502050/pdf/62executivesummary_english.pdf

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 20th century have been 'years of productive life lost' (YPLL) (7) and 'disability-adjusted life years' (DALYs) (8). 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. 1.1.4).

Comment [u5]: This whole section fine, only needs updating of figures and data.

Using death to identify disease priorities, the leading cause is non-communicable diseases, which account for 70% of diseases worldwide (Fig. 1.1.2). Among the chronic diseases, cardiovascular diseases account for half of the deaths. 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. 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.

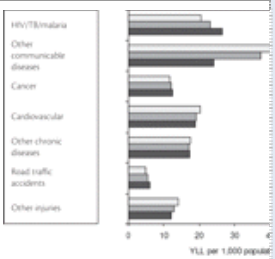


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Figure 1.1.4.
Trends in global years of life lost (YLL) per 1000 population, by broad cause group and income group, 2002–2030 (2005).
Source: Mathers C.D., Loncar D. *Updated projections of global mortality and burden of disease, 2002–2030: data sources,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

DALYs and years of life lost (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. The WHO has projected that the ranking of total DALYs for neuropsychiatric disorders, injuries, and non-communicable and/or chronic diseases will increase by 2020, whereas the ranking for communicable diseases will decline. Communicable diseases, which currently account for 40% of the DALYS, are expected to decline to 30% by 2030 (9).

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 non-communicable 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, better health habits, and better drugs to sustain life with these conditions.

Communicable diseases

Many new vaccines against infectious agents have been and are being developed and many have become more affordable. 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 affecting willingness to accept vaccination, logistical problems, civil unrest

Comment [u6]: More vaccines available, many at affordable rates, but many barriers still exist such that overall coverage rates remain variable.

and wars, corruption, 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. Table 1.1.4 below presents worldwide mortalities due to infectious diseases.

Table 1.1.4

Worldwide mortality due to infectious diseases[10][11]

Rank	Cause of death	Deaths 2002 (in millions)	Percentage of all deaths	Deaths 1993 (in millions)	1993 Rank
N/A	All infectious diseases	14.7	25.9%	16.4	32.2%
1	Lower respiratory infections[12]	3.9	6.9%	4.1	1
2	HIV/AIDS	2.8	4.9%	0.7	7
3	Diarrheal diseases[13]	1.8	3.2%	3.0	2
4	Tuberculosis (TB)	1.6	2.7%	2.7	3
5	Malaria	1.3	2.2%	2.0	4
6	Measles	0.6	1.1%	1.1	5
7	Pertussis	0.29	0.5%	0.36	7
8	Tetanus	0.21	0.4%	0.15	12
9	Meningitis	0.17	0.3%	0.25	8
10	Syphilis	0.16	0.3%	0.19	11
11	Hepatitis B	0.10	0.2%	0.93	6
12-17	Tropical diseases (6)[14]	0.13	0.2%	0.53	9, 10, 16-18
Note: Other causes of death include maternal and perinatal conditions (5.2%), nutritional deficiencies (0.9%), noncommunicable conditions (58.8%), and injuries (9.1%).					

http://en.wikipedia.org/wiki/Infectious_disease

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 (10).

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 animal feed have all contributed to the emergence of these new diseases. Table 1.1.5 lists many of the new diseases that have been recognized since 1980, and Table 1.1.6 lists the factors that contribute to the emergence of these new agents and disease threats.

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Figure 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 1.1.5. Newly identified infectious diseases and pathogens

Year	Disease / pathogen
2004	H1N1 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.

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.

Table 1.1.6. 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.
   People living in close proximity to domestic animals, poor animal husbandry in many parts of the developing world leading to zoonotic infections.
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.

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 (11). 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 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. Unless the world faces the consequences of not protecting the environment in which we live, newly emerging diseases will continue to plague us.

Non-communicable diseases

With increasing control of communicable diseases and increasing lifespan, non-communicable diseases have emerged as the major global health problem in both developed and developing countries. Even in developing countries, non-communicable diseases have assumed greater importance. The prevalence of type 2 diabetes in rural India is 13.2% (12). Cardiovascular diseases have become a major cause of death in China. During 2000-2008, the incidence of stroke in low- and middle-income countries exceeded that in high-income countries by 20% (13).

Comment [u7]: In many developing countries, NCDs now are responsible for greater mortality and disease burden than CDs. Data update required.

