

## EPIDEMICS AND ECONOMICS<sup>1</sup>

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### *Introduction*

*Principiis obsta; sero medicina paratur cum mala per longas convaluere moras.*  
'Stop it at the start; it is late for medicine to be prepared when disease has grown  
strong through long delays'.  
(Ovid, around 17 AD)

The association between health and wealth is well established. Rich countries tend to have healthier populations than poor countries. Figure 1 (see page 419) shows that life expectancy, a commonly used summary measure of a population's health, increases sharply as income per capita rises among poorer countries and continues to rise, though at a much slower rate, as countries become wealthier. Between 1995 and 2000, life expectancy at birth in the world's least developed countries was 51 years. In other low-income countries it was 59 years, in middle-income countries 70 years, and in high-income countries 78 years.<sup>2</sup> For decades, it was thought that the causality ran in only one direction – as incomes rose, health improved. Recent years, however, have seen increased attention paid to assessing the reverse effects, as health has come to be seen as a key driver of economic development.

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<sup>2</sup> Commission on Macroeconomics and Health (2001), *Macroeconomics and Health: Investing in Health for Economic Development*, Geneva: World Health Organisation.

This paper discusses the links between infectious disease epidemics and income and asks how these links are affected by changing global circumstances.<sup>3</sup> At the outset we must recognize that there is considerable heterogeneity among infectious diseases that have the potential to become epidemics – in terms of transmission; latency; prevention, treatment, and care; and their short- and long-term economic effects. Regarding transmission, for example, poverty has a greater influence in some diseases than in others. Because of the wide range of characteristics that distinguish some epidemic diseases from others, detailed consideration of specific diseases is beyond the scope of the paper.

Part 1 of the paper looks at the mechanisms through which health affects wealth and vice versa. It then looks at how epidemics and pandemics in particular interact with economic development. Part 2 discusses the challenges facing those attempting to respond to epidemics. Part 3 offers some ideas for overcoming the challenges, while the final section provides conclusions.

In brief, this paper argues that epidemics of infectious diseases can have sizable economic impacts – both in the short and long term – and that their management and control require investment in national and international health systems. When they threaten to erupt, control of epidemics should be a priority, given the significant human and economic tolls they inflict. Globally, the long-term vulnerability to epidemics should decrease as development standards rise, but a more highly interconnected world may actually promote the occurrence of infectious disease epidemics.<sup>4</sup>

<sup>3</sup> The definition of ‘epidemic’ does not technically include malaria, because it is globally endemic. However, malaria is tempo-spatially epidemic and is therefore included in the scope of this paper. On the other hand, we do not address ‘deliberate’ epidemics (e.g., ones that may be caused by bioterrorism), although many of the arguments made herein apply to those as well. We discuss some of the differences between epidemic, pandemic, and endemic diseases below.

<sup>4</sup> The spread of SARS and HIV are cases in point. Still, not every new disease is likely to spread wildly, and those arising in very isolated areas do not necessarily pose near-term threats to the industrialized world.

## PART 1: HEALTH AND WEALTH

*Wealth as a Determinant of Health*

‘Health is the first wealth’  
(Ralph Waldo Emerson, *The Conduct of Life*, 1860).

The view that higher incomes lead to better health stems from several mechanisms. Within a population, wealthier individuals can afford the essential products necessary for a healthy life: sufficient, nutritious food, adequate housing, clean water, and quality health care. They also enjoy better access to information and therefore have more knowledge of how to foster and maintain one’s health. The wealthy have a stronger influence with policymakers than the poor, so their demands for improvements in health services are more likely to be acted upon. Wealthier countries and their residents, moreover, have greater strengths in education, ability to develop and buy medicines and other health technologies, training and paying doctors and nurses, building and maintaining hospitals and clinics, minimizing nosocomial infections (although recent reports emphasize the extent to which these are still a problem in developed countries), providing water and sanitation facilities, (often) using less noxious energy sources, and implementing comprehensive public health campaigns.<sup>5</sup>

The empirical literature, however, is mixed with respect to the link that runs from average income to population health. Lant Pritchett and Lawrence Summers have found that differences in income growth account for 40% of the difference in mortality rate reductions between countries.<sup>6</sup> Angus Deaton, however, finds that ‘gains in life expectancy have been only weakly correlated with growth rates’.<sup>7</sup> Mortality has declined as incomes have risen, but it has also fallen (at least until the advent of HIV/AIDS) in countries that have remained poor. Some poor countries and regions, notably Cuba and the state of Kerala in India, have first-rate health systems and healthy populations. Some rich countries, on the other hand, have pockets of ill health (poor communities in the US

<sup>5</sup> All of this said, we note that population aging in wealthy countries is one factor that will make them more vulnerable to epidemics.

<sup>6</sup> Pritchett, Lant, and Lawrence H. Summers (1996), *Wealthier is Healthier*, *Journal of Human Resources*, 31 (4): 842-68.

<sup>7</sup> Deaton, Angus (2004), *Health in an Age of Globalization*, *NBER Working Paper No. w10669*, August.

and the OECD, and indigenous populations in the US and Australia, for example).<sup>8</sup> Improving economic conditions can lead to better health, if governments and societies mobilize to bring it about, but the link is not assured.<sup>9</sup> Other factors that may affect population health at a given level of income are the distribution of income<sup>10</sup> and the level and distribution of health spending and the organization of the health system.<sup>11</sup>

### *Health as a Determinant of Wealth*

There are a number of mechanisms through which population health can increase or decrease per capita income. First, health can affect income via its intermediate effect on education. Healthy children are less likely to suffer from impaired cognitive development and better able to attend school regularly.<sup>12</sup> Their parents are more likely to invest in their education if they are confident their offspring will live long enough to benefit from it. Better-educated children, in turn, have greater potential to contribute to a country's economic development when they reach working age.

Second, good health boosts labor productivity. As with schoolchildren, healthier workers attend work more often and are more mentally alert and physically energetic. This effect is particularly important in poor countries, where, unlike in developed countries, people whose sickness

<sup>8</sup> Sen, Amartya (1993), The Economics of Life and Death, *Scientific American*, 268(5): 40-47.

<sup>9</sup> Moreover, developed countries often experience poor health and even epidemics, such as obesity, that are based on behavior.

<sup>10</sup> Kennedy, Bruce P., Ichiro Kawachi, and Deborah Prothrow-Stith (1996), Income Distribution and Mortality: Cross-Sectional Ecological Study of the Robin Hood Index in the United States, *British Medical Journal*, 312: 1004-1007; Wilkinson R.G. (1996), *Unhealthy Societies. The Afflictions of Inequality*, London: Routledge.

<sup>11</sup> Anand, Sudhir, and Martin Ravallion (1993), Human Development in Poor Countries: On the Role of Private Incomes and Public Services, *Journal of Economic Perspectives*, 7:133-50; Anand, Sudhir, and Till Bärnighausen (2004), Human Resources and Health Outcomes: Cross-Country Econometric Study, *The Lancet*, 364 (30 October) 1603-09.

<sup>12</sup> Leslie, J. and Dean Jamison (1990), Health and Nutrition Considerations in Educational Planning: The Cost and Effectiveness of School-Based Interventions, *Food and Nutrition Bulletin*, 12: 204-215; Bhargava, Alok (2001), Nutrition, Health, and Economic Development: Some Policy Priorities, World Health Organization, Commission on Macroeconomics and Health, *CMH Working Paper Series*, Paper No. WG1: 14. Available at [http://www.cmhealth.org/docs/wg1\\_paper14.pdf](http://www.cmhealth.org/docs/wg1_paper14.pdf)

impedes their ability to do manual labor, often lose what may be their only major resource. Healthier communities, too, mean that workers take less time off to care for sick relatives.

