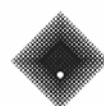


CENTRE FOR STRATEGIC ECONOMIC STUDIES

SUSTAINABLE HEALTH SYSTEMS TO SUPPORT INNOVATION

FRAMEWORK PAPER
APEC LIFE SCIENCE INNOVATION FORUM IV
HOI AN, VIETNAM

September 2006



Report authors

Peter Sheehan, Bruce Rasmussen and Kim Sweeny

Disclaimer

While every effort has been made to ensure its accuracy, the Centre for Strategic Economic Studies (Victoria University) does not make any representations or warranties (express or implied) as to the accuracy or completeness of the information contained in this report. The Centre for Strategic Economic Studies (Victoria University), its employees and agents do not accept any liability in negligence for the information (or the use of such information) which is provided in this report.

© CSES 2006

Centre for Strategic Economic Studies
Victoria University
PO Box 14428
Melbourne VIC 8001 Australia
Telephone +613 9919 1340
Fax +613 9919 1350
Website: <http://www.cfses.com>
Email: csesinfo@vu.edu.au

Centre for Strategic Economic Studies
Victoria University, Melbourne

**Sustainable Health Care Systems
to Support Innovation**

Framework Paper

Executive Summary

Remarkable gains in health outcomes have been achieved across the APEC region in recent decades. Since 1960 life expectancy has grown by at least 15-20 years in most economies, and by much more in some, while child mortality has fallen sharply. These are both indicators of strong improvements in general health. But very much remains to be done – there are some signs of less rapid gains in some countries in recent years, outcomes remains unequal across countries, many communities do not have adequate access to advanced health products and services and both HIV/AIDS and many chronic diseases threaten the populations of the region. This paper provides background to discussion at LSIF IV of the continued innovation within health systems necessary to produce improved health outcomes, and of how such innovations might be facilitated.

Three Major Challenges

The economies of the region must address three major challenges to achieve further strong gains in health outcomes. The first is the continuing high incidence of communicable, maternal, perinatal and nutritional diseases in some APEC economies, to which is being added the burden of HIV/AIDS. While deaths or disease adjusted life years (DALYs) lost from communicable diseases now account for a relatively low share of the total in the developed economies and in Korea, in some APEC economies these diseases still account for more than 20% of deaths, and more than 30% of DALYs (and in India more than 40%). In addition, rapid growth in HIV/AIDS infection is occurring in a number of economies, implying major long-term health issues.

A second challenge is the ‘pandemic’ of chronic, non-communicable diseases, such as cardiovascular disease, cancer and respiratory diseases, which is developing in the region, as elsewhere in the world. Projections from the World Health Organisation (WHO), on a basis which assumes improving income and education levels and continued innovation, indicate 12.9 million deaths per year from these three causes in the Western Pacific region in 2030. This is an increase of 65% over the 2002 figure and would account for 73% of all deaths in that region in

2030. These diseases have been a key focus in developed countries for some years, and are now becoming central in other member economies, as lifestyles change and as populations age.

Thirdly, almost all economies in APEC face a substantial ageing of their populations over coming decades. This ageing will contribute to the growing incidence of chronic diseases and also means that the diseases that especially afflict older persons, such as Alzheimer's disease, sense organ diseases and arthritis, will become increasingly important. But there is considerable evidence that ageing can involve both a significant postponement of disability, which would allow extended productive engagement in society, and a compression of the period of severe morbidity, involving a reduction in the high health costs typically incurred in the last years of life. Thus ageing poses a challenge to develop both the medical technologies and policies and the economic and social arrangements to permit the productive involvement of individuals as they age. The potential for this approach can be seen in some developed countries, such as USA and Australia, where there has been rapid growth in the employment of older persons in recent years, so much so that about half of the total increase in employment has been provided by persons aged 55 years or over.

The Central Role of Innovation

Responding to these challenges will require innovation across all aspects of health systems, together with structures, institutions and incentives to encourage such innovation. In terms of technologies, powerful resources are becoming available to economies to improve health outcomes. Many quality drugs that have contributed to improved outcomes in developed economies over the past decade are going out of patent, providing opportunities for lower cost treatments. Pharmaceutical R&D has increasingly shifted to cancer and to the diseases of old age, such as dementia and arthritis; to the use of genomic and proteomic databases; to new detection and diagnosis techniques, including pharmacogenomics, and to quite new approaches such as stem cell therapy. Renewed attention is also being given to the development of vaccines and treatments for many of the diseases that bedevil developing economies.

The existing global stock of medical knowledge is one thing, but applying that knowledge effectively in a given economy is quite another. This requires innovation at all levels, from detection, screening and prevention to the delivery of high quality products and services to patients in a wide variety of settings. How such a continuing, system wide process of innovation can be achieved and financed is an important question for discussion. Given patent expiries and the increasing costs of the new technologies, there are also real questions about how the next major round of drug development will be financed.

Increased Priority for Health in Development

Improved health not only delivers major benefits to individuals and communities but also contributes to economic growth. One estimate is that about half of the improvement in welfare of the world's population during the 20th Century came from improved health, and there is evidence that improved population health makes a positive contribution to economic growth. Given the past record and the challenges that APEC member economies currently face, it is highly likely that the provision of increased resources to health, provided they are efficiently managed and effectively delivered, will offer further major improvements in welfare in most economies. This is particularly so in some rapidly growing member economies, where public spending on health has been given lower priority than the demands of development and where private spending has been constrained by inadequate supply of quality services.

Priorities within Health – Early Intervention, Advanced Treatments and Capacity Building

Each member economy faces its own unique pressures and circumstances, and each must establish its own priorities, having regard to its specific burden of disease, current challenges and future trends. Some general themes stand out, however. One is that the early detection of disease, or of the propensity to get disease, together with early action to prevent or treat disease, offers great promise of improved health outcomes. This is especially so as advanced methods for early detection and diagnosis and a range of new vaccines are in the pipeline. Thus there is a strong case for giving increased priority to early intervention. Secondly, there is considerable evidence that, as medical science advances, newer generations of medicines and other treatments offer better health outcomes than previous generations. While this fact raises complex financing, institutional and delivery systems issues, facilitating widespread access to the most advanced treatments possible within a given context needs to be a priority within health systems. More generally, there is a need to develop sustainable systems to support relevant and effective innovation within a given economy, on a continuing basis. This will include building the capability, in terms of physical, human and social capital, for the delivery of improved health services to the community.

1. Introduction

Health care systems are under considerable stress in most economies, with growing demand for services, including those using new technologies, and limits on financial resources even in the richest economies. At the same time, innovation in health systems has contributed greatly to increased longevity and quality of life in recent decades, and there is strong potential for further gains. Among the factors contributing to the unique mix of pressures and opportunities are the following:

- a new wave of technological innovation, offering better and more targeted methods for detection, diagnosis and treatment of disease;
- the high costs of applying advanced medical technologies, including building the skill and infrastructure base for effective use, together with the additional costs of emerging technologies;
- demographic and lifestyle factors (such as ageing and obesity) that increase the need for health care services; and
- continuing inequality in access to health care services, with the ongoing need to extend high quality services to less privileged groups, even though the technological intensity of those services continues to increase.

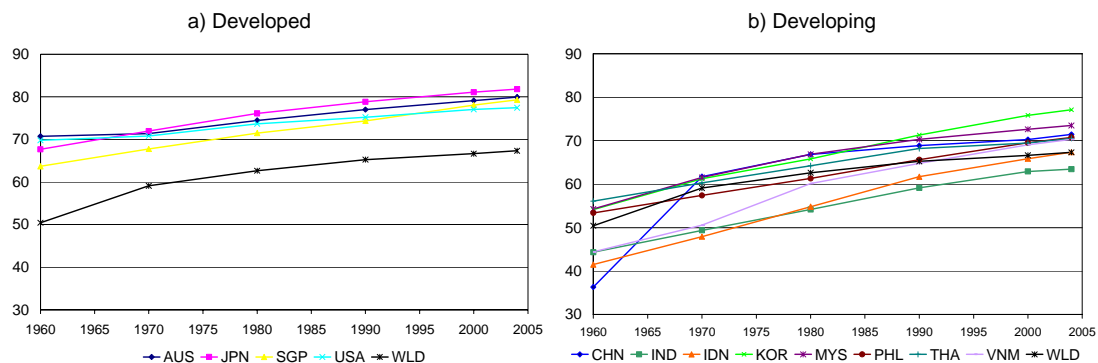
At their October 2002 meeting the APEC Leaders, in establishing LSIF, stressed the need ‘to be more effective with our investment at every stage of the health care process, including primary prevention against disease risks, and focusing on most vulnerable populations’. Given its overall remit, and the progress that has been made in other areas, it is appropriate for LSIF IV to adopt as a key theme the efficient and effective allocation of resources to promote innovation as a response to the challenges facing health care systems. Some aspects of that theme are noted below. There are likely to be many areas within this theme where progress could be made by collaborative efforts between member economies, making use of the tripartite structure of LSIF.

2. Improving Global Health: New Pressures and Opportunities

Health outcomes for APEC economies, both developed and developing, have improved remarkably over the last four to five decades. Reductions in communicable infectious diseases and maternal and perinatal conditions have had a major impact in the developed world and increasingly in the developing world. Mass vaccination programs such as that against polio conducted by the World Health Organization (WHO) and its partners has all but eradicated one of the world's oldest diseases (WHO 2003). These improvements have had a major impact on increasing longevity and reducing child mortality.

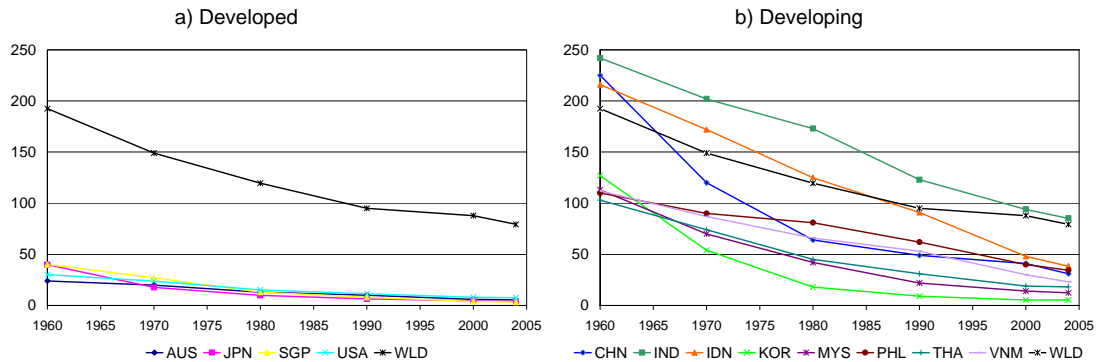
The two charts in Figure 1 show the impact on mortality under five years of age and life expectancy at birth for selected APEC economies and India for the period 1960 to 2004. The economies shown have been grouped into developed and developing economies according to WHO classification of Member States. This classifies Australia, Japan, Singapore and the United States as *developed* while China, India, Indonesia, Korea, Malaysia, Philippines and Vietnam are classified as *developing*. Korea's inclusion in the latter grouping is now something of an anomaly. Although its health outcome indicators were in keeping with those of its peers in 1960, it has achieved, with its economic transformation, 'developed economy' health status towards the end of the period. India, while not a member of APEC, has been included in this analysis for several reasons. It is the largest economy in the WHO South East Asia Region in which a number of APEC economies are included and makes an interesting point of comparison, especially with China.

Figure 1. Life expectancy at birth, selected developed and developing economies, years



Source: WHO (2006).

For economies in both groupings, life expectancy has been increased to an extraordinary degree. This has been particularly the case for the developing economies where life expectancy has been lengthened by some 22 years (unweighted average) compared with the average for the world of about 17 years. This has been the result, firstly, of a certain degree of 'catch-up,' in which medicines and treatments available in the developed world have been adopted by the developing economies, and, secondly, of the continued advance of health technologies and preventative strategies. These latter factors are fundamental to the continuing improving trend in life expectancy in developed economies, which has increased by some 12 years (unweighted average) over the period. Given the already high standard of health services available in developed economies in the 1960's this increase is no less remarkable than that which has occurred in developing economies.

Figure 2. Child mortality, selected developed and developing economies, years

Source: WHO (2006).

