Chapter Two

FACTORS ASSOCIATED WITH THE INCREASED INCIDENCE AND SPREAD OF INFECTIOUS DISEASES

The bubonic plague that swept across Europe during the Middle Ages, the smallpox that was carried to the Americas by the Spanish, and the influenza outbreak of 1918 all bear testimony to the historic relevance of infectious pathogens and their ability to cause widespread death and suffering. In many ways, however, the nature and magnitude of the threat posed by infectious pathogens are greater today than they have ever been in the past, developments in modern science notwithstanding. Emerging and reemerging infections present daily challenges to existing medical capabilities. Not only have deadly and previously unimagined illnesses, such as AIDS, Ebola, Creutzfeldt-Jakob disease, and Legionnaires' disease, emerged in recent years, but established diseases that just a few decades ago were thought to have been tamed are also returning, many in virulent, drug-resistant varieties.[1] Modern manifestations of TB, for instance, bear little resemblance to the 19th-century strains that haunted Europe. TB treatment now requires a daily drug regimen that often requires health workers to personally monitor patients to ensure that they are complying with necessary procedures.[2]

In many ways, this situation is a result of the natural balance of forces between people and infectious organisms. By one estimate, there are at least 5,000 kinds of viruses and more than 300,000 species of bacteria that challenge human beings, many of which are

---

[1]George Armelagos, "The Viral Superhighway," p. 24.

[2]See, for instance, Mark Earnest and John Sbarbaro, "A Plague Returns," *The Sciences,* Vol. 33, No. 5, September/October 1993, pp. 17–18.

able to replicate and evolve billions of times in one human generation.[3] These disparities clearly work to the advantage of pathogens, enabling the evolution of ever more virulent strains that quickly outstrip the ability of humans to respond to them. Just as important, however, are "artificial" disease force-multipliers, which are serving to greatly exacerbate the incidence and spread of infectious microbes. Foremost among these are globalization, modern medical practices, accelerating urbanization, climatic change resulting from global warming, and changing social and behavioral patterns. Each of these factors and its interaction with the spread of disease are discussed below.

GLOBALIZATION

The present international system is now more globally interdependent than at any other time in history. Today one can physically move from one part of the world to another in the same time (if not more rapidly than) it used to take to journey between cities or counties. Indeed, no part of the planet remains inaccessible to human penetration, with current estimates of the number of people crossing international frontiers on board commercial flights at more than 500 million every year.[4]

Thanks to developments in transportation technology, this movement has become progressively more rapid and affordable, meaning that fewer people are restricted to localized business, employment, and leisure activities. At the same time, differentials in labor, production, and operating costs, as well as comparative advantages in resource allocations, have led to an increasingly vibrant and active global economic system, characterized by the largely unimpeded flow of goods and commodity-related services.[5]

Whether measured on the basis of information flows, the total volume of world trade and commerce, contact between governments, or

---

[3]Armelagos, "The Viral Superhighway," p. 25.

[4]Derek Yach, "The Globalization of Public Health I," p. 737.

[5]Chemical and Biological Arms Control Institute and the CSIS International Security Program, *Contagion and Conflict; Health as a Global Security Challenge,* Washington D.C.: CSIS, January 2000, p. 3.

links between people, the figures all show major increases, especially over the last 20 years.[6] While it is not necessary to spell out these developments in terms of specific statistics—the trends are both clear and well known—the consequences for the spread and emergence of infectious diseases do require some elucidation.

On one level, the global trade in agricultural products has increasingly brought people into contact with exotic and foreign animal diseases that have subsequently "jumped" across the species line to infect humans. Several examples stand out. In September 2000 a major outbreak of Rift Valley fever hit Saudi Arabia, killing several dozen people in a matter of days. The source of the epidemic was eventually traced back to imports of infected sheep from neighboring Yemen.[7] In Europe, the emergence of the nervous system disorder Creutzfeldt-Jakob disease has been linked to the consumption of beef products originally derived from British cattle afflicted with *bovine spongiform encephalopathy,* or "Mad Cow Disease." And in the United States, the outbreak of West Nile virus in 2000 is now believed to have originated at least partly from the importation of chickens into New York.[8]

On a more direct level, the speed of modern air transportation has greatly facilitated the global transmission of disease among humans. Travelers experiencing either fully developed or incubating endemic or emerging diseases from their departure location can rapidly carry microbes into nonendemic areas. In the United Kingdom and the United States, for instance, there have been numerous cases of people living near major metropolitan airports contracting malaria apparently imported aboard jets operating transcontinental routes.[9] Equally as indicative is typhoid fever. Roughly 400 cases of the disease are reported every year in America, 70 percent of which are

---

[6]Chalk, *Non-Military Security and Global Order,* p. 6.