Third, good health promotes saving and investment, which are important drivers of economic growth. As life expectancy increases, saving for retirement becomes a more rational decision for individuals.<sup>13</sup> Retirement savings translate into funds available for investment. In addition, healthy, productive workforces are more likely to attract foreign investment than sick populations.

Fourth, health improvements will have both transitional and permanent effects on a country's population age structure, with potentially huge impacts on economic development. As health advances begin to reduce infant and child mortality, the number of children surviving to adulthood increases. Either rapidly or over a longer period of time, parents realize they need to bear fewer offspring in order to attain their desired family size, thus prompting a decline in fertility rates. This effect is typically buttressed by rising levels of female education and labor market opportunities that reduce desired fertility. Fertility levels also fall in response to the provision of family planning services,<sup>14</sup> and knowledge about family planning options may increase with access to cultural influences from outside the local community, such as relevant public service announcements<sup>15</sup> and docudramas<sup>16</sup> on television. The cohort of children born after mortality rates fall and before fertility rates decline is larger than both the preceding and succeeding cohorts – often known as a 'baby boom' generation. A baby boom cohort has the potential, when it reaches adulthood, to swell the workforce, and provide a boost to a nation's economic produc-

<sup>13</sup> Bloom, David, David Canning, and Bryan Graham (2003), Longevity and Life Cycle Savings, *Scandinavian Journal of Economics*, 2003 (Vol. 105, No. 3): 319-338.

<sup>14</sup> Schultz, T. Paul (1997), The Demand for Children in Low Income Countries, *Handbook of Population and Family Economics*, Vol. 1A, Chapter 8, (eds.) M.R. Rosenzweig and O. Stark, Amsterdam: North-Holland Publishing.

<sup>15</sup> Hegazi, Sahar, Suzan Kelini, and Gihan Rashti (2002), Family planning TV spots in Egypt: Did they change knowledge, attitudes and practices of women in slum areas in Cairo?, Abstract #38946 of November 11 presentation at annual meeting of American Public Health Association. Available at: [http://apha.confex.com/apha/130am/techprogram/paper\\_38946.htm](http://apha.confex.com/apha/130am/techprogram/paper_38946.htm)

<sup>16</sup> Relevant experience in Bangladesh is documented at <http://www.jhuccp.org/pubs/ci/7/index.shtml>

tivity.<sup>17</sup> The aforementioned fertility decline implies these economic gains will not be encumbered by having to support a large number of children.

East Asia appears to have benefited greatly from the effects of its baby boom. Mortality in the region declined sharply during the period of the baby boom, likely the result of improvements in sanitation and the introduction of antibiotics and DDT.<sup>18</sup> Eventually, fertility rates followed and when the baby boomers reached working age, aided by strong education systems and flexible labor market policies that encouraged job creation, they gave a huge boost to East Asian economies. It has been estimated that this 'demographic dividend' accounted for one third of the region's spectacular economic growth between 1965 and 1990.<sup>19</sup>

The links between health and wealth are often mutually reinforcing. In East Asia for example, a virtuous spiral was created whereby health improvements catalyzed the baby boom generation and boosted economic

<sup>17</sup> The economic boost that demographic change can thus provide depends on a country's ability to employ its large cohort of working-age people. Policies that lead to such employment are therefore crucial. Numerous countries have failed to capitalize on the potential dividend that demographic change made available. And since this dividend most often arises from declines in mortality and fertility, it creates opportunities during a specific period of time for economic growth in a given population. Whether these opportunities spill over into an increased economic growth rate in the longer term is unknown.

<sup>18</sup> In the West, however, the decline in mortality from infectious diseases predated the introduction of antibiotics and vaccines. See T. McKeown, *The Role of Medicine: Dream, Mirage, or Nemesis*, Princeton: Princeton University Press, 1980, or Armstrong G.L., Conn L.A., Pinner R.W., Trends in infectious disease mortality in the United States during the 20th century, *Journal of the American Medical Association*, 1999 Jan 6;281(1):61-6. For further discussion of this issue, see David M. Cutler, Angus S. Deaton, Adriana Lleras-Muney, The Determinants of Mortality, *NBER Working Paper No. 11963*, January 2006, which finds that the application of scientific advances is 'the ultimate determinant of health'. In explaining mortality differences across countries, Samuel Preston stresses the importance of 'medical and public health factors' in *The Changing Relation between Mortality and Level of Economic Development*, *Population Studies*, Vol. 29, No. 2. (Jul., 1975), pp. 231-248. See also, Easterlin, R. (1999), How beneficent is the market? A look at the modern history of mortality, *European Review of Economic History*, 3(3): 257-294, for research that finds that the determinants of mortality decline involve the advent of new institutions and policy initiatives that build on an understanding of disease.

<sup>19</sup> Bloom, David E. and Jeffrey Williamson (1998), Demographic Transitions and Economic Miracles in Emerging Asia, *World Bank Economic Review*; Bloom, David E., David Canning, and Pia Malaney (2000), Demographic Change and Economic Growth in Asia, *Population and Development Review*, 26: 257-90; Bloom, David E., David Canning, and Jaypee Sevilla (2002), *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*, Santa Monica, California: RAND, MR-1274.

growth. Some of the fruits of this growth were then reinvested in health care, family planning, and education, which further reduced fertility rates and lightened the burden the workforce had to support.<sup>20</sup> Vicious spirals are also possible. In Sub-Saharan Africa, the infectious disease burden has continued to undermine children's prospects of surviving to adulthood. Fertility rates have therefore remained high and, instead of concentrating their resources on one or two children, parents have had to spread their investments in nutrition, health, and education thinly, thus limiting their potential for lifting the family out of poverty. The loss of workdays and selling of assets to pay for health care not only impoverishes poor families further, but also makes it more difficult to cope with future health shocks. Ruger et al.<sup>21</sup> detail, for example, the high cost of outpatient visits by the poor in China, and cite Liu *et al.*<sup>22</sup> to the effect that 'high health expenditures were a major cause of poverty in rural areas [in China]'.

Finally, and turning specifically to recent epidemics: Health scares may deter both investors and tourists from a country, as the recent SARS epidemic in China and Southeast Asia demonstrated. Foreign direct investment (FDI) in Hong Kong at the height of the crisis fell by 62% in one quarter.<sup>23</sup> These observations jibe with the finding of Alsan, Bloom, and Canning (2006) that FDI into low- and middle-income countries grows by 9% for every one-year increase in life expectancy.<sup>24</sup>

Health, then, can have strong effects on economic growth. Bloom, Canning, and Sevilla (2004) have found that each additional year of life

<sup>20</sup> Bloom, David E. and David Canning (2001), Demographic Change and Economic Growth: The Role of Cumulative Causality. In: Nancy Birdsall, Allen C. Kelley, and Stephen Sinding (eds.), *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World*, New York: Oxford University Press, 2001.

<sup>21</sup> Ruger, Jennifer Prah, Dean Jamison, David Bloom, and David Canning (2006), Health and the Economy. In: Michael H. Merson, Robert E. Black, and Anne J. Mills (eds.), *International Public Health: Diseases, Programs, Systems and Policies*, Sudbury, MA: Jones and Bartlett Publishers, 601-647.

<sup>22</sup> Liu, Y., S. Hu, W. Fu, and W.C. Hsiao (1998), Is community financing necessary and feasible for rural China?. In: M.L. Barer, T.E. Getzen, and G.L. Stoddart (eds.), *Health, health care and health economics: Perspectives on distribution*, New York: John Wiley & Sons.

