1.1 The scope and concerns of public health
Roger Detels and Chorh Chuan Tan

Introduction

There have been many definitions and elaborations of public health. The definition offered by the Acheson report (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 all of society’s efforts viewed 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. The United Nation’s Millennium Development Goals, the slogan of which is “Health for All” (the Acheson report), and Detels’ goals depict public health as being concerned with more than the mere elimination of disease and placing public health issues as a fundamental component of development.
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 (Detels and Breslow, 2006). 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>
<thead>
<tr>
<th>Table 1.1.1 Functions of public health</th>
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</thead>
<tbody>
<tr>
<td>1. Prevent disease and its progression, and injuries</td>
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<tr>
<td>2. Promote healthy lifestyles and good health habits</td>
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<tr>
<td>3. Identify, measure, monitor, and anticipate community health needs (e.g., surveillance).</td>
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<td>4. Investigate and diagnose health problems, including microbial and chemical hazards</td>
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<tr>
<td>5. Formulate, promote, and enforce essential health policies</td>
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<tr>
<td>6. Organize and ensure high-quality, cost-effective public health and health-care services</td>
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<td>7. Reduce health disparities and ensure access to health care for all</td>
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<td>8. Promote and protect a healthy environment</td>
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<td>9. Disseminate health information and mobilize communities to take appropriate action</td>
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<td>10. Plan and prepare for natural and man-made disasters</td>
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<tr>
<td>11. Reduce the impact of interpersonal violence and aggressive war</td>
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<tr>
<td>12. Conduct research and evaluate health-promoting/disease-preventing strategies</td>
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<td>13. Develop new methodologies for research and evaluation</td>
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<td>14. Train and ensure a competent public health workforce</td>
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Public health *identifies, measures, and monitors* health needs and trends at the community, national and global levels through surveillance of disease and risk factor
(e.g. smoking) trends. Analysis of these trends and the existence of a functioning health information system provide 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 and policies 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.

Technological advances and increasing commerce have done much to improve quality of life, but these advances have often 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 can contribute much to the protection and monitoring of the environment to ensure that it is conducive for the population to live healthily.

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. This is vital, since many major public health problems are linked to human behaviour and lifestyles. 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 the fact 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 addressing 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 in diverse groups and populations.

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. Rapid advances in computational hardware and techniques have increased our ability to analyse massive amounts of data, and to use multiple strategies to aid in the interpretation of data. Despite this, it will be a major challenge to keep pace with the explosive growth in the volume and complexity of data being generated, driven by a range of factors, from the pervasive use of the internet, social media and mobile phones, to the masses of data from molecular biology and sequencing studies. To glean valuable insights pertinent to public health from these huge datasets will require new approaches, strategies and methodologies. It is essential that public health continues to use such leading-edge
technologies to develop more sophisticated research strategies to address public health issues.

A major problem in public health has been translating research advances into effective health practices and policies 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.

Finally, a thread that runs through all these functions is the necessity for much greater international collaboration in data sharing, policy formulation and implementation, and management of specific public health issues. With globalisation, the rapid flow of information, people, goods, and services across national boundaries means that many public health concerns and issues are interconnected in complex ways. Effective solutions will therefore often depend on joint action between different countries. In addition, now more than ever, there are many opportunities for major public health attainments to be made through cooperative action at the global level, as has been demonstrated in the past by milestones such as the eradication of smallpox. The media can play an important role in educating the public and in facilitating public health interventions.
Contemporary health issues

Underlying the bulk of the public 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 (World Bank 2012). 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 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 (U.S. Census Bureau 2009). Poverty causes a cascade of problems leading to poor health (Figure 1.1.1). It is incumbent on public health to work to reduce the impact of these disparities to ensure that all members of the global society share in a healthy quality of life.

Figure 1.1.1. From poverty to disease

*Insert Fig 1.1.1*

Reproduced, with the permission of the publisher, from Global status report on noncommunicable diseases 2010. Geneva, World Health Organization, 2011 (Fig. 2.1, Page: http://www.who.int/nmh/publications/ncd_report_full_en.pdf, accessed 29 July 2013)

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 causes of death, and 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, enhance nutrition, and provide clean water and safe disposal of wastes were key to reducing communicable diseases.