There are some notable differences in the trend in life expectancy of individual economies. Of the developing economies, China experienced a rapid improvement in life expectancy between 1960 and 1970 but the rate of change has levelled off in the last decade compared with its peers. Both Indonesia and Vietnam have increased their life expectancy from low 40s to over 67 and 70 respectively. Life expectancy in Korea is now 77 years, comparable to that of the United States. Amongst the developed economies the United States has had the least increase in life expectancy, from 70 to 77, which is low compared with Australia and Japan where it reached 80 and 82 respectively in 2004.

The two panels in Figure 2 show the mortality of children aged under five years. It has fallen significantly over the period in all the selected developing economies, but except for Korea remains at levels well above that in developed economies. Child mortality in developed economies such as Singapore is less than 4, whereas it is over 12 for Malaysia and 85 in India. China has reduced its child mortality from 225 to 31 over the period. All the selected APEC economies are below the world average of 79.

Table 1 shows, for the selected economies, the values for life expectancy and child mortality for 2004 and their compound annual growth rates over two periods, 1960 to 1980 and 1980 to 2002. This shows the comparative rates of change for each economy. It shows that China has had the most rapid improvement in life expectancy over the whole 1960-2002 period (1.55% pa), even though the rate of increase is considerably slower in the post 1980 period. The most rapid rate of reduction in child mortality was in Korea, with a 6.9% pa average decline over full 1960-2004 period. Korea reduced its child mortality to 5.5 per 1000 in 2004, the same as for Australia and lower than the United States.

Table 1. Health outcome indicators, selected APEC economies and India

	Life expectancy at birth (years)			Child mortality rate		
	Level in 2004	Annual average growth (% pa)		Level in 2004	Annual average growth (% pa)	
	(years)	1960-80	1980-2002	(per 100,000 population)	1960-80	1980-2002
Developing Countries						
China	71.4	3.1	0.3	31	-6.1	-3.0
Indonesia	67.4	1.4	0.9	38	-2.7	-4.8
Korea, Rep.	77.1	1.0	0.7	6	-9.3	-4.8
Malaysia	73.5	1.0	0.4	12	-4.8	-5.0
Philippines	70.8	0.7	0.6	34	-1.5	-3.5
Thailand	70.5	0.7	0.4	18	-4.1	-3.7

Vietnam	70.3	1.5	0.7	23	-2.6	-4.3
India	63.5	1.0	0.7	85	-1.7	-2.9
Developed Countries						
Australia	79.9	0.3	0.3	6	-3.0	-3.5
Japan	81.8	0.6	0.3	4	-6.7	-3.9
Singapore	79.3	0.6	0.4	3	-5.5	-5.6
United States	77.4	0.3	0.2	8	-3.4	-2.8
World	67.3	1.1	0.3	79	-2.4	-1.7

Source: WHO (2006).

Case Study 1 – Republic of Korea: Rapid Transition to High Health Outcomes

Korea has made remarkable progress in its health outcomes for its people since the 1960's. Life expectancy at birth has increased from 54.2 to 77 years, an increase over 40 per cent. The under-5 mortality rate (per 100,000 live births) has fallen from 127 in 1960 to 5 in 2003. The immunisation rates against basic diseases such as tuberculosis and measles are higher than the world averages, at 87% and 96% respectively.

Korea now has a relatively low number of deaths from infectious diseases. Communicable, maternal, perinatal and nutritional conditions account for less than 6 percent of all deaths. Like many developed economies Korea's deaths from non communicable or lifestyle related diseases account for a significant number of deaths. Cancer and cardiovascular disease are the highest at 162 and 160 per 1000 of population. The reasonably high rate of lung cancer can be partially explained by the fact that the prevalence of smoking among males is 64%.

Korea's health policies have changed along with its rapidly changing economic situation. Initially health policy focused on containing communicable diseases such as diphtheria, tetanus, measles, tuberculosis etc., and family planning. Towards the second half of the 1970's attention turned to secure and equitable access to health services. In 1977 it established a compulsory medical insurance programme for companies with more than 500 employees. By 1989 all employees and self-employed in urban and rural areas were covered by compulsory insurance. In July 2000 all insurers were integrated into the National Health Insurance Corporation (NHIC). The NHIC purchases health care services for the total population but contracts it to mostly private providers.

About half of all expenditure on health is private and is mostly out-of-pocket payments. Total expenditure on health is increasing rapidly. In 2003 it was 5.6 per cent of GDP compared with 4.8% in 1990. The expansion of insurance coverage and benefits over the last few decades has contributed positively to Korea's health outcomes.

There is pressure to contain the costs of health care services in the future. Like many developed economies health expenditures on the elderly are likely to keep increasing as a proportion of total expenditure.

Korea: Health Outcomes and Resources, 2003

Life expectancy (1)	77
Under-5 mortality rate (3)	5
Maternal mortality rate (2,3)	20
Private health expenditure, % of total expenditure	51%
Physicians (per 100,000) (4)	181
% of one-year-olds immunized against:	
TB	87
Measles	96
Deaths from cancer (per 10,000)	162
Deaths from cardiovascular disease (per 10,000)	160

Notes: (1) 2000-05. (2) 2000. (3) per 100,000 live births.
(4) 1990 to 2004, most recent available.

Source: UNDP (2005, pp. 236-239 and 250-252).

2. The Changing Burden of Disease

In considering the ways in which continued innovation within health systems in member economies can lead to further improvements in health outcomes, it is useful to start by reviewing trends in the burden of disease. The data for this review are drawn from the Global Burden of Disease Project sponsored by WHO and the World Bank and based at the Harvard School of Public Health. This provides comprehensive and broadly comparable measures of death and disability, both for projections for historical data back to 1990 and for 2005, 2015 and 2030. The latest actual data are for 2002. Data for 2002 are available at the economy level, while earlier data and the projections are available only for regions or subregions. Data are provided for a number of APEC economies in the table and charts below, and for all APEC economies (other than Hong Kong and Chinese Taipei, for which comparable data are not available from WHO) and India in the appendix tables.

The measures used here are deaths and disability adjusted life years lost (DALYs). The Global Burden of Disease Project developed DALYs as a single measure of the impact of premature death and disability. DALYs are calculated by summing the years of life lost as a result of early

death and the proportion of years of quality life lost by living with a disability of known severity and duration (CPDS 2006, p. 7). The measure is a normative one, which makes interpersonal comparisons such as those relating to different health or disability conditions and the value of a healthy life at different ages. Where possible the Project has adopted an egalitarian approach - the value of a healthy life for a poor peasant is the same as that of a wealthy director of a bank (CPDS 2006, p8). In assessing years of life lost, the Project has adopted as a 'standard life' that of the average for the longest living population (Japan) and has placed a higher value on the life of young adults than those of children or the elderly. It has also discounted future years lost compared with ones lost now using discount rate of 3% per annum. The weights for comparing different disabilities were established by considering the budget equivalent costs of caring for different disabilities based on the resources required for 1000 healthy people (CPDS 2006, p. 11).

It should also be noted that the disability adjusted life years lost measure used below is an incidence rather than a prevalence measure. That is, it is a measure of the disability adjusted life years lost as a result of the deaths, injuries and onset of disease occurring in a given year. Thus if a person dies in 2002, the DALY measure for 2002 will include an estimate of the life years lost; if a person has a stroke in 2002, the 2002 measure will include an estimate of the effective, disability free years of life that that person will lose as a result of that stroke. But it does not take account of the prevalence of strokes within the community, and hence of the adjusted life years lost by people who had strokes before 2002 but are still alive in 2002. It is a measure of the life years lost as a result of events in 2002, not of those lost from the diseases prevalent in that year.

Uneven Decline in the Incidence of Communicable Diseases

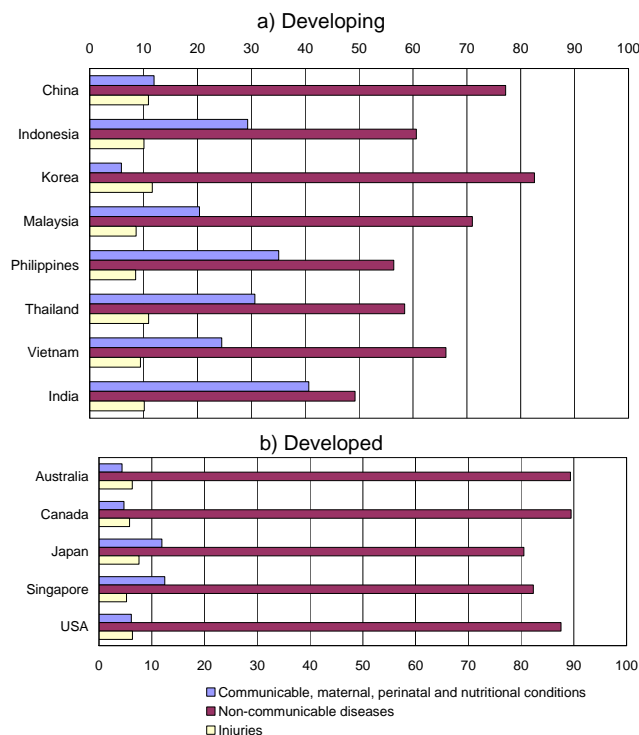
A key to improving health outcomes in all countries has been the progressive reduction in death and disability arising from infectious and parasitic diseases, respiratory infections and maternal and perinatal conditions (which are grouped under the heading of 'communicable diseases'). This is evident from Figure 3, which compares the broad causes of death of selected APEC developed and developing economies. India, although not a member of APEC, is included as a point of comparison. The main difference between the developing and developed economies shown is that communicable diseases and maternal, perinatal and nutritional conditions have been all but eliminated as a cause of death from developed economies, except among the elderly. Only 4-6% of deaths in Australia, Canada and USA are due to communicable diseases. In contrast the proportion exceeds 40% in India and is at about 30% for Indonesia, Philippines and Thailand. A reduction in such diseases is one of the markers of the successful application of economic development to health, as illustrated by Korea, with only 5.8% of deaths due to communicable diseases. China has also reduced these diseases substantially, with only about 12% of deaths due to these diseases in 2002. Among developed economies Japan and Singapore, which have a relatively high proportion of deaths among elderly people from respiratory infections.

Injuries such as car accidents and work injuries also account for a higher proportion of deaths in developing compared with developed economies. Most of the developing economies shown have about 10% of deaths due to injuries compared with levels of 5-6% in developed economies. With the reductions in communicable diseases and injuries, the proportion that dies from non-communicable diseases rises in more developed economies. There has been some success at reducing their incidence through better drugs, treatments and preventative programs such as that to reduce smoking, and this is taken up further below.

One way in which the disability adjusted life years lost measure differs from a simple mortality count is that it reflects the affect of age of death or of the onset of disability – such an event for a young person leads to more life years lost than for an older person. This is particularly relevant for communicable diseases, which often strike people at a young age and hence result in more

years of life lost than some chronic diseases. Thus for many of the developing countries shown in Figures 3 and 4 (and generally for the developed countries also) the share of DALYs lost from communicable diseases is higher than the share of deaths arising from these causes. This effect is especially pronounced for China, where the share of DALYs arising from communicable diseases is 19% by comparison with 12% for deaths, and in Vietnam, where the DALY share is 32% by comparison with 24% for deaths. These facts further confirm the continuing importance of communicable diseases for many developing countries.