<sup>23</sup> Tam, J. (2003), SARS slashes FDI inflows by 62 per cent, *The Standard: Greater China's Business Newspaper*, 1 October.

<sup>24</sup> Alsan, Marcella, David E. Bloom, and David Canning (2006), The Effect of Population Health on Foreign Direct Investment Inflows to Low- and Middle-Income Countries, *World Development*, April, 2006 (Vol. 34, No. 4), forthcoming.

expectancy raises per capita GDP by 4%.<sup>25</sup> GDP per capita does not provide a full picture of the economic impacts of improved health, however, since health improvements, by reducing mortality, boost population size as well as productivity. Health reversals, conversely, reduce population size. When the value of the extra lives that result from health improvements is taken into account, the effect of health improvements on economies will be much greater than the effect on per capita GDP alone.<sup>26</sup> In addition, GDP per capita, since it is an average, does not account for the greater economic benefits that may accrue to the poor, as compared to the rich, when population health improves.

The foregoing arguments are germane to showing a causal link from health to prosperity, but much research remains to be done. Efforts to assess and quantify these links are severely hampered by lack of data (in the cases of plague and influenza) or by reverse causality between GDP and health (in the case of HIV/AIDS).<sup>27</sup> Many studies of the economic impacts of epidemics, such as that of Brainerd and Siegler (2003) and Bloom and Mahal (1997a), focus on GDP per capita effects, ignoring the potential for duplicating the longer-term but very significant changes in education, fertility, and savings rates that may have resulted from the influenza epidemic.<sup>28</sup> In addition, as the SARS case vividly illustrates, expectations have a very significant role (more than ever), which can lead to economic effects vastly out of proportion to the number of infected people. This suggests that one take care not to extrapolate economic effects on the basis of earlier epidemics, which arose in a far less integrated world. Expectations, however, are only one factor in retrospectively evaluating the response to a budding epidemic. In the face of uncertainty about an agent's contagiousness, how fatal it is likely to be, and how it is transmitted, caution makes sense.

<sup>25</sup> In principle, this effect is net of the reverse causal effect that runs from higher income to life expectancy. See Bloom, David E., David Canning and Jaypee Sevilla (2004), The Effect of Health on Economic Growth: A Production Function Approach, *World Development*, January, (Vol. 32), pp. 1-24.

<sup>26</sup> Bloom, David E., David Canning and Dean T. Jamison (2004), Health, Wealth, and Welfare, *Finance and Development*, March 2004, Vol. 41, No. 1, pp. 10-15.

<sup>27</sup> Bloom and Mahal (1997a), *op. cit.*

<sup>28</sup> See, for example, Andrew Noymer and Michel Garenne, The 1918 Influenza Epidemic's Effects on Sex Differentials in Mortality in the United States, *Population and Development Review*, Volume 26, No. 3, 2000, for a discussion of the demographic effects of the epidemic.

In short, the links between health and wealth change over time and vary in different contexts – the effects of one on the other are not inevitable and are often unpredictable. Health is, however, clearly an intrinsic part of the development process. A country's wealth (and indeed its health) can often be enhanced by traditional measures such as opening up to trade, promoting exports, restructuring or eliminating inefficient state-owned enterprises, improving infrastructure, and investing in education. It can also be enhanced by investments in health. Specific, cost-effective entry points such as efforts to reduce infant mortality via vaccines or to improve maternal health via family planning programs can, by changing a country's age structure and increasing labor productivity, have resounding long-term economic effects. Neglect of such issues, on the other hand, can contribute to economic stagnation or impoverishment.

#### *Epidemics, Pandemics, and Economic Prosperity*

*Epidemic*: 'The occurrence in a community or region of cases of an illness, specific health-related behaviour, or other health-related events clearly in excess of normal expectancy. The community or region and the period in which the cases occur are specified precisely. The number of cases indicating the presence of an epidemic varies according to the agent, size, and type of population exposed; previous experience or lack of exposure to the disease; and time and place of occurrence ... Generally, a disease that exhibits large inter-annual variability can be considered as epidemic' (World Health Organization).<sup>29</sup>

*Pandemic*: 'An epidemic occurring over a very wide area (several countries or continents) and usually affecting a large proportion of the population' (US Centers for Disease Control and Prevention).<sup>30</sup>

*Endemic*: 'The constant presence of a disease or infectious agent within a given geographic area or population group; may also refer to the usual prevalence of a given disease within such area or group' (World Health Organization).<sup>31</sup>

The subject of this paper is epidemics and their relationship to economic outcomes. Since pandemics are simply epidemics spread over a

<sup>29</sup> Adapted by WHO from Last J.M., *A Dictionary of Epidemiology*, 2001.

<sup>30</sup> <http://www.cdc.gov/excite/library/glossary.htm>

<sup>31</sup> Adapted by WHO from Last J.M., *A Dictionary of Epidemiology*, 2001.

wide area, a discussion of the two naturally goes hand in hand. Endemicity, however, presents a slightly different situation. First, some diseases that are endemic (such as malaria) periodically cause epidemics, as they break out into, or become more prevalent in, a specific population. AIDS and tuberculosis are also endemic in many areas. Each of these diseases, in part by virtue of its endemicity, brings with it economic effects that are likely to be long term and that have been the subject of much consideration. Epidemics are of a more well-defined time and geographic scope. Their economic effects are more likely to be short term, although they can also have long-term economic consequences.

Assessing whether the linkages between epidemics and wealth are similar to those between general health and wealth is complex. This section will ask whether wealth protects against epidemics, and then whether epidemics affect wealth.

Epidemics – and we limit our discussion here to epidemics of communicable diseases spread by long-known pathogens – are most likely to arise and persist under conditions commonly created by poverty.<sup>32,33</sup> First, the spread of infectious diseases often requires close and frequent contact between individuals. This, in turn, requires either or both of crowded living conditions and a high level of (preferably rapid) mobility. (Recall Charles Dickens' graphic descriptions of the overcrowded and poorly ventilated housing of the poor and how those conditions abetted the spread of tuberculosis). Second, poor sanitation and hygiene allow bacteria, viruses, parasites (e.g., worms and amoebae), and the vectors of transmission to thrive. Third, weak bodies are more easily infected and less able to fight infection;<sup>34</sup>

<sup>32</sup> The spread of the SARS virus in Asia is an example.

<sup>33</sup> As with epidemic diseases, endemic diseases are also often abetted by poverty conditions. Examples include malaria, tuberculosis, schistosomiasis, dengue fever, and hepatitis B and C.

<sup>34</sup> There is evidence that better nutritional status helps to prevent infection and more evidence that it helps in fighting infections. See, for example, Scrimshaw N.S., SanGiovanni J.P., Synergism of nutrition, infection, and immunity: an overview, *Am. J. Clin. Nutr.*, 1997 Aug. 66(2):464S-477S; Bhutta Z.A., Bird S.M., Black R.E., Brown K.H., Gardner J.M., Hidayat A., Khatun F., Martorell R., Ninh N.X., Penny M.E., Rosado J.L., Roy S.K., Ruel M., Sazawal S., Shankar A., Therapeutic effects of oral zinc in acute and persistent diarrhea in children in developing countries: pooled analysis of randomized controlled trials, *Am. J. Clin. Nutr.*, 2000 Dec;72(6):1516-22; Fawzi W., Msamanga G., Spiegelman D., Hunter D.J., Studies of Vitamins and Minerals and HIV Transmission and Disease Progression, *J. Nutr.*, 2005 Apr. 135(4):938-44; Villamor E., Fawzi W.W., Vitamin A supplementation: implications for morbidity and mortality in children, *J. Infect. Dis.*, 2000 Sep. 182 Suppl 1:S122-33.

where populations are malnourished, left weak by other health setbacks, or have a high proportion of very young or very old members, epidemics have the potential to thrive. Fourth, epidemics tend to occur where health systems are weakest and therefore incapable of detecting and responding to rapidly evolving health threats. Finally, poverty conditions can lead individuals to engage in behaviors that facilitate disease transmission (e.g., sex workers, or poor Chinese farmers who sell blood in Henan province, who contract HIV).