The causes of non-communicable diseases are many and complex. 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. WHO estimated that insufficient physical activity contributed 3.2 million deaths and 32.1 million DALYs in 2008, and that obesity contributed to 2.1 million deaths and 35.8 DALYs globally (5). Some non-communicable diseases have been associated with infectious disease agents. For example, *Chlamydia pneumoniae* has been implicated in the development of atherosclerosis (14), hepatitis C as a leading cause of hepatocellular (liver) cancer, and human papilloma virus (HPV), as a cause of cervical cancer. Recently, an effective vaccine has been developed, which protects against cervical cancer, but it is expensive and must be administered before sexual activity begins (i.e., early adolescence).
Figure 1.1.6. shows global distribution by gender of non-communicable diseases.

Comment [u8]: Need to review recent data which I believe have not advanced this association.

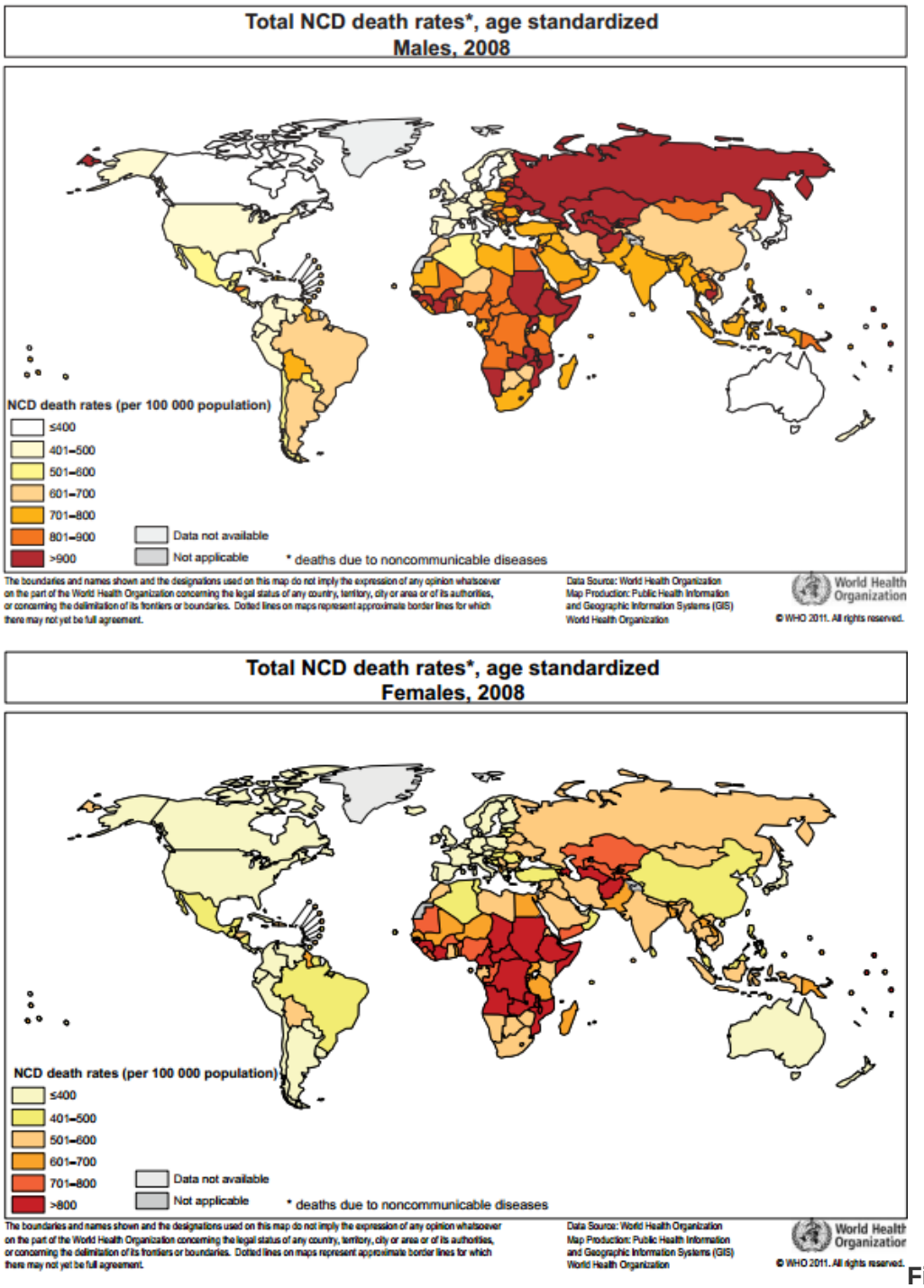

Figure 1.1.6. Global distribution of non-communicable diseases (2008)