[7]See, for instance, "Fever Kills 200 in Saudi Arabia and Yemen," Reuters, September 24, 2000, and "Sheep Smuggled from Yemen Responsible for Jizan Outbreak," *Arab News,* September 24, 2000.

[8]Comments made during the International Conference on Emerging Infectious Diseases (ICIED), Atlanta, July 16–19, 2000.

[9]Joseph Smith, "The Threat of New Infectious Diseases," *Journal of the Royal Society of Medicine,* Vol. 86, 1993, p. 376; A. Kondrachine and P. Trigg, "Global Overview of Malaria," *Indian Journal of Medical Research,* Vol. 106, 1997, pp. 39–53.

acquired by individuals while traveling overseas.[10] Outbreaks of Legionnaires' disease have been similarly linked to such dynamics. As Laurie Garrett observes:

> In the age of jet travel, a person incubating a disease such as Ebola can board a plane, travel 12,000 miles, pass unnoticed through customs and immigration, take a domestic carrier to a remote destination, and still not develop symptoms for several days, infecting many other people before his [or her] condition is noticeable.[11]

Compounding the problem is the fact that overcrowded, poorly ventilated, and (sometimes) unsanitary aircraft constitute ideal environments for the transmission of viruses and bacteria, particularly on long flights. Reflecting this, travel health guidelines issued by the World Health Organization (WHO) now specifically refer to the possibility of catching infectious TB in flight as "realistic," especially on flights of more than eight hours. The WHO has recorded several instances in which individuals flying on planes with other TB-infected travelers have been infected with the bacterium that causes the lung infection.[12]

One disease that has certainly reached pandemic proportions at least partly as a result of globalization and the international movement of goods and people is AIDS. Studies in Africa have tracked the progress of the causative HIV agent along trucking routes, with major roads acting as principal corridors of viral spread between urban areas and other proximal settlements. In one study of 68 truck drivers and their assistants, 35 percent were found to be HIV-positive. Further epidemiological research revealed a wide travel history for these individuals, involving seven different countries served by the ports of Mombassa, including Kenya, Uganda, Zaire, Burundi, and Rwanda. Tourism, especially tourism involving sex, has also played a contributing role. There can be little doubt that the global spread of AIDS has been encouraged by the substantial

---

[10]See "Disease Information: Typhoid Fever," available at http://www.cdc.gov/ncidod/dbmd/diseaseinfo/typhoidfever_g.htm.

[11]Garrett, "The Return of Infectious Disease," p. 69.

[12]Smith, "The Threat of New Infectious Diseases," p. 376; "WHO Cites Air Travel Risk," Associated Press, December 18, 1998.

patronage of the Asian sex markets and by the equally large number of international travelers visiting such countries as Thailand, India, and the Philippines every year.[13]

MODERN MEDICAL PRACTICES

During the 1960s and 1970s, there was a great deal of hope that humankind had tackled some of its worst infectious diseases through medical advances. This sense of confidence culminated in 1978 when the member states of the United Nations (UN) signed the Health for All, 2000, agreement. The accord set out ambitious goals for responding to infectious diseases among other things, predicting that at least some of the world's poorest and least developed states would undergo a fundamental (positive) health transition before the end of the century.[14]

The optimism inherent in the UN declaration rested on the belief that advances in antibiotics, vaccines, and other remedial treatments—together with striking improvements in food preparation and water treatment—had provided the world's polities with a formidable armory that could be brought to bear against microbial agents. Indeed, just the year before, the WHO had announced the effective eradication of the smallpox virus after the last known case of smallpox had been tracked down and cured in Ethiopia.[15]

While scientific progress has certainly helped to mitigate the effects of certain infectious ailments, overuse and misuse of antibiotics—both in humans and in the agricultural produce they consume—has contributed to a process of "pathogenic natural selection," which is helping to generate ever more resilient, resistant, and powerful dis-

---

[13]Thomas Quinn, "The AIDS Epidemic: Demographic Aspects, Population Biology and Virus Evolution," in Richard Krause, ed., *Emerging Infections,* New York: Academic Press, 1998, p. 331; Thomas Quinn, "Population Migration and the Spread of Types I and 2 Human Immunodeficiency Viruses," in Bernard Roizman, ed., *Infectious Diseases in an Age of Change,* Washington, D.C.: National Academy Press, 1995, p. 81; FitzSimons and Whiteside, "Conflict, War and Public Health," p. 24.