Wealth enables people to safeguard themselves against or mitigate the effects of many of these risk factors. The wealthy generally have less crowded living space than the poor, greater access to health care, drugs, and vaccines (and where state provision is weak, they can better afford private care), better sanitation, and better nutrition. Economic decline, moreover, often triggers the spread of disease. In Russia in the 1990s, for example, political and economic stress had severe effects on health systems. Diphtheria thrived, and there was a resurgence of tuberculosis and measles. As Figure 2 (see page 419) shows, the share of deaths from infectious diseases is much higher in poor countries than in rich ones.<sup>35</sup>

The issue of mobility, however, is more complicated. The rich may be more mobile than the poor, and tourism and business travel can lead to greater exposure to disease (trade has been a conduit for epidemics since ancient times, and globalization allows disease-causing microbes to spread faster and further than previously). The mobility of the poor, on the other hand, is likely to be more risky. Migration, for example, is a risk factor for HIV transmission, as male migrants tend to have social anonymity and cash, and may be lonely when separated from their families, leading them to seek commercial sex; female migrants are often abused.

More generally, poor people often move to escape catastrophic events such as war or environmental disasters, frequently ending up in crowded, makeshift camps or slums where poor sanitary conditions create an ideal environment for epidemics such as typhus and cholera. They may also move to find work. Much of this movement is from rural areas into cities,

<sup>35</sup> WHO supplies detailed data online on cause of death for each of 14 region/mortality strata. Infectious diseases are the cause of many deaths. To this number we have added respiratory infections, which are not included in the former category. For each region, this sum, divided by total deaths, gives the fraction that appears on the vertical axis. The source of the data for the horizontal axis is World Bank, *World Development Indicators 2004*, online.

and occurs when cities begin to prosper. Friedrich Engels observed the perils of urbanization in the 19th century: 'Dirty habits', he wrote, 'do no great harm in the countryside where the population is scattered. On the other hand, the dangerous situation which develops when such habits are practiced among the crowded population of big cities must arouse feelings of apprehension and disgust'.<sup>36</sup> As well as offering some protection against epidemics, the changes in living habits (specifically, movement from rural to urban areas) that accompany increased incomes can also make epidemics more likely to occur.

The effect of an epidemic disease on the economy is complex and depends upon many factors. These include what group of individuals is most at risk for contracting the disease, the natural history of the illness (e.g., how long the epidemic lasts), and how the disease is transmitted (via airborne vs. blood-borne pathogen).

Annual epidemics often reserve their harshest impacts for youth and the elderly (although this is not necessarily so for pandemics).<sup>37</sup> By reducing dependency ratios, this pattern can have positive impacts on economies – with fewer non-earners and a reduced number of dependents for those who are earning, per capita income is likely to rise (although it would be difficult to argue that these income gains offset the welfare costs of premature deaths associated with the flu). Of course, when a depleted youth generation enters the workforce, the reduced number of workers may itself become an economic problem.

Given the vast trail of death and morbidity left by epidemics, they obviously diminish human well-being. Even where they affect people of working age, however, epidemics may not have negative economic impacts on income per capita. The Black Death, which wiped out an estimated quarter of Western Europe's population in the 14th century, is thought by some to have had a positive effect on incomes,<sup>38</sup> (which could have resulted from a reduced number of individuals benefiting from and building on the same set of fixed assets, including, for example, land and

<sup>36</sup> Friedrich Engels (1845), *The Condition of the Working-Class in England*, Leipzig: new edition, Stuttgart, 1892.

<sup>37</sup> See Simonsen L., Clarke M.J., Schonberger L.B., Arden N.H., Cox N.J., Fukuda K., Pandemic versus epidemic influenza mortality: a pattern of changing age distribution, *Journal of Infectious Diseases*, 1998 Jul;178(1):53-60.

<sup>38</sup> Clive Bell and Maureen Lewis (2004), The economic implications of epidemics old and new, *World Economics*, Vol. 5, No. 4, October-December.

physical capital). Others have concluded that it had little or no effect on incomes (at least in England and France).<sup>39</sup> The 1918 flu epidemic killed over 40 million people worldwide, but its economic effect in the US was, if anything, positive.<sup>40</sup> By contrast, Bloom and Mahal found no evidence of a significant effect from that epidemic on output (i.e., acreage sown) per capita in India.<sup>41</sup> When there are deaths, of course, there are welfare losses. But these are cases where, although the economy may have been disrupted, there was no long-term negative effect on per-capita income. These results highlight the fact that many economies are flexible and resilient, and that people adapt to unforeseen changes. Finally, even though these epidemics caused many deaths, some of them came and went quickly, with the possible consequence that the economic dislocations that arise from morbidity, treatment, and transitional social arrangements did not last long enough to engender a long-term effect, at least with respect to the measures used in this literature.

Writers on this topic, however, are most often looking only at the economic well-being of those who survive. In a high unemployment situation, total output may not change, since new workers take the place of those who die (in some instances, however, as when skilled workers die, there may be clear and negative financial repercussions and output may fall). Perhaps most typically, GDP per capita may rise, at least initially, when some people die. Longer-term equilibration may minimize this effect, however, and overall it is not clear whether GDP per capita is greatly affected either positively or negatively.<sup>42</sup> Recent research by Mahal,

<sup>39</sup> Bloom, David E. and Ajay Mahal (1997a), AIDS, Flu, and the Black Death: Impacts on Economic Growth and Well-Being. In: David Bloom and Peter Godwin (eds.), *The Economics of HIV and AIDS: The Case of South and South East Asia*, New Delhi: Oxford University Press, 1997, 22-52.

<sup>40</sup> Brainerd E. and M. Siegler (2003), The Economic Effects of the 1918 Influenza Epidemic, No 3791, *CEPR Discussion Papers*. The authors note that a disproportionate share of those who died were of working age. They then 'examine the impact of this exogenous shock on subsequent economic growth using data on US states for the 1919-30 period. Controlling for numerous factors including initial income, density, urbanization, human capital, climate, the sectoral composition of output, geography, and the legacy of slavery, the results indicate a large and robust positive effect of the influenza epidemic on per capita income growth across states during the 1920s'.

