The epidemiologic transition theory revisited thirty years later

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Background
As we arrive at the new millennium, documenting and reflecting on the past can guide the future. This is one of the functions of the Epidemiologic Transition Theory. The theory is based on the systematic application of epidemiologic inference to changing health, mortality, survival and fertility over time and place linked to their socio-economic, environmental, lifestyle, demographic, health care and technological determinants and/or correlates in different societal settings. There can be no doubt that a profound epidemiological change has been taking place in the world over the last several centuries, albeit at a varying pace and take-off time in different populations.

The purpose of this essay is to revisit the original 1971 presentation of the Epidemiologic Transition Theory, moving from a three-stage/three-model formulation to a five stage/five-model formulation. This will make use of the accumulation of information and insights over the last 30 years as partly demonstrated in Box 1.

The epidemiologic transition
Epidemiology is the study of health and disease patterns and their determinants and consequences in population groups. All of the transitions involved in both the dependent and independent variables are the subject of epidemiological study and, hence, are encompassed by the epidemiologic transition. Epidemiology incorporates the scientific capacity to analyze social, economic, demographic, health care, technological and environmental changes as they relate to health outcomes. Classifying all the changes in these variables under the "health transition" would, however, be confusing. Health is a dependent variable of epidemiology, not vice-versa. Figure 1 diagrammatically portrays the dynamics involved in the epidemiologic transition. Triggered by economic and social development, the epidemiologic transition encompasses the changing disease and health patterns (the health transition), the changing fertility and population age structure leading to ageing (parts of the demographic transition), the changing lifestyles (the lifestyle transition), the changing health care patterns (the health care transition), the medical and technological evolutions (the technologic transition), and the environmental and ecological changes (the ecological transition).

The relative role of mortality and fertility experiences in the transition dynamics is discussed under Proposition 1. The long-term dynamics of the transition are classified into at least five transition stages, which are described under Proposition 2. The particular determinants of mortality and fertility changes are given thereafter. Different kinds of inequities are noted during the transition and are captured under Proposition 3. Transition models characterizing the dynamics, timing of the transition take-off, and subsequent changes in different country groups are briefly discussed in Proposition 4.

Proposition 1: Relative role of mortality and fertility in the transition
Within the complex dynamics of the epidemiologic transition, mortality is a most fundamental force,
exerting its influence through rises in pre-modern societies or through declines in modern times. Fertility is a potent co-variable staying at a high level in the early stages, then declining and becoming virtually the pacesetter of population growth. Reversal or stagnation of the transition is possible during economic, political, environmental, morbidity or other crises.

**Mortality** The absence of continuous and reliable information on levels of mortality and fertility in pre-modern times and in pre-industrial countries precludes deterministic statements about their relative demographic impact. An assessment of the possible range of variations in mortality, fertility, disease pattern and age structure does allow probabilistic conclusions. The scanty evidence that is available indicates that frequent and violent fluctuations characterized the mortality patterns in pre-modern societies and that overall mortality levels were extremely high, even in the so-called good years. Caught between the towering peaks of mortality from epidemics, famine and wars, and the high plateaus of mortality dictated by chronic malnutrition, endemic infectious diseases, and high prenatal and maternal mortality, life expectancy at birth was short. Several authors have described low, yet fluctuating, life expectancies in pre-modern times of about 18 years for Ancient Greece (18), less than 20 for Rome, 21 to 23 for Gaul, 28.7 for Roman Egypt, and between 17 and 35 for nobility in Medieval Britain (19). Life expectancies for Geneva have been estimated at 22 years in the 16th, 26 in the 17th, and 34 in the 18th century (20). With such short life expectancy and concomitant high birth rates, populations were typically young and their growth patterns cyclic, yielding small, if any, net increments of growth over long periods. That severe epidemics could result in a significant decline in population size is exemplified by plague epidemics including the Black Death that afflicted Europe from the 14th to the 17th centuries taking a great toll in several countries (21). Thus more than any other single factor, mortality that is fluctuating at high levels offers the most likely explanation of the slow rate of world population growth pre-modern and pre-industrial times.

In the modern period that followed (from the mid-17th century onward), the growth curve of world population slowly departed from the cyclic pattern and assumed a pattern of exponential growth. Ironically, mortality continued to be of overwhelming influence in determining population changes before and during the industrial revolution in western Europe.

In modern times, it was predominantly the declining mortality more than increasing fertility that caused the West’s growth phase in western Europe in the 18th and 19th centuries. There was debate, particularly in the case of England, as to whether
the rise of population at the time was due to an increase in the birth rate (suggested by Habakkuk, 1953) (22), or a decline in the death rate (held by Griffith in 1926 (23), Marshall in 1929 (24), Hicks in 1942 (25), McKeown and Brown in 1955 (26) and McKeown et al. in 1972 (27).

A ready example comes from the Swedish data, that are generally acknowledged as reliable, (see Figure 2). The demographic trends in Sweden over the last three centuries demonstrate that the rise of population in the 18th century was associated with mortality decline. In 1945 (28) Myrdal compared two consecutive 50-year periods in Sweden. The first extends from 1761–1765 to 1806–1810 and the second from 1811–1815 to 1856–1860. He found that the population increased by 28% and by 54% in the two periods respectively, because whereas the average birth rate was the same in both periods (approximately 32.6/1,000 population), the average death rate declined from 27.6/1,000 in the earlier 50-year period to 22.7/1,000 in the second.

Determinants of mortality decline The decline of mortality in western societies in the 18th or 19th century was more socially than medically determined. Medical or health care developments were too limited to have a significant impact at that time. Few decisive therapies existed and surgery, practised by barbers at that time, was not an accepted medical profession. Much more influential were some personal, lifestyle, social, and environmental factors which alone, or in combination with marginal health care practices, made the change possible. Included were:

- Improvement in nutrition, which not only reduced the undernutrition factor in mortality, but also contributed to the decline in infectious diseases (the largest component in overall mortality decline at that time) by increasing resistance to infection. Nutrition improvement resulted from advances in agriculture, which spread in the West from about the end of the 17th century, and the introduction of new crops such as the potato and maize;
- early improvements in personal cleanliness, especially the use of soap, which encouraged more frequent washing and bathing. The use of washable cotton underwear and bedding encouraged more frequent change of clothing and protection from disease-carrying body lice and fleas;
- ecological recession of certain diseases which occur in waves, (such as scarlet fever) or which lose an important link in transmission (such as the disappearance of the black rat from Europe and the decline of plague);
- better housing with ventilation, cleanliness and some household form of waste disposal; and
- contraception that could prevent unwanted pregnancy, reduce reproductive risks to mother and child, and ameliorate rapid population growth.

Fertility Fertility is crucial during all stages of the epidemiologic transition as discussed under Proposition 2. The demographic gap between the birth and death rates is responsible for population growth (positive or negative) with modifications by net migration. Later in the transition, when mortality rates reach low levels, fertility takes over as the primary pacesetter of population growth.

Possible reversal of acceleration of the transition Reversal of transition trends may take place under
worsening situations. Such is exemplified by the recent experience of the former USSR where the stressful economic problems resulted not only in halting health progress, but apparently triggering a decline in life expectancy, especially for males (see the article by Mesle, Vallin & Shkolnikov later in this issue of the *World Health Statistics Quarterly* - editor).