Another aspect of non-communicable 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 non-communicable diseases can be reduced by a combination of healthy behaviours, including not smoking, moderate alcohol use, and exercise (15). Many developed countries have been promoting healthy lifestyles, but there is need for greater 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% of the world's population suffers from mental illness at any given time, and that mental illness represents 13% of the global burden of disease (16) (Table 1.1.7). Mortality rates seriously underestimate the burden of mental health on society. The true extent of mental illness is probably greater—only 73% of countries have a formal mental health reporting system, and only 57% have done epidemiologic studies or have data collection systems for documenting mental illness (17).

Comment [u9]: Need data update.

Table 1.1.7. Global burden of mental, neurological and substance-use (MNS) disorders[*]

Rank	Worldwide		High-income countries[†]		Low- and middle-income countries	
	Cause	DALYs[‡] (millions)	Cause	DALYs (millions)	Cause	DALYs (millions)
1	Unipolar depressive disorders	65.5	Unipolar depressive disorders	10.0	Unipolar depressive disorders	55.5
2	Alcohol-use disorders	23.7	Alzheimer's and other dementias	4.4	Alcohol-use disorders	19.5
3	Schizophrenia	16.8	Alcohol-use disorders	4.2	Schizophrenia	15.2
4	Bipolar affective disorder	14.4	Drug-use disorders	1.9	Bipolar affective disorder	12.9
5	Alzheimer's and other dementias	11.2	Schizophrenia	1.6	Epilepsy	7.3
6	Drug-use disorders	8.4	Bipolar affective disorder	1.5	Alzheimer's and other dementias	6.8
7	Epilepsy	7.9	Migraine	1.4	Drug-use disorders	6.5
8	Migraine	7.8	Panic disorder	0.8	Migraine	6.3
9	Panic disorder	7.0	Insomnia (primary)	0.8	Panic disorder	6.2
10	Obsessive–compulsive disorder	5.1	Parkinson's disease	0.7	Obsessive–compulsive disorder	4.5
11	Insomnia (primary)	3.6	Obsessive–compulsive	0.6	Post-traumatic stress disorder	3.0

Rank	Worldwide		High-income countries[†]		Low- and middle-income countries	
	Cause	DALYs[‡] (millions)	Cause	DALYs (millions)	Cause	DALYs (millions)
			disorder			
12	Post-traumatic stress disorder	3.5	Epilepsy	0.5	Insomnia (primary)	2.9
13	Parkinson's disease	1.7	Post-traumatic stress disorder	0.5	Multiple sclerosis	1.2
14	Multiple sclerosis	1.5	Multiple sclerosis	0.3	Parkinson's disease	1.0

Nature. 2011 July 6; 475(7354): 27–30.

[†]World Bank criteria for income (2009 gross national income (GNI) per capita): low income is US$995 equivalent or less; middle income is $996–12,195; high income is $12,196 or more.

Global provisions for treatment of mental illness are still significantly below what is necessary to adequately address the problem. Of those with mental illness in developing countries, 76-85% do not have access to appropriate care (18). Although 87% of the world's governments offer some mental health services at the primary-care level, 30% of them have no relevant programme, and 28% 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 projections

Although the rate of growth of the world's population has slowed in the latter half of the 20th century, the world's population, currently over 7 billion people, is estimated to grow to 9 billion by 2050. The growth in the population will be mostly among the elderly and the old elderly (those over 80 years of age).

The well-being of society is dependent on the ratio of those who produce to those who are dependent. Improved technology and strategies will be required to increase worker productivity, because the majority of the population growth in the coming decades will be among the old and old elderly, not through increasing birth rates, and 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 65 years and over was 8%; by 2050, it will be at least 30% (19). 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. The productivity and efficiency of those who produce must increase if we are to sustain and improve the quality of life for all.

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 healthy lifestyles are successful, not only will there be an increase in the proportion of elderly, but also an increasing proportion of them will require assistive care, placing a further economic and social burden on families and society.

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, commercial or industrial use. 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, especially in light of global warming?