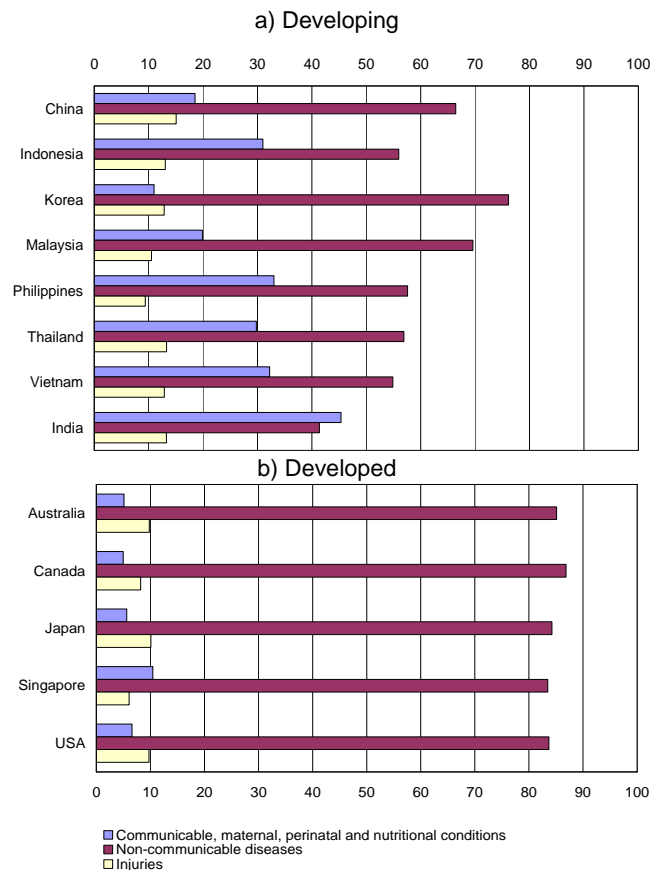
Figure 3. Deaths by cause, selected APEC economies, per cent



Source: WHO (2005).

These broad trends conceal some diverse trends in particular diseases within the communicable, infectious and maternal, perinatal and nutritional conditions grouping. TB is a greater cause of death than a contributor to DALYs and so is HIV/AIDS for a number of economies. On the other hand diseases associated with maternal, perinatal and nutritional conditions tend to be more of a disease burden than causes of death and therefore the share of DALYs is larger than the share of deaths. The proportions for the major communicable and infectious diseases and maternal, perinatal and nutritional conditions are set out in Table 2.

In terms of divergence across economies, some diseases are particularly severe in some economies while being at modest levels or almost non-existent in others. HIV/AIDS is a very high cause of death and disease burden in Thailand with more than 13.5% of deaths in 2002 being due to HIV/AIDS and 10.8% of total DALYs due to this cause. Other economies with relatively high levels of HIV/AIDS are India, Vietnam and Malaysia. While Indonesia and the Philippines have very low levels of HIV/AIDS, the incidence of TB is relatively high for these economies with 7.8% and 10% of deaths and 6.3% and 4.8% of DALYs respectively. Deaths and DALYs due to respiratory infections are also high in Indonesia and the Philippines.

Figure 4. DALYs by cause, selected APEC economies, per cent

Source: WHO (2005).

The share of DALYs for maternal, perinatal and nutritional conditions is particularly high, at over 11%, in Indonesia, Philippines, Vietnam and India, being a source of disease burden more so than death. Each of these diseases and conditions is capable of significant reduction through appropriate health treatment programs. Overall TB and respiratory infections are a higher proportion of deaths than DALYs, while maternal, perinatal and nutritional conditions are a larger share of DALYs than deaths.

Table 2. Major communicable and infectious diseases and maternal, perinatal and nutritional conditions, selected developing economies, 2002, percentage share

	Tuberculosis		HIV/AIDS		Respiratory infections		Maternal, perinatal and nutritional conditions	
	Deaths	DALYs	Deaths	DALYs	Deaths	DALYs	Deaths	DALYs
China	3.0	2.2	0.5	0.6	3.2	3.1	3.2	8.1
Indonesia	7.8	6.3	0.1	0.2	6.5	3.0	6.5	11.4
Korea	1.6	0.9	0.0	0.0	1.9	0.7	1.0	3.1
Malaysia	2.9	1.9	1.8	2.2	6.0	2.4	2.7	6.5
Philippines	10.0	4.8	0.0	0.0	10.5	6.7	7.6	12.2
Thailand	2.3	1.6	13.5	10.8	3.1	2.6	2.4	5.0
Viet Nam	3.8	3.1	1.5	2.1	5.4	3.4	4.6	11.3
India	3.5	2.8	3.5	3.4	10.8	8.7	9.9	15.3

Source: WHO (2005).

The data provided in Figures 3 and 4 and Table 2 do not cover all APEC economies but, together with the material in the appendix tables, they do show that the incidence of communicable diseases remains unacceptably high in many APEC economies. This is one area in which sustained innovation, in many dimensions, remains an urgent priority.

The Emerging 'Pandemic' of Chronic Diseases

While various communicable diseases still require urgent attention in many countries, the common challenge, facing all countries alike in different ways and to different degrees, is to deal with what the World Health Organisation (WHO 2006a) has described as the emerging pandemic of chronic, non-communicable diseases. The main chronic diseases are cardiovascular disease, including heart attack and stroke, cancer, chronic respiratory diseases and diabetes. According to WHO estimates, some 35 million people worldwide, including many young people and those in middle age, will die from these diseases in 2005; without specific further action, this number will rise by 17% to over 40 million by 2015 (WHO 2006a). Figures 3 and 4, and the appendix tables, show that for all APEC economies for which data are available, non-communicable diseases were the largest cause of death or disability adjusted life years lost in 2002, and for most economies they were by far the dominant cause.

As noted above, the WHO provides projections of deaths and DALYs for periods to 2030 for selected regions. None of these regions coincide at all closely with the APEC region, but we concentrate here on projections for deaths and disease adjusted life years lost from various causes for the Western Pacific region. This region contains eleven APEC members (Australia, Brunei, China, Japan, Malaysia, New Zealand, PNG, Philippines, Republic of Korea, Singapore and Vietnam), comprising a population of 1.7 billion, about two thirds of the APEC region's population, and also a number of other small economies which are not members of APEC. These projections take account of improvements in education levels and income, and of an underlying rate of improvement in technology and in health systems (as represented by a time trend), as well as specific analyses of some diseases such as HIV/AIDS (Mather and Loncar 2005).

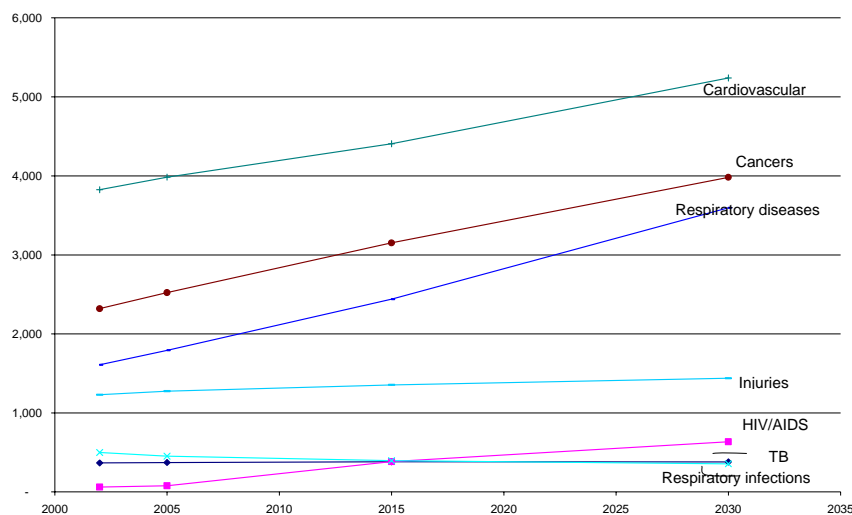
The baseline projection for deaths by major cause in the Western Pacific region to 2015, summarised in Figure 5, illustrates the rising impact of cancers, cardiovascular disease, respiratory disease and HIV/AIDS. After showing some benefit from the increased availability of anti-retroviral treatments, deaths from HIV/AIDS are expected to increase tenfold from 62,000 in 2002 to 635,000 by 2030. This will be especially significant for those APEC economies with high incidence rates, such as Thailand and to a lesser extent Vietnam and Malaysia. On the other hand deaths from other infectious and parasitic diseases are expected to decline by one third over the region, to the still high figure of 495,000 by 2030. This will be of major benefit for a range of developing APEC economies where incidence rates are currently relatively high. Such reductions will not occur automatically, however, and the projections assume continued innovation in technology and health systems.

It is clear from Figure 5 that the dominant cause of death in the region is now, and will increasingly be, the key chronic diseases - cardiovascular disease, cancers and respiratory disease. By 2030 there are expected to be about 12.9 million deaths per year from these three causes, an increase of 65% over the 2002 figure and accounting for 73% of all deaths in the region. The strongest growth (123%) is in respiratory diseases, while deaths from cancers are projected to grow by 72% and from cardiovascular disease by 37%.

Some chronic diseases have a serious impact on human well-being without being the direct cause of death – diabetes increases the risk of stroke or heart attack; depression, bipolar disorder and Alzheimer's disease can be very debilitating without being a direct cause of death, as can many

musculoskeletal diseases such as the various forms of arthritis. Thus an additional perspective to that provided by the deaths data can be gained by examining the projections for disability adjusted life years lost by cause of disease through to 2015 (Table 3), again for the Western Pacific region.

Figure 5. Projected trends in total deaths for selected causes, baseline scenario, Western Pacific region, 2002-2030



Source: WHO (2006)

These projections illustrate the key points about communicable diseases made above. For this region, disease adjusted life years lost from communicable and infectious diseases and from maternal, perinatal and nutritional conditions are projected to be at 40 million in 2015. While this is a reduction of 27% from the 2002 figure it remains a high level for a region that should have reasonably strong GDP per capita by that time. The key contributors are tuberculosis, DALYs from which are projected to remain almost unchanged at 6 million through the period, and HIV/AIDS, for which DALYs are expected to increase almost five fold to over 10 million by 2015. For other diseases in this category DALYs are expected to fall significantly through to 2015, but all of this assumes continued trend improvement in technologies and health systems over the period.

By contrast, the number of DALYs lost through non-communicable or chronic disease is expected to rise by 13.3% to 197 million by 2015. Growth in the incidence of cardiovascular diseases should slow as the innovations that have been successful in reducing these diseases in developed countries spread through the economies of the region, although life style changes and the prevalence of diabetes remain risk factors. DALYs lost through cancers and respiratory diseases are projected to increase rapidly (growing by 24.2% and 42.3% respectively between 2002 and 2015). However the use of DALYs highlights the impact on human welfare of other non-communicable diseases. Neuropsychiatric conditions are expected to increase further, and to account for 18.3% of all DALYs lost in 2015; DALYs lost through sense organ diseases, such as cataracts and vision or hearing disorders are projected to grow by 28.6% over the period; and the incidence of musculoskeletal disease will increase significantly. For this Western Pacific region as a whole in 2015, 72.6% of disability adjusted life years lost from death, injuries or the onset of disease are expected to result from non-communicable diseases.

Table 3. Disease adjusted life years lost, Western Pacific Region, by cause, 2002 and 2015

Cause of life years loss	2002	2015	Change 2002-15
	DALYs (million)		(%)
Communicable and perinatal diseases	54.3	39.5	-27.3
Tuberculosis	6.0	5.8	-3.1
HIV/AIDS	2.3	10.2	342.9
Respiratory infections	8.7	3.5	-59.6
Perinatal and other conditions	22.0	11.2	-48.9
Other communicable	15.3	8.7	-43.3
Non-communicable diseases	173.6	196.8	13.3
Cancers	24.8	30.8	24.2
Cardiovascular diseases	32.4	33.6	3.6
Respiratory diseases	15.5	22.1	42.3
Sense organ diseases	18.5	23.8	28.6
Neuropsychiatric disorders	46.5	49.5	6.5
Musculoskeletal diseases	9.2	11.0	19.6
Other non communicable	26.6	26.0	-2.3
Injuries	37.0	34.7	-6.1
All causes	264.9	270.9	2.3
Reference Items			
Population (million)	1,718	1,841	7.2
DALYs per thousand population	154.2	147.2	-4.6

Source: WHO (2006a).

Again there are some striking differences in the incidence of particular diseases between economies and marked differences between diseases as a cause of death or disease burden (Table 4). For instance while neuropsychiatric conditions are a low proportion of deaths, the highest being for Korea with 4.7%, they represent a major source of disease burden, ranging from a low of 10.9% of total DALYs for India to 25.1% for Korea. For the majority of these APEC developing economies the range of DALYs is between 15% and 20%. In contrast, cancers and cardiovascular diseases are major causes of death but involve a less severe disease burden. Cardiovascular diseases for instance account for between 20% and 33% of deaths but only between 7% and 13% of DALYs.