In 1994, the United Nations recorded a decline of 1.4 years in life expectancy in the now former USSR for the period of 1960 to 1985. In 1996 (29), the UN revealed further that the loss continued with the greatest impact recorded for the Russian Federation and Ukraine, which reported losses of 3.6 and 3.2 years for males respectively between 1960 to 1965 and 1990 to 1995. For females in both countries, life expectancy stagnated (30). In 1998, the World Health Organization reported that sixteen countries with a total population of 300 million people experienced a decrease in life expectancy at birth between 1975 and 1995 (31). The resurgence of old scourges such as malaria, tuberculosis and cholera are also signs of transitional setbacks. Conversely, better transition achievements beyond expectation could occur, such as the decline in cardiovascular mortality in western countries around 1970 (32).

**Proposition 2: Stages of the epidemiologic transition**

During the transition, a long-term shift occurs in patterns of mortality, disease and survival whereby pandemics of infection and gross malnutrition are progressively, but never entirely, displaced by degenerative, stress and man-made diseases and ageing. These patterns distinguish several major transition stages with overlaps among the stages. The stages are named after the most palpable transition variables, namely the changing pattern of health and disease.

**2a. The stages in the western transition**

First stage Age of pestilence and famine
Second stage Age of receding pandemics
Third stage Age of degenerative, stress, and man-made diseases
Fourth stage Age of declining cardiovascular mortality, ageing, lifestyles modification, emerging and resurgent diseases
Fifth stage Age of aspired quality of life, with paradoxical longevity and (futuristic stage) persistent inequities.

For illustrating the classical transition, demographic and health trends for Sweden are given in Figure 2 while trends of causes of death in USA are given in Figure 3. Proposition 2 is presented in two parts. Proposition 2a is in reference to stages in the West, followed by Proposition 2b that refers to non-western societies. The Fifth stage is discussed later in the paper, in the conclusion, under the title *Into the future...*

Fig. 3
Causes of death in New York City (1866–1900) and the United States (1900–1990)


Sources for the figure cited in Omran, op. cit.:
National Center for Health Services Research & the National Center for Health Statistics, Health, United States, Maryland, National Center for Health Services Research & National Center for Health Statistics, 1993.

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The First stage: Age of pestilence and famine
This is a stage of high mortality, high fertility, and slow or cyclic population growth, which is, for all practical purposes, an extension of the pre-modern epidemiological patterns. It continued in the West until, the late 18th or early 19th centuries, but continued until the middle decades of the 20th century in the Third World.

Mortality Fluctuations in mortality were typical and peaks coincided with the years of epidemics, famine, crop failure, disasters and wars. Life expectancy was short, oscillating between 20 and 30+ years, while infant mortality exceeded 200 deaths per 1,000 live births. An early epidemiological study based on the Bill of Mortality in 17th century London, reported that 3/4ths of deaths were attributed to infectious diseases, malnutrition and maternal complications. In contrast, heart diseases and cancer were responsible for less than 6% of deaths (33).

Health care was provided by indigenous systems that relied on herbal remedies, barber surgery, cautery, blood letting, bone setting, and sometimes witchcraft. Only a few therapies that are still in use today were available for a small number of diseases: digitalis for heart failure, cinchona for malaria, mercury for syphilis and ipecacuanha for alimentary upset (34). Poor sanitation prevailed in the home and workplace.

Fertility in the West was moderately high (birth rate around 30 or more births per 1,000 population) and fluctuating. Combined with young age at death, it effected a young age structure in the West.

Socially, this early stage is characterized by low standards of living and unsanitary environments. Clan or extended multiple-generation families leading agricultural lifestyles prevailed. The marriage institution and traditional family values were strong. Women had low status and were cast in the mother role with virtually no rights. They were overworked, underfed and frequently pregnant or lactating during most of their reproductive life span. Maternal mortality was high, exceeding 1,000/100,000 live births. Life expectancy for females was equal to or a few years shorter than that of males.

The Second stage: Age of receding pandemics
Mortality This stage marks the early relief from the devastating epidemics that could be transmitted from one area to another and from one country to another (hence the use of the term pandemic). Early in this stage, mortality remained at a high level. With later recessions of pandemics and famine, mortality in some countries began to decline late in the 18th century (e.g., England and Sweden), or early to mid-19th century in other western countries, including the USA. Life expectancy at birth increased to 40 to 50 years while infant mortality declined gradually to below 200/1,000 live births. Despite the relative recession, communicable diseases (especially tuberculosis) continued to lead the causes of death. During the period of overlap between the Second and Third stages, however, the triad of heart diseases, stroke and cancer started to take rising positions. Still several communicable diseases were more common. Mortality from tuberculosis began to decline toward the end of this stage and was responsible for part of the decline in general mortality.

Fertility, on the other hand, remained at high levels for most of this stage. The widening demographic gap between the birth and death rates resulted in rapid population growth. This was relieved partly by massive migration to the colonies (the USA, Australia and Canada). Population composition was also influenced by improved child survival and high fertility, resulting in the continuation of a young age structure. During the latter part of this stage, and often after a time lag of 50 or more years from the onset of mortality decline, fertility began to decline as well. This was achieved most probably by high motivation to space children and limit family size through the use of coitus interruptus, safe period or periodic abstinence, prolonged breastfeeding, or abortion, and occasional infanticide in some communities. Delaying the age of marriage also played a role. One exception occurred in France where the declines in mortality and fertility were almost parallel, but with a gap that sponsored population growth.

Access to Health Care and sanitation during most of this stage in the West was still quite limited. By the late 18th century, however, some improvements occurred, as already mentioned, in nutrition, personal hygiene and housing. Later in this stage, public works stimulated the beginnings of sanitation and public health by Chadwick in England and Shattuck in the USA. Inoculation by variolation against smallpox began to be used on a limited scale during this stage, although Jenner had introduced the procedure in 1796. Modern organized health care services in the form of health departments were started after the mid-19th century (e.g., a health department was established in New York City in 1866).

Socially, better housing and the development of tenements led to modest improvements in living conditions. The extended family system continued in rural areas while nuclear families began to flourish in urban and industrial centers. The maternal role of women began to accommodate increasing involvement in activities outside the home. Females began to have, in some countries, a few years' advantage in life expectancy over males.

The Third stage: Age of degenerative, stress, and man-made diseases
Mortality Taking place in the West during the second half of the 19th century (e.g., northern and western Europe) or somewhat later in the USA, this stage is a manifestation of the increasing prevalence of heart diseases, cerebro-vascular accidents (strokes), cancer at various sites, diabetes, chronic obstructive
pulmonary disease and metabolic disorders. Increasing also were diseases introduced by man (man-made diseases). These include, for instance, radiation injury, industrial hazards, chemical and biological warfare, environmental pollutants, motor vehicle and aviation accidents, and exposure to carcinogens in industry, environment, or food additives. Hazards attributed to health care are also man-made. Examples include side effects of drugs (such as hormones, antibiotics, chemotherapy, aspirin and oral contraceptives), errors in surgery, anesthesia, invasive diagnostic procedures and radiotherapy, and the hazards to the health providers themselves. Stress-related diseases such as depression and other mental illness, violence, and drug dependency also increased. Although conceding their leading position, infectious diseases and gross malnutrition continued as leading causes of morbidity and mortality.

During this stage in the West, mortality continued to decline and life expectancy at birth rose gradually from about 50 to 75 years or more, starting the relative ageing of the population.

**Modern health care**, organized locally and nationwide, became widely spread with integrated systems of curative and preventative health. Health insurance plans were designed for individuals, groups, or the whole nation (e.g., the national health services in United Kingdom, Canada and northern Europe).

**Socially**, significant improvement in living conditions and sanitation took place gradually and incrementally. Nuclear families and small family size norms became institutionalized. Women were increasingly emancipated from traditional roles and became better educated. A few became more career oriented with more political and social involvement. Marriage as an institution began to deteriorate.

