**8. Health**
**How can the threat of new and reemerging diseases and immune microorganisms be reduced?**

For the first time in 40 years, WHO declared a pandemic. The H1N1 influenza (swine flu) rapidly infected thousands of people in 74 countries, resulted in 145 deaths as of mid-June 2009, and is expected to last for one or two years. Although it has a very low mortality rate, it could mutate to become more lethal like the H5N1 avian flu virus, which killed about half of those infected. Tuberculosis, malaria, and AIDS together cause over 300 million illnesses and more than 5 million deaths each year, while Hepatitis B infects up to 2 billion people globally. Although the small numbers of people with Ebola and West Nile viruses have garnered media attention, the bigger impacts are from schistosomiasis (200 million cases), dengue fever (50 million new cases a year), measles (30 million cases a year), onchocerciasis (18 million cases in Africa), typhoid and leishmaniasis (approximately 12 million each globally), rotavirus (600,000 child deaths per year), and shigella childhood diarrhea (600,000 deaths per year).

Infectious diseases are the second leading cause of death worldwide, killing about 17 million people a year, of whom 9 million are young children. About half of the world's population is at risk of several endemic diseases. The leading causes of deaths among children under five are pneumonia, diarrhea, malaria, and measles. Over the past 40 years, 39 new infectious diseases have been discovered. In the last five years, more than 1,100 epidemics have been verified, and we face 20 drug-resistant “superbugs,” including deadly skin infections (MRSA) and food poisoning, that are increasingly difficult to counter. About 75% of emerging pathogens are zoonotic (they jump species). Old diseases have reappeared, such as cholera, yellow fever, plague, dengue fever, meningitis, hemorrhagic fever, and diphtheria, and new strains have developed, such as the H1N1 flu virus. Massive urbanization, increased encroachment on animal territory, and concentrated livestock production could trigger new pandemics. Climate change is altering insect and disease patterns. Other problems may come from synthetic biology laboratories.

Although 25% of all deaths are caused by infectious diseases; for the first time in history non-communicable chronic conditions such as cardiovascular disease (the leading cause of death worldwide), cancer (second leading cause of death), heart disease, and stroke now kill more people even in developing countries than infectious diseases. It is expected that by 2030 non-communicable diseases will account for 70% of all deaths globally. Some 80% of this year's 35 million chronic disease-related deaths will occur in low- and middle-income countries.

AIDS is the third leading cause of death but the leading cause by an infectious disease. TB is the leading cause of death among those with HIV/AIDS. Improvements in the methodology for analyzing available data have permitted adjustments of estimates of people who are living with HIV from 34.1–47.1 million in 2006 to 30.6–36.1 million in 2007. Yet data from some reports indicate that the dissemination of the infection is not declining and may peak by 2012 at over 2 million per year and then start steadily declining. Estimated deaths from AIDS dropped from almost 3 million in 2006 to around 2 million in 2007. This reflects the increased access to treatment by about one-third of those who need it.

Two broad patterns in HIV/AIDS are emerging: generalized epidemics in sub-Saharan Africa and more local epidemics in the rest of the world concentrated among populations at risk—men who have sex with men, injecting drug users, and sex workers and their sexual partners. There are also increases among heterosexual women. Young girls and women are more vulnerable to HIV infection than young men are, and two-thirds of the 5.5 million 15- to 24-year-olds with HIV worldwide are women. The Clinton Foundation continues to reduce costs of second-line drugs in some areas to $100/year and the daily regimens to $1/day. No significant positive vaccine results are yet available, but new genetic-based vaccines are undergoing trials, and pre-exposure treatment and radioactive anti-HIV antibodies show promise in animal models. Male circumcision may reduce infection by 50%.