<sup>41</sup> Bloom and Mahal (1997a), *op. cit.*

<sup>42</sup> For example, notwithstanding the mixed evidence on the long-term effect of the Black Death on wages, it is clear from the diaries of plantation owners that the very short run effect was a substantial elevation of wages. See Hirschleifer, Jack (1987), *Economic Behaviour in Adversity*, Chicago: The University of Chicago Press.

however, has uncovered signs that as the AIDS epidemic grows, there may be negative effects on a country's GDP per capita.<sup>43</sup>

If we take the economic value of human life into account, however, it is clear that epidemics have a high cost. How high, of course, depends on the economic value one assigns to life. People who die during epidemics, along with their families, obviously lose out economically. One could, moreover, add other losses to this if one places an economic value on intangible impacts such as the lost companionship and love felt by friends and relatives of the dead. A thorough discussion of valuing the cost of life appears in Viscusi and Aldy (2003).<sup>44</sup>

In recent years, some epidemics have had clear negative economic effects. The HIV/AIDS pandemic too, while not (yet) significantly affecting per capita GDP, has had major effects at the household level, particularly on the poor.<sup>45,46</sup> As well as suffering from lost earnings, poor families hit by AIDS have to draw down savings and sell assets to pay for treatment. Relatives of infected individuals may have to take time off work or withdraw from school to provide care. A family's future economic prospects are thereby further impaired; indeed, even the immediate spending can be catastrophic to the individual family. The long-term costs of HIV/AIDS, and in particular the vast scale on which social and economic effects are likely to be felt (because of decreased investment in human capital), are laid out in Bell, Devarajan, Gersbach (2003).<sup>47</sup> In addition, the long latency period of the HIV virus means that the long-

<sup>43</sup> Mahal, A. (2004), The economic implications of inertia on HIV/AIDS and the benefits of action, *Economic and Political Weekly*, 39(10): pp.1049-63.

<sup>44</sup> Viscusi, W. Kip, and Joseph E. Aldy (2003), The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World, *Journal of Risk and Uncertainty*, 27(1): 5-76.

<sup>45</sup> Bloom, David and Ajay Mahal (1997b), Does the AIDS Epidemic Threaten Economic Growth?, *Journal of Econometrics*, 105-124; Bloom, David E., Ajay Mahal, Larry Rosenberg, Jaypee Sevilla, David Steven, and Mark Weston (2004), *Asia's Economics and the Challenge of AIDS*, Asian Development Bank.

<sup>46</sup> Although the poor have in general been the most affected segment of society, GDP can still remain only minimally affected. This is because the total economic output of the poor is in many instances sufficiently small that decreased output by the poor has only a small effect on total GDP. In countries in which the poor contribute a sizable share of GDP, this explanation suffices only if a small percentage of the poor are affected.

<sup>47</sup> Bell, C., S. Devarajan, and H. Gersbach (2003), *Thinking about the Long-run Economic Costs of AIDS*, World Bank (October) (Draft). Available at [http://emlab.berkeley.edu/users/webfac/bardhan/e271\\_f03/thinking.pdf](http://emlab.berkeley.edu/users/webfac/bardhan/e271_f03/thinking.pdf)

term course of the disease is difficult to predict, as are, therefore, the long-term economic effects.

AIDS may also affect businesses. In a global survey of 8719 firms conducted by the World Economic Forum in 2004,<sup>48</sup> business leaders expressed some concern over the current and future impacts of the pandemic on their workforces and other aspects of company operations.<sup>49</sup> 16% of respondents expected the virus to have serious impacts on their business. In low-income countries this figure rose to 35%, and in Sub-Saharan Africa to 45%. Although few firms reported current negative impacts on productivity, revenues, and medical expenses, in low-income countries over 1 in 10 respondents had already experienced serious impacts on each of these aspects of their business.

AIDS has, in recent years, begun to claim the lives of large numbers of people, especially in countries that were hit early by the virus. It is possible – some would say quite likely – that the economic effects will grow over time, as dwindling working-age populations (which are disproportionately affected by the disease) have to support burgeoning numbers of children and orphans and social breakdown becomes a reality. Education systems have already begun to suffer because of deaths among teachers. Orphans, in particular, are subject to becoming a particularly uneducated segment of the next generation. Weakened education systems that in many instances are already inadequate are likely to impair countries' efforts to strengthen their economies.

In the past decade, Severe Acute Respiratory Syndrome (SARS) and Bovine Spongiform Encephalitis (BSE)<sup>50</sup> have also had economic impacts. The panic caused by these diseases led to economic costs that were disproportionate to the number of cases. Although fewer than a thousand people died in the 2003 SARS outbreak, for example, tourism and business in affected areas were hit hard, with some estimates putting the cost of the virus at over \$11 billion.<sup>51</sup> The European Association of

<sup>48</sup> World Economic Forum Global Health Initiative (2005), *Business and HIV/AIDS: Commitment and Action?*, [http://www.weforum.org/pdf/Initiatives/GHI\\_Report\\_2005\\_Final.pdf](http://www.weforum.org/pdf/Initiatives/GHI_Report_2005_Final.pdf)

<sup>49</sup> For a review of the previous year's report, see David E. Bloom, Lakshmi Reddy Bloom, David Steven, and Mark Weston (2004), *Business and HIV/AIDS: Who Me?*, World Economic Forum, Geneva.

<sup>50</sup> BSE is epizootic (i.e., it affects many animals in a certain region and time period). But its much less prevalent human variant, Creutzfeldt-Jakob disease (CJD), has provoked widespread fear.

<sup>51</sup> Trish Saywell, Geoffrey A. Fowler, Shawn W. Crispin (2003), *The Cost of SARS: \$11 Billion and Rising*, *Far Eastern Economic Review*, 24 April.

Animal Production, meanwhile, has estimated that BSE, which has caused fewer than 200 deaths, has so far cost the 15 European Union states at least \$110 billion.<sup>52,53</sup>

It appears, then, that the relationship between epidemics and wealth has many similarities to that between overall health and wealth. Economic growth is likely to protect populations against health setbacks and against epidemics (although the examples of BSE and SARS show that even the richest countries cannot afford to be complacent). Both epidemics and other health problems, moreover, can impede economic development and set off vicious spirals whereby poor health leads to reduced wealth and makes the task of improving health ever harder. It is possible, however, that only in cases where epidemics are sustained over a long time period will the effects on survivors prove harmful at a macro-economic level (although those who die sustain clear economic losses, along with their families). Short epidemics may have negative effects on individual households and firms, but the overall damage to economies will be less severe.

It is relevant to note here that, as with epidemics, endemic diseases can also have major economic consequences. On the individual and family level, for example, it is clear that malaria's effects can be economically devastating. And at the macro level, according to the report of the Commission on Macroeconomics and Health, high malaria prevalence in an area can reduce economic growth by over 1 percentage point per annum.<sup>54</sup>

Given time to accumulate, as in the cases of malaria and HIV/AIDS, micro-level effects may have macro-level consequences. The exceptions to this are short epidemics that cause large panics. SARS, for example, wreaked economic havoc not because of the number of cases of the disease but because of the alarm it provoked and uncertainty about its ease and routes of transmission. In addition, the chaos caused by SARS was as severe in Toronto as it was in Beijing and Bangkok, despite the fact that Toronto had significantly fewer cases.

<sup>52</sup> <http://europa.eu.int/comm/research/press/2004/pr1805en.cfm>

<sup>53</sup> \$110 billion is roughly 1% of the GDP of the EU. But the \$110 billion loss, which may not have all occurred during one year, is a *capital* loss, not an *income* loss. The share of income lost would be much tinier.

<sup>54</sup> *Commission on Macroeconomics and Health* (2001).

## PART 2: THE CHALLENGE OF EPIDEMICS

Epidemics have afflicted human civilizations for ages. The challenge they present has not always been met, and many millions have died as epidemics have ravaged populations with no effective means of resistance. Although better sanitation, rapid response measures, and specific medical advances have given humanity new tools to resist epidemics, the forces of 'globalization' have, at the same time, abetted the spread of epidemics. For example, more frequent international travel facilitates the access of many pathogens to new populations. Similarly, increased international trade during the last couple of decades has meant that disease-causing agents from one area can more easily find their way to regions that were previously thought immune to a particular disease. Some have argued that competitive pressures and freer trade have led to export pressures that abet the spread of infections, as seems to have been true with Bovine Spongiform Encephalitis, the Nipah virus, and avian flu. Other twentieth-century developments are also relevant here: massive movement from rural areas to cities and the accompanying poverty in peri-urban areas makes epidemics more likely. Global climate change, too, may be affecting the spread of malaria, dengue fever, and yellow fever. Higher-temperature ocean currents have been linked to increased cholera rates.<sup>55</sup>

One of the sources of the panic created by some epidemics (but not all of them) is their unpredictability, which flows in part from some of the new factors cited above. This applies as much to their economic impacts as to their likely transmission speed and direction. As the examples of HIV/AIDS and SARS show, different epidemics can have widely differing economic effects.