**The Fourth stage: Age of declining cardiovascular mortality, ageing, lifestyles modification, emerging and resurgent diseases**

**Mortality** Arising within the Third stage of degenerative and man-made diseases, this stage is characterized in the West by further increases in life expectancy (which approach 80 to 85 years or longer, especially for females), with increased disease chronicity, and ageing, accompanied by mounting medical costs for both the state and the individual. A most distinctive characteristic of this stage, *which also marks its beginning*, is the leveling off, then decline of cardiovascular mortality which occurred around 1970 in many developed countries. This decline was not expected and some time passed before it was fully recognized through debates in literature and conferences during the mid-1970s. Three influences were postulated. The first is *deliberate lifestyle modifications* such as cessation of smoking, low-fat diets, and regular and aerobic exercise. The second is the parallel influence of medical breakthroughs in early diagnosis and management of cardiovascular diseases, including new decisive drugs; cardiac surgery, intensive care and advanced emergency care technology as well as preventative cardiology. The third factor is the treatment of risk conditions (particularly hypertension, diabetes and stress). Despite the relative decline in mortality from cardiovascular diseases (CVDs) and some cancers, these diseases continue as leading causes of death simply because of their established numerical predominance over the other causes. Furthermore, morbidity from these diseases does not necessarily decline to the same extent. Murray and Lopez (1996) project that in 2020 the causes of death in the developed regions will be led by ischemic heart disease, cerebro-vascular disease, a variety of cancers, chronic obstructive pulmonary disease, lower respiratory infection, self-inflicted injuries, diabetes and road traffic accidents (35).

It should be mentioned that not all countries that entered the Third stage have yet entered the Fourth. Several countries in Europe (particularly eastern Europe and the Russian Federation) continue to experience a rise in cardiovascular diseases. In contrast, some societies outside of Europe and North America, namely Australia, New Zealand, Japan and Israel, have entered the Fourth stage.

A new and disquieting problem arose with the emergence of new diseases and resurgence of old diseases. The WHO in 1998 listed some 30 such diseases recognized since 1970 (36). Viral diseases are those caused by HIV, Hepatitis B and C, Ebola, Hanta pulmonary and renal syndromes, Monkeypox, Rift Valley fever and several hemorrhagic fevers. Bacterial diseases include Toxic Shock Syndrome, Legionnaires’ disease, Lyme disease, ehrlichiasis and new strains of E-colii, and cholera (Vibrio cholerae 0139). Among the resurgent diseases are malaria, cholera, tuberculosis, dengue, Chagas’ disease, plague, diphtheria and others. Some of the resurgent organisms demonstrate serious resistance to existing antibiotics and chemotherapy.

**Health care systems** in countries entering this stage continue to improve, including development of health insurance plans, managed care plans and health care reform, with particular attention to long-term care for the aged and disabled. Intensive medical research flourishes in many areas of health care. Emphasis is placed on molecular medicine, genetic engineering, sports medicine, geriatrics, organ transplantation and rehabilitative medicine. The negative features of this include the rising cost of medical care, exaggerated physician overspecialization and the continuing inequities in health care coverage and accessibility.

**Fertility** in the West continued at low levels during this stage. In some countries the birth rate may drop lower than the death rate, producing a population decline and passing through zero population growth.

**Socially**, the standard of living in the West is generally very high. Western women in this stage reach unprecedented high status, and many of them
are great achievers in science, technology, business and public life. The erosion of the marriage-based family is increasing. Many couples live together without religious or state marriage.

### 2b: Stages of the transition in non-western societies

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The epidemiological transition non-western regions differs fundamentally from that which occurred in the more developed countries, as elaborated in Box 2.

#### Box 2

**General remarks**

- Throughout the non-western transition, poverty, limited education, low status of women and slow pace of development have been formidable obstacles to timely and successful transition takeoff in much of the developing world.
- The timing of the transition is crucial for the differentiation of the non-western transition. Since mortality decline was delayed until well into the 20th century, it must have, per force, been influenced by the availability of new health discoveries such as chemotherapy, antibiotics, insecticides, food quality control and sanitary measures.
- Ageing in non-western societies was delayed, but increased at a relatively fast rate in the later decades of the 20th century. Because of the larger population size, these countries harbour the larger number of the world's aged population.
- Fertility decline in the developing regions was harder to initiate and required organized family planning campaigns to promote small family size norms and raise the age at marriage.
- The overlap of stages was much wider in the non-western transitions which are classified further into three transition models under Proposition 4.

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**The First stage: Age of pestilence and famine**

**Mortality** This stage is a most prolonged stage in non-western and pre-industrial societies stretching from medieval times to the middle decades of the 20th century. Mortality was extremely high, fluctuating with peaks during the years of epidemics, famine, crop failures and wars. Infant mortality exceeded 200 to 250/1 000 live births. Maternal mortality likewise exceeded 1 000 to 1 200/100 000 live births. Life expectancy was short, oscillating between 20 and 35 years with a distinct predominance of communicable, maternal, perinatal and nutritional diseases. Of the notable scourges in this stage were (and many continue to exist) smallpox (now eradicated), cholera, plague, malaria, tuberculosis, typhoid, typhus, diarrhoeal diseases, streptococcal infections, meningitis, hepatitis B, Chagas' disease, yellow fever, leprosy, measles, diphtheria, neonatal tetanus and poliomyelitis. Young age at death means a large number of potential lives years lost.

**Health care** in this stage was primitive, provided by untrained lay people, traders, barbers and vendors of herbs and untested concoctions. Maternity care was provided by local traditional birth attendants (e.g., dayas), and clandestine abortions were performed under technically primitive and unsanitary conditions contributing to high maternal mortality.

**Fertility** was extremely high with 7 to 10 births per woman. Childbearing started at a young age and continued until close to the end of the reproductive span. High fertility was considered the proof of a woman's fecundity and a man's virility.

**Socially**, poverty, illiteracy, and a low standard of living with large multi-generation families prevailed. Lifestyle was largely agricultural. Women were of low status and were typically confined to childbearing and childrearing roles. Their contribution to family income through unpaid labour on the farm or in family business was rarely noted. In many cultures, a woman's worth was measured by the number of sons she carried.

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The Second stage: Age of receding pandemics

In some countries, this stage was delayed until the 1940s or 1950s, when epidemics started to recede and mortality began to fall. Unlike the western experience, the decline was more medically than socially determined. This was because of the timing of this stage which coincided with the availability of antibiotics, chemotherapy, immunization, insect control, early water sanitation and waste disposal (especially in cities), maternal and child health, and specific disease control programmes. The latter were sponsored largely by international organizations.

The recession was not complete, however, and several of the scourges remained or resurfaced later. The gap between declining mortality and high fertility during most of this stage triggered a population explosion in the Third World. It took several centuries for the population of the developing world to reach 1.7 billion (67.8% of the world population) in 1950. In the space of 50 years, it grew to 4.9 billion (almost three times as much) and by 2050 is projected to reach 8.2 billion (87.6% of world population) (37).

Despite improvements in healthcare, access to care and sanitation remained limited. Physicians were few in numbers and were concentrated in cities at the expense of rural and remote areas. This was somewhat compensated for by special disease control and public health projects sponsored largely by international organizations.

**Fertility** continued to be high. Toward the end of this stage (1960s-1990s), and through organized birth control programmes, fertility started to decline at various rates in different countries. Before it falls, fertility may, in some areas, sustain a temporary increase that coincides with the beginnings of mortality decline. This is reasonably attributable to improved health, better nutrition, increasing sur-
vival through the reproductive years, and decline in pathologic sterility and possibly some erosion in traditional taboos such as post-pregnancy abstinence. **Socially**, the standard of living and literacy began to improve. Women were still of low status and low literacy, except in some urban areas. Family values remained very strong.

