Reforming Health Through Innovation: A Global Challenge

The Re-emergence of the 'Developing Countries'

For millennia prior to the Industrial Revolution China and India dominated the world economy – in economic terms, Europe was a bit player. When the history of our times is written, the central feature will be the dramatic re-emergence of China and India, along with other developing countries, since about 1990. Using conventional measures of growth (real GDP), China's economy will be about seven times larger in 2020 than it was in 1990, and India's will be about four times larger.

Growth has been unequal across developing countries, of course, but many are sharing in this extraordinary acceleration of growth. Using the World Bank's latest forecasts[1], the economies of developing countries as a group will be in 2016 two and half times their size in 2001 (annual growth rate of 6.2%) while those of the advanced countries will increase by just over a quarter (1.6% pa). The developing countries are growing at about four times the rate of the advanced countries.

This phenomenon is certainly worth one or more lectures on its own, but it is not my topic here. Nevertheless, it is worth noting some of the key features of the modern re-emergence of major developing countries, of which the dominant one to date is of course China, because they help to shape the global health challenges that we face. Five features are worth noting:

- Following the model of the Industrial Revolution, growth policies have focused mainly on growth in the production of goods, following an industrialisation model in increasingly open global markets for trade in goods.
- In many emerging countries, and especially China and India, the energy system is built around coal and other fossil fuels.
- With growing incomes, pervasive global communications and rapid urbanisation, there has been a sharp shift to more 'Western' lifestyles.
- Populations in many developing countries are beginning to age rapidly, as a result of control of infectious diseases and low birth rates, in some case due to population control measures.
- Even so, most of these countries remain very poor overall – China's GDP per capita, in PPPs, is still only about one-sixth of that of the USA and that of India is one-fourteenth of the USA.

[1] World Economic Outlook, April 2011, World Bank

Such profound changes raise many critical issues, one of which is the nature of development itself. If China's GDP increases sevenfold in two decades, does this mean that China's people will be seven times better off? Or will these potential benefits be substantially offset by the adverse effects of GDP growth, such as pollution, increasing congestion, limited and unequal access to education and health services, and so on? Will they be purchased at the cost of future generations, by using up natural resources and destroying the global environment? Does real GDP as conventionally measured capture development in its true sense – a sustainable increase in the welfare and living standards of the people?

Another critical issue is the Earth's climate. Global warming was set in train by the advanced countries through their fossil fuel intensive pattern of development. The initial responsibility to address it rests with them, but they have been slow to respond. In this context, if the current rapid growth in developing countries follows a similar fossil intensive pattern the prospects for global warming are bleak indeed.

The Implied Health Challenge

But my focus here tonight is on a third issue. To rephrase a famous comment of Gro Harlem Brundtland, while the developed countries became rich before they were old, the developing countries are becoming old, and are adopting 'Western' lifestyles, before they are rich. The unprecedented pace of economic transition is raising equally unprecedented issues of epidemiological transition, of the changing pattern of diseases. As countries grow rapidly and their people adopt 'Western' lifestyles, they are rapidly acquiring the diseases of the advanced world - such as cancers, cardiovascular diseases, chronic respiratory diseases and diabetes – at an early stage of their development, and even as many continue to battle with a substantial burden of infectious disease and of neglected tropical diseases.

Insert Chart 1

Chart 1 shows age-adjusted mortality rates from communicable and non-communicable diseases (or infectious and chronic diseases as they are often called) in 2008 for groups of countries classified by income level. In the poorest countries, accounting for 845 million people or one in eight (12.4%) of the world's population, the double burden is starkly apparent, with both mortality rates very high. The poorest countries have by far the highest death rates from infectious diseases, but also the highest death rates from chronic disease. In the lower middle income group of countries (3.9 billion people or 57% of global population) deaths from communicable diseases are much lower, but the mortality rate from them is still about eight times that in high income countries, and deaths from chronic disease are very high. Even in upper middle countries the mortality rate from chronic diseases is over 600 per 100,000

persons, even though the death rate from infectious diseases is still four times that of the rich countries.