This presents policymakers with two main challenges. First, their response needs to be swift. Rapid action taken by the global health community was instrumental in limiting the impacts of SARS. Had the response been slower and the disease allowed to spread further, its economic effects would have been even more catastrophic. In contrast, the sluggish speed of the reaction to HIV/AIDS in many parts of the world has greatly increased the virus's impacts. Second, the response needs to be flexible. Epidemics can change quickly, forcing decision-makers to act without complete information. The initial effects of HIV/AIDS, for example, were felt by gay communities and injecting drug users in the West.

<sup>55</sup> Colwell, R.R. (1996), Global Climate and Infectious Disease: The cholera paradigm, *Science*, 274:2025-2031.

Policy-makers were caught off guard when they began to realize that it was spreading rapidly among heterosexuals in Africa.

This need for flexibility in policy response applies, of course, to resource allocation. The costs of less-sudden health problems, such as chronic disease or mental illness, are relatively easy to forecast and budget for. The unpredictability of epidemics, however, makes planning for the effective allocation of human and physical resources difficult. Diverting funds to counter epidemics may, for instance, temporarily halt progress made against non-communicable diseases. It may also require health workers to take on new responsibilities for which they are not fully equipped. The costs of an epidemic, moreover, may change suddenly as it spreads or is contained. Avoiding waste while ensuring resources are sufficient to tackle a disease is a difficult balancing act, particularly for policymakers who have not previously been confronted with such a threat. This challenge is all the more difficult because anticipatory investment is required.

Another of the unique challenges posed by epidemics is the requirement they impose for people to limit their movement. As long ago as the 14th century, villages afflicted by the plague were cordoned off from the rest of the society to limit the disease's spread. In the more recent case of SARS, travelers were strongly advised by the World Health Organization not to visit high-risk areas such as southern China, Hong Kong, and even Toronto. Restricting movement, particularly in a globalizing world, has serious negative implications for tourism and sometimes for trade, as well. These impacts will likely be felt more strongly in industrializing or industrialized countries, where the requirement for movement is greater than in predominantly agricultural economies.

Epidemics that cross national borders and become pandemics pose further taxing challenges and mean that few countries can afford to drop their guard. Dengue fever, for example, had for long been confined to tropical regions until spreading into temperate zones in recent years, largely as a result of the increase in air travel and the shipping of used tires harboring dengue-carrying *Aedes* mosquitoes.<sup>56</sup> For epidemics not to

<sup>56</sup> It is sometimes suggested that the resurgence of tuberculosis in New York City in the early 1990s, was due to, among other factors, immigrants importing drug-resistant forms of the bacillus into the city. This, however, appears to be an urban myth, as the primary causes seem to have been the spread of HIV – TB is an opportunistic infection – and prison crowding stemming from the drug war of the 1980s. New York's public health system had become unused to dealing with the disease and was thus at first unable to cope effectively with the new threat.

become pandemics, countries need to be constantly alert to their occurrence in neighboring and even far-off societies, and aware of the risks to which their links with affected countries expose them.

Perhaps the biggest test posed by epidemics is the propensity of the underlying disease agent to mutate. Success against one strain of a disease (either by natural resistance or medical intervention) can open a niche for the emergence of a new strain, and new strains are likely to be more virulent. The emergence of new epidemics – in the past 15 years alone, hantavirus, SARS, and avian flu have hit the international headlines – and the resurgence of old ones demands great agility and ingenuity from medical practitioners, drug developers, public health professionals, and policymakers.

The best way of countering drug-resistance, of course, is to prevent it, and the best way of preventing it is to halt the spread of disease in the first place through the use of vaccines, bed nets, elimination of vectors, educational programs, etc. Resistance occurs through the use of antimicrobials. Overuse is common in industrialized countries, where patients are inappropriately prescribed antimicrobials for viral infections (e.g., the common cold) or when antibiotics that are used by people are also employed in bulk as growth-promoters in livestock, which is common in OECD countries. Misuse may occur when patients lack access to appropriate therapy, but also when the general public is misinformed and individuals successfully demand unnecessary antibiotics. Finally, underuse is typically encountered among the poor, when inadequate financial resources impede the completion or continuation of treatment regimens. With diseases such as tuberculosis and HIV/AIDS, where drugs are now available, it is better – from a population health point of view – to have no treatment at all than ‘bad’ treatment.

While reacting speedily to epidemics is important, undue haste to push people onto underfunded treatment regimens may have dire unintended consequences. Recent research on effective strategies for using anti-retrovirals in treating HIV epidemics shows that determining the optimal use of such drugs is extremely complex.<sup>57</sup> The WHO has made

<sup>57</sup> Blower, Sally, Li Ma, Paul Farmer, Serena Koenig (2003), Predicting the Impact of Antiretrovirals in Resource-Poor Settings: Preventing HIV Infections whilst Controlling Drug Resistance, *Current Drug Targets – Infectious Disorders*, 3, 345-353.

significant efforts to summarize the world's response to increasing drug resistance and has highlighted the steps needed to counteract it.<sup>58</sup>

There are two forms of resistance: primary and secondary. Primary resistance occurs when a person is infected with a drug-resistant strain harbored by another individual. Thus, even when antimicrobials are not available in a given community, resistant strains can enter the population through trade and tourism. Secondary resistance develops when an individual's treatment is inadequate to achieve complete cure or suppression of the infectious agent and mutant strains develop that are not susceptible to the previous therapy. New models predict that drug-resistant strains of TB will soon come to dominate the drug-sensitive type.<sup>59</sup> This should alarm policymakers in wealthy and poor countries alike, given the ease of transmissibility of TB and the woeful lack of novel therapeutics to tackle this ancient microbe.

Thus, with international borders becoming ever more porous and the ability to treat infectious disease threats now within reach, it is essential for the international community to provide appropriate and sustainable therapy to those seeking treatment before resistance becomes unmanageable.

The recent emergence of Avian, H5N1 flu on the world scene has drawn renewed attention to epidemics and is an example of the challenges posed by new pathogens. Although flus in birds do not usually infect humans, they can do so on occasion, most likely by contact with infected poultry. The first observed case in humans took place in Hong Kong in 1997. During 2003 and 2004, humans contracted bird flu in Thailand and Vietnam. The death rate of infected people in the most recent set of reported cases is around 70%. If the virus mutates and human-to-human transmission becomes possible, a worldwide avian flu pandemic could occur.<sup>60</sup> Alternatively a trading of genetic material between the avian and human forms of the virus could lead to an epidemic. (Such trading is particularly likely to occur in pigs, which can host both the avian and human forms of the virus. The most virulent form of the avian flu virus, – (A) H5N1 – is particularly adept at obtaining genet-

<sup>58</sup> World Health Organization, 2001, *WHO Global Strategy for Containment of Antimicrobial Resistance*, Geneva. Available at [http://www.who.int/emc/amrpdfs/WHO\\_Global\\_Strategy\\_English.pdf](http://www.who.int/emc/amrpdfs/WHO_Global_Strategy_English.pdf)

<sup>59</sup> Cohen, Ted, and Megan Murray(2004), Modeling epidemics of multi-drug resistant *M. tuberculosis* of heterogeneous fitness, *Nature Medicine*, 10:10, October.