The Third stage: Age of triple health burden in non-western societies

This stage is more challenging in non-western societies. It has been taking place since the 1970s or later depending on the particular non-western transition model (Figure 4). It entails at least three major health burdens superimposed upon one another: unfinished old health problems; rising new health problems; and ill-prepared health systems and medical training.

The unfinished old set of health problems

Despite relative but unequivocal decline in morbidity and mortality, the old set of health problems remains an overtaxing health burden. It includes communicable diseases, perinatal and maternal morbidity and mortality, malnutrition, poor sanitation, and tenacious problems of poverty, low literacy, overpopulation and limited access to health care and safe water, especially in rural areas.

A rising new set of health problems

Heading the list of rising problems is the gradual increase in degenerative diseases (heart diseases, stroke, cancer, and metabolic disorders), stress (especially despair and depression) and man-made diseases specified earlier in this essay. Many of the above diseases continue almost unabated as long as the traditional lifestyle, risky health habits, particularly smoking, and paucity of special technologies will allow it. The prevalence of cigarette smoking in the Third World is high and will probably increase; the diet may be increasingly burdened with excess empty calories and cholesterol; the sedentary lifestyle is increasing in cities, while practice of regular and aerobic exercise is not increasing at the same pace in some non-western cultures. Also rising are elements from the western Fourth stage, namely, the emerging and resurgent diseases whose timing after mid-20th century coincide with the Third stage in the developing countries (examples of the diseases are included in the Fourth stage). In addition to these problems is the challenging issue of young and older populations. More than half of the population today is less than twenty-five years old. In Latin America and the Caribbean, the population cohorts of 10–24 years represent 30% of the total population, or 148,000,000 people. This population is likely to engage in risk behaviour and often lacks access to reproductive health services. The average annual percent growth of population age 60 years and older in the developing societies started at slightly under 2% in the 1950s, then accelerated in the 1960s, and is expected to reach slightly under 4% in the 2020s. The pace in the more developed countries is, in contrast, slower and, fluctuates mostly between 1% and 2% per year (38).

During this stage (mostly in the 1970s or later), fertility starts to decline, albeit at a pace and magnitude that differs in the varying transition models.
(see Proposition 4). Despite the decline in rates, the absolute number of births is huge and contributes to the tenacious overpopulation problem.

**Lagging or ill-prepared health systems and medical training**

In most non-western countries, the health systems, physician and other health professionals are grossly ill-prepared for such a consortium of demanding problems. They are geared mainly to acute diseases and short-term care and are not yet able to initiate prevention and care for chronic diseases, or for long-term medical or rehabilitative care. They may also not yet be prepared to handle the problems of ageing. In addition, these countries are experiencing a growing expectation of quality services such as those sensationalized in the national and international media. All of these demands require assertive reshaping of the countries' health care models and priorities. Included are structural adjustment of the health system and reorientation of medical education and training that emphasizes knowledge and skills to face multiple old and new problems. Community participation and continued improvement in the status of women are equally needed. Without international support added to local resources, solutions will remain elusive.

**Illustrating the non-western epidemiologic transition**

Mortality decline in non-western countries was delayed until the middle decades of the 20th century. Once it started, however, it tended to proceed relatively quickly compared to the previous experience in the West. One series of estimations and projections of mortality by cause in developing regions was made for the period 1970–2015 by Bulatao and Stephens in 1989 (39). The shift in predominance from communicable to neoplasm and circulatory disorders is quite substantial for all developing regions and sub-regions. Communicable diseases will drop from being responsible for 42.1% of all deaths in the less developed regions in 1970 to 19.4% in 2015. In contrast, neoplasms and circulatory disorders will rise from being responsible for 21.6% of all deaths however, from one group of developing countries to another. For example, Latin America was ahead of sub-Saharan Africa.

In a recent projection for its African region, the WHO (1998) stressed the tenacity of the old set of health problems such that communicable diseases and prenatal and maternal mortality would lead the causes of death in 2025, followed in order by circulatory diseases, respiratory diseases and endocrine/nutritional disorders.

HIV/AIDS serves as an illustration of the gravity of the health burdens in non-western societies. In 1997, Africa reported 20 800 000 prevalent cases and 1 800 000 deaths for a prevalence rate of 7 463, and a death rate of 648/100 000 population in contrast to the European prevalence rate of 153, and a death rate of 3/100 000 population. This means that whereas the prevalence rate in Africa was 49 times that in Europe, the death rate is a colossal 216 times as much. Not only is the disease burden heavier in Africa, but also the means of prevention, detection, treatment, repeated hospitalization, and rehabilitation are grossly inadequate, if not totally unavailable.

**What about a Fourth stage in non-western societies?**

It is quite unlikely that these countries will enter the Fourth stage of the transition—the Age of Declining cardiovascular mortality, ageing, lifestyle modification, and emerging and resurgent diseases—in a manner similar to the one experienced by Western societies. It is possible, however, that in the future an increasing number of countries in the developing world will be able to halt the rise in cardiovascular diseases and cancer or reduce mortality therefrom, but the prevailing disease patterns and health care responses will be more mixed, and with significant inequities compared to the West.

**Proposition 3: Differentials and inequities in the transition**

During the epidemiologic transition, profound inequities or differentials in health and disease changes occur according to age, gender, race or ethnic origin, social class and indigenous status. There may also be inequities and differentials by geopolitical locales within or among countries.

**3.a Age group differential during the epidemiologic transition**

The clinical differential of disease and mortality risks according to age is beyond this account. The focus here is on the trends in changing risks by age. At high mortality levels, when life expectancy is 50 years or less, the bulk of mortality is in younger age groups and is due largely to communicable, perinatal and nutritional diseases. As the transition proceeds, the age structure changes to one that is older and in which the bulk of mortality shifts to older age groups as a result of greater occurrence of cardiovascular, malignant and other chronic non-communicable diseases. This longitudinal change has already been observed in western countries and is in process in non-western societies. The WHO (1998) shows that in 1950, 40% of world deaths occurred under age 5 years while 22% occurred at age 65 years and over.

The 1989 work by Bulatao and Stephens referred to earlier focuses on the less developed countries for the period 1970–2015. It demonstrates a decline in proportionate mortality under age 15 years from 50% in 1970 to a projected 18.5% in 2015, and a rise in mortality at age 65 years from 22.2% to 47.2% respectively. The change in Latin America was faster than that in Africa.
In another projection mentioned earlier, Murray and Lopez considered the years of life lost (YLLs) due to premature death, giving greater weight to deaths at younger ages. At the global level, YLLs from the group of communicable, nutritional, perinatal and maternal conditions are expected to decline by 50% from 491 000 000 years lost in 1990 to 241 000 000 by 2020. Heart diseases, stroke and cancers are expected to cause more YLLs in 2020. For males, the losses from these diseases are expected to rise from 153 000 000 to 257 000 000 years of life lost, a rise of more than 2/3rds. The rise for females is expected to be more modest: 130 000 000 to 167 000 000 YLLs respectively. Injuries are expected to cause more than 50% more YLLs in males and about 30% in females. Overall, taking all causes together, YLLs are expected to decline from 907 000 000 in 1990 to 859 000 000 in 2020, a modest decline of 5.3% (35).