This double burden, and especially the high rate of chronic disease, poses enormous challenges for many developing countries, and especially for those whose populations are ageing rapidly. The incidence of chronic disease rises rapidly with age, so that for a young population a high age-adjusted mortality rate can be consistent with a relatively low incidence across the whole population. But if the age-adjusted mortality rate remains fixed as the population ages, this will mean rapid growth in the proportion of the population suffering from chronic diseases.

Insert Chart 2

Substantial efforts are being made – by national agencies, by international organisations such as WHO and by a wide range of NGOs – to improve population health in developing countries. In many cases these efforts have to confront and offset the impact of changing lifestyles on risk factors and on health outcomes. Chart 2 shows that age-adjusted non-communicable disease mortality rates have fallen between 2004 and 2008 in each of the four country groupings, but progress is slow. By 2008 these mortality rates from chronic disease for the poorest 85% of the world population were more than double that in the best performing country (Japan) and nearly double that in Australia. In many of the rapidly growing countries progress has been especially slow, perhaps reflecting the effects of rapid growth – age-adjusted chronic disease mortality rates fell by less that 4% between 2004 and 2008 in both China and India, and by less than 1% in Vietnam.

There is clearly a need for urgent action to reduce incidence rates for both chronic and infectious diseases, before the full effects of population ageing are felt. A wealth of knowledge exists around the world about how to prevent, diagnose and cure these diseases, and this is being added to each year. What is needed is greatly increased investment in doing things differently, and better - that is, in health innovation. By health innovation I mean *discovering and applying ideas new to the organisation or region in risk detection, prevention, treatment and cure*. Innovation can be global – discovering new ideas that no one has previously thought of – but in most cases it is local. That is, identifying and putting into practice ways of doing things that are new to the local context, be it the country, the hospital, the village, the factory or the home, and lead to better outcomes in that local context.

But how can the greatly increased investment in health innovation that is required be justified, and be funded? This is the central question of this address, and one key issue for the APEC Life Sciences Innovation Forum which I represent as Academic Co-Chair. Governments, other agencies and individuals already spend large sums on health, including on health innovation, and face many other demands as well. But spending on health is seen as a cost not an

investment. We regularly see league tables about health expenditure, with much hand-wringing about the rising cost of health. But we don't see such figures on total expenditure on information technology, or energy or even on eating out, nor such concern about rising costs. Health is assumed to be different, being a cost that needs to be minimised, while true investment is on things such roads, railways, factories, mines, computer facilities and shopping centres.

My argument is that two key changes of mindset are necessary if we are to justify and fund the level of investment in health innovation required to address the double burden of infectious and chronic disease confronting 85% of the world's population. The first is to go beyond the mindset of the Industrial Revolution, which sees development as industrialisation and growth as above all the production of goods, to a richer concept of sustainable development for the 21st Century. The second is to go beyond seeing spending on health as consumption to be minimised and to realise that it can and should also be an investment, with much higher economic and social returns that most of the projects to which we give investment priority at the present time.

These two propositions are two faces of the one underlying reality – development is about increased human welfare, and good health and long life are the most basic forms of welfare that any society can provide for its citizens. In the balance of this address I will consider these two propositions further, and then provide two examples of cases in which increased investment in health innovation can provide high returns.

Reconsidering the Nature of Development

It is widely accepted that development is driven by knowledge, and by the incorporation of that knowledge in goods and services. That is, it is driven by the process of developing new ideas and by the investment that takes place to incorporate them in goods and services, and then to expand production of those goods and services. Growth after the Industrial Revolution focused initially on the incorporation of knowledge in goods, and on increasing the stock of those new goods. But the expression of knowledge in services has always been important, and this has increased sharply in recent decades.