<sup>60</sup> Website of the United States Centers for Disease Control, <http://www.cdc.gov/flu/avian/gen-info/facts.htm>

ic material from other viruses, a process known as ‘reassortment’. Such trading could lead to much easier human-to-human transmission).<sup>61,62</sup> A virus that resembles the one that caused the 1918 flu epidemic could ‘kill 175 to 350 million people’,<sup>63</sup> and some estimates go higher. (On the other hand, these very high estimates do not take into account the possibility that the death rates reported so far may be higher than the actual mortality rate, since people who contracted mild cases may not be included in the data).<sup>64</sup> A recent and careful estimate of the possible human and economic consequences suggests that, in a worst-case scenario, 142 million people could die and global economic losses could reach \$4.4 trillion.<sup>65</sup> In any case, the economic and human consequences of such a pandemic are impossible to predict with any certainty, but the scale of the potential disaster warrants broad and serious international cooperation now. Measures to keep the disease from spreading from animals to humans are essential, as are preparations for containing it should it make further inroads among humans.

### PART 3: CONFRONTING THE CHALLENGES

#### *Epidemic Prevention*

Measures to confront epidemics can take the form of either prevention or treatment. Although it is impossible to prepare fully for diseases that do not yet exist or have been latent for many years, it is feasible to

<sup>61</sup> <http://www.mayoclinic.com/invoke.cfm?id=DS00566>

<sup>62</sup> A detailed explanation of the risks of an avian flu epidemic in humans appears in Ferguson N.M., Fraser C., Donnelly C.A., Ghani A.C., Anderson R.M., Public health risk from the avian H5N1 influenza epidemic, *Science*, 2004 May 14;304(5673):968-9

<sup>63</sup> Fedson, David S. (2005), Preparing for Pandemic Vaccination: An International Policy Agenda for Vaccine Development, *Journal of Public Health Policy*, 26, 429. This article reviews the many steps that will be needed to achieve international cooperation in development and testing of an effective vaccine for avian flu. It also points out the difficulties of ensuring that residents of countries that do not produce the vaccine will have access to it.

<sup>64</sup> Bradsher, Keith, and Lawrence K. Altman (2004), W.H.O. Official Says Deadly Pandemic Is Likely if the Asian Bird Flu Spreads Among People, *New York Times*, 30 Nov., page A12.

<sup>65</sup> Warwick J. McKibbin and Alexandra A. Sidorenko, *Global macroeconomic consequences of pandemic influenza*, Sydney: The Lowy Institute. 2006. Available at [www.lowyinstitute.com/PublicationGet.asp?i=345](http://www.lowyinstitute.com/PublicationGet.asp?i=345)

change behavior and strengthen health systems, sanitation, and people's bodies so that epidemics are both less likely and less damaging.

Similar to the great majority of microbes that affect human beings, many new viruses reaching humans (HIV/AIDS, hantavirus, and avian flu, for example) are thought to have originated in animals. Poor hygienic practices or behavior that brings humans into contact with animals can lead to epidemics. In other instances, a failure to adhere to drug regimens is believed to be at least partially responsible for the emergence of drug-resistant tuberculosis. Modifying human behavior to limit these risks is far from unachievable. The provision of high quality, convenient and *affordable* health services are essential aspects of an effective strategy to increase adherence at the population level. One such example is the successful delivery of antiretrovirals (ARVs) to treat HIV-infected persons in rural Haiti. Through a combination of community health workers, free antiretrovirals (ARVs) to treat HIV/AIDS, and an intensive information campaign, the Haiti project has served as a model for increasing adherence in resource-scarce settings.<sup>66</sup>

Closing the gap between health professionals and communities, so that relationships of trust are established and health messages are thereby more easily transmitted, is also important. A study by the Navrongo Health Research Centre in northern Ghana found that moving nurses into communities and mobilizing community volunteers to help them reduced mortality in an area by 30%. Part of this reduction was due to improved access to treatment, but much was also due to the behavior-related messages disseminated to communities by the nurses. The strategy has since been adopted as part of Ghana's national health care policy. Of course, such dissemination is only useful if the messages are adopted by the community.

Health systems' readiness for epidemics can also be improved. Reliable epidemiological surveillance is critical to identifying new health threats. Southern China's weak surveillance systems meant that the SARS virus had already begun to spread far beyond the original source area before policy-makers knew of its existence. The World Health Organization's global surveillance systems were effective in picking up new cases of the disease once it began to roam the world, but local monitoring capacity is more important if epidemics are to be nipped in the bud. It is in every country's interest for local disease surveillance in other countries to be effective – if your neighbor fails to spot a fledgling epidemic, you may well suffer

<sup>66</sup> Farmer, 2004.

(though not always, since some epidemics die out because of low transmissibility or other reasons). International efforts to improve surveillance are therefore needed, with countries that possess effective systems assisting those that lack them.

In the case of a new epidemic, especially when the transmission mechanism has not yet been identified, the first line of defense is isolation and quarantine. Even these measures, however, need preliminary research to establish the mode of transmission. Many of the most infectious and dangerous diseases are those that spread by airborne transmission. These may require stringent quarantine measures, whose effectiveness varies considerably from one situation to another.

Particularly important for readying health systems to manage epidemics is the focused allocation of resources. Poor countries, as we have seen, are most vulnerable to severe infectious disease outbreaks, and in these resource-constrained settings, it is vital to put epidemic preparedness at the center of health strategies. In societies where epidemics pose the main threat, directing resources towards preventing and coping with them is likely to have a greater impact on a population's health than dealing with chronic diseases or providing expensive surgical operations. Training health workers to respond to infectious diseases, for example, and ensuring immunization programs reach those – often the poor – who are most at risk, may prove a cost-effective approach to health care.<sup>67</sup> Simple, cheap, disease-prevention strategies such as the provision of insecticide-treated bed nets to combat malaria have also been proven to have impacts on health outcomes that go beyond the immediate users.<sup>68</sup> Where funds and human resources are limited, health strategists should not attempt to solve every problem, but should direct their efforts to areas where they can have the greatest effect on health outcomes. In some poor countries, this means epidemic prevention, although in most, endemic diseases will merit the greater share of attention.

<sup>67</sup> Even when some of the population cannot be reached by immunization programs, herd immunity has a positive spillover effect, as many non-immunized people are protected from disease because of those who are immunized.

<sup>68</sup> A study by the Navrongo Health Research Centre found that sleeping under bed nets soaked every six months in insecticides reduces the number of deaths in children below the age of five by 17%. It also found that even those who cannot afford nets may benefit, since the more insecticide-treated bed nets a community has, the fewer mosquitoes it harbors.

Health programs, such as for immunization, are also important for the other main strand of epidemic prevention: strengthening human bodies. Strong bodies are better able to fend off disease and better able to recover if an epidemic – whether old or new – does penetrate their defenses. The effectiveness of immunization programs depends critically on vaccines being available when they are needed – a condition that has not always been met. In the case of flu, for example, where the strains most prevalent in one year typically differ from those of previous years, manufacturing capacity is often not adequate to rapidly produce the required vaccines. Building up such capacity between epidemics is a crucial measure for preventing them. Such an investment in infrastructure (i.e., expanding and ensuring the reliability of the production line) can also be invaluable in containing an epidemic once it has started. For some diseases, however, such as malaria in Africa, the relatively low return on such investment elicits little vaccine supply. In such situations, it may be appropriate for the government to make or subsidize investments in vaccine infrastructure.