3.b Gender differential and inequity during the epidemiologic transition

The epidemiologic transition usually favours the female over the male, especially after the recession of pandemics and the improvement of living standards. Age-specific mortality rates shift over time from higher levels for females, especially those of reproductive age, to lower mortality rates than males, especially when fertility is reduced. Data for pre-modern periods demonstrate that females had lower or equal life expectancy than for males, especially during the reproductive years. This is exemplified by Roman life tables based upon tomb inscriptions showing a difference in female life expectancy of minus 5.1 years for Liberia, minus 2.2 for Africa and plus 1.1 for Rome. Even among the nobility of medieval England, males lived an average 31.7 years, compared to 29.8 years for females even though males in that group were more exposed to warfare and assassinations (40).

During the 18th century or earlier in most western countries, but not until the 20th century in developing countries conditions began to change in favour of the female. These changes can be illustrated by comparing the probability of dying at different levels of life expectancy in the four regional life tables by Coale and Demeny (1966) (41).

In all of the regional tables (Figure 5), the probability of dying for females shifts from a level higher than that of males, especially during reproductive ages, to a lower level than males as life expectancy increases. It is of interest to note, however, that certain developing countries continued to show an exceptionally shorter life span for females until recent decades. Such is most apparent in the Asian subcontinent, where until the 1950s or even later (1980s in Bangladesh), males outlived females for reasons that are not totally clear (42). Females usually received poor treatment in nutrition, health care, and psychological support, while being overworked and overburdened with reproductive demands and maternal mortality risks (Table 1).

Today, women are more likely than men to develop anemia, osteoporosis, depression, anxiety and Alzheimer’s syndrome, although the incidence of myocardial infarction is higher in males. Women suffer more from acute and chronic conditions, although they die later. Diabetes and obesity are stronger risks associated with heart diseases in women than in men. Attempted suicide is more common in women, but completed suicides more common in men. Men have higher rates of coronary heart diseases (rates rise rapidly in women after menopause with gender-equal risk by age 75 years), and lung cancer, but it is rising with increased smoking by women. Women use health care services more frequently and with more compliance.

3.c Ethnic differential and inequity

Different racial, ethnic, or socio-cultural groups may experience different health and health care levels and a varying pace of the transition in the same country. Outstanding examples come from multiracial societies, where the white population fares much better than other ethnic groups. In 1900, the black

Table 1

Sex differential in life expectancy (years), 1950–1995

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>World</td>
<td>45</td>
<td>48</td>
<td>51</td>
<td>54</td>
</tr>
<tr>
<td>More Dev. C.</td>
<td>64</td>
<td>69</td>
<td>68</td>
<td>73</td>
</tr>
<tr>
<td>Less Dev. C.</td>
<td>40</td>
<td>42</td>
<td>47</td>
<td>48</td>
</tr>
<tr>
<td>Least Dev. C.</td>
<td>35</td>
<td>36</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Sweden</td>
<td>70</td>
<td>73</td>
<td>72</td>
<td>76</td>
</tr>
<tr>
<td>USA</td>
<td>66</td>
<td>72</td>
<td>68</td>
<td>73</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>38</td>
<td>35</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Pakistan</td>
<td>40</td>
<td>38</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>India</td>
<td>39</td>
<td>38</td>
<td>46</td>
<td>45</td>
</tr>
<tr>
<td>Yemen</td>
<td>32</td>
<td>32</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>58</td>
<td>56</td>
<td>63</td>
<td>64</td>
</tr>
</tbody>
</table>


Rapp. trimest. statist. sanit. mond., 51 (1998)
male in the USA had a life expectancy of 33 years compared to 47 years for the white male. By 1992, the respective figures were 65 and 73 years. The black female was expected to live 34 years in 1900, 15 years less than the white female. By 1992, the gap was shortened to 5.5 years when the white female expected to live 80 years (See Table 2) (43).

In South Africa, during the period 1981–1985, blacks suffered an infant mortality rate ranging from 94 to 124/1000 live births and a life expectancy ranging from 49 to 55 years compared to an infant mortality rate of only 12.3/1000 and a life expectancy as high as 75.3 years for whites (Yach, 1988) (44). This means that the pace of the epidemiologic transition in most ethnically mixed societies is slower among non-whites than among whites. Among the possible explanations are variations in lifestyles, education, poverty level, self-image, access to services, disposable income, and overt or covert inequities and discrimination.
While the transition produces change in all social classes, it usually starts earlier and proceeds more quickly among the more affluent and privileged than among the poor and disadvantaged sectors of the same society. This is clearly demonstrated by trend data from England and Wales where five social classes are identified by grouping similar occupations. The highest mortality area for 1986 was in Uttar Pradesh State (representing 16.2% of India's population). Life expectancy was 48 years and the infant rate was 132/1000 live births. The lowest mortality area encompassed Kerala, Maharashtra, and Punjab States (representing 15.3% of India's population); life expectancy was 63.5 years and the infant mortality rate was 54.9/1000 live births.

3.d Social class differential or inequity
While the transition produces change in all social classes, it usually starts earlier and proceeds more quickly among the more affluent and privileged than among the poor and disadvantaged sectors of the same society. This is clearly demonstrated by trend data from England and Wales where five social classes are identified by grouping similar occupations. The highest is the first, and the lowest is the fifth. The system has been in use throughout the 20th century. Infant mortality declined steadily and substantially in every social class, but the differential between classes persists. Although the numerical gap has narrowed, the ratio in the infant mortality rate of the lowest to the highest class has increased (Table 3).

3.e Inequities experienced by indigenous peoples
In many countries around the world, there is a group of people whose ethnic, cultural, historical, linguistic and territorial traits distinguish them as indigenous people. As documented in a 1998 PAHO report on Health in the Americas (45), indigenous people usually live under adverse conditions, are subject to discrimination and have the lowest level of health status and health care access. In Chile in 1992, for example, infant mortality rates among the indigenous people were 40 points higher than the national average, and the life expectancy was 10 years lower in the case of the Aymara people. In Bolivia in 1993, 20% of indigenous children died before their first birthday, and 14% of those who survived their first year died before they reached school age. Even in wealthy countries such as the USA, the Native Americans (and other minorities) are groups characterized by a disproportionate share of deaths, disease, disability and adverse health conditions.

3.f Geopolitical differential or inequity
In almost every country there are areas with lower standards of health and less access to health care than other areas in the same country. Variations may be due to geopolitical division (rural versus urban, mountain versus valleys), ethnic clusters, religious minorities, poor-resource districts, and isolated or neglected regions with limited access to education, development or health services. A prominent example comes from India as reported by its Office of the Registrar General (1988) (46). The highest mortality area for 1986 was in Uttar Pradesh State (representing 16.2% of India's population). Life expectancy was 48 years and the infant rate was 132/1000 live births. The lowest mortality area encompassed Kerala, Maharashtra, and Punjab States (representing 15.3% of India's population); life expectancy was 63.5 years and the infant mortality rate was 54.9/1000 live births.

Another prominent example comes from Mexico, as reported by Bobadilla et al. (1989) (47). The highest mortality areas in Mexico for the period 1982-1988 were found in 8 southern states representing 16.6% of Mexico's population. Life expectancy was 55.5 years and the infant mortality rate was 92/1000 live births. The lowest mortality areas were 7 northern states (representing 14.8% of Mexico's population), where life expectancy was 70.2 years and the infant mortality rate was 28/1000 live births. A more recent example comes from the USA and confirms that the more developed countries are not immune to geopolitical differentials. Murray and his colleagues found great variations of life expectancy by county in the USA in the 1990s (Murray et al., 1998) (48). The highest life expectancy for women was 83.5 years for Stearns County, Minnesota, and the lowest was 70 years in Bernett Jackson, Malett Shanon and Todd Counties, South Dakota. These same counties also had the shortest life expectancy for men, 61 years, followed by Washington, D.C., 62.2 years, and Baltimore, 63.0 years. The longest life expectancy for men was 77.5 years.