Table 4. Major non-communicable diseases, selected APEC developing economies and India, 2002, percentage share

	Cancers		Neuropsychiatric conditions		Cardiovascular diseases		Respiratory diseases	
	Deaths	DALYs	Deaths	DALYs	Deaths	DALYs	Deaths	DALYs
China	19.0	9.7	1.1	17.5	32.9	12.6	15.7	6.3
Indonesia	11.6	5.0	2.2	12.6	28.8	11.2	6.7	4.2
Korea	27.9	12.1	4.7	25.1	27.5	10.4	6.4	3.7
Malaysia	16.7	6.5	2.2	19.7	30.0	10.6	8.1	4.4
Philippines	9.0	4.0	1.2	16.1	27.3	10.0	6.1	4.4
Thailand	14.3	5.6	3.4	15.7	20.0	7.6	6.6	3.5
Viet Nam	12.4	5.0	2.6	16.4	31.0	10.4	9.9	4.2
India	7.2	2.9	1.8	10.9	27.1	10.2	5.9	3.6

Source: WHO (2005).

In terms of comparisons between the economies, as shown in Figures 3 and 4 above the pattern of disease for Korea is more in keeping with a developed economy with a relatively high proportion of deaths due to cancers (27.9%) and cardiovascular diseases (27.5%) and a low proportion (6.4%) due to respiratory diseases. China has a particularly high proportion of deaths (15.7%) due to respiratory diseases. This may relate to high levels of smoking and air pollution. Vietnam also has a high incidence of respiratory disease. Of particular note are the low levels of incidence for cancers in the Philippines (9%) and cardiovascular disease in Thailand (7.6%).

The Rising Importance of the Diseases of the Elderly

The third message, somewhat more hidden, to be drawn from an analysis of the changing burden of disease is that, again in different countries at different time frames, certain diseases that particularly affect elderly people are of rising importance. For example, according to the projections cited above, the disability adjusted life years lost in 2015 through Alzheimer's disease will be 37% higher than in 2002, while for cataracts the increase is 39% and for both age-related vision impairments and for musculoskeletal diseases the projected increase is 32%. These are initial indications of the central fact that as populations age these and other such diseases will become more important issues for health systems.

Case Study 2 - China: Slower Health Gains in the Market Era

China has made strong progress in health outcomes for its population since 1960. Life expectancy at birth has increased from less than 40 to over 71.5. Child mortality has fallen from 225 to 31. It has embarked on major immunisation programs including TB and measles as shown in the table below with high levels of coverage. The number of physicians is reasonably high relative to the population.

However much of this progress was evident by the 1980s. Life expectancy was 66.8 in 1980 compared with Malaysia of 66.9 and Korea of 65.8. In the years since, while Malaysia's life expectancy at birth has increased to 73.5 and Korea's to 77.1, China's improvement has been rather less. Similarly the rate of improvement in child mortality has tended to slow in the period since 1990.

The reasons for this slow down in the rate of progress are complex. One may be an inadequate overall level of resources for health. In contrast to many developed countries, China's general government expenditure on health has been falling from 12.5% of total government expenditure to 9.7% (WHO 2006). Accordingly a high proportion of expenditure on health is privately financed (64%).

China: Health Outcomes and Resources, 2003

Life expectancy (1)	71.4
Under-5 mortality rate (3)	31
Maternal mortality rate (2,3)	56
Private health expenditure, % of total expenditure	64%
Physicians (per 100,000) (4)	164
% of one-year-olds immunized against:	
TB	93
Measles	84
Deaths from respiratory diseases (per 10,000)	11

Notes: (1) 2000-05. (2) 2000. (3) Per 100,000 live births. (4) 1990 to 2004, most recent available.
Source: UNDP (2005, pp. 236-239 and 250-252).

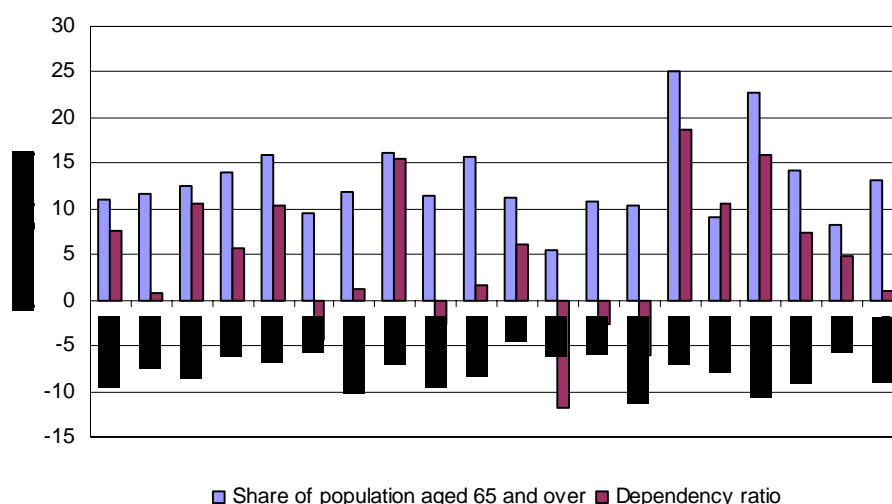
The rapid marketisation of the Chinese economy has been matched by similar trends in the health sector, raising the price of access and inevitably leading to the exclusion of the poorer sections of the community. Health treatment is a heavy burden on a population with low levels of medical insurance. Only 20.9% of rural residents and 55.2% of urban residents have medical insurance, generally those employed by government and SOEs. In this environment efficient and effective delivery systems for drugs and medical services are lacking.

It is notable that the incidence of death from respiratory diseases is very high at 110 per 100,000 (15.7% of all deaths in 2002), typically associated with high levels of smoking and air pollution. China's rapid industrialisation and high levels of expenditure on coal fired generating capacity may be having a negative effect on public health.

3. Ageing

Population ageing is either occurring or is in prospect in most APEC economies, and has been the subject of a good deal of analysis. Ageing is influenced, in most cases, by both a sustained decline in the birth rate and in a decline in mortality rates, leading to an increase in life expectancy. In most APEC economies the share of the population aged 65 years and over will rise by between 8 and 16 percentage points between 2005 and 2050 (see Figure 8 and Appendix Table A5), with only Korea and Singapore (25.1 and 22.8 percentage points respectively) being above that range and only Papua New Guinea (5.5 percentage points) being below it. The most recent UN population projections imply that in three economies – Japan, Singapore and Korea – the share of the population aged 65 and over will by 2050 be well over 40%. In some respects the increase in the so-called dependency ratio, here defined as the share of the population that is less the 15 years or over 64 years, is a better measure of the potential social implications of changing population structure. In most economies the dependency ratios rises much less than the aged share, but in six APEC economies (Korea, Singapore, Japan, Canada, Russia and China) this ratio rises by more than 10 percentage points between 2005 and 2050.

Figure 8. Change in population aged 65 years and over, and in dependency ratio, APEC economies and India, 2005-2050



Source: UN (2005); excludes Chinese Taipei and Hong Kong.

Thus population ageing will be a major issue to be addressed in almost all APEC economies in coming decades, but the interpretation of ageing, and of its policy implications, is not a straightforward matter. Figure 9 provides a schematic representation of the process of ageing, in terms of the average onset of disability and chronic infirmity, covered by the general term 'morbidity', prior to death. Three possibilities are displayed, relative to an assumed starting point of onset of morbidity at 55 years and death at 75 years. These three possibilities reflect different interpretations of the impact of improved health practices and technologies leading to an increase in life expectancy.

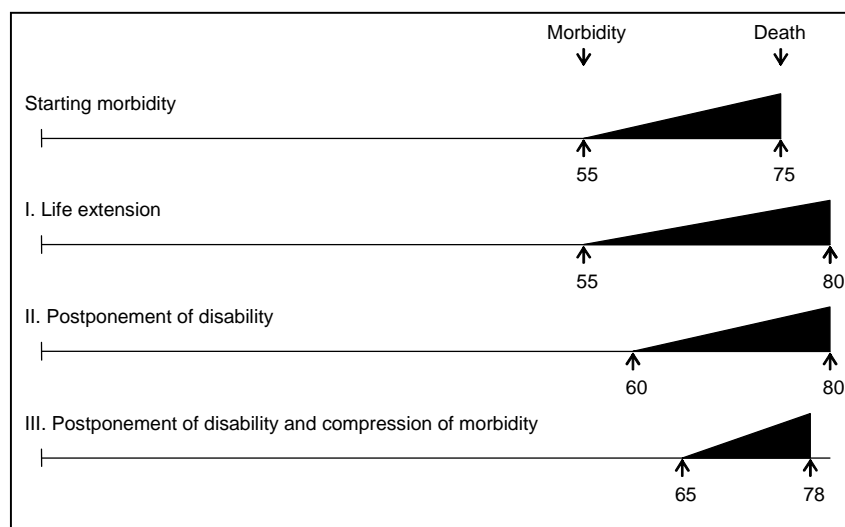
The first representation, life extension, assumes that the onset of morbidity remains at 55 years but that death is delayed until 80 years, implying an increased period and extent of morbidity. This is a natural interpretation of the ageing process, in which increased longevity involves an increase in the period of morbidity after 55 years of age, and hence an increase in the individual burden of

morbidity and in health system cost. It might be described as representing ageing as involving being older longer, in the sense that individuals encounter frailty and disability at the same average age but bear it for a longer period. Such a representation is widely used in economic modelling of the impact of ageing on future health system costs, and typically shows substantially increased health costs as a result of ageing populations.

The second representation of ageing involves the postponement of disability until say 60 years of age, as improved health practices and technologies allow individuals of a given age to enjoy better health and functioning than did people of the same age in earlier generations. The period of morbidity remains the same, but begins and ends later than in the base case. In terms of capability, ageing is thus a matter of getting old later rather than being old longer. In this case there are great individual and social benefits from longer life, including the ability to work longer, while the costs of morbidity are delayed but not reduced.

In the third representation, the compression of morbidity, the postponement of disability takes place at a faster rate than the increase in longevity, so that the period of frailty and disability is reduced. This would imply that, in addition to the individual and social benefits arising from the postponement of disability, the costs associated with the period of frailty and chronic illness towards the end of life may also be reduced.

Figure 9. Possible scenarios for future morbidity and longevity



Source: Adapted from Fries (2005, p. 165).

These issues have been the subject of an extensive empirical literature, mainly for the developed economies and especially for the USA. More summarised the conclusions as follows:

...several consensus publications, as well as a meta-analysis that stratified results based on the adequacy of measurement, concluded that there appeared to have been a significant reduction in the rate of functional decline over the last three decades and that this finding was robust with respect to measurement approach, methodology and to some extent by economy (Cutler 2001; Freedman et al. 2003; Hubert et al. 2002). Although difficult to pinpoint, in the face of an approximately 1% reduction in mortality in older people, most researchers conclude that there has been at least a 2% reduction in disability over the last several decades (Manton et al. 2001). (2005, p. s308)

Fries, the originator in 1982 of the idea of the compression of morbidity, reached a similar conclusion in a review of the literature (Fries 2005). The reasons for the postponement of disability lie in a wide range of innovations across the life cycle and health system: improved lifestyles and practices, both in earlier life and when aged; early detection and intervention, preventing disabling events (e.g. stroke, heart attack, the onset of osteoporosis) at an early age; changes in the built environment and in the medical supports available to the aged; and improved levels of nutrition and education.

These findings have major implications for how APEC economies respond to the prospective ageing of their populations. Rather than ageing simply being seen a threat to economic growth and as likely to drive health system costs, this view of ageing calls increased innovation in two main dimensions. First, an appropriate response will require an enhanced pursuit of innovations in many facets of the health system, as discussed elsewhere in this paper, to ensure that a postponement of disability and a compression of morbidity are achieved. Second, the postponement of disability implicit in the modern ageing process makes possible increased employment of older people, with substantial individual and social benefits. For this to be achieved, however, substantially change in community attitudes, workplace practices, superannuation arrangements and financial incentives are necessary.

Table 5. Change in employment, by age and sex, Australia, 1978-2006, annual growth rates based on data at June of each year

	1978-2001	2001-2006
Age groups	(% pa)	
16-54 years	1.8	1.5
55-59 years	1.9	7.4
60-64 years	1.8	8.3
65 years and over	2.0	8.6
Total – all ages	1.8	2.3

Source: ABS (2005).