To counter bioterrorism, R&D has increased for improved bio-sensors and general vaccines able to boost the immune system to contain any deadly infection. Such vaccines could be placed around the world like fire extinguishers. Some small viruses have been found to attack large viruses, offering the possibility of a new route to disease cures. The global shortage of 4.3 million health workers is growing. People are living longer and health care costs are increasing, making tele-medicine and self-diagnosis via biochip sensors and online expert systems increasingly necessary. In the meantime, the best ways to address infectious diseases remain early detection, accurate reporting, prompt isolation, transparency of information, increased investment in clean drinking water, sanitation, and handwashing.

If Asian poultry farmers received incentives to replace their live-market businesses—the source of some viruses—with frozen-products markets, the annual loss of life and economic impacts could be reduced. WHO’s eHealth systems, International Health Regulations to address SARS-like threats, immunization programs, and the Global Outbreak Alert and Response Network are global responses to this challenge. Scientists are working to develop a genetically modified mosquito that would not carry the malaria parasite. Better trade security will be necessary to prevent increased food- or animal-borne disease. Viral incidence in animals is being mapped in Africa, China, and South Asia to divert epidemics before they reach humans. Future uses of genetic data, software, and nanotechnology will detect and treat disease at the genetic or molecular level.

**Regional Considerations**

**Africa:** The region has only 11% of the world’s population but 25% of its disease burden, with only 3% of world health workers and 1% of world health expenditures. Sub-Saharan Africa accounted for 66% of all people living with HIV and for 75% of deaths from it worldwide in 2007. Although the prevalence and incidence of HIV/AIDS continues to fall in Africa, death rates are high enough among professionals to slow African development. Patients on antiretroviral treatment increased from 1–2% in 2003 to 30–37% by the end of 2007. Polio outbreaks from northern Nigeria and Sudan continue to elude international calls for eradication.

**Asia and Oceania:** Asia is an epicenter of emerging epidemics. Avian flu outbreaks were reported in China, Vietnam, and Indonesia during 2009; and there were 395 cases of H1N1 flu throughout the region. Although total statistics for the region may not be reliable, at least 5 million people have HIV/AIDS and, with increases in India and China, this could reach 10 million in several years. About 75 million Asian men engage in commercial sex with 10 million women. Southeast Asia has the highest rate of new TB cases in the world, with 5 million new cases annually. Promotion of children’s hand washing in Karachi, Pakistan, decreased impetigo by 34%, diarrhea by 53%, and pneumonia by 50%.

**Europe:** The burden of disease in Europe is generally non-communicable, mostly heart disease and cancers. However, TB deaths have been increasing after a 40-year decline, and HIV infection remains a serious public health problem. Sex between men and heterosexual contact are the predominant modes of HIV transmission in EU/European Free Trade Association. Yet in Western and Central Europe, heterosexual sex is the predominant mode of transmission (about 42%), and IV drug use accounts for 83% of the spread of HIV in Eastern Europe. The prevalence of HIV in Western and Central Europe has stabilized at around 0.3%, while it is still increasing in Russia, with 0.6% of the population infected.

**Latin America:** Latin America has the highest life expectancy among developing regions (75.5 years in 2008). Neglected tropical diseases affect 200 million people in Latin America (intestinal worms, Chagas, schistosomiasis, trachoma, dengue fever, leishmaniasis, lymphatic filariasis, and onchocerciasis). The HIV epidemic remains stable with about 2 million people with HIV. Although Brazil has offered free antiretroviral treatment to citizens since 1996, halving AIDS mortality rates between 1996 and 2002, the nation still accounts for more than 40% of people infected with HIV in the region.

**North America:** Genetics-based and molecular research in North America will affect prevention, diagnosis, and treatment of a large number of diseases. The leading causes of death are heart disease and cancer. New HIV infections remain stable, and antiretroviral medications keep AIDS death rates low (1.2 million have HIV in the U.S.; 73,000 in Canada). Unprotected sex between men is the most common mode of HIV transmission in North America. Increased food and worldwide mobility raise vulnerability to new infections from overseas.