### Table 2

<table>
<thead>
<tr>
<th>Year</th>
<th>White M</th>
<th>White F</th>
<th>Nonwhite M</th>
<th>Nonwhite F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>47</td>
<td>49</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>1910</td>
<td>50</td>
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<tr>
<td>1930</td>
<td>59</td>
<td>63</td>
<td>48</td>
<td>50</td>
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<td>1940</td>
<td>63</td>
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<td>1980</td>
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</tr>
<tr>
<td>1992</td>
<td>73</td>
<td>80</td>
<td>65</td>
<td>74</td>
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</tbody>
</table>


### Table 3

<table>
<thead>
<tr>
<th>Year</th>
<th>I Lowest class</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V Highest class</th>
<th>Ratio of V to I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>46.4</td>
<td>66.2</td>
<td>77.0</td>
<td>93.4</td>
<td>109.2</td>
<td>2.35</td>
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<td>1930</td>
<td>39.6</td>
<td>51.1</td>
<td>58.3</td>
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<td>89.0</td>
<td>2.25</td>
</tr>
<tr>
<td>1950</td>
<td>17.3</td>
<td>24.0</td>
<td>28.2</td>
<td>32.2</td>
<td>42.9</td>
<td>2.52</td>
</tr>
<tr>
<td>1970</td>
<td>11.0</td>
<td>14.0</td>
<td>16.0</td>
<td>18.2</td>
<td>25.5</td>
<td>2.23</td>
</tr>
<tr>
<td>1980</td>
<td>3.1</td>
<td>6.0</td>
<td>7.0</td>
<td>7.9</td>
<td>12.3</td>
<td>3.79</td>
</tr>
</tbody>
</table>

for residents of Cache and Rich counties, Utah. It should be remembered that the differentials may also reflect ethnic, religious, social or indigenous composition in different geographic locations.

3.g Inter-country differential or inequity by level of development
Experiences observed over the last 50 years have repeatedly demonstrated differentials or inequities in health status by level of development. It is projected that such inequities will continue well into the 21st century and beyond with an eventual narrowing over time. This is well demonstrated by comparing life expectancy at birth for males and females, in different world regions, for the period 1950–2050. The data, including projections, are provided by the United Nations and are portrayed in Figure 6 (1996) (49). The general trend for all regions is increasing between 1950 and 2050, but the rate of change is faster in the least developed regions compared to the more developed regions. In 1950–1955, a female in the developed region had a life expectancy at birth of 69 years compared to 41.8 years in the developing regions and 36.2 years in the least developed regions. For 1995–2000, the respective figures are 78.4, 65.2 and 53.0 years. It is projected that the respective figures for 2045–2050 will be 84.0, 78.2 and 73.5 years. The sex differential is persistent in all regions, albeit decreasing over time.

3.h Inequities of colonization
It has been noted that in lands under foreign occupation for some time, a transition differential ensues whereby the nationals are far behind the colonizers in their transition. For example, during the French occupation of Algeria (until their departure in 1954), the French experienced the low mortality and long life expectancy of a western transition, whereas the Algerians remained in their high mortality and low life expectancy non-western transition.

![Life expectancy at birth (years) by level of development, 1950–2050](image)

**Fig. 6**
Life expectancy at birth (years) by level of development, 1950–2050

**Proposition 4: Models of the epidemiologic transition**

During the transition, systematic variations in the pattern, pace, determinants and consequences of health, survival and population changes distinguish several models of the epidemiologic transition, of which 2 in the western societies, which started before the 20th century (Figure 7). Co-existence of more than one model may be found in some multiracial or multicultural societies. This classification of countries is more representative of country grouping than regional comparison, taking together countries with differing epidemiological experiences simply because of geographic location.

**The western transition model**

The Classical Transition Model describes the transition in western societies during at least the past 300 years. It demonstrates the shift from high death rates of about 30-35/1,000 per year to low death rates of less than 10/1,000; from high birth rates of 30-35/1,000 to low birth rates of less than 15/1,000; and from short life expectancy of 30-40 years to unprecedented long life expectancy of 80-90 years and more. Mortality decline was gradual and occurred primarily in response to social, economic, and environmental improvements, better nutrition and personal health habits. During the transition, pandemics and major epidemics receded and degenerative, stress-related, and man-made diseases replaced communicable diseases gradually, but not totally. These developments correspond with an improvement in life expectancy, especially for children, young adults, and females of reproductive age. Typically, the classical transition passed through the 4 transition stages described in more detail under Proposition 2. It should be emphasized that this model is unique to the historical and circumstantial experience of the West during the last 3 centuries, which includes the industrial revolution. Hence, it is not automatically transferable to less developed countries.

**The semi-western / accelerated model**

The accelerated designation was used in previous pub-
lications to describe the experience in eastern Europe, the former USSR, and Japan (model 2a), where rigorous fertility control efforts (including widespread use of induced abortion) were used. The semi-western version (model 2b) is used to encompass a similar transition in European populations living outside Europe, North America or Australia. Included, for example, are Europeans living in Argentina, Uruguay, Israel and South Africa, and the French in Algeria during the occupation. This model (with its two variants) has some common features: (a) Mortality and fertility declines came later than in the Classical Model; (b) Countries in this model, with a few exceptions, have not yet entered the Fourth stage of the transition; (c) Many countries in this model exhibit a continuing rise in cardiovascular mortality and some members of the former USSR have, as already mentioned, lost years of life expectancy associated with social and economic crises.

One of the two notable exceptions is Japan, which started in the accelerated model, but soon joined the western countries in many respects during the later decades of the 20th century and is now leading them in having a longer life expectancy. Japan entered the Fourth stage during the 1970s. The other exception is Israel, which has recently experienced declining death rates from cardiovascular diseases.

**The non-western transition models**

These models describe epidemiological changes over time in Third World countries where mortality decline was delayed until 1930–1950, and fertility decline was delayed further until after 1950. During the period, population growth rates reached unprecedented high levels. Differences in the post-war patterns in mortality and life expectancy, and more distinctly the variation in fertility trends, distinguish three non-western models named according to the speed, timing, and magnitude of change, particularly fertility decline.

**The rapid transition model**

This model describes the experience of rapidly industrializing or socially developing countries and territories (usually small, and mostly island entities). Prominent examples include the Chinese provinces of Taiwan and Hong Kong, Singapore, the Republic of Korea, Sri Lanka, Mauritius, Barbados, China, Chile, Cuba, Costa Rica, the French overseas departments of Martinique, Guadeloupe, and Reunion, Jamaica, Bahamas, Puerto Rico, and Trinidad and Tobago. Mortality in these countries began to decline to moderate levels one or more decades before mid-century, but the decline in fertility to less than 5 children per woman was delayed until after mid-century, some time in the 1960s. These countries are still in the Third stage of the transition and have also been victimized by emerging and resurgent disease on top of unfinished communicable and perinatal disease control. They are nevertheless showing signs of controlling the triple disease burden, and their health parameters are getting closer to those of the western models. For example, in the space of decades, the Republic of Korea experienced a rapid change from a predominance of communicable diseases in the 1950s and 1960s (when 5 of the leading causes of death were communicable diseases) to a predominance of degenerative and non-communicable disease and fewer communicable diseases as leading causes by 1991. (50)

**The intermediate transition model**

This represents the experience of countries with middle or lower-middle levels of income. The mortality dynamics, prevalence of various causes of death, and fertility patterns fall between those in the rapid and slow models. In the intermediate model, some countries cluster closer to the rapid model, such as Indonesia, Colombia, Mexico, Brazil, Panama, Venezuela, Tunisia, Lebanon, and Thailand. Some other countries cluster closer to the slow model, such as India, Egypt, Morocco, Ecuador, Peru, Paraguay, and the Dominican Republic, and are characterized by having organized family planning programmes that have different degrees of success. On the health side, they face a huge overlap between continuing communicable diseases and malnutrition problems, and the rising prevalence of degenerative and man-made diseases. The emerging diseases, particularly HIV/AIDS, and the resurgent diseases, such as malaria and other old-time scourges, complicate the picture further. Some countries, particularly Mexico, come close to the rapid model, but for the delay in its fertility decline.