[14]Garrett, "The Return of Infectious Disease," pp. 66–67. See also CDC, "Preventing Emerging Infectious Diseases: A Strategy for the 21st Century," Atlanta: CDC, October 1998, p. 3.

[15]Eradication was not certified officially by the WHO until 1980. Ibid., p. 67.

ease strains. Much of this evolution stems from the rapidity with which microbes are able to adapt and replicate plasmid in their DNA and RNA codes, the genetic dynamic of which commands mutation under stress. Individuals who fail to complete prescribed treatment courses further aggravate the problem by allowing a residual, more resistant viral or bacterial base to survive and flourish.[16]

The result has been the systematic emergence of microbial "super genes" that either offer resistance to several families of antibiotics (or dozens of individual drugs) at any one time or confer greater powers of infectivity and virulence.[17] Very much indicative of this was the emergence of a previously unknown and highly potent derivative of the *Staphylococcus aureus* bacteria in the late 1990s. The microbe has proven so resistant that it is able to survive exposure to vancomycin—a so-called "silver bullet" drug that is typically used to treat infections when all other recourses fail. It is believed that part of the reason for the emergence of the enhanced *aurea* strain was an overwillingness to prescribe antibiotics for routine illnesses that could have been cured by the natural workings of immune systems.[18]

Unfortunately, multiple antibiotic resistance and/or increased virulence and tolerance are developing in some of the most prevalent and lethal diseases of our time. As noted in Chapter One, strains of *Mycobacterium tuberculosis*, the organism that causes TB, that are resistant to more than one medication have already appeared and are becoming increasingly prevalent not just in the developing world but also in "medically advanced" nations such as the United States (see Chapter Three). Highly resilient varieties of cholera, pneumo-

---

[16]Garrett, "The Return of Infectious Disease," p. 67; "The Global Infectious Disease Threat and Its Implications for the United States," *Foreign Affairs,* Vol. 75, No. 1, January/February 1996, p. 23; "Wonder Drugs at Risk," *Washington Post*, April 19, 2001, p. A19.

[17]Garrett, "The Return of Infectious Disease," p. 67. Microbes have appeared, for instance, that can grow on a bar of soap, swim in bleach, ignore exposure to higher temperatures, and survive doses of penicillin logarithmically larger than those effective in 1950.

[18]See, for instance, T. L. Smith et al., "Emergence of Vancomycin Resistance in *Staphylococcus aureus*," *New England Journal of Medicine,* Vol. 340, 1999, pp. 493–501; "Antibiotic Resistant Germ Kills Woman, Hong Kong Officials Say," CNN Interactive World Wide News, February 22, 1999. See also CDC, *Preventing Emerging Infectious Diseases,* p. 1.

nia, malaria, dysentery, and typhoid have also emerged and are now prevalent in varying degrees throughout the Asia-Pacific region, Europe, and Africa (see Table 2.1). Influenza, in particular, has exhibited a remarkable ability to change genetically. The phenomenon, termed "antigenic drift," occurs nearly every year and makes it extremely difficult for the body to mount defenses because antibodies against one type of influenza confer little or no immunity against other types or subtypes.[19] "Antigenic shift," which is a more dramatic genetic change, may leave a large proportion of the world's population without protective immunity, which could result in a pandemic if the genetically evolved influenza is easily transmitted between people.[20] Indeed, the Centers for Disease Control and Prevention (CDC) expects that a new, deadly strain of the virus may strike sometime within the next ten years, quite possibly on the same scale as the 1918 outbreak (which killed 21 million people in a matter of months).[21]

Modern medical science and/or associated practices are helping to heighten human vulnerability to viral and bacterial pathogens in other ways. Invasive treatment procedures are exposing people to hospital-acquired infections, including the *S. aureus* bacterium noted above. This is particularly true in the developing world, where typically only the sickest—and, therefore, the most vulnerable—are hospitalized. The use of contaminated blood to make clotting agents and antibody plasma proteins such as gamma globulin has similarly exposed patients to highly debilitating diseases such as AIDS and

---

[19]NIC, "The Global Infectious Disease Threat and Its Implications for the United States," p. 23.