Table 1.1.2. Leading causes of death in the United States

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases of the heart</td>
<td>167</td>
<td>307</td>
<td>152</td>
<td>131</td>
<td>248</td>
<td>180</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>81</td>
<td>125</td>
<td>135</td>
<td>126</td>
<td>196</td>
<td>174</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>134</td>
<td>89</td>
<td>28</td>
<td>26</td>
<td>58</td>
<td>39</td>
</tr>
<tr>
<td>Chronic obstructive lung diseases</td>
<td>—</td>
<td>4</td>
<td>20</td>
<td>13</td>
<td>44</td>
<td>42</td>
</tr>
<tr>
<td>Motor vehicle injuries</td>
<td>—</td>
<td>23</td>
<td>19</td>
<td>16</td>
<td>15</td>
<td>37</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>13</td>
<td>14</td>
<td>12</td>
<td>13</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td>Pneumonia and influenza</td>
<td>210</td>
<td>26</td>
<td>14</td>
<td>13</td>
<td>22</td>
<td>16</td>
</tr>
<tr>
<td>HIV infection</td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Suicide</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Homicide and legal intervention</td>
<td>1</td>
<td>5</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Alzheimer's disease</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>23</td>
</tr>
</tbody>
</table>

Values expressed as rates per 100,000, age-adjusted.


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 severe acute respiratory syndrome (SARS) outbreaks in the early 2000s,
demonstrated the fallacy of their thinking, as do the persisting high rates of infectious diseases, particularly in Africa.

Although communicable diseases persist as a major public health concern, globally, chronic non-communicable diseases (NCDs) have become the major health problem, accounting for 70% of deaths (Table 1.1.3). Even in poor, developing countries, NCDs are a dominant and growing challenge. 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 (WHO 2011). 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 to address 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.

Figure 1.1.2. NCDs constitute more than 60% of deaths worldwide

*Insert Fig 1.1.2*

Table 1.1.3. Top ten causes of death worldwide, 2011

<table>
<thead>
<tr>
<th>Causes of death</th>
<th>Deaths in millions</th>
<th>% of deaths (within income group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischaemic heart disease</td>
<td>7.0</td>
<td>12.9</td>
</tr>
<tr>
<td>Stroke</td>
<td>6.2</td>
<td>11.4</td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>3.2</td>
<td>5.9</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>3.0</td>
<td>5.4</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>1.9</td>
<td>3.5</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>1.6</td>
<td>2.9</td>
</tr>
<tr>
<td>Trachea, bronchus, lung cancers</td>
<td>1.5</td>
<td>2.7</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.4</td>
<td>2.6</td>
</tr>
<tr>
<td>Road injury</td>
<td>1.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Preterm birth complications</td>
<td>1.2</td>
<td>2.2</td>
</tr>
</tbody>
</table>


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) (United Nations Population Division). Population growth is already below replacement in many countries, both developed and developing. This demographic shift has widespread and profound implications. It will increase the burden of chronic disease in these countries, place increasing demands on healthcare and social support services, and strain public financing systems. This will occur even as the proportion of the population in the productive ages will decrease, which in turn will impact economic growth. 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

*Insert Fig 1.1.3*

Reproduced, with the permission of the publisher, from World Population Ageing: 1950-2050.
**Measuring disease occurrence**

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) (Lopez et al. 2007) and ‘disability-adjusted life years’ (DALYs) (Murray and 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 include 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.

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 majority of victims of these communicable diseases are infants and children under five. The persistence of communicable diseases in these areas represents a continuing major public health challenge.

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. When using DALYs to establish global disease priorities, communicable diseases and injuries, which tend to disproportionately affect the young, are emphasized, and the relative importance of cardiovascular diseases and other chronic diseases that primarily affect the elderly are reduced. 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 (Mathers and Loncar, 2006).