This focus on goods has had several adverse consequences, such as the degradation of the environment and rising greenhouse gas emissions, and low levels of investment in health innovation in many developing countries. As a result, serious questions have arisen about the sustainability of this development pattern, and about the extent to which it is delivering a true net increase in welfare to populations.

Growth that achieves a higher living standard for one generation at the expense of further generations cannot be regarded as true development – development must be sustainable,

increasing intergenerational welfare. There has been considerable focus in the literature on sustainable development, with new approaches emerging in recent times. Here I wish to focus on the most recent, and certainly one of the most important of those, by a number of economists in the USA and UK including Kenneth Arrow, the doyen of economic theorists in the 20th Century [2].

Insert Table 1

These authors start from the proposition that intergenerational wellbeing will increase if and only if the economy's wealth, defined in a suitably broad way, increases. They refer to this measure of wealth as comprehensive wealth, which in per capita terms includes four components: natural capital, human capital, physical or reproducible capital and health capital. Arrow et al study the conditions under which changes in comprehensive wealth per capita track intergenerational well-being, and hence under those conditions treat changes in such wealth per capita as a measure of changes in intergenerational welfare.

The key question then is to measure the components of comprehensive wealth, and to assess their relative importance, so as to assemble a single measure of comprehensive wealth at various points of time. Changes in that aggregate per capita wealth measure can then be taken as a measure of true or sustainable development. Arrow et al compile such measures, on a preliminary basis, for five countries over the period 2000-05.

Insert Table 2

From our point of view several things are important about these estimates. First, for the period studied, the growth rates for the different forms of per capita wealth vary greatly across wealth types. For all five countries, natural capital per capita falls while for some countries, notably China and India, reproducible capital rises rapidly. Secondly, health capital is by far the most important component of the four in quantitative terms, and in particular is a far bigger contributor to comprehensive wealth than reproducible capital, for example. Thus, thirdly, the measured changes in comprehensive wealth, and hence in sustainable development, are quite different from recorded changes in GDP, again especially for China and India.

Insert Chart 3

Chart 3 shows how, on these new estimates, changes in reproducible capital give a very misleading picture of sustainable development. Growth rates for comprehensive wealth are much lower, and more equal, across countries than those for reproducible capital or GDP. For

[2] Arrow, K.J., Dasgupta, P., Goulder, L.H., Mumford, K.J. and Oleson, K., Sustainability and the Measurement of Wealth, NBER Working Paper 16599, NBER Cambridge MA.

the US, for instance, the rate of sustainable development for this period was much closer to that for China and India for those measures using reproducible capital or GDP.

This work by Arrow and his colleagues is preliminary in nature, and the authors clearly acknowledge it to be so. They note that the results so far 'suggest that health capital magnitudes and their changes swamp other considerations', but further work is necessary to clarify the significance of this important observation. While further theoretical and empirical work will lead to revised estimates, there is little doubt that this broadly based approach to development, incorporating the central role of health, will be a persistent and fruitful strand of economic thinking in the decades ahead.

Evaluating the Returns to Health Innovation

If better health is indeed a major component of economic development, then investing in effective forms of health innovation should indeed be an investment, providing strong economic and social returns. Understanding and documenting this proposition, both in specific cases and by broader studies, has been one of the key activities of the APEC Life Sciences Innovation Forum. I will report here on one part of that work, undertaken at the Centre for Strategic Economic Studies at Victoria University in Melbourne in conjunction with the Institute for Population Studies at Peking University[3].

One way of getting a handle on how much investment in health innovation matters is to look at projections of health outcomes on the basis of different levels of innovation. In the context of the APEC LSIF work on which I will report here, we have focused on the 14 developing economies of APEC, with a population of about 2.2 billion persons. We use WHO projections and a simple population model to define three innovation scenarios for these economies as a whole, based on age and gender specific mortality rates. One, which is our base case and which assumes no new innovation, holds those mortality rates at their levels in the starting year. The second is the WHO projections to 2030, with the level of ongoing innovation implicit in the WHO's assumptions and projection model. The third, which we refer to as the enhanced innovation case, includes further substantial investment in health innovation such as to reduce all age and gender specific mortality rates by 1% per annum over the period to 2030.