[20]Thomson American Healthcare Consultants, "Guidelines for Prevention and Control of Pandemic Influenza in Healthcare Institutions," March 23, 2000, available at http://www.ahcpub.com/ahc_root_html/hot/breakingnews/flu03232000.html, accessed March 16, 2002.

[21]Comments made by Scott Lillibridge during the Biological and Chemical Preparedness: The New Challenge for Public Health meeting, Decatur, July 19–20, 2000. See also Armelagos, "The Viral Superhighway," p. 24, and Chow, "Health and International Security," p. 63.

Table 2.1

Examples of Drug-Resistant Infectious Agents and Percentage of Infections That Are Drug Resistant, by Country or Region

Pathogen	Drug	Country/Region	Percentage of Drug-Resistant Infections
Streptococcus pneumonia	Penicillin	United States	10 to 35
		Asia, Chile, Spain	20
		Hungary	58
Staphylococcus aureus	Methicillin	United States	32
	Multidrug	Japan	60
Mycobacterium tuberculosis	Any Drug	United States	13
	Any Drug	New York City	16
	Any Drug	Eastern Europe	20
Plasmodium falciparum (malaria)	Chloroquine	Kenya	65
	Mefloquine	Ghana	45
		Zimbabwe	59
		Burkino Faso	17
		Thailand	45
Shigella dysenteriae	Multidrug	Burundi, Rwanda	100

SOURCES: U.S. Institute of Medicine, 1997; WHO, 1999. Reproduced in NIC, *The Global Infectious Disease Threat and Its Implications for the United States,* p. 23.

hepatitis C—a problem becoming especially prevalent in China, where there exists a thriving illegal trade in blood.[22]

Just as serious are the nature and direction of contemporary medical research, which is exhibiting an increased predilection toward the wholesale eradication (rather than control) of microbial organisms. Significantly, much of this exploratory work is proceeding in the absence of a definitive understanding of the etiology of diseases and the environmental contexts in which they exist. As Joshua Lederberg, a Nobel prize–winning biologist, points out, this is liable to prove a highly costly (and misplaced) "war of attrition" in that it will probably merely upset the delicate ecological balance between

[22]See, for instance, Elisabeth Rosenthal, "In Rural China, a Steep Price for Poverty: Dying of AIDS" *New York Times,* October 28, 2000, p. A1; "Out in the Open," *Newsweek,* December 4, 2000; and Elisabeth Rosenthal, "With Ignorance as the Fuel, AIDS Speeds Across China," *New York Times,* December 30, 2001, p. A1.

microbes and their human hosts and, in so doing, exacerbate overall individual vulnerability to pathogenic infections and mutations.[23]

Further, improved medical practices have extended the lives of many ill people whose immune systems are less capable of combating microorganisms. An increasing number of individuals in the United States and elsewhere are living with HIV/AIDS infection, cancer, transplanted organs, and aged immune systems. The presence of these people raises the likelihood that opportunistic pathogens will take hold.

ACCELERATING URBANIZATION

At the turn of the 20th century, only 5 percent of the globe's inhabitants lived in cities with populations over 100,000. By the mid-1990s, more than 2.5 billion people resided in metropolitan centers.[24] Most of this urban growth has taken place in the poorer parts of the world. In 1950, for instance, roughly 18 percent of the population of developing states lived in cities. By 2000, the number had jumped to 40 percent, and by 2030 it is expected to reach 56 percent. Several of these conglomerations will have populations in excess of ten million inhabitants. Indeed, according to the UN, 24 so-called "megacities" have already surpassed this demographic threshold, including Jakarta, Calcutta, Lagos, Karachi, and Mexico City.[25]

The reasons for the high rate of rural-urban migration throughout the developing world are complex and varied. However, they typically incorporate factors such as drought, flooding, and other natural disasters; an excess of agricultural labor; sociopolitical unrest generated by civil war; a lack of employment opportunities; and rural banditry. Fleeing these types of conditions (or variations of them), millions of dispossessed workers have moved to squalid shantytowns on the outskirts of major third-world cities, swelling urban popula-

---

[23]Comments made by Joshua Lederberg during the ICEID, Atlanta, July 16–19, 2000.