Other public health issues

Nutrition

Appropriate nutrition is essential for health. In many developing countries (as well as among the poor and homeless in developed countries), under-nutrition is a problem. Although access to nutritious and safe food is a problem, many of the poor have little knowledge about what constitutes a healthy diet, compounding the problem. In developed and many rapidly developing countries such as China, over-nutrition and obesity are a major problem. We in public health have failed to counter the barrage of advertising, particularly for fast but unhealthy food. Industries such as McDonald's have been far more successful in promoting unhealthy foods than we have in promoting health foods and reasonable quantities. The food industry has been particularly successful in targeting youth, leading to a major problem in childhood obesity in many countries, including the more affluent in developing countries.

Oral health

Worldwide, 60-90% of school children and nearly 100% of adults have dental cavities. About 30% of adults 65-74 years have no natural teeth. 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 (20). These high rates of dental problems reflect poor dental hygiene and preventive care (21). Unfortunately, many people believe that dental care is an expendable luxury, and that visits to dentists are only necessary when there is a problem. Oral cancers are the 6th most common cause of cancer globally. Poor dental hygiene is probably a major reason why the five-year prevalence of oral cancer is estimated to be 6.8% globally (20). 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.

Comment [u10]: Together with betel nut chewing in some countries. Can check on data on the latter.

Injuries

Injuries and violence caused 5.8 million deaths in 2011, of which 1.6 million were due to global violence, 1.3 to traffic accidents, and 844,000 to suicide. 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 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.

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.

Homicide, violence, and suicide

Homicide, violence, and suicide represent a growing problem, particularly among the young. Homicide and suicide are among the leading causes of death globally. 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. The WHO predicts that by 2020, war will become the sixth leading cause of DALYs, violence the twelfth, and self-inflicted injuries the fourteenth.

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 constitutes 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. The list of vulnerable groups includes the poor, minorities, women, children, the elderly, the handicapped, the illiterate, orphans and street children, immigrants, rural-to-urban migrants, 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 should also consider adolescents to be a vulnerable group. Often vulnerable individuals 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 or dysfunctional, 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.

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. This is a particular challenge in respect to persons with handicaps. Many developed countries have made provision for persons with handicaps, but those with handicaps in poorer countries are unable to function in society, and many do not survive.

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).

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.

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 20th century. Murray and Lopez (8) estimated that 1,379,238 DALYs are caused annually by environmental exposures. As the 21st century progresses, 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 21st 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 (22). Recent studies have demonstrated that children living near freeways in Southern California also suffer long-term lung damage (23). Levels of pollutants observed in many developing countries, especially in China and India, are considerably higher than in developed countries. Studies have documented the serious health effects of long-term exposure to the levels of pollutants occurring in China (24,25). However, the true cost of uncontrolled industrialization and pollution in these countries is not known.

Indoor pollution is a particular problem in developing countries where they use coal/charcoal for cooking in poorly ventilated houses, but it is also a problem in wealthier countries in which harmful chemicals are used for cleaning and household construction.

Water pollution

Those who live in developed countries take the provision of safe drinking water for granted, but 40% 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% 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 (26). 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.

Comment [u11]: Suggest to review more recent data on this.

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 21st century will be global warming due to the release of carbon dioxide and other 'greenhouse gases'.

Comment [u12]: Useful to add a para or 2 on the public health risks of nanoparticles, now being increasing used for products ranging from sunscreen to drug-delivery systems.

Comment [u13]: I think we should have a new section on climate change and its potential impact on public health.

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 to confront cultural norms, strong economic interests (e.g. industry), and current attitudes of much of the world's population to take the steps necessary to reduce global warming. 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

Comment [u14]: To review recent data as public opinion has largely moved to accepting that climate change is a reality.

be a part of the process. Determining the level of acceptable risk will probably 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)

The International Labour Organization's Health and Safety Programme estimated that there were 2.3 million work-related deaths, 340 million work-related injuries, and more than 160 million cases of occupational disease annually worldwide (27). In some developing countries, child labour is still the norm. Twelve million of the serious injuries occurred among young workers. This affects 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 in developed countries are 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% 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 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% in Japan and 10% in the United States by 2030 (28). 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. 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. Recently, President Obama and the U.S. Congress implemented the Affordable Care Act, which will extend coverage significantly, but it is vigorously opposed by much of the American public and the Republican political party. 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. However, 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, children are forced to serve as soldiers, 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 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 (29), the Belmont Report (30), and the Council for International Organizations of Medical Science (31) 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, some consider that 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 continuing to prepare 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 globally, 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 too little 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 while minimising unintended consequences.