Insert Chart 4

The outcomes from these three scenarios in terms of disability adjusted life years lost (DALYs) are shown in Chart 4. If mortality rates remained at their starting level, over 450 million

[3] Centre for Strategic Economic Studies and Institute of Population Research 2008. 'Investing in the Future: An Assessment of the Returns to Investing in Health Innovation', available at http://www.cfses.com/documents/2008_CSES_LSIF_VI_APEC_Investing_in_the_Future.pdf.

disability adjusted life years would be lost from the diseases newly affecting the population in 2030. The level of innovation implied in scenario two (the WHO case) reduces that number by 72 million, and that in the enhanced scenario reduces the number by a further 55 million, given a total of 127 million adjusted life years avoided altogether. This is a massive effect, even in a region with over 2 billion people.

The question that we then asked was this: how can we begin to estimate the net costs and benefits of such levels of investment in health innovation. The methodological framework adopted for a preliminary analysis of this issue is summarised in Chart 5.

Insert Chart 5

Starting with the costs of innovation, there is an extensive literature on the cost of interventions that might reduce the burden of disease, and this effort has been co-ordinated in part through the Disease Control Priorities Project, which is supported by the World Bank, the World Health Organization and the Gates Foundation[4] (DCPP 2008). We drew on this literature to prepare some estimates of the likely cost of the innovation necessary to achieve the two alternative scenarios.

The cost of health innovation is mainly measured, in this literature, in terms of cost per DALY saved, and this approach is also adopted here. There is a wide range of potential innovations available to economies, at both the population and individual health levels. There is also wide variation in the cost of these innovations, some with a cost as low as US$100 per DALY and other ranging up to US$50,000 per DALY, although the majority cited are below US$3000-4000. While the full report looks at several options, the results presented below use an average cost per DALY saved of US$2500. These costs are only the direct costs in the framework of Chart 5; in further work we are examining the infrastructure and education costs associated with increased innovation.

In terms of benefits, in terms of the framework of Chart 5 six benefits are distinguished, but the estimates to date take account of only four of them: the value to the individual, reduced treatment costs, increased labour force participation and increased productivity while working with disease. The other two are again the subject of further work.

Every additional life year made possible by better health saved is a benefit to the individual concerned, who enjoys the additional year of life without disability. There is an extensive literature on the value of a year of life. Several studies for the US have estimated this value of

[4] Jamison, D.T. et al. (eds) 2006, *Disease Control Priorities in Developing Countries*, 2nd edn, World Bank and Oxford University Press, New York.

the order of US$150,000 or about three times GDP per capita, but there are other competing views and methods. It was beyond the scope of the study to address this issue for the APEC developing economies, so we take a very conservative valuation, that the value of a DALY is equal to average GDP per capita in the APEC developing economies region in the year in question. Even on this conservative basis the value of DALYs saved in the two innovation scenario is substantial – for the enhanced innovation scenarios about 4.2% of GDP in 2030 (Table 2, upper panel).

One important component of the benefit from greater investment in innovation, and the resulting lower incidence of chronic disease, is the reduced costs of treating chronic diseases. We use Australian data of the distribution of costs across diseases, together with other information, to estimate the likely relative level of treatment costs per DALY by cause for the region in 2005. As economies get richer, a greater proportion of disease is treated, and more sophisticated and costly methods of treatment are employed. Thus there is a positive relationship between economic growth and health spending, with an elasticity of health spending with respect to GDP considerably higher than one. It is therefore assumed that real treatment costs per DALY in the region will rise over time more than proportionately to per capita GDP growth.