[24] Eugene Linden, "The Exploding Cities of the Developing World," *Foreign Affairs,* Vol. 75, No. 1, January/February 1996, p. 53.

[25]These figures come from the UN's Population Division and are based on 2000 estimates. Data in Eric Pianin, "Around Globe, Cities Have Growing Pains," *Washington Post*, June 11, 2001, p. A9.

tions and overloading already inadequate water, sanitary, medical, food, housing, and other vital infrastructural services. These expanding metropolitan hubs are proving to be excellent breeding grounds for the growth and spread of infectious bioorganisms.[26] According to one study, a lack of clean water, sanitation, and hygiene alone account for an estimated 7 percent of all disease-related deaths that occur globally.[27]

Asia in particular has been severely hit by the negative interaction between unsustainable city growth and disease spread. The region's urban population is currently estimated to be 1.1 billion. By 2025, it is expected to have risen to 3.8 billion and Asia will contain half the world's people—more than half of whom will live in cities. Nine of the aforementioned "megacities" already exist in the region, including Beijing, Calcutta, Jakarta, Mumbai (formerly Bombay), Osaka, Shanghai, Tianjin, and Tokyo.[28]

Many of these cities lack the basic infrastructure funding necessary to provide proper roads, sewers, housing, and sanitation systems—all essential if economic productivity and a minimal standard of living are to be sustained. According to the Asian Development Bank, 13 of the world's 15 most polluted cities are in the Asia-Pacific region, some rivers of which are thought to carry up to three to four times average world levels of fecal pollutants.[29] The infectious consequences of these developments are inevitable, with widespread outbreaks of typhoid, malaria, dengue fever, dysentery, and cholera a common occurrence. As Eugene Linden observes:

> Advances in sanitation and the discovery of antibiotics have given humanity a respite from the ravages of infectious disease. But many

---

[26]Last, *Public Health and Human Ecology,* pp. 347–348; Armelagos, "The Viral Superhighway," p. 28; Garrett, "The Return of Infectious Disease," p. 71.

[27]The results of the *World Resources 1998–1999: A Study on the Global Environment* study were reported in "Polluted Environment Causing Worldwide Illness and Deaths," *Manila Times* (Philippines), May 24, 1998. The study used scientific data to explore the relationship between environment and death and disease around the world.

[28]Figures are from the Asian Development Bank as cited in "Rise of the Megacity," *The Australian,* April 24, 1997. See also "Chinese City Portrays Good and Bad of Rapid Growth," *Bangkok Post,* October 12, 1997.

[29]"Cleaning Up in Asia," *The Australian,* May 19, 1997.

> epidemiologists [now] fear that this period is drawing to a close as urban growth outruns the installation of sanitation in the developing world and resilient microbes discover opportunities in the stressed immune systems of the urban poor.[30]

Unsustainable urbanization can affect the spread of disease in other ways. Rapid intrusion into new habitats has disturbed previously untouched life forms and brought humans into contact with pathogens and contaminants for which they have little, if any, tolerance.[31] Mushrooming cities in the developing world are also helping to transform oceans into breeding grounds for microorganisms. Epidemiologists have warned, for instance, that toxic algal blooms, fed by sewage, fertilizers, and other industrial and human contaminants from coastal metropolises in Asia, Africa, and Latin America contain countless viruses and bacteria. Mixed together in what amounts to a dirty "genetic soup," these pathogens can undergo countless changes, mutating into new, highly virulent antibiotic strains that can be quickly diffused by nautical traffic. The devastating cholera epidemic that broke out in Latin America in 1991, for instance, occurred after a ship from Asia unloaded contaminated ballast water into the harbor of Callao, Peru. The epidemic, which originated from a resistant strain of the El Tor serogroup, subsequently spread to neighboring countries, infecting more than 320,000 people and killing 2,600.[32]

ENVIRONMENTAL FACTORS

Over the past century, humanity has dramatically affected the global biosphere in deep and complex ways. One important effect of such actions has been a gradual increase in the earth's average surface temperature, a change that many scientists now believe has the potential to actively contribute to the transnational spread of disease. According to two 2001 UN studies by the Intergovernmental

---

[30]Linden, "The Exploding Cities of the Developing World," p. 56.