Other factors that help to strengthen bodies and thereby prevent epidemics will also likely require government intervention. Improving nutrition and providing a safe water supply are two examples, as is improving sanitation, which is important for depriving microbes of a favorable environment.

### *Treating Epidemics*

Even if all these prevention methods are in place, however, some diseases will slip through the net. The effective global campaign to combat SARS provides several guidelines for those attempting to reverse epidemics that have evaded prevention efforts. The campaign, which was coordinated by the World Health Organization, attempted to disrupt the transmission pattern of the virus via a multi-pronged assault.<sup>69</sup> First, it limited movement of the virus by issuing a global travel warning against travel to and from infected areas. Second, it used the international media as a means of transmitting information about the virus and explaining preventive measures. Third, it mobilized the international scientific community to develop quarantine measures and identify the source of the

<sup>69</sup> Michael Merson (2003), SARS Proved Health is Global Public Good, *Yale Global*, 24 September.

virus – it took just one month to discover that a specific corona virus caused SARS, whereas the discovery that HIV caused AIDS took two years. Fourth, the WHO quickly strengthened its existing global surveillance system by working with immigration departments, airlines, and airports to track the spread of the virus.

The economic impacts of some of these measures offer an interesting lesson for future epidemic containment efforts. As Michael Merson notes, the extensive media coverage of SARS ‘exaggerated public fear, feeding the growing stigma attached to the illness. Chinatowns were deserted, recovering SARS patients were turned down for jobs, and universities made it difficult for Asian students to attend commencement ceremonies. The economic impacts were immense’.<sup>70</sup> Although the travel warning and the use of the media were effective in highlighting awareness of the disease, their economic impact was disproportionate to its spread. Looking backwards, therefore, it may seem that the world overreacted. Nevertheless, when confronted with such situations, looking forward, and essentially always in the absence of complete information, it is difficult to argue that extreme precautionary measures should not be taken.

Modern technology, as the response to SARS showed, has great potential for combating epidemics. The WHO used a worldwide network of 11 laboratories to isolate the virus. The laboratories were connected by a shared website and held several telephone conferences each day. International cooperation to improve health is not new – the smallpox vaccine, developed in England in the late 18th century, was introduced to Latin America soon after by Spanish missionaries<sup>71</sup> – but new communication technologies have dramatically increased its scope. Developing countries now have expanded opportunities to learn from those with greater health care expertise, and international collaboration can more quickly spot emerging epidemics and more quickly mobilize to stifle them.

Mass mobilization is an important tool for reversing epidemics’ spread. In Botswana, where over 100,000 people are in need of antiretroviral drug treatment for AIDS, the government committed to supplying treatment free of charge in January 2002. It has so far, however, been able to reach only a fraction of those in need, as the country lacks the medical staff to distribute the drugs and the stigma of HIV infection dissuades

<sup>70</sup> *Ibid.*

<sup>71</sup> William H. McNeill (1976), *Plagues and Peoples*, Monticello Editions, New York.

people from seeking treatment. In such settings, mobilizing non-medical personnel to provide treatment is likely to be the only way of reaching sufficient numbers of patients. Providing training in drug delivery to community health workers, traditional healers, and other prominent community figures, for example, may be a cost-effective way to deepen the pool of human resources. Many non-governmental organizations, too, have strong links with poor communities that governments struggle to reach, and businesses are often trusted sufficiently by their employees to transmit health messages and, perhaps, treatment.

Members of society should also be enlisted in the effort. Malcolm Gladwell, in *The Tipping Point*, writes of the role of 'connectors' in spreading social epidemics.<sup>72</sup> Connectors are community members whose large range of contacts puts them in a strong position to spark new trends or change behavior. With epidemics that require behavioral change, and particularly those such as HIV/AIDS whose containment depends on breaking stigma, enlisting connectors may be central to success. The stigma surrounding AIDS means many of its victims die rather than admit publicly to being infected. That stigma can be broken if influential individuals admit their infection and tell others it is nothing to be ashamed of. Nelson Mandela's acknowledgment that his son died of HIV/AIDS is an excellent example of this.

Once a disease has broken through prevention efforts and has become an epidemic, mass mobilization is essential to its containment. An epidemic's sudden, rapid spread is likely to be too much for resource-limited health systems to be able to cope with without wider societal support. As an epidemic crosses borders and becomes a pandemic, the international community is likely to awaken to the threat, but it is in the latter's interests to prevent pandemics emerging by helping vulnerable countries to prepare for and deal quickly with new infectious disease threats. International mobilization was instrumental in limiting the effects of SARS, but had that mobilization occurred while the disease was confined to southern China, its economic effects would have been drastically reduced.

<sup>72</sup> Malcolm Gladwell (2000), *The Tipping Point*, Little, Brown & Company.

### *Conclusion*

'In view of globalization, high productivity is an essential ingredient for competitiveness. [Yet] a number of factors account for the loss of productivity, and one notable factor is the HIV/AIDS pandemic'.

Levy Mwanawas (President of Zambia, March 31, 2004)

The links between epidemics and economics are broadly similar to those between health and wealth in general. Prosperous societies not only have better health; they are also at least somewhat protected against epidemics. Like other health problems, meanwhile, epidemics can hamper economic development and trigger vicious spirals whereby worsening health reduces wealth and diminishes the protection against further health threats. Recent epidemics of HIV/AIDS (and the linked epidemic of TB) and SARS have had strong impacts on the wealth of households, businesses and, in some cases, entire economies.

Epidemics, however, pose different challenges than other health problems. The speed and unpredictability of their spread mean that policymakers have to strike a fine balance between acting swiftly (and without complete information) and guarding against the undue haste that may make matters many times worse. Presenting facts in a clear and measured way and having the patience not to begin drug treatment programs until correct adherence is at least probable, for example, can help contain both the health and economic impacts of an epidemic.

Prevention of epidemics is also often feasible. Strengthening health systems and the populations they protect can help fend off disease outbreaks and limit the impacts of those that do emerge. Having strong quarantine measures ready to be employed to prevent an incipient epidemic, and preparation for the mass mobilization of civil society, business, and community members will both relieve the strain on health services caused by present epidemics and reinforce society's defenses against future outbreaks. However, a central obstacle to preventing epidemics is that spending on anti-epidemic and basic health infrastructure must be seen as an investment, with part of the return being the reduction in the future costs of epidemics. Policymakers are often influenced by short-term political considerations, causing them to pay too little heed to important longer-term realities.

International cooperation is also vital for preventing and containing epidemics. Epidemics can have economic impacts far beyond the borders of their source countries – and these potential economic impacts are

often amplified by those aspects of the modern world that facilitate disease spread, affect tourism and trade, disseminate awareness and fear, and exacerbate counter-productive forms of protective behavior and isolationism. Indeed, both the health and economic consequences of epidemics suggest the value of the international community shoring up the health systems of poor countries to strengthen their capacities to prevent and to respond to epidemics.<sup>73</sup> This, combined with their effects on health, makes combating epidemics a global public good. Globalization can facilitate the spread of new diseases, but it also offers opportunities for tackling them. International collaboration in epidemiological surveillance, scientific investigation, and public health and medical efforts to tackle and treat disease has already proved effective in tackling diseases such as SARS. It is likely to become increasingly important as new epidemics emerge and old ones reemerge.

<sup>73</sup> The Global Fund to Fight AIDS, *Tuberculosis and Malaria* might serve as a starting point for such an effort. See <http://www.theglobalfund.org/en/>