In a number of economies employment of older people has been growing rapidly in recent years. One striking example is Australia, where up to the early 1990s there was a strong trend to early retirement, with both governments and companies providing inducements to their staff to leave early. In recent years this has been strongly reversed, with employment growing by about 8% per annum between 2001-06 for persons aged 55 years and over, with the growth spread across all the age sub-groups for persons over 55 years (Table 5). This rate of growth is four times that of all persons aged less than 55 years, and persons over 55 contributed 43.8% of the growth in total employment in Australia over this period. Thus the increased employment of older Australians is making a major contribution to its economic growth. Recent trends in the USA have been in some respects more striking. Between 1998 and 2006 employment among persons aged 55 years and over grew by 5.2% per annum, by comparison with only 0.5% for persons less than 55. As a result, as much as 63.8% of increased employment in the USA over 1998-2006 consisted of people in the older age group.

Ageing is sometimes seen as a problem arising in good part from modern medicine. But rather it is part of a success of modern medicine - enabling individuals to lead longer, more productive lives – and contains within itself the means of offsetting many of the social costs. We should not limit health innovation in response to prospective ageing, but maximise what can be achieved through enhanced innovation to create healthy, productive populations in older age groups that can in turn contribute strongly to meeting the social costs of their own ageing.

Case Study 3 – Indonesia: Improving Health Outcomes with Limited Resources

According to the key health outcome indicators of life expectancy child mortality, Indonesia in 1960 was in a comparable position to India and China with life expectancy at birth being 41 and child mortality being 216. In the period since then its health outcomes have improved substantially, with the pace of improvement higher than in India and many other developing countries, but less rapid than in China. Its life expectancy at 67 remains at lower end of the range covered in Table 1, below Philippines and Malaysia which are above 70. Child mortality is also relatively high at 38 compared with some other developing APEC countries. Public spending on health, at little more than 1% of GDP, remains low.

Indonesia suffers from a high incidence of deaths due to TB, respiratory infections and perinatal conditions. TB is particularly high compared with its peers and its modest success with immunisation at 82% for one year olds has not been high enough to drive it down. Deaths due to respiratory infections and perinatal conditions at 49 and 34 per 100,000 respectively are also relatively high. The disease burden (DALYs) of perinatal conditions is also very high, at about 10% of total DALYs.

Indonesia is working with the WHO to implement over 5 years the so called DOTS program to more effectively address detection and system management of TB. The high death rate due to perinatal conditions is a severe problem in relatively remote areas, where attendance by skilled medical personnel is infrequent and the problem is compounded by other diseases such as diarrhoea and malaria. The Ministry of Health is committed to improving maternal and neonatal health in conjunction with the WHO.

Indonesia is reviewing the management and supply of drugs which tends to be somewhat haphazard. Indonesia has participated in a number of vaccination programs. A measles program was introduced in 1984 and the polio program accelerated in 1995 in an attempt to achieve eradication. Measles remains a problem, with high levels of deaths from measles and an immunisation coverage of only 72%.

Indonesia: Health Outcomes and Resources, 2003

Life expectancy (1)	67.4
Under-5 mortality rate (3)	38
Maternal mortality rate (2), (3)	230
Private health expenditure, % of total expenditure	64%
Physicians (per 100,000) (4)	268
% of one-year-olds immunized against:	
TB	82
Measles	72
Deaths from critical diseases (per 100,000):	
TB	59
Respiratory infections	49
Perinatal conditions	34

Notes: (1) 2000-05. (2) 2000. (3) Per 100,000 live births.
(4) 1990 to 2004, most recent available.

Source: UNDP (2005, pp. 236-239 and 250-252).

4. New Technologies for the Changing Burden of Disease

The Continuing Search for New Medicines and Treatments

As noted earlier, many economies have achieved great success in reducing both mortality and morbidity for a range of health problems that used to make up a large part of the burden of disease. Deaths from cardiovascular problems, for instance, while still the major cause of death, have been reduced markedly through a combination of health interventions. Public health campaigns have been successful in reducing the incidence of tobacco smoking and alcohol consumption and in promoting improved nutrition and awareness of early detection of disease. Medical technologies, principally medicines aimed at controlling blood pressure and cholesterol levels but also improved surgical intervention, have been successful in preventing death and disability from heart attacks and strokes.

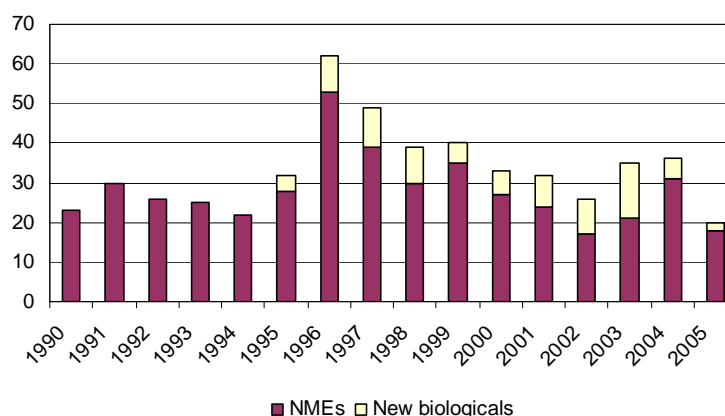
Aside from cardiovascular disease, medicines developed over the second half of the 20th Century have been successful in providing acceptable control for a wide range of common contributors to the disease burden. Vaccines have been developed to prevent common infectious diseases such as smallpox, tetanus and measles and influenza while conditions such as peptic ulcers, asthma, depression and bacterial infections are well controlled by existing medicines. Even major threats such as HIV/AIDS are now under control in many economies through active prevention campaigns and the development of better antiretroviral therapies that are easier to use.

Increasingly these widely used medicines are reaching the end of their patent lives and generic suppliers are providing cheaper substitutes for originator brands.

As these common health concerns are being addressed, attention has turned to the treatment of more intractable problems. Cancer has become more important as a cause of death and while improvements have been made in earlier detection and intervention, there is still a long way to go in curing cancers or achieving major extensions of life once cancer has been diagnosed. Similarly, the other disease of old age such as dementia and arthritis are inadequately treated by existing medicines. Obesity and overweight associated with more sedentary lifestyles and inappropriate nutrition are of increasing concern because of a perceived link to type II diabetes and cardiovascular problems.

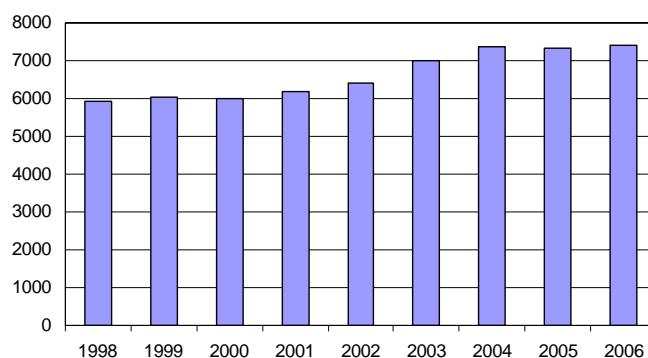
In response to these trends, about a quarter of pharmaceutical company R&D spending is now concentrated on treatments for cancer with increasing amounts being dedicated to medicines for pain and arthritis, cognition enhancement, diabetes and ophthalmological diseases of old age (Pharmaprojects 2006). It is becoming increasingly apparent, however, that the usual approach by pharmaceutical companies to developing medicines to treat these conditions is not as productive as it used to be. Despite a large increase in spending on R&D, the pharmaceutical pipeline has been declining, as shown by the decline in recent years in new molecular entities and biological drugs being approved by the FDA, from the high levels of the second half of the 1990s. (Figure 6).

Figure 6. FDA approvals for new molecular entities and biologicals



Source: PAREXEL (2005).

In part this reflects the fact that the easy targets to treat have been addressed and it is inherently more difficult to treat conditions such as cancer and dementia. The switch by companies from developing traditional small molecule drugs to those based on biotechnology opens up a wider range of drug targets and potential drug candidates, and promises to provide better treatments for these conditions, although there are still relatively few biotechnology medicines that treat widespread problems. The massive sources of genomic and proteomic data thrown up by breakthroughs in molecular biology have created more drug candidates in the early stages of the drug development pipeline. Figure 7 shows the increase in the number of drugs in development up to 2004, although the number has stabilised over the past two years. There is accumulating evidence that the failure rates in the early stages, particularly in Phase 2 trials, have increased, resulting in fewer new biotechnology based drugs entering large scale clinical tests and surviving to reach the market.

Figure 7. Number of drugs in active development

Source: Pharmaprojects (2006).

Successful treatment of disease is usually enhanced if the disease is recognised at an early stage. Sensitive diagnostics are being developed using biotechnology and nanotechnology to both identify disease conditions and to test for genetic or other predisposition to certain diseases. This in turn will enable medicines to be better tailored to an individual patient's profile using pharmacogenomic techniques so that medicines are more efficacious with fewer side effects. These developments in diagnostics combined with information technology should mean that they can be routinely deployed to test for a wide range of conditions and predispositions.

Other treatment approaches besides medicines also hold out great promise in delivering better treatment for some major conditions. Stem cell therapy in particular is likely to enable replacement tissues and organs to be grown which can treat difficult conditions such as cystic fibrosis and other lung diseases, spinal cord injuries and others.

Meeting the Cost of New Treatments

Biotechnology-based drugs and these new kinds of treatment are often much more expensive than traditional treatments, reflecting the rising cost of discovering and proving new drugs and, in some cases, higher costs of production. This raises significant problems for all parties: for individuals who meet their own treatment costs, for government and other third party payers of medical care which seek to ensure equitable access to these treatments and for the companies that must finance the development of new treatments.

As the cost of medical treatments rise, there is greater use among payers of standard economic evaluation techniques such as cost-effectiveness analysis in making decisions on whether treatments should be supported and at what price. These techniques, the application of which to medicines was pioneered in Australia, are becoming increasingly widespread not only among government pharmaceutical insurance schemes but also among private insurers. Of the various types of economic evaluation widely used in different industries, only cost-benefit analysis (in which all costs and benefits are valued in dollars) can provide an absolute rather than a relative assessment, but it is of very limited application within health. The three types of evaluation widely used in relation to medicines (cost effectiveness analysis, cost-minimisation analysis and cost-utility analysis) are all inherently comparative, in that they compare the effectiveness, cost or contribution to utility of two drugs at a given set of prices.

Such methods can play a valuable role in comparing the effectiveness of two (or in some circumstances more than two) treatments at a given level of prices. But it is important to note that

they are inherently comparative at a given level of prices. They do not set either the overall level of drug prices or the value assigned to a unit difference in effectiveness between two drugs, and other rules are required for these purposes (Drummond et al 1997). One way in which the overall level of prices might be set is through so called 'Ramsey' pricing principles (Danzon and Towse 2003), through which the overall price level would reflect the standard of living in an economy and hence its ability to pay. However, the practical implementation of these approaches needs to overcome a number of hurdles, especially that of parallel trade.

The downward pressure on the price of medicines arising from the greater availability of generic medicines, the increasing expense in developing new medicines and the necessity to prove cost-effectiveness contribute to an environment in which it becomes more difficult for pharmaceutical companies to generate the returns necessary to support the cost of investing in innovation. If, in a cost-effectiveness or reference pricing framework, the increasing availability of low cost generics is used to lower the average prices for new medicines, global investment in the next generation of treatments could be curtailed.

Renewed emphasis on 'developing country' diseases

Developing economies face the same challenges in providing adequate health care to their people as do other economies, but with fewer resources. In addition they face health problems that are either not present to the same extent in developed economies or are better controlled. The major problems are insect-borne diseases endemic in some tropical and semi-tropical regions such as malaria, dengue fever, leishmaniasis, trypanosomiasis, Chagas disease, schistosomiasis and diseases closely associated with poverty, such as tuberculosis, HIV/AIDS, pneumonia and hepatitis. For some of these diseases such as TB there are already effective treatments and the challenge is to be able to provide the medicines at an affordable price, and to deliver them to the individuals and communities that need them. For diseases such as HIV/AIDS the problem of cost is compounded by the necessity to have an adequate health infrastructure to ensure effective delivery and continuance of treatment.