[31]Armelagos, "The Viral Superhighway," p. 28. This occurred during the early colonization of the United States as well as in Europe at the height of the Industrial Revolution.

[32]Armelagos, "The Viral Superhighway," p. 28; Linden, "The Exploding Cities of the Developing World," p. 57.

Panel on Climate Change, the earth's temperature could rise between 1.4 and 5.8 degrees Celsius over the 1990 average surface temperature during the next century.[33]

Global warming could expose millions of people for the first time to malaria, sleeping sickness, dengue fever, yellow fever, and other insect-borne illnesses. In the United States, for instance, a slight increase in overall temperature would allow the mosquitoes that carry dengue fever to survive as far north as New York City. Also, the insects that carry the *Plasmodium falciparum* parasite, which causes malaria, thrive in the warm climates of the tropics. Increased temperatures in more temperate areas could, conceivably, provide a habitat suitable for the increased distribution of these anopheline vectors.[34]

Of particular concern are the studies that show an association between climatic events and outbreaks of diseases that have already occurred in several parts of the world. Instances of malaria in Madagascar, India, Ethiopia, and Peru have been attributed to sudden increases in mosquito densities resulting from higher rainfall patterns in arid and semiarid regions.[35] Epidemics of cholera, typhoid, and dengue fever in Venezuela, Peru, and Bangladesh and plague in

---

[33]See C. D. Harvell et al., "Climate Warming and Disease Risks for Terrestrial and Marine Biota," *Science,* June 21, 2002, pp. 2158–2162; L. Cifuentes et al., "Hidden Health Benefits of Greenhouse Gas Mitigation," *Science,* August 17, 2001, Vol. 293, pp. 1257–1259; J. T. Houghton et al., eds., *IPCC Third Assessment Report: Climate Change 2001—The Scientific Basis*; and James McCarthy et al., eds., *IPCC Third Assessment Report: Climate Change 2001—Impacts, Adaptation, and Vulnerability.* Both reports are available on-line at http://www.ipcc.ch/pub/reports.htm. See also Eric Pianin, "U.N. Report Forecasts Crises Brought on by Global Warming," *Washington Post*, February 20, 2001, p. A6; Eric Pianin, "Two Studies Affirm Greenhouse Gases' Effects," *Washington Post*, April 13, 2001, p. A6; and Philip P. Pan, "Scientists Issue Dire Prediction on Warming," *Washington Post*, January 23, 2001, p. A1.

[34]Armelagos, "The Viral Superhighway," p. 28; Smith, "The Threat of New Infectious Diseases," p. 376; "Changing Climate," *The Australian*, July 15, 1996.

[35]See, for instance, NIC, "The Global Infectious Disease Threat and Its Implications for the United States," p. 24; A. Kondrachine, "Mission Report on Malaria Epidemics in Rajasthan," unpublished WHO report, 1996; A. Kondrachine, "Malaria in Peru," unpublished WHO report, 1997; J. Lepers et al., "Transmission and Epidemiology of Newly Transmitted Falciparum Malaria in the Central Highland Plateau of Madagascar," *Annals of Tropical Medicine,* Vol. 85, 1991, pp. 297–304; and A. Teklehaimanot, "Travel Report to Ethiopia," unpublished WHO report, 1991.

India have similarly been linked to major shifts in vector and infectious agent distributions caused by altered weather patterns.[36]

Global warming and climatic change may also influence the spread of disease by potentially increasing the incidence and magnitude of natural disasters such as landslides, storms, hurricanes, and flooding. Just as in war and conflict, these events invariably lead to the destruction/disruption of vital communication, health, and sanitation infrastructure as well as the displacement of people into overcrowded, makeshift shelters and camps. Such consequences are likely to have direct adverse effects on public health, transforming a disaster area into a potential "epidemiological time bomb."[37]