On the other hand, according to projections by the WHO, while lower respiratory infections and diarrhoea remain the dominant communicable diseases, infections such as HIV, tuberculosis, and malaria will rise in terms of YPLL per 1000 population by 2030, even as other communicable diseases will yield to intervention efforts and account for progressively fewer YPLL (World Heath Organization). The YPLL per 1000 population due to non-communicable diseases, which 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 in patients 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 and wars, corruption, and mistrust of governments. Poverty, weak governments, and misuse of funds have also prevented the control of disease vectors that play a key role in diseases such as malaria and dengue, 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). Similarly, due to the extensive global food supply chains, food-borne infections can spread rapidly within and across countries.

Another source of communicable diseases is the continuing emergence of new infectious agents, many of them adapting to humans from animal sources. Figure 1.1.4 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’
(selling live animals for food) 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 1.1.4 lists many of the new diseases that have been recognized since 1980, and Table 1.1.5 lists the factors that contribute to the emergence of these new agents and disease threats.

**Table 1.1.4. Newly identified infectious diseases and pathogens**

<table>
<thead>
<tr>
<th>Year</th>
<th>Disease/ pathogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>H1N1 avian influenza (human cases)</td>
</tr>
<tr>
<td>2003</td>
<td>SARS</td>
</tr>
<tr>
<td>1999</td>
<td>Nipah virus</td>
</tr>
<tr>
<td>1997</td>
<td>H5N1 (avian influenza A virus)</td>
</tr>
<tr>
<td>1996</td>
<td>New variant Creutzfeld-Jacob disease; Australian bat lyssavirus</td>
</tr>
<tr>
<td>1995</td>
<td>Human herpes virus 8 (Kaposi’s sarcoma virus)</td>
</tr>
<tr>
<td>1994</td>
<td>Savia virus; Hendra virus</td>
</tr>
<tr>
<td>1993</td>
<td>Hanta virus pulmonary syndrome (Sin Nombre virus)</td>
</tr>
<tr>
<td>1992</td>
<td><em>Vibrio cholerae</em> O139</td>
</tr>
<tr>
<td>1991</td>
<td>Guanarito virus</td>
</tr>
<tr>
<td>1989</td>
<td>Hepatitis C</td>
</tr>
<tr>
<td>1988</td>
<td>Hepatitis E; human herpes virus 6</td>
</tr>
<tr>
<td>1983</td>
<td>HIV</td>
</tr>
<tr>
<td>1982</td>
<td><em>Escherichia coli</em> O157:H7; Lyme borreliosis; human T-lymphotropic virus type 2</td>
</tr>
<tr>
<td>1980</td>
<td>Human T-lymphotropic virus</td>
</tr>
</tbody>
</table>
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. The frightening potential for rapid and dangerous spread of antibiotic-resistance through genetic elements that are transmissible between different bacterial species was highlighted by reports of the speed and extent by which New Delhi metallo-beta-lactamase (NDM-1), which encodes multiple-antibiotic resistance, spread to many different countries (Moellering 2010).

Table 1.1.5. 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.


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.
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 (World Health Organization 2006). The functional ability of those so afflicted is severely compromised, in turn affecting the economic competitiveness of the poorest countries, which suffer the greatest burden of these tropical diseases. 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% (Chow and Raju, 2006). 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% (Feigin et al. 2009).

The causes of non-communicable diseases are many and complex. Although the immediate causes are factors such as raised blood pressure, increased 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, especially, tobacco use; these in turn are the products of social change, including globalization, urbanization, and aging. WHO estimated that insufficient physical activity contributed to 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 (WHO 2011). Some non-communicable diseases have been associated with infectious disease agents. For example, *Chlamydia pneumoniae* has been implicated in the development of atherosclerosis (Kuo and Campbell, 2000), hepatitis C is a leading cause of hepatocellular (liver) cancer, and human papilloma virus (HPV) is a cause of cervical cancer. Recently, an effective vaccine has been developed that protects against cervical cancer, but it is expensive and must be administered before sexual activity begins (i.e., early adolescence).
Figure 1.1.5. shows the global distribution by gender of deaths from non-communicable diseases, demonstrating the higher rates of death from non-communicable diseases in developing countries, especially in Africa.