Comment [u15]: Not clear about the point being made here.

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 20th 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 that 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 20th 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 21st century, directly observed treatment short course (DOTS) has been successfully implemented in countries where the disease persists and reducing transmission and the development of multi-drug-resistant TB organisms. 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. Recently there has been optimism that treatment as prevention can result in control of HIV (32).

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, and accompanied by appropriate regulations and policies. 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 (33), 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.

Comment [u16]: They also work best when supplemented by appropriate policies eg bans on cigarette ads, high import taxes, restriction of smoking places, etc

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 requiring global coordination and action. 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.

Comment [u17]: Should emphasise that this is now extended to the global coordination and governance arena, eg control of epidemic spread requires effective IHRs, etc.

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, even 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 reduced the incidence of associated brain injuries and deaths. The incidence of lung cancer and heart disease among men has been significantly reduced, partly 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 best 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 20th 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 (34,35). Other foundations, including the Gates Foundation, 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 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. 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 (36).

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 addressing 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 greatly benefited public health in the 20th century. The challenge for the 21st century is for public health and private support to agree on the most effective use of private funds for achieving the greatest public health advances.

Social activism

Action by groups within society has led to improvements in the health of the public. Social activism by workers and others in the 19th and early 20th century in England and the United States resulted in improved working conditions for workers in a variety of industries and to the development of the field of occupational health. More recently, social activism by social groups adversely affected by HIV/AIDS led to the policy to provide access to treatment for all with HIV infection and the need to recognize the human rights of marginalized groups in both developed and developing countries. Demands for better health conditions led by society itself are most likely to result in positive changes.

Comment [u18]: We should perhaps consider an extra section here – "social activism". In today's age of internet and social media, campaigns can spread very quickly to many parts of the world. I can't think of a good example for PH offhand (equivalent for eg to the Occupy Wallstreet movement) but worth looking, I think.

The future of public health

Comment [u19]: Perhaps, this is the best place to re-cap the major drivers for the future which I have summarised at the beginning of this paper.

Public health does not lack challenges requiring solutions. Poverty is the major cause of poor health globally, yet income disparities in most countries of the world are growing. Developing countries must continue to cope with infectious diseases while confronting the epidemic of non-communicable diseases, further compounded by the threat of emerging diseases such as new variants of influenza. The rapid development of communication and transportation assures that local problems will quickly become global problems in the future requiring international cooperation. 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 and increasing urbanization 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 in many countries 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. The rising cost of health care will make closing the gap in access to health care even more challenging.

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 present a particularly great challenge, and will require new strategies not hitherto widely used in public health. Public health must contribute to strategies to resolve differences between countries by promoting cross-national and international cooperation in confronting global health problems and by contributing to strategies to implement successful conflict resolution.

Public health must convince people and provide the environment that allows them to adopt healthy lifestyles. The major strategies to combat the current epidemic of non-communicable diseases are regular exercise, a healthy diet, and development of good health habits.

We in public health know what needs to be done to significantly reduce non-communicable 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