Hurricane Mitch, which struck Honduras, Nicaragua, Guatemala, and El Salvador in 1998, while not a result of climate change, clearly demonstrated that natural disasters can increase the incidence of infectious illnesses in a population. The desolate landscapes left in the wake of the storm quickly degenerated into disease-ridden slums with children swimming in rivers contaminated by putrefying bodies and flood debris and famished survivors eating animals that had fed on rotting flesh. Cholera and other enteric diseases became especially endemic, their spread facilitated by the lack of clean drinking water, appalling sanitary conditions, and overcrowded shelters. Compounding the problems were impassable roads, wrecked bridges, and poor communications, making the provision of aid and essential medical relief supplies virtually impossible. The catastrophe is one of the worst natural disasters to have hit Central America in 200 years.[38]

---

[36]Karen Day, "Malaria: A Global Threat," in Richard Krause, ed., *Emerging Infections,* New York: Academic Press, 1998, p. 485; "Changing Climate," *The Australian*; "Raining Misery: Millions Marooned in Bangladesh," *Sydney Morning Herald*, September 19, 1998; "A Needy Nation Struggles with Disaster," *Sydney Morning Herald*, September 19, 1998.

[37]See, for instance CSIS, *Contagion and Conflict,* p. 21–22; Logue, "Disasters, the Environment, and Public Health," pp. 1207–1210; Gregg, ed., *The Public Health Consequences of Disasters*; Lechat, "The Epidemiology of Health Effects of Disasters," pp. 192–198; A. McMichael, "Global Environmental Change and Human Population Health: A Conceptual and Scientific Challenge for Epidemiology," *International Journal of Epidemiology,* Vol. 22, 1993, pp. 1–8; and Epstein, "Emerging Diseases and Ecosystem Instability," pp. 168–172.

[38]"Disease Threatens Survivors," *The Australian*, November 9, 1998; "They Survived Mitch—To Live in Misery," *Sunday Times* (Singapore), November 15, 1998.

CHANGES IN SOCIAL AND BEHAVIORAL PATTERNS

Changes in human social and behavioral patterns have had a profound impact on the spread of infectious illnesses. HIV/AIDS represents a case in point. Although the precise ancestry of HIV is uncertain, early transmission of the disease was undoubtedly facilitated by greater acceptance of multiple sexual partners and permissive homosexuality, particularly in nations such as the United States. Today, almost 1.4 million people are living with HIV throughout North America and Western Europe, with some cities, such as New York, among the places in the world where the disease is most prevalent.[39] While the rate of new infections in the developed world slowed during the 1990s (especially in the United States)—largely because of the initiation of effective sex education campaigns and the availability of effective antiretroviral drugs[40]—the disease continues to decimate Africa and South/Southeast Asia (see Table 2.2). Sub-Saharan Africa has been particularly badly affected, where a staggering 21.8 million people have died since the disease was first diagnosed in the early 1980s. Overall, the subcontinent accounts for roughly 70 percent of the world's AIDS cases and three-quarters of its AIDS-related deaths.[41]

In Thailand, Cambodia, and India, thriving sex industries have served to compound already serious problems stemming from greater sexual promiscuity. More than 100,000 cases of AIDS were reported in Thailand between 1994 and 1998. Although an intensive campaign initiated by the government has helped to slow the overall rate of new infections in major centers such as Bangkok, the disease remains a serious problem in northern cities such as Chiang Rai, where roughly 40 percent of female prostitutes are thought to be HIV

---

[39]Whiteside and FitzSimons, "The AIDS Epidemic," p. 7; "Young Bear the Brunt as AIDS Spreads Through the World on a Biblical Scale," *The Independent*, November 25, 1998; Garrett, "The Return of Infectious Disease," p. 72.

[40]It should be noted that the increased availability of effective antiretroviral drugs has, to a certain extent, negatively affected unprotected sex awareness, particularly among young women and men, who are once again beginning to engage in potentially risky behavior (such as engaging in sex with multiple partners).

[41]See "The Spectre Stalking the Sub-Sahara," *The Economist,* December 2, 2000, and Bill Brubaker, "The Limits of $100 Million," *Washington Post,* December 29, 2000, p. A1.