**Figure 1.1.5. Global distribution of non-communicable diseases (2008)**


Another aspect of non-communicable diseases is the increasing survival of affected individuals who would not have survived as long previously. However, many of them are left with disabilities that 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 (Breslow and Breslow, 1993). 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 importance of addressing 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 accounts for 13% of the global burden of disease (Collins 2011) (Table 1.1.6). 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 (WHO 2001a).

Table 1.1.6. Global burden of mental, neurological and substance-use (MNS) disorders

<table>
<thead>
<tr>
<th>Rank</th>
<th>Worldwide</th>
<th>High-income countries</th>
<th>Low- and middle-income countries</th>
</tr>
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<tr>
<td></td>
<td>Cause</td>
<td>DALYs (millions)</td>
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<tr>
<td>1</td>
<td>Unipolar depressive disorders</td>
<td>65.5</td>
<td>Unipolar depressive disorders</td>
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<td>2</td>
<td>Alcohol-use disorders</td>
<td>23.7</td>
<td>Alzheimer's and other dementias</td>
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<td>3</td>
<td>Schizophrenia</td>
<td>16.8</td>
<td>Alcohol-use disorders</td>
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<td>4</td>
<td>Bipolar affective disorder</td>
<td>14.4</td>
<td>Drug-use disorders</td>
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<td>5</td>
<td>Alzheimer's and other dementias</td>
<td>11.2</td>
<td>Schizophrenia</td>
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<td>6</td>
<td>Drug-use disorders</td>
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<td>Panic disorder</td>
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<td>Insomnia (primary)</td>
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<td>10</td>
<td>Obsessive–compulsive disorder</td>
<td>5.1</td>
<td>Parkinson's disease</td>
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<td>11</td>
<td>Insomnia (primary)</td>
<td>3.6</td>
<td>Obsessive–compulsive disorder</td>
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<td>12</td>
<td>Post-traumatic stress disorder</td>
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<td>Epilepsy</td>
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<tr>
<td>13</td>
<td>Parkinson's disease</td>
<td>1.7</td>
<td>Post-traumatic stress disorder</td>
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<tr>
<td>14</td>
<td>Multiple sclerosis</td>
<td>1.5</td>
<td>Multiple sclerosis</td>
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†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 (World Health Organization (2001b). 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 still 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. It is also expected that more of the elderly will have to continue to
be economically productive. 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% (World
demographics profile 2012). 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. Shifts in dietary preferences in
developing countries towards greater meat consumption also puts additional strains
on food production. Fertile farmlands are increasingly being converted to residential,
commercial or industrial use. Thus, more people will effectively need to be supported
on less arable land. Food security will hence be a key issue for the future, and this
will be affected by a multitude of factors, but most notably sufficiency of water resources and whether there will be major increases in agricultural productivity.

**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. Beyond access to nutritious and safe food, many of the poor have little knowledge about what constitutes a healthy diet, compounding the difficulties. At the same time, in developed and many rapidly developing countries such as China, over-nutrition and obesity are a major problem. Some industry sectors have been more effective in promoting calorie-dense, salt-rich, and unhealthy diets than public health professionals have been in championing healthy food choices consumed in reasonable quantities. This has particularly been the case for the youth, and has contributed to rising childhood obesity in many countries, including the more affluent in developing countries.

**Oral health**

Good dental health is essential for maintaining adequate nutrition and a good quality of life. Worldwide, however, 60-90% of school children and nearly 100% of adults have dental cavities. About 30% of adults aged 65-74 years have no natural teeth. It was also estimated in 2004 that globally there was an average of 1.6 decayed, missing, or filled teeth (DMFT) among children aged 12 years old (WHO Oral Health Program 2004). These high rates of dental problems reflect poor dental hygiene and
preventive care (Pine and 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. Oral cancers are the 6th most common cause of cancer globally, with the five-year prevalence estimated to be 6.8% globally (WHO Oral Health Program 2004). Poor dental hygiene is an important risk factor, together with smoking, as well as the habit of betel nut chewing, which is common in parts of Asia. 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 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 into the following groups: motor vehicle accidents, suicide, homicide, and 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 as well.