If individuals die early, their potential future contribution to GDP through being in the labour force is lost. However, if they continue to live with disease, and suffer some disability from that disease, they may withdraw prematurely from the labour force or they may continue to work with somewhat impaired productivity. Estimating these impacts on labour force and productivity, and hence on GDP, in the region is therefore an important aspect of this study.

Insert Table 3

Table 3 summarises the results for these costs and benefits, for one central set of parameters and assumptions, for the enhanced mortality scenario relative to the constant mortality scenario, and expressed as a share of GDP. By 2030 the annual cost of the required innovation path is about 0.5% of GDP. For the benefits, lower treatment costs by 2030 are estimated at 1.1% of GDP, the labour force and productivity benefits at 2.7% of GDP and the individual welfare benefit at 4.2% of GDP, giving a total of about 8% of GDP.

Insert Table 4

Expressing these results in terms of benefit/cost ratios, the various forms of economic benefits are 7.4 times the innovation cost in 2030, while individual benefits are about 8 times the cost. Taking all the benefits together the benefit/cost ratio is 15.4. Even taking account of the uncertainty around these estimates and the many assumptions involved, this looks like high return investment indeed.

As with that on the nature of development discussed above, work of this type – examining in detail the various costs and benefits of large scale, system wide investment in health innovation – is in its early stage at LSIF and elsewhere. But the early results are so strong, and so consistent with the new development work, that it is highly likely that the finding of very strong returns to well configured programs of investment in health innovation will prove to be robust.

Two Examples

The varieties of forms of health innovation (*discovering and applying ideas new to the organisation or region in risk detection, prevention, treatment and cure*) available for consideration are now very diverse. As the definition notes, innovation is to be sought across the entire value chain, and ranges from establishing and extending small rural health systems to setting up major national health insurance system and from wider use of existing vaccines and medicines to discovering and applying highly advanced medicines and practices, such as genetic screening and stem cell therapy. I would like to finish this presentation by briefly noting two quite different cases in which we can be sure that further investment in health innovation would have very high economic and social returns: cardiovascular diseases and related diseases of the circulatory system, and neglected tropical diseases in Asia.

Cardiovascular disease

One area in which innovation has led to major health gains in the developed world in recent decades has been in cardiovascular disease, broadly defined to include diseases of heart and blood vessels. Reflecting a range of innovations – from lifestyle changes to diet and reduced smoking levels, new medicines such as those to control blood pressure and cholesterol levels to many new surgical procedures – mortality rates from cardiovascular disease have dropped sharply in many countries since the 1970s.

Insert Chart 6

Australia in a case in point, with mortality rates from cardiovascular disease dropping from 800 deaths per 100,000 people in the early 1970s to only about 200 today. This reduction represents a major success for health policy, as well as a major demonstration of the power of health innovation, both in terms of lifestyles and new medicines and other technologies. While I am not aware of any detailed study for Australia of the relative roles of different types of innovation on this outcome it is clear that each of the major types – lifestyle changes, new medicines and other new technologies and practices – each played a significant part. Now do we have any comprehensive study of the net costs and benefits of this reduction in

cardiovascular disease, but there is little doubt that the net benefits were massive, if all the benefits noted above are taken into account.

Insert Chart 7 and 8

The extent of the health innovation achievement is evident in the fact that during this period of falling heart disease obesity levels within the Australian population were increasing strongly (Chart 7) and yet blood pressure and cholesterol levels were falling (Chart 8)[5].

Developing countries are at quite a different stage of this cycle of cardiovascular disease. As noted earlier, they are experiencing growth in 'Western' lifestyles and a rising incidence of chronic disease even in relatively young populations. There is evidence of rising obesity and increasing blood pressure and cholesterol levels, suggesting the prospect of substantial increases in cardiovascular disease in many of these societies as they age. Here I will make a few observations about the case of China, as an example.