Being able to control these diseases will make a major contribution to the ability of developing economies to achieve economic growth and improved living standards. While the WHO and individual economies have been active in developing programs for attacking disease in developing economies, much of the international activity has been undertaken by independent and non-government organisations. An example is the Global Fund to Fight AIDS, Tuberculosis and Malaria headquartered in Switzerland. The Global Fund aims to attract, manage and disburse resources to fight these diseases and has provided some US\$1.5 billion since its inception in 2002.

For those diseases of developing economies for which there are inadequate treatments, however, the difficulty has been to devise a mechanism that will provide an incentive for pharmaceutical companies to develop medicines at a price to at least cover the costs of development. The traditional system for developing new drugs has been to provide patent protection for new medicines enabling companies to charge prices above the marginal cost of production for long enough to recoup their development costs. Alternative mechanisms to patent protection have been proposed and discussed including funding new drug development through government agencies and replacing patents with prizes or rewards (Hollis 2005; Hubbard and Love 2004; DiMasi and Grabowski 2004).

The proposal that has gained most attention and support however is the idea of Advance Purchase Commitments (or Advanced Market Commitments) developed by a group of economists with links to the Center for Global Development at Harvard University (Barder et al. 2005; Kremer,

Towse and Williams 2005; Towse and Kettler 2005; Berndt et al. 2005). This mechanism is aimed at encouraging pharmaceutical companies to undertake the R&D necessary to develop a new medicine. Sponsors such as international funding agencies would commit in advance of the product development taking place to fully or partially finance the purchase of a certain amount of the medicine at a pre-specified price. Developing economies would decide whether to buy the medicine at a particular price and the sponsor would guarantee to fund the difference between this price and the agreed price (Berndt et al. 2005). Sales of the medicine beyond the agreed amount would be at an affordable price.

The idea is based on the support already provided for the development of medicines for so-called 'orphan drugs' for diseases with fewer than 200,000 sufferers in the United States. It has been implemented in a limited way by the United Kingdom and the United States to spur the development of vaccines for meningitis C and anthrax (Towse and Kettler 2005). Transferable patent extensions have also been proposed as a mechanism for encouraging the development of developing country diseases.

A major study for the Wellcome Trust conducted by researchers at the London School of Economics (Moran et al. 2005) has identified over 60 projects that are aimed at developing medicines for the treatment of a number of disease common to developing economies such as malaria, tuberculosis and dengue fever. About half of these are undertaken by multinational pharmaceutical companies on a not-for-profit basis with the remainder being undertaken by smaller companies or research groups. Most projects are conducted under a Public-Private Partnership arrangement with the involvement of organisations such as the WHO and philanthropic funds.

All these projects are aimed at developing medicines to treat people who are already suffering from the disease being targeted. Once these medicines have been developed, there remains the problem of their cost and the necessity for an adequate health delivery infrastructure to ensure effective delivery. Attention therefore has turned increasingly to the development of vaccines to prevent people developing the disease in the first place.

Several major international initiatives such as the Global Alliance for Vaccines and Immunization supported by the Bill and Melinda Gates Foundation, the WHO and the World Bank among others are aimed at developing vaccines for malaria, tuberculosis and HIV/AIDS.

Over the course of the 20th Century great strides were made in the development of vaccines for common communicable diseases such as smallpox, polio, tuberculosis, influenza, diphtheria, measles, pertussis, and tetanus. Although the development of vaccines slowed in the latter part of the century other vaccines for hepatitis A and B, rabies, meningitis, pneumococcal disease and yellow fever also appeared on the market. Just in the past 12 months, new vaccines for rotavirus, human papilloma virus and herpes zoster (shingles) have been approved for use.

The renewed interest in vaccines has seen their importance grow in recent years. The Pharmaprojects database for instance reports that there are some 341 active vaccine R&D projects at the moment, an increase of 29% over the past 6 years (Pharmaprojects 2006). There at least 78 cancer vaccines in development (Pjipers et al. 2005) and the concern about biological warfare has seen an increase in vaccines being developed for anthrax, Ebola disease, plague and West Nile virus.

Case Study 4– India: Major Health Challenges as the Economy Booms

Although India has continued to make progress in improving health outcomes, indicators such as life expectancy and child mortality have remained at the low end of the range achieved by developing APEC countries. Life expectancy at birth has increased from 44 in 1960 to 63 and child mortality fallen from 240 in 1960 to 85. Immunisation against basic diseases remains relatively low, the measles program reaching only 67 % of one year olds.

As previously discussed the level of communicable diseases and maternal and perinatal conditions remains very high. As shown in the table below deaths from respiratory infections totals 107 per 100,000 compared with China at only 22. The incidence of deaths from perinatal conditions is also very high at 73 compared with China, which has an incidence of only 21 per 100,000. These are diseases that can be reduced by greater availability of health services, particularly in rural areas. Many of the rural health centres lack qualified staff and medication. The number of physicians per 100,000 is only 51, substantially lower than in developing APEC countries, limiting access to medical services.

India has attempted to control the price of drugs to make them more accessible to the poor by listing a certain number of drugs under the Drug Price Control Order (DPCO). In 1979, 347 or approximately 80% of drugs were listed, but the low price discouraged innovation in the Indian pharmaceutical industry and reduced the industry's growth. Many global drug companies left the Indian market. Accordingly the number of drugs under DPCO has been reduced to about 20% of the total (Malhotra and Lofgren 2004).

Some early intervention and prevention programs have been successful, such as an antenatal care program in Maharashtra which reduced the infant mortality rate from 75 to 39 in three years. However such programs tend to be limited in scale. HIV/AIDS is an emerging problem and Indian drug companies have played a role in reducing the price of the anti-retrovirals.

Financing health care is a major problem. Government expenditure on health is less than 1% of GDP, leaving 75% of its cost to private expenditure. Only an estimated 3-5% of the population have private health insurance.

India: Health Outcomes and Resources, 2003

Life expectancy (1)	63.5
Under-5 mortality rate (3)	85
Maternal mortality rate (2), (3)	540
Private health expenditure, % of total expenditure	75%
Physicians (per 100,000) (4)	51
% of one-year-olds immunized against:	
TB	81
Measles	67
Deaths from critical diseases, (per 100,000):	
Respiratory infections	107
Perinatal conditions	73

Notes: (1) 2000-05. (2) 2000. (3) Per 100,000 live births. (4) 1990 to 2004, most recent available.

Source: UNDP (2005, pp. 236-239 and 250-252).

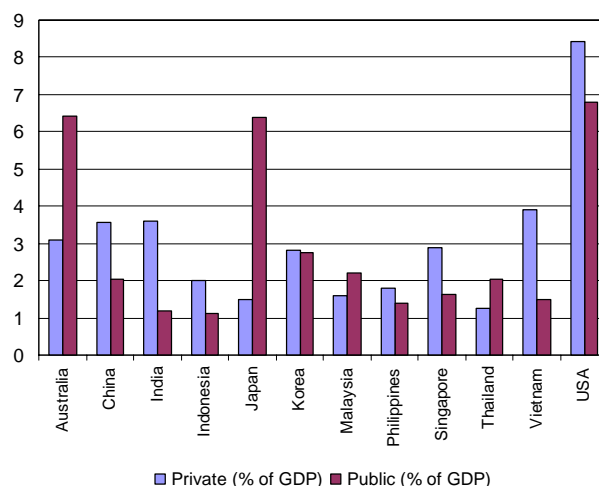
5. The Priority of Health in Public Policy

All economies face competing demands on resources, in both the public and private sectors. Within Government budgets health spending competes with many other spending priorities, and sometimes with tax cuts, within a given level of revenue. Individuals in many economies have shown a willingness to pay for health services, but aggregate private spending is constrained by an inability to pay for important sections of the community, and for others by an inability to get access to high quality goods and services. In spite of this the share of GDP devoted to health spending is rising in most economies, as societies place high value on the benefits that such spending can deliver.

While there is much emphasis on GDP growth rates and on various national league tables, the ultimate purpose of economic growth is the improvement in human welfare that it delivers to individuals and communities. Recent estimates suggest that, of the welfare gains to the human community from economic development over the past century, fully half came from improved health outcomes (Nordhaus 1999). That is, improved welfare from better health is as important as

all the other benefits of development put together. There is also now a growing literature about the benefits of technological and policy innovation in health, in various dimensions. For example, Murphy and Topel (1999) have examined the value of medical research by estimating the economic and social value of the increased longevity to which it has given rise. Among studies focusing on specific health areas, Cutler and McClellan (2001) examine the impact of technological change in the treatment of five conditions – heart attacks, low-birthweight, depression, cataracts and breast cancer – to determine whether the benefits of increased spending exceeds the costs. Using a value for an additional year of life of \$100,000, they find that for four of the five treatments benefits substantially outweighed costs, while for the fifth (breast cancer) costs and benefits were approximately equal. The benefits being considered here are, of course, total social benefits, rather than that specific component of benefits that involves lower health costs.

Figure 10. Spending on health, selected economies, 2003, by public and private sectors



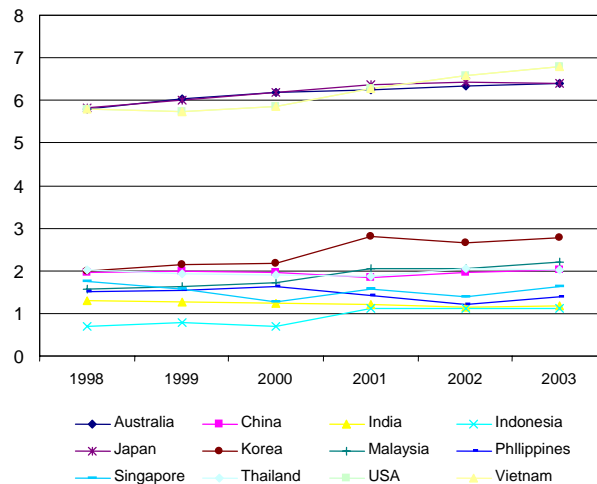
Source: World Bank (2006).

Given the health challenges outlined above, and the growing technological resources available to economies to address them, there appears to be a persuasive economic case for devoting increased resources to health in many APEC economies. This is especially so for economies which have achieved rapid growth through a focus on industrial development, with low levels of health spending and increasing inequality of access to health services. It is likely that such economies could achieve more rapid increases in the welfare of their populations by placing greater priority on health services and their distribution. In China, for example, there is increasing concern that large sections of the population have not shared fully in the benefits of rapid growth, that one reflection of this is an inadequate level of access to health services in many areas and that an insufficient public funding of health is a major contributing factor (Ministry of Health et al 2005; Du Lexun et al 2006).

The inequality of access to health services in China has been exacerbated by the high reliance on private resources for health financing in China, where about two thirds of health costs are met privately (Figure 10). This heavy reliance on meeting health costs from private incomes is common to some other developing countries (eg Indonesia, Vietnam and the Philippines, and outside APEC is particularly notable in India, where less than 30% of health costs are met by the public sector. This contrasts sharply with the situation in developed countries – the USA is the only OECD country for which more than 50% of health costs are met privately – and is the most

notable difference in funding structure between the two groups of countries (Figures 10 and 11). Especially in large and diverse economies, with significant income dispersion and geographical variation, a strong public infrastructure and financing framework may be necessary to ensure that more recent innovations are available widely throughout the population.

Figure 11. Public sector spending on health, as a share of GDP, selected economies, 1998-2003



Source: World Bank (2006).

It is likely that the share of GDP devoted to health will continue to rise in the OECD countries, as populations seek access to the longer and healthier lives that modern medicine makes possible. Although private spending will also increase, this growth is also likely to continue to be concentrated in public spending, both because of shared infrastructure and service requirements and because of the need to ensure that the whole population has adequate access to high quality goods and services. An increased diversion of public sector resources into health in many developing economies within APEC seems both necessary in terms of the needs of their populations and likely to foster the quality and sustainability of their development processes.

6. Priorities within Health Services

Within a given level of resources for health, all economies face major issues concerning the priority to be given to particular areas. One difficult choice relates to the resources to be devoted to detection of disease, including early detection, to prevention and to treatment respectively. Many aspects of emerging innovations bear on this choice. These include new technologies for early detection and prevention, the role of medicines (for example in terms of cardiovascular disease) in preventing disease, new approaches to lifestyle management and change, and so on. Another difficult matter for priority setting which faces all economies is the balance between two necessities: creating a vibrant innovative environment, which provides incentives to and rewards for innovation throughout the health system, and delivering a readily accessible level of services, of the best possible quality, to the whole population.