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 automobiles, 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 highest cause of DALYs, violence (including gender-based and personal) the 12th, and self-inflicted injuries the 14th.

_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 varies by time, situation, and culture, but the common characteristic across all vulnerable groups is their special 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 ample 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 access to 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 and developing, there are the homeless, many of whom suffer from multiple problems, including mental illness. The ability to function adequately and achieve good health among many vulnerable groups, including the homeless, mentally ill, alcoholics, and drug addicts, is adversely impacted by additional factors such as poverty, prejudice, and stigmatization by society. Thus, programmes to assist the vulnerable need to also encourage society to take supportive action in order to be optimally effective. This is a particular challenge in respect to persons with handicaps. Many developed countries have adequate provision for persons with handicaps, but in poorer countries, those with handicaps face substantial difficulties in functioning in society, and many do not survive.
In designing programmes for vulnerable groups, a further complication is the fact that the specific problems and needs of each of these groups differ, and they thus require public health actions that are more tailored to their requirements. 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 the world faces 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 rapid economic growth has been achieved at the expense of the environment. The most polluted cities of the world are concentrated in developing countries, which often 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. The full health effects of many of these chemicals are still unclear and difficult to establish. Murray and Lopez (1995) estimated that 1,379,238 DALYs are caused annually by environmental pollutant 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 (e.g., air and water pollution), and globally (e.g., 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, periodic air pollution caused by slash-and-burn agricultural practices in Sumatra severely affects the health of residents of Singapore and Malaysia. Industrial pollutants released in the industrial states of the 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, for example, 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.
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 (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 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 (Chen et al. 2004; Wong et al. 2008). 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 cooking is traditionally carried out using coal or charcoal fires in poorly ventilated houses. However, 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 rises. 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 can occur, as happened in Milwaukee, Wisconsin when cryptosporidium 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 that drain into the vicinity 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 amounts, but also the varieties of pollutants increase. As new substances are developed, it would be ideal if their use is not permitted until plans and provisions have been developed and implemented for their safe disposal. However, this is often not the case in practice.
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. The problem of discarding these materials safely has become a major public health issue. In some cases, developed countries are 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 challenge.

In the past decade, nanoparticles (one nanometer is one billionth of a meter) have been increasingly used in the production of foods, drugs, cosmetics, and other products used by humans. Particles of this small size become reactive in the body and, according to recent reports (**OUP, 2009; Li et al. 2009), can cause serious damage to lung cells, the liver, and brain cells. Given this problem, it is important that the use of nanoparticles in products intended for human use be regulated.

**Climate change**

One of the most serious, long-term challenges of the 21st century is global warming due to the release of carbon dioxide and other ‘greenhouse gases’. There is growing evidence that the consequential climate change will be associated with increased public health risks (Patz et al. 2005).

A major review by WHO to assess the public health impact of anthropogenic climate change to date, estimated that from the mid-1970s, climate change might already have contributed to 150,000 deaths and about 5 million DALYs per year. These are largely related to increased incidence of conditions such as malnutrition, diarrhoea
and malaria (World Health Organisation, 2002). Mitigating the health impact of global warming and climate change at the regional level will be a major public health issue for this century.

*Rescuing the environment*

To prevent further degradation of the environment and to tackle the threat of global climate change, strong political will is required of the countries of the world. For example, while the United States is one of the world’s major producers of carbon dioxide and other greenhouse gases, it has yet to ratify the UN Framework Convention on Climate Change, an international treaty aimed at stabilising global greenhouse gas at levels that would avoid dangerous climate change.

From a public health perspective, it is unrealistic to expect that the risks from environmental pollution and hazardous waste can be reduced to zero. Instead, the concept of ‘acceptable risk’ will continue to be a part of the process. Determining the level of acceptable risk will probably be arrived at through an interplay of the scientific data and evidence, with policy and political judgements. Public health professionals and researchers must endeavour to play a strong role in these determinations.

*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 annually worldwide there are 2.3 million work-related deaths, 340 million work-
related injuries, and more than 160 million cases of occupational disease (World Statistics 2011). In some developing countries, child labour is still the norm. Twelve million 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 health of the worker often receives less priority than the need to produce goods cheaply, especially in developing countries.