**The slow transition model**

In this model, which describes the experience of the least-developed and some less-developed countries in Africa, Asia, and Latin America, mortality started to decline to moderate levels after mid-century, while fertility levels remained high until close to the last decade of the 20th century. Like the intermediate and rapid models, considerable overlap exists in this model among communicable diseases, malnutrition, and the rise in degenerative and man-made diseases. Countries in this model are also those that are least prepared to handle any one health burden, let alone three health burdens all at once. HIV/AIDS, malaria, tuberculosis, and other emerging and resurgent disease abound in countries belonging to this model in sub-Saharan Africa, Latin America, and parts of Asia, compounding further their morbidity burden.

In their Global Burden of Disease study, Murray and Lopez examined the trends of causes of death compared with projections in 3 developing countries that happen to belong to the 3 non-western models. In China (representing the rapid model), their study estimated that degenerative and chronic diseases increased incrementally to become responsible for 75% of causes of death in 1990. The study...

*World Health Statist. Quart., 51 (1998)*
projected this to rise to 85% by 2020. For India, the study estimated an intermediate pace of the transition in which the communicable disease group is still responsible for half the deaths in 1990 and is projected to be responsible for 22% in 2020. In sub-Saharan Africa, the study confirmed the slow pace of the transition where communicable, perinatal, maternal and nutritional diseases are projected to be responsible for 39% of all deaths in 2020.

Illustration of the transition models in one world region
For illustration, the epidemiological experience of the region of the Americas will be used where the 5 major models coexist and where comparable data are available. The classification of the countries of the Americas into models is given in Box 3.

Box 3
Countries and territories in the Americas classified under each model

<table>
<thead>
<tr>
<th>The Western Models:</th>
<th>The Classical Model: USA and Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Semi-Western Model:</td>
<td>Argentina and Paraguay</td>
</tr>
<tr>
<td>The Non-Western Models:</td>
<td>The Rapid Model: Bahamas, Barbados, Chile, Costa Rica, Cuba, Guadeloupe, Jamaica, Martinique, Puerto Rico, and Trinidad and Tobago.</td>
</tr>
</tbody>
</table>

Of the criteria used in classifying countries in different models, 4 are selected for a brief illustration. These are the life expectancy at birth, the infant mortality rate, total fertility rate (TFR), and an index of ageing (proportion of population aged 65 years and older). A weighted average for countries in each model was calculated (for the TFR, a simple average was used) (see Figure 8).

Life expectancy The profiles of life expectancy depict a picture of improving survival in all models since at least 1950, with the classical model having the highest level (increasing from 69 years in 1950–1955 to 76 years in 1990–1995), and the slow model having the lowest life expectancy, increasing from 43 years in 1950–1955 to 64 years in 1990–1995 (51).

Infant mortality Whereas the infant mortality rate is declining in all models since 1950, its level differs from one model to the other. The highest level throughout was experienced by countries in the slow model, and the lowest by countries in the classical model; those in the intermediate model experienced rates lower than those in the slow model and higher than those in the other models. In 1950–1955 the rapid model had rates higher than the semi-western model, but its rates soon dipped lower, probably because of more successful child survival programmes in the rapid model.

Fertility The highest total fertility rate is found in the slow model (7 children per woman in 1950–1955), with fertility starting to decline slowly since the mid-1970s. By the end of the century, fertility was still high (4 to 5 children per woman). The other models start with relatively lower levels with further decline at an earlier date. The classical model starts at a higher level between 1950/1955 than the semi-western model, because of the baby boom. After the baby boom, the TFR declined rapidly to around 2 children, the lowest level among all models (52).

Age structure The classical model has the oldest ageing structure, with the proportion 65 years and older increasing from 8% in 1950–1955 to 12.5% in 1995–2000. The semi-western model follows the pattern at a lower level with the rapid model following at some distance. The intermediate model and slow model have a much younger population (53).

Transition in the causes of death In the classical model (represented by the USA, Figure 3), the leading causes of death are the degenerative diseases (cardiovascular diseases and neoplasms). On the graph, the slight shrinking of the area due to declining cardiovascular disease mortality after 1970 may be noted. Communicable diseases and perinatal mortality were responsible for a very small proportion of deaths and the area is getting even smaller. The semi-western model (not shown in this figure) had a predominance of degenerative diseases (with no shrinkage of their area after 1970). Communicable diseases and perinatal mortality have somewhat higher shares of deaths.

The rapid variant (represented by Trinidad and Tobago in Figure 9), shows higher proportions for communicable diseases and perinatal mortality, with a gradual decline over time. A rise in proportionate mortality from degenerative diseases is noted over time. Accidents as a cause-of-death have also increased.

The pattern in the intermediate variant model (represented by Mexico in Figure 9), shows visibly higher levels for mortality from communicable diseases and perinatal mortality in the 1960s, with an impressive decline thereafter. Proportionate mortality from cardiovascular diseases and neoplasms was relatively modest in the 1960s, but started to show small additive increases thereafter. Accidents and violence as causes of death demonstrated impressive increases since 1970.

The slow variant model (represented by Nicaragua in Figure 9), shows the highest proportionate mortality from communicable diseases and perinatal mortality, with relative but small decline over time. This model also shows the lowest proportionate mortality from degenerative diseases. Mortality from accidents and violence shows some increase since 1975.
Conclusion

Into the future: The Fifth stage, Age of aspired quality of life with paradoxical longevity and persistent inequities

This Fifth stage for the mid-21st century and beyond is expected to be one of great human achievements in disease control, health promotion, and further prolongation of healthy life. Inevitably this stage will include paradoxical longevity, emerging new morbidity and persistent inadequacies. There will be disparities between people because of the polarization of socio-economic status within and between countries.

5.a The traditional health scenario in the Fifth stage

This scenario is based on measuring health in the traditional way, in terms of morbidity and mortality, and is logically an extension of the Fourth stage. During the 21st century and beyond, life expectancy should continue to rise to or exceed 90 years, especially for females. This can be a result of two primary mechanisms: (a) an actual increase in the average life span due to medical breakthroughs and favourable lifestyles and (b) a relative increase in the longevity of disadvantaged groups. The increments of growth in life expectancy would become smaller and smaller as humankind reaches the upper asymptote of survival.


Wld hlth statist. quart., 51 (1998)
on earth, with the gender gap narrowing. However, longevity will continue to be a mixed blessing, hence its being called “paradoxical”. While it means more years to live and contribute, it also means greater chances for chronic morbidity, physical and psychological impairments, isolation, separateness, depression, loss of independence, and decline in social status. Particularly females who survive to older ages may be at great disadvantage in this regard. Further mounting medical, long-term care and nursing costs, which are beyond the financial ability of retired citizens will become more common. Thus, the ageing process may spell increasing needs for social, emotional, economic, health and rehabilitative care, as well as psychological support systems. In some cases, longevity may specifically mean prolongation of agony. Some afflicted individuals may resort to euthanasia and assisted suicides that are expected to increase among the aged, the disabled, and those living in unbearable pain or depression. Moral, legal and religious antagonism to this practice will continue, but with diminishing influence in the West. Conservative cultures outside the West usually leave it to religion, without legislative interference.