1. Acheson E.D. On the state of the public health [the fourth Duncan lecture]. *Public Health*1988;**102**(5):431–437.
2. Detels R, Breslow L. Current scope and concerns in public health. In *Oxford Textbook of Public Health*, ed 4, vol 1. pg 3-20, 2006.
3. WorldBank.org/en/news/2012/world_bank
4. U.S. Census Bureau, 2009.
5. Global status report on non-communicable diseases, 2010. WHO April 2011. ISBN:9789241564229
6. World Population Aging: 1950-2050. United Nations Population Division.
7. 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.
8. 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.
9. Mathers C.D., Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. [Online].*PLoS Medicine* 2006;**3**(11):e442.
10. Lee S.H. The SARS epidemic in Hong Kong. *Journal of Epidemiology and Community Health* 2003;**57**(9):652–4.
11. World Health Organization. Neglected tropical diseases—hidden successes, emerging opportunities. Available from: http://whqlibdoc.who.int/hq/2006/WHO_CDS_NTD_2006.2_eng.pdf [accessed 2007 May].
12. Chow C.K, Raju R. The prevalence and management of type 2 diabetes in India. *Diabetes Care* 2006;**29**:1717–1718.
13. Feigin VL, Lawes CM, Bennett DA, Barker-Collo SL, Parag V. Worldwide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. *Lancet Neurology* 2009; 8(4):355-69.
14. Kuo C.C, Campbell L.A. Detection of *Chlamydia pneumoniae* in arterial tissues. *Journal of Infectious Diseases* 2000;**181**:S432–S436.
15, Breslow L., Breslow N. Health practices and disability: some evidence from Alameda County. *Preventive Medicine* 1993;**22**:86–95.
16. Collins PY, Patel V, Joestl SS, March D, Insel TR, Daar AS; Scientific Advisory Board and the Executive Committee of the Grand Challenges on Global Mental Health, Anderson W, Dhansay MA, Phillips A, Shurin S, Walport M, Ewart W, Savill SJ, Bordin IA, Costello EJ, Durkin M, Fairburn C, Glass RI, Hall W, Huang Y, Hyman SE, Jamison K, Kaaya S, Kapur S, Kleinman A, Ogunniyi A, Otero-Ojeda A, Poo MM, Ravindranath V, Sahakian BJ, Saxena S, Singer PA, Stein DJ. Grand challenges in global mental health. *Nature* **475**(7354):27-30.
17. WHO: Mental disorders affect one in four people http://www.who.int/who/2001/media_centre/press_release/en/index.html
18. World Health Organization. *Atlas mental health resources in the world, 2001*. Available from: http://whqlibdoc.who.int/whr/2001/WHR_2001.pdf [accessed 2007 May].
19. World demographics profile 2012 www.index.mundi.com/world/demographics_profile.htlm
20. WHO Oral Health Program. [Online]. Sweden: Malmo University; 2004. Available from:http://www.whocollab.od.mah.se/index.html [accessed 2007 May]
21. Pine C., Harris R. *Community oral health*. London: Quintessence Books; 2007.

22. 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.
23. 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.
24. Chen B, Hong C, Kan H. Exposures and health outcomes from outdoor air pollutants in China. 2004l;*198*(1-3);291-300
25. Wong CM, Vichit-Vadakan N, Kan H, and Qian Z. Public Health and Air Pollution in Asia (PAPA): a multicity study of short-term effects of air pollution on mortality. *Environmental Health Perspect*ives 2008;116-1202
26. 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.
27. World Statistics. International Labor Organization 2011. www.ilo.org/public/English
28. Population Projections. *Health Affairs* 2000 May/June.
29. World Medical Association. *Declaration of Helsinki*. 5th revision. Washington (DC): World Medical Association; 2002.
30. U.S. National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1978.
31. Council for International Organizations of Medical Sciences, 2002.
32. Cohen J. HIV treatment as prevention. Science 334(6063):1628, 2011.
33. 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.
34. 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.
35. Brown E.R. *Rockefeller medicine men: medicine and capitalism in America*. Berkeley (CA): University of California Press; 1979.
36. Garrett L. The challenge of public health. *Foreign Affairs*; 2007 Jan/Feb.

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

11. Department of Health and Human Services, National Center for Health Statistics, *Health, United States, 1999*. Washington (DC): US Government Printing Office; 1999.
12.
13. Sigerist H.E. *A History of Medicine*. Oxford and New York: Oxford University Press, 1958–1961.
14. 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/ACriticalWindowforPolicymakingonPopulationAgingDevelopingCountries.aspx [accessed 2007 May].
15. -
16. 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.
17. -
18. McGinnis J.M., Foege W.H. Actual causes of death in the United States. *Journal of the American Medical Association* 1993;**270**:2007–2012.
19. Merson M.H., Black R.E., Mills J.E., eds. *International public health.* 2nd edn. Sudsbury (MA): Jones & Bartlett; 2006. p. 326.
20. 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).
21. 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
22. Pan American Health Organization. *Essential public health services.* [Online]. 2002. Available from:http://www.sopha.cpha.ca/english/ephf_e.html
23. 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.
24.
25. United States Census Bureau. *International database*. [Online]. 2006. Available from:http://www.census.gov/ipc/www/idbnew.html [accessed 2007 May].
26. 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.
27. .
28.
29. 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].
30. World Health Organization. Indicators for Policy and Decision Making in Environmental Health. Geneva, Switzerland: WHO; 1997.
31. 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&NRNODE

GUID=%7BF17BB93C-267E-49F1-B089-F4C4710AED39%7D&NRCACHEHINT=NoModifyGuest[accessed 2007 May].
32. 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].
33. 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].
34. World Health Organization. *World Health Report, 2001.* Geneva: World Health Organization; 2001.
35.