The nature of the workplace is constantly changing, with increasing proportions of workers being involved in services industries rather than in manufacturing. Over the last decade particularly, the production of goods has shifted rapidly to developing countries, where labour costs are lower. The manufacturing industries in these countries are often subject to fewer and less comprehensive safety regulations, and in some cases, are associated with low salaries, and few or low healthcare benefit provisions for workers, especially for migrant workers from rural areas. Increasingly, women are entering the workforce and must juggle work and family. Larger numbers of workers are being employed on an informal part-time basis. While this reduces labour costs for industry, these informal part-time workers do not usually receive work-related benefits. They now represent 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 is economically active 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 (Health Affairs 2000). The needs of older workers are different from those of younger workers. Thus, the changing nature of the workforce will require corresponding 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 affordable 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 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 promote universal coverage and ensure that the rural poor and elderly have access to reasonable healthcare.

**Bioterrorism and war**

The history of use of biological weapons in war extends back 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 bioterrorist 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. The consequences of war are so severe and wide-ranging that it is imperative that better ways be reached to resolve international conflicts. The resources ploughed into armed conflict could be better deployed on humanitarian and public health support.
Although ethical issues are 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 (U.S. National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1978), and the Council for International Organizations of Medical Science (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, 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. In this, an appropriate balance has to be struck, since raising the level of anxiety too little will result in inadequate or no action, while raising the level too high may 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 minimizing unintended consequences.

Public health interventions can be divided into four categories: 1) social/biologic/environmental; 2) behavioural; 3) political; and 4) 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, inadequate housing, 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 series of actions. 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 remain, such as hepatitis and tuberculosis and 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’, together with adequate political will and funding 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 reduces transmission and development of multi-drug-resistant TB. 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 (Cohen 2011).

**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, excessive 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 anti-smoking 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 (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. Ultimately, if public health interventions are to be effective, they must be adopted by the community. The media can play an important role in facilitating these interventions and assuring that they become community norms.

**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. Many needed regulations transcend boundaries and require international cooperation (e.g., regulation of greenhouse gases).
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 joint 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.

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 collective political will to take the necessary steps to arrest or reverse this detrimental warming trend.

It is important that the political process to put in place measures 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 that are difficult for the public to understand, and are often subject to debate, even within the scientific community.
**Structural interventions**

An important end-point 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 in public spaces 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 and ensuring that public health regulations and laws are enforced.

**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 in 1921, the Peking Union Medical College; and has continued to contribute to global health since its founding in 1913 (Berman 1983; Brown 1979). 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: 1)
establishment of charitable foundations by industry; 2) development of international,
national, and local non-governmental organizations (NGOs); and 3) 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 (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
addressing specific health problems and issues because they are closer to the
problem than health professionals who must handle 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. Public health needs to convince industry to temper its profit motive to incorporate responsible citizenship at all levels. Certainly, industry is frequently a significant contributor to 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 professionals. Thus, it behoves public health organisations 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 centuries in England and the United States resulted in improved working conditions for workers in a variety of industries and 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.

**The future of public health**

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. Rapid communications and transportation greatly increase the likelihood that local problems will quickly become global problems. This underscores the urgent need for much better international cooperation. An increasing proportion of the world's population will live longer. We have been successful at adding ‘years to life’, but chronic diseases such as Alzheimer’s have reduced the quality of some of the years of life added. We must now concentrate on adding ‘life to years’, helping older people to continue to be healthy and 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 also compromise global food production. The world’s population is still growing, and together with increasing urbanization, will further exacerbate the problem of environmental degradation.
Despite the economic and health advances of the past century, disparities between the rich and the poor in many countries are widening. This gap needs to be narrowed, 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, as well as behavioural and structural approaches.

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 contribute 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.

Much is known about what needs to be done to significantly reduce the incidence of non-communicable diseases such as cardiovascular diseases, stroke, and cancer, but much more effective ways are needed to effect the necessary changes in personal and community behaviour, and to promote healthy lifestyles.
Tremendous strides have been made 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.
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