There are no easy answers to these and other questions, and issues of priority setting will always remain the responsibility of the governments of individual economies. But the issues involved and the options available can be clarified by elucidation of principles and emerging technological options, by the sharing of experiences and perspectives of economies at different stages of

development, and by increased collaboration between economies and across sectors. In this setting, and having regard to our early analysis, three general themes stand out.

The first is that the early detection of disease, or of the propensity to get disease, together with early action to prevent or treat disease, offers great promise of improved health outcomes. This is especially so as advanced methods for early detection and diagnosis and a range of new vaccines are in the pipeline. Thus there is a strong case for giving increased priority to prevention, detection and early intervention. Such increased priority should range across the whole spectrum, and hence covering such activities as improved sanitation and living conditions in poor areas; expanded vaccination programs, with both older proven vaccines or new ones as they emerge; prevention programs based on lifestyle changes and early detection of blood pressure, high cholesterol levels and cancers; and advanced screening and biomarker projects designed to identify and treat the preconditions for disease. Not every such program will be socially cost-effective and each needs to be individually assessed, but overall such an emphasis is likely to contribute strongly to better health outcomes.

Secondly, there is considerable evidence that, as medical science advances, newer generations of medicines and other treatments offer better health outcomes than previous generations. For example, Lichtenberg has undertaken a substantial body of work (summarised in Lichtenberg 2006) to show that in many different circumstances, for many different drugs and diseases and using a range of alternative data sets, new drugs lead to significantly better health outcomes, and in many cases improved financial outcomes, than older medicines. This fact is not surprising, but it does raise complex financing, institutional and delivery systems issues about how the most advanced treatments can be made widely available to whole populations. But it does imply that facilitating widespread access to the most advanced treatments possible within a given context needs to be a priority within health systems.

Thirdly, all economies, however rich or poor, face the challenge of building enhanced domestic capability to be able to participate in and benefit from continued progress in the life sciences and their applications to health services. In human terms this need for continually increased capability ranges from skilled nursing and medical staff to specialists working in advanced hospital settings, from equipment and laboratory technicians to researchers of international standing, and from school teachers to high level university lecturers. Building corporate and institutional capability, across the broad range of companies and other institutions that contribute to the creation and diffusion of innovation in health services, is also critical.

This issue of building greater capability in member economies, and particularly of how this might be advanced by cooperation between economies and/or sectors, has been a primary focus of LSIF to date, and should continue to be so under this theme for LSIF IV.

References

- Australian Bureau of Statistics (ABS) 2005, *Labour Force, Australia*, ABS Catalogue No. 6291.0.055.001, Canberra.
- Barder, O., Kremer, M. and Levine, R. 2005, *Making Markets for Vaccines Ideas to Action*, Report of the Center for Global Development Advance Market Commitment Working Group, Center for Global Development, Harvard University, Cambridge, Mass.

- Berndt, E., Glennerster, R., Kremer, M.R., Lee, J., Levine, R., Weizsäcker, G. and Williams, H. 2005, 'Advanced Purchase Commitments for a Malaria Vaccine: Estimating Costs and Effectiveness', NBER Working Paper 11288, National Bureau of Economic Research, Cambridge, Mass.
- Center for Population and Development Studies (CPDS) 2006, *The Executive Summary of The Global Burden of Disease and Injury Series*, Harvard School of Public Health, Cambridge, Mass., available at: <http://www.hsph.harvard.edu/organizations/bdu/GBDseries.html>
- Cutler, D. 2001, 'Declining disability among the elderly', *Health Affairs*, vol. 20, pp. 11–27.
- Cutler, D. and McClellan, M. 2001, 'Is technological change in medicine worth it?', *Health Affairs*, vol. 20, no. 5, pp. 11–29.
- Danzon, P. and Adrian, T. 2003, 'Differential pricing for pharmaceuticals: Reconciling access, R&D and patents', *International Journal of Health Care Finance and Economics*, vol. 3, pp. 183–205.
- Davies, K. 2006, 'Drug costs nearing \$2 billion, Warns Lilly Executive', *Bio-IT World*, 23 August.
- DiMasi, J. A., and Grabowski, H. G. 2004, 'Patents and R&D Incentives: Comments on the Hubbard and Love Trade Framework for Financing Pharmaceutical R&D', Tufts Center for the Study of Drug Development, Tufts University, Medford, Mass.
- DiMasi, J. A., Hansen, R. W. and Grabowski, H. G. 2003, 'The price of innovation: New estimates of drug development costs', *Journal of Health Economics*, vol. 22, pp. 151–185.
- Du Lexun, Zhang Wenmin and Huan Zemin 2006, *Report on China's Medical and Health Development*, Sheke Wenxian Publishing, Beijing.
- Freedman, V.A., Martin, L.G. and Schoeni, R.F. 2002, 'Recent trends in disability and functioning among older adults in the United States: A systematic review', *JAMA*, vol. 288, pp. 3137–3146.
- Fries, J. 1982, 'The compression of morbidity', keynote address to the Institute of Medicine, National Academy of Sciences, Washington, 20 October 20, 1982; first published in *The Milbank Memorial Fund Quarterly*, vol. 61, no. 3, pp. 397–419, 1983; and reprinted in *The Milbank Quarterly*, vol. 83, no. 4, pp. 801–23, 2005.
- Fries, J. 2005, 'Frailty, heart disease and stroke: The compression of morbidity paradigm', *American Journal of Preventive Medicine*, vol. 29, pp. 164–168.
- Hollis, A. 2005, 'An Efficient Reward System for Pharmaceutical Innovation', Institute of Health Economics, University of Calgary, Calgary, Canada.
- Hubbard T. and Love, J. 2004, 'A new trade framework for global healthcare R&D', *PLoS Biology*, vol. 2, no. 2, pp. 147–150
- Hubert, H. B., Bloch, D. A., Oehlert, J. W. et al. 2002, 'Lifestyle habits and compression of morbidity', *Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, vol. 57A, pp. M347–M351.
- Kola, I.I. and Landis, J. 2004, 'Can the pharmaceutical industry reduce attrition rates', *Nature Reviews Drug Discovery*, vol. 3, August, pp. 711–715.
- Kremer, M., Towse, A. and Williams, H. 2005, *Briefing Note on Advanced Purchase Commitments*, DFID Health Systems Resource Centre, London.
- Lichtenberg, F. 2006, 'The benefits to society of new drugs: A survey of the econometric evidence' in Grewal, B.S. and Kumnick, M. (eds) *Engaging the new world: Responses to the knowledge economy*, Melbourne University Press, Melbourne.
- Manton K. G. and Gu, X. 2001, 'Changes in the prevalence of chronic disability in the United States black and non-black population above age 65 from 1982 to 1999', *Proceedings of the National Academy of Science*, vol. 98, pp. 6354–6359.
- Mathers, C. D. and Loncar, D. 2005, 'Updated Projections of Global Mortality and Burden of Disease, 2002–2030: Data Sources, Methods and Results', Evidence and Information Policy Working Paper, World Health Organization, Geneva.

Ministry of Health, State Development Research Centre of the State Council and Ministry of Social Security, China 2005, 'Evaluation and Suggestions Regarding China's Health Care System Reform', *China Development Review*, vol.7, Beijing, August.

Mor, V. 2005, 'The compression of morbidity hypothesis: A review of research and prospects for the future', *Journal of the American Geriatrics Society*, vol. 53, pp. S308-S309.

Moran, M., Ropars, A., Guzman, J., Diaz J. and Garrison, C. 2005, *The New Landscape of Neglected Disease Drug Development*, The Wellcome Trust, London.

Murphy, K. and Topel, R. 2003, 'The economic value of medical knowledge', in K. Murphy and R. Topel (eds), *Measuring the Gains from Medical Research: An Economic Approach*, University of Chicago Press, Chicago.

Nordhaus, W. D. 2003. 'The health of nations: The contribution of improved health to living standards', in K. Murphy and R. Topel (eds), *Measuring the Gains from Medical Research: An Economic Approach*, University of Chicago Press, Chicago.

PAREXEL 2005, *PAREXEL's Bio/Pharmaceutical R&D Statistical Sourcebook 2005/2006*, Waltham, Mass.

Pharmaprojects 2006, *Annual Review*. May 2006, available at:
http://www.pjbpubs.com/pharmaprojects/annual_review.htm

Pjipers F., Faint, R. and Saini, N. 2005, 'Therapeutic cancer vaccines', *Nature Reviews Drug Discovery*, vol. 4, no.v205, pp. 623-624.

Towse, A. and Kettler, H. 2005, 'Advance price or purchase commitments to create markets for treatments for diseases of poverty: Lessons from three policies', *Bulletin of the World Health Organization*, vol. 83, no. 4, pp. 301-307.

Tufts Center for the Study of Drug Development 2003, 'Total cost to develop a new prescription drug, including cost of post-approval research, is \$897 million', *News Release*, Tufts Center, 5/13/2002.

United Nations (UN) 2005, *World Population Prospects. The 2004 Revision Population Database*, United Nations Population Division, New York, available at:
<http://esa.un.org/unpp/>

United Nations Development Program (UNDP) 2005, *Human Development Report 2005*, New York, available at: <http://hdr.undp.org/reports/global/2005/>

Weil, D. 2005, 'Accounting for the Effect of Health on Economic Growth', NBER Working Paper No. 11455, National Bureau of Economic Research, Cambridge, Mass.

World Bank (WB) 2006, World Development Indicators Online, Washington, available at:
<http://publications.worldbank.org/WDI/>

World Health Organization (WHO) 2003, *World Health Report 2003: Shaping the Future*, Geneva.

World Health Organization (WHO) 2004, 'Death and DALY Estimates for 2002 by Cause for WHO Member States', Department of Measurement and Health Information December 2004, WHO, Geneva, available at: <http://www.who.int/healthinfo/en/index.html>

World Health Organization (WHO) 2006, *World Health Report 2006: Statistical Appendix*, Geneva.

World Health Organisation 2006a, *Preventing Chronic Diseases: A Vital Investment*, Geneva, available at:
http://www.who.int/chp/chronic_disease_report/contents/en/index.html

Table A1. Estimated total DALYs ('000), by cause APEC economies and India, 2002

	Australia	Brunei	Canada	Chile	China	Indonesia	Japan	Korea	Malaysia	Mexico	NZ	PNG	Peru	Philippines	Russia	Singapore	Thailand	USA	Vietnam	India
All causes	2,154	45	3,693	2,188	200,273	46,385	13,296	6,370	3,505	15,387	452	1,608	5,153	14,991	39,410	442	12,755	41,521	13,360	299,910
Communicable, maternal, perinatal and nutritional conditions	110	7	183	244	37,083	14,372	749	701	696	2,914	22	868	1,573	4,952	3,154	46	3,801	2,738	4,305	136,003
Infectious and parasitic diseases	35	3	63	117	14,833	7,689	263	457	384	959	7	448	690	2,129	1,564	20	2,838	1,058	2,337	63,926
Tuberculosis	1	0	1	7	4,350	2,940	34	55	67	59	0	63	138	714	701	1	199	9	418	8,478
HIV/AIDS	4	0	16	36	1,270	107	3	1	77	132	1	16	147	4	537	3	1,381	380	287	10,178
All other infectious diseases	30	2	46	74	9,213	4,643	225	401	241	768	7	369	405	1,410	327	16	1,258	668	1,632	45,269
Respiratory infections	13	1	26	39	6,113	1,413	317	43	86	387	3	109	283	997	582	11	331	325	460	26,094
Maternal, perinatal and nutritional conditions	62	3	94	88	16,138	5,270	170	201	226	1,567	12	310	600	1,825	1,008	16	632	1,355	1,509	45,983
Non-communicable diseases	1,834	33	3,207	1,668	133,056	25,959	11,206	4,850	2,440	10,301	386	578	2,912	8,635	27,019	369	7,260	34,747	7,334	124,099
Malignant neoplasms	306	3	581	176	19,455	2,302	2,361	768	229	711	67	43	332	595	3,211	50	720	5,077	674	8,565
Neuropsychiatric conditions	599	10	1,197	666	34,952	5,827	2,986	1,598	689	3,773	114	142	1,078	2,409	5,400	103	2,004	12,288	2,195	32,666
Cardiovascular diseases	268	4	460	173	25,233	5,191	2,156	659	370	882	66	121	268	1,501	11,533	52	975	6,156	1,389	30,481
Respiratory diseases	242	2	199	90	12,603	1,936	750	236	156	678	54	35	224	665	962	18	453	2,968	565	10,789
Other non-communicable diseases	419	15	769	563	40,813	10,703	2,953	1,588	996	4,256	85	237	1,011	3,465	5,914	145	3,108	8,258	2,512	41,597
Injuries	211	5	302	276	30,134	6,054	1,341	819	369	2,172	44	162	668	1,404	9,238	27	1,694	4,036	1,721	39,807
Unintentional injuries	151	5	196	178	23,044	4,374	772	615	257	1,577	30	117	619	737	5,906	13	1,264	2,806	1,389	32,209
Intentional injuries	59	1	106	98	7,090	1,680	569	204	112	596	14	46	49	668	3,331	14	431	1,230	332	7,598

Source: WHO (2004).