Insert Chart 9

First, it is interesting to note the different trends in systolic blood pressure in Australia and China. In 1980 mean blood pressure levels were much lower in China than in Australia, reflecting a wide variety of historical factors. But, as the chart shows, the trends have been quite different, with an increase in mean levels in China for men after 1990 and for women after 2000. By 2008 the Chinese rates were higher than there Australian counterparts for both men and women. While the future is uncertain, it is likely that there will be significant further increases in mean blood pressure in China, with the prospect of increased incidence of cardiovascular disease.

Insert Chart 10

One important study examined the extent and treatment of high blood pressure (hypertension) in a sample of Chinese urban residents in 2004 and 2006, and the results were striking. As one would expect, the incidence of high blood pressure increases with age. But, as Chart 10 shows, at age 60 years the actual prevalence of hypertension in this Chinese sample was over 30%, of which about half was undiagnosed, with the diagnosed prevalence being less than 15%. However, whether diagnosed or not, only a fraction of that hypertension was controlled.

[5] All of the data on blood pressure, cholesterol and BMI are drawn from seminal international studies on these three issues, the results of which were published in three articles in the Lancet, Vol 377, February 2012.

Insert Chart 11

Chart 11 provides some information relevant to the effectiveness of current diagnosis and treatment regimes, and the potential role for innovation. Both the level of awareness of hypertension and the extent of treatment given awareness rise with age, but only a small proportion (about 20%) of diagnosed hypertension is controlled, and this is fairly stable with age. As a result only a very small proportion of actual hypertension is controlled. At age 60 years, for example, over 30% of the population have hypertension with only about half of that diagnosed and just over 20% of the proportion diagnosed being effectively controlled. That is, only about 15% of actual hypertension of 60 year olds in this sample is controlled.

As the WHO has said, China and other countries face a virtually epidemic of cardiovascular disease. But in the developed countries such as Australia an effective suite over innovation programs have been put in train to curtail such disease sharply. While we don't have the detailed estimates, it must be the case that, when all the benefits discussed above are taken into account, the returns to large scale investment in such programs in China would be very high.

Neglected tropical diseases – the Sabin Institute Proposal

My second example is of a quite different type, and concerns the incidence of what are often called neglected tropical diseases (NTD). The diseases referred to as NTDs are a group of 13 or 14 parasitic and infectious diseases in developing countries, especially in tropical areas. They are ancient conditions, often affecting the poorest people disproportionately, are very disabling although with relatively low direct mortality but have an adverse impact on economic development. Overall the number of people affected is very high, with a significant proportion of the incidence of many NTDs in South East Asia.

Insert Table 5

Because there is a range of such NTDs across many countries, affecting very poor people in poor countries, the market incentives do not exist for large commercial firms to develop, produce and market vaccines to treat such diseases. Developing such vaccines therefore falls to the university and NGO sector, and the Sabin Institute in Washington, one of the leaders in this field, has developed a comprehensive, relatively low-cost model for vaccine development. The Institute has developed a proposal to establish a facility for developing, testing and producing such vaccines in Indonesia or in another country of South East Asia, and this proposal has been supported by LSIF. The development cost is estimated at $10 million over five years, and this is my second example of an investment in health innovation that is likely to generate very high economic and social returns. I recommend it to the Australian Government, or any other

interested party, as a high effective use of aid funds, targeted at both development and the poorest members of society.

Conclusion

Going ahead we need to think differently about growth and development, putting more emphasis on sustainable development in terms of adding to the sum of natural, human and health capital and well as physical capital. These central means of doing this is by investing in innovation, which is in the development and implementation of new ways of doing things. In the area of human health there are major challenges ahead, requiring a sharp increase in investment in health innovation. But for this to occur it needs to be recognised that this is an investment – with goods returns and a high cost/benefit ratio – and perhaps the best investment that there is. And it will also need for some countries a shift in the development models, from an emphasis on industrial goods and construction to health and other welfare enhancing services. This will also benefit the other great challenge of our time, climate change.