Degenerative, stress and man-made diseases are apt to be the lead causes of morbidity, disability and mortality, along with much increased chronicity. The rising cardiovascular mortality in developing countries will more than compensate for its decline in the West and will keep CVDs as the leading causes of death in the world for quite some time. Mortality from these diseases may eventually decline as well, thus ushering the entry of these countries into the Fourth stage. In contrast, trends in cancer are not unidirectional; as mortality declines for most cancers, new forms of malignancy would arise in the future and would energize the ever-continuing search for a cancer cure. Being involved in both these and other disease categories, tobacco will remain the most villainous disease risk factor in the Fifth stage.
achieve better quality of life and social justice. Health is not a commodity, and eco-
For many, Health for All remains a far-reaching goal.

Without established world, or national systems of disaster relief and control, environmental ca-
etrophies are added forms of mass destruction. In addition, the environment is becoming more polluted in many locations and is being altered by man’s misadventures, which will undoubtedly increase in the future, as will global warming. Access to fresh water sources is becoming a serious concern and will be a source of the regional wars. This is simply because the world is running out of fresh water in the face of increasing populations and ever-mounting industrial, agricultural, municipal and domestic water demands. All these will be joined by new categories of diseases characteristic of the space age. New forms of man-made diseases are expected to evolve with advanced industrial, electronic, genetic, chemical innovations and radiation energy, as well as biological and chemical warfare. There will likely be more enigmatic disease conditions that would, at least for a while, challenge the existing diagnostic and therapeutic abilities, just as with the evolution of HIV/AIDS or of the so-called Gulf War Syndrome.

The question about the future of communicable diseases is examined in Box 4.

5.b The Health for All (HFA) initiative:
The HFA initiative has been a global rallying point and organizing principle since its adoption within the 1978 Alma-Ata declaration. Medical breakthroughs, innovative disease control, and health promotion technologies during the Fifth or late stages of the epidemiological transition, will bring humankind closer to success for the rainbow of complete physical, mental and social well-being for all citizens (54). The renewal of the Health for All Strategy brings to the forefront concerns for human rights, equity, diversity, and development for all. Health cannot be seen as isolated from the larger processes of social and human development (55). Also, economic growth can not be regarded as a supra-goal under which individual’s health is nothing but a commodity. Health is not a commodity, and economic growth is not the end, but the means to achieve better quality of life and social justice (56). For many, Health for All remains a far-reaching goal.

Will infectious diseases ever be extinguished?

<table>
<thead>
<tr>
<th>The answer is regrettable because:</th>
</tr>
</thead>
</table>
| • While some more infections will be eradicated or elimi-
nated, new viruses or new strains (or mutations) of old  |
| viruses and bacteria are likely to emerge. HIV/AIDS is a |
| prominent reminder. |
| • Human beings are encroaching on the jungle and may  |
| encounter yet new wild viruses or bacteria. |
| • International travelers can return home within the incuba-
| tion period of infectious diseases. |
| • Infectious diseases also have the habit of coming back even |
| after they are believed to have been controlled; many of the  |
| resentuous diseases demonstrate obstinate resistance to |
| existing drugs. |
| • Infections would continue to plague, in particular, the aged,  |
| the chronically ill, the prematurely born, the malnourished,  |
| the disadvantaged, those hospitalized (nosocomial infec-
| tions) and those in high-risk groups. |
| • Infections with opportunistic pathogens would also threaten  |
| those whose immunity has been compromised by old or new  |
| pathogens or by chemotherapy. |
| • Certain viruses, bacteria or parasites have been implicated  |
| in the etiology of certain cancers. Examples include: a) the  |
| Epstein-Barr virus (EBV) in Burkitt’s lymphoma, Hodgkin’s  |
| disease and naso-pharyngeal cancer; b) hepatitis B virus  |
| (HBV) in hepatocellular carcinoma; c) human immunodefi-
| ciency virus (HIV) in Kaposi’s sarcoma; d) human  |
| papilloma virus (HPV) in cervical cancer; e) schistosoma  |
| hematobium in bladder cancer. Non-viral agents may be  |
| found to be involved in nonmalignant conditions such as  |
| Helicobacter pylori in peptic ulcer and chlamydia pneumonieae  |
| in cardiovascular diseases. |

This utopian goal should, however, be viewed more figuratively than literally. It should be appreciated that certain intrinsic and extrinsic factors may tend to tarnish the achievements. First, the nature of human beings as mortal and vulnerable to some physical, mental, or social ailment should restrict its complete expression. Second, the concept for All would be virtually impossible to achieve with the continued persistence of inequities according to colour, ethnic origin, age, gender, social affluence, region, or residence, or biases according to political, religious, or cultural affiliation. Reduction of these inequities would be a measure of progress in the Fifth stage. Third, the future of mankind will not be completely free from natural or man-made disasters, economic crisis or wars that contribute to the limited or extensive deterioration of living and health conditions somewhere in the world. Fourth, there is always the possibility of shortcomings of imperfect health care even in the most affluent countries. Fifth, health hazards can be presented by health care itself, which is getting much more aggressive and more likely to take risks (57). Sixth, some of the powerful means of disease prevention are showing signs of fatigue. Organisms are developing drug resistance on a scope wider than ever expected and in the case of successive generations of powerful antibiotics. Finally, there are
no guarantees that promise that new diseases will not emerge, or that old diseases will not resurge. Of the disquieting sources for concern are four invisible threats to the future of mankind: viruses, the atom, the gene and continued population growth (see Box 5).

Box 5
The four invisible perils in the future of mankind

- **Viruses** stand out as enigmatic pathogens with the peculiar ability to mutate, change virulence and find ways of compromising their host's immunity, often defying and neutralizing medical innovations. It would be catastrophic, for example, if viruses should evolve that exhibited ability as those of HIV, and could be air-borne or propagated by casual contact.

- **Atomic energy** will always fascinate the human mind for peaceful, medical and military purposes. It is well to recall the devastation of the atomic bombs on Hiroshima and Nagasaki. Bombs that are even more powerful now exist and their potential use will remain a threat.

- **Recognition of the gene's role** will continue to expand as it is discovered as a factor in increasing numbers of disorders, dysfunction, or behavioural traits. Conversely, it has great potential in combating, or preventing disease or infirmity. This field will benefit from intensive genome research and scientific experimentation in genetic engineering.

- **High rates of population growth** will become increasingly undesirable for economic, social, lifestyle or health reasons. Population programmes will include well-managed family planning efforts, political commitment, efforts by non-governmental organizations (NGOs), acceptance of small family size norms, female education and higher socio-economic status for women.

5.c Beyond the Fifth stage: quality of life, equity, development, and social justice for all

This emerging vision takes a holistic view of health, considers it an integral dimension of the quality of life, and views it in the context of development. It accentuates health potential, social participation, economic productivity, and social justice. This approach will target the control of risk factors as a way to eliminate the root of human suffering. The new vision, which is implied in the definition of health in the WHO constitution, and renewal of the Health for All Strategy, means that health will cease to be measured solely in terms of mortality, morbidity and disability. Health will increasingly be measured in terms of human development; positive physical, mental, social, and spiritual well-being in the context of harmony with the environment; and equity in quality health care accessibility. To achieve quality of life, health is guaranteed as a human right for all. This will have to await subsequent stages of the transition, hopefully within the third millennium.

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