Table A2. Estimated total DALYs by cause APEC economies and India, 2002, percentage share

	Australia	Brunei	Canada	Chile	China	Indonesia	Japan	Korea	Malaysia	Mexico	NZ	PNG	Peru	Philippines	Russia	Singapore	Thailand	USA	Vietnam	India
All causes	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Communicable, maternal, perinatal and nutritional conditions	5	15	5	11	19	31	6	11	20	19	5	54	31	33	8	10	30	7	32	45
Infectious and parasitic diseases	2	6	2	5	7	17	2	7	11	6	2	28	13	14	4	4	22	3	17	21
Tuberculosis	0	0	0	0	2	6	0	1	2	0	0	4	3	5	2	0	2	0	3	3
HIV/AIDS	0	0	0	2	1	0	0	0	2	1	0	1	3	0	1	1	11	1	2	3
All other infectious diseases	1	5	1	3	5	10	2	6	7	5	1	23	8	9	1	4	10	2	12	15
Respiratory infections	1	1	1	2	3	3	2	1	2	3	1	7	5	7	1	2	3	1	3	9
Maternal, perinatal and nutritional conditions	3	7	3	4	8	11	1	3	6	10	3	19	12	12	3	4	5	3	11	15
Non-communicable diseases	85	74	87	76	66	56	84	76	70	67	85	36	57	58	69	83	57	84	55	41
Malignant neoplasms	14	6	16	8	10	5	18	12	7	5	15	3	6	4	8	11	6	12	5	3
Neuropsychiatric conditions	28	22	32	30	17	13	22	25	20	25	25	9	21	16	14	23	16	30	16	11
Cardiovascular diseases	12	8	12	8	13	11	16	10	11	6	15	8	5	10	29	12	8	15	10	10
Respiratory diseases	11	5	5	4	6	4	6	4	4	4	12	2	4	4	2	4	4	7	4	4
Other non-communicable diseases	19	32	21	26	20	23	22	25	28	28	19	15	20	23	15	33	24	20	19	14
Injuries	10	11	8	13	15	13	10	13	11	14	10	10	13	9	23	6	13	10	13	13
Unintentional injuries	7	10	5	8	12	9	6	10	7	10	7	7	12	5	15	3	10	7	10	11
Intentional injuries	3	1	3	5	4	4	4	3	3	4	3	3	1	4	8	3	3	3	2	3

Source: WHO (2004).

Table A3. Estimated total deaths ('000), by cause APEC economies and India, 2002

	Australia	Brunei	Canada	Chile	China	Indonesia	Japan	Korea	Malaysia	Mexico	NZ	PNG	Peru	Philippines	Russia	Singapore	Thailand	USA	Vietnam	India
All causes	127	1	222	84	9,135	1,626	973	275	119	470	27	47	170	448	2,406	18	419	2,421	516	10,378
Communicable, maternal, perinatal and nutritional conditions	5	0	11	10	1,090	477	116	16	24	78	1	24	55	157	101	2	128	148	126	4,218
Infectious and parasitic diseases	2	0	3	3	507	265	21	8	14	21	0	14	22	76	53	0	106	64	75	2,071
Tuberculosis	0	0	0	1	271	127	4	4	3	3	0	3	6	45	31	0	10	1	20	365
HIV/AIDS	0	0	0	1	43	2	0	0	2	4	0	0	4	0	15	0	57	13	8	361
All other infectious diseases	2	0	3	1	194	136	17	4	8	14	0	10	12	32	7	0	40	50	47	1,345
Respiratory infections	3	0	6	5	292	106	92	5	7	16	1	4	20	47	37	2	13	60	28	1,123
Maternal, perinatal and nutritional conditions	1	0	1	2	291	106	3	3	3	40	0	7	12	34	11	0	10	24	24	1,024
Non-communicable diseases	113	1	199	66	7,051	986	784	227	85	340	25	18	99	253	1,953	15	245	2,120	341	5,110
Malignant neoplasms	36	0	65	20	1,738	188	308	77	20	60	7	3	30	40	305	5	60	559	64	745
Neuropsychiatric conditions	7	0	17	3	104	35	14	13	3	12	2	1	3	5	31	0	14	154	13	182
Cardiovascular diseases	47	0	77	24	3,001	469	312	76	36	105	11	9	30	122	1,432	7	84	923	160	2,810
Respiratory diseases	8	0	14	5	1,433	110	48	18	10	26	2	2	7	27	62	1	28	183	51	609
Other non-communicable diseases	14	0	27	14	775	184	101	44	17	138	3	4	29	58	123	2	59	302	52	764
Injuries	8	0	13	8	994	164	74	32	10	52	2	4	16	38	352	1	46	153	48	1,050
Unintentional injuries	5	0	9	5	681	110	41	22	7	38	1	3	15	17	229	0	32	107	36	800
Intentional injuries	2	0	4	3	313	54	32	10	4	14	1	1	1	21	124	0	13	46	12	250

Source: WHO (2004).

Table A4. Estimated total deaths by cause APEC economies and India, 2002, percentage share

	Australia	Brunei	Canada	Chile	China	Indonesia	Japan	Korea	Malaysia	Mexico	NZ	PNG	Peru	Philippines	Russia	Singapore	Thailand	USA	Vietnam	India
All causes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Communicable, maternal, perinatal and nutritional conditions	4.3	10.3	4.7	12.1	11.9	29.3	11.9	5.8	20.4	16.5	3.3	52.1	32.2	35.1	4.2	12.5	30.6	6.1	24.5	40.6
Infectious and parasitic diseases	1.4	3.6	1.5	3.9	5.6	16.3	2.2	2.9	11.7	4.5	0.6	29.7	13.2	17.0	2.2	2.1	25.2	2.7	14.5	20.0
Tuberculosis	0.0	1.5	0.1	0.7	3.0	7.8	0.5	1.6	2.9	0.7	0.1	6.5	3.7	10.0	1.3	0.6	2.3	0.0	3.8	3.5
HIV/AIDS	0.1	0.1	0.2	1.6	0.5	0.1	0.0	0.0	1.8	0.9	0.1	0.9	2.6	0.0	0.6	0.1	13.5	0.5	1.5	3.5
All other infectious diseases	1.3	2.0	1.2	1.5	2.1	8.4	1.7	1.3	7.0	2.9	0.4	22.4	6.8	7.0	0.3	1.3	9.4	2.1	9.1	13.0
Respiratory infections	2.2	2.6	2.6	5.6	3.2	6.5	9.5	1.9	6.0	3.4	2.1	7.7	11.9	10.5	1.5	10.3	3.1	2.5	5.4	10.8
Maternal, perinatal and nutritional conditions	0.7	4.0	0.6	2.6	3.2	6.5	0.3	1.0	2.7	8.5	0.6	14.7	7.1	7.6	0.5	0.2	2.4	1.0	4.6	9.9
Non-communicable diseases	89.4	78.6	89.5	78.8	77.2	60.6	80.5	82.6	71.0	72.4	91.1	38.4	58.3	56.4	81.2	82.3	58.4	87.6	66.1	49.2
Malignant neoplasms	28.8	18.9	29.3	23.5	19.0	11.6	31.7	27.9	16.7	12.7	27.2	6.0	17.6	9.0	12.7	28.9	14.3	23.1	12.4	7.2
Neuropsychiatric conditions	5.9	1.3	7.7	3.6	1.1	2.2	1.5	4.7	2.2	2.5	5.8	1.2	1.7	1.2	1.3	0.8	3.4	6.4	2.6	1.8
Cardiovascular diseases	37.3	30.0	34.5	28.7	32.9	28.8	32.0	27.5	30.0	22.4	40.3	18.3	17.8	27.3	59.5	36.9	20.0	38.1	31.0	27.1
Respiratory diseases	6.1	7.9	6.1	5.7	15.7	6.7	5.0	6.4	8.1	5.4	7.4	4.3	4.3	6.1	2.6	4.5	6.6	7.5	9.9	5.9
Other non-communicable diseases	11.2	20.5	12.0	17.3	8.5	11.3	10.4	16.1	13.9	29.4	10.4	8.7	16.9	12.9	5.1	11.2	14.2	12.5	10.2	7.4
Injuries	6.3	11.1	5.8	9.1	10.9	10.1	7.6	11.6	8.6	11.1	5.6	9.5	9.5	8.5	14.6	5.2	10.9	6.3	9.4	10.1
Unintentional injuries	4.3	10.1	3.9	6.0	7.5	6.8	4.3	8.1	5.5	8.1	3.7	6.3	8.6	3.9	9.5	2.5	7.7	4.4	7.0	7.7
Intentional injuries	2.0	1.1	1.9	3.1	3.4	3.3	3.3	3.5	3.1	3.0	1.9	3.1	0.8	4.6	5.1	2.7	3.2	1.9	2.4	2.4

Source: WHO (2004).

Table A5. APEC economies projections to 2050

	Percentage of population aged 0 to 14			Percentage of population over 65 years			Dependency ratio		
	2000	2025	2050	2000	2025	2050	2000	2025	2050
Australia	21.2	17.6	16.2	12.1	19.0	23.8	33.3	36.6	40.0
Brunei	31.2	22.1	18.7	2.9	7.6	14.8	34.1	29.7	33.5
Canada	19.0	15.4	15.7	12.6	20.9	25.6	31.6	36.3	41.3
Chile	27.8	19.4	16.5	7.3	14.3	22.1	35.1	33.7	38.6
China	24.8	17.9	15.7	6.8	13.7	23.6	31.6	31.6	39.3
Hong Kong	16.6	12.0	12.5	11.0	21.5	32.3	27.6	33.5	44.8
Indonesia	30.2	21.3	17.6	4.9	8.6	17.4	35.1	29.9	35.0
Japan	14.7	12.5	13.4	17.2	29.1	35.9	31.9	41.6	49.3
Malaysia	33.7	23.7	18.2	4.1	8.9	16.1	37.8	32.6	34.3
Mexico	33.7	21.9	16.7	4.8	9.9	21.1	38.5	31.8	37.8
New Zealand	22.9	17.9	16.1	11.9	18.8	23.6	34.8	36.7	39.7
Papua New Guinea	41.5	30.5	22.9	2.3	3.6	7.9	43.8	34.1	30.8
Peru	34.5	25.0	18.8	4.8	8.5	16.1	39.3	33.5	34.9
Philippines	37.5	26.0	18.9	3.5	6.8	14.2	41.0	32.8	33.1
Korea	20.9	13.0	12.0	7.4	19.6	34.5	28.3	32.6	46.5
Russia	18.2	15.9	16.6	12.3	17.6	23.0	30.5	33.5	39.6
Singapore	21.7	13.3	12.6	7.2	22.3	31.3	28.9	35.6	43.9
Thailand	25.6	19.3	16.8	6.0	13.3	21.4	31.6	32.6	38.2
USA	21.6	18.7	17.3	12.3	17.7	20.6	33.9	36.4	37.9
Vietnam	33.4	22.0	17.4	5.4	8.4	18.6	38.8	30.4	36.0
Memorandum item									
India	34.1	24.4	18.3	4.9	8.1	14.8	39.0	32.5	33.1
World	30.0	24.1	20.2	6.9	10.5	16.1	36.9	34.6	36.3

Source: UN (2005).