Table 2.2

Regional HIV/AIDS Statistics and Features, End of 2001

Region	Adults and Children Living with HIV/AIDS	Adults and Children Newly Infected with HIV	HIV/AIDS Adult Prevalence Rate (15–49 Years of Age) (Percentage)
Sub-Saharan Africa	28.1 million	3.4 million	8.4
South/Southeast Asia	6.1 million	800,000	0.6
Eastern Europe/Central Asia	1.0 million	250,000	0.5
Latin America	1.4 million	130,000	0.5
East Asia/Pacific	1.0 million	270,000	0.1
North Africa/Middle East	440,000	80,000	0.2
Caribbean	420,000	60,000	2.2
North America	940,000	45,000	0.6
Western Europe	560,000	30,000	0.3
Australia and New Zealand	15,000	500	0.1
Total	40 million	5.0 million	1.2

SOURCE: UNAIDS, "AIDS Epidemic Update—December 2001," available at http://www.unaids.org/publications/index.html.

positive.[42] In Cambodia, nearly half of *all* the country's sex workers are known to be infected by HIV, which causes AIDS. Based on current trends, a staggering 10 percent of the country's population could be infected by 2010.[43] Figures for India are equally as serious. In Mumbai alone, 75 percent of the city's 60,000 to 70,000 prostitutes have contracted the disease, up from just 1 percent in 1990.[44] In total, roughly 3.5 million people are currently thought to be living with the disease in India, a rate of infection that owes much to com-

[42]Kenrad Nelson, "Thailand's HIV-Prevention Program Has Slowed the Epidemic, but AIDS-Related Opportunistic Infections Have Increased," Johns Hopkins School of Public Health, May 31, 2001, available at http://www.jhsph.edu/pubaffairs/press/thailands_HIV.html. See also "More Thai Patients Progress to Full-Blown Disease," *Bangkok Post*, March 22, 2001, and "Thai Army Winning AIDS Battle," *Far Eastern Economic Review*, May 5, 1998.

[43]UNAIDS, "AIDS Hits Asia Hard," December 1997, available at http://www.thalidomide.org/FfdN/Asien/asia.html.

[44]UNAIDS, "Aids Hits Asia Hard"; UNAIDS, *HIV/AIDS: The Global Epidemic,* Geneva: UNAIDS Publication, December 1996; UNAIDS, *The Status and Trends of the Global HIV/AIDS Pandemic,* Geneva: UNAIDS Publication, July 1996.

mercial sex and the high levels of sexually transmitted diseases (STDs) in the country.[45]

The increasing prevalence of intravenous drug use has also been instrumental in encouraging the spread HIV/AIDS. Burma, for example, which sits at the heart of the infamous opium-producing "Golden Triangle"[46] and was free of HIV only a few years ago, now has an estimated 200,000 people carrying the virus, 74 percent of whom are intravenous drug users.[47] Equally indicative is India, where intravenous drug use is now the second most common method of transmission for the disease (behind heterosexual sex), something that is especially true in the northeast regions that border Burma.[48] China has been especially hard hit. The Beijing government freely admits that the outbreak of an AIDS epidemic in the country's south is directly related to drug addicts sharing needles to inject heroin. Indeed Ruili, a border town in the southwestern province in Yunnan with one of the highest concentrations of opium addicts in the country, is now in the unenviable position of also being the AIDS capital of China.[49] In Kunming China, 40 percent of intravenous drug users are estimated to be HIV-positive, and because HIV/AIDS education in China is extremely poor, many of these abusers are unknowingly spreading the HIV virus to the general population through sexual encounters and through contaminated blood donations.[50] This resulted in a 67 percent increase between 2000 and 2001 in reported AIDS cases in China.[51]

---

[45]A. Fauci and T. Quinn, "The AIDS Epidemic: Considerations for the 21st Century," *New England Journal of Medicine,* Vol. 341, No. 14, 1999, p. 336; Whiteside and Fitz-Simons, "The AIDS Epidemic," p. 7.

[46]The Golden Triangle is composed of eastern Burma, northern Laos, and northern Thailand. During the 1980s and the first part of the 1990s, the region constituted the world's main source of refined opiates, after which it was superseded by Afghanistan.

[47]Peter Chalk, "Low Intensity Conflict in Southeast Asia," *Conflict Studies,* Vol. 305, No. 306, 1998, p. 12.

[48]World Bank Group, "India's National AIDS Control Program," September 1999, available at http://www.worldbank.org/aids.

[49]Noted in Whiteside and FitzSimons, "The AIDS Epidemic," p. 30.

[50]The vast majority of blood in China is not donated voluntarily. Unsterilized needles, improper practices at blood collection centers, and inadequate laboratory capabilities for blood testing make the blood donation system in China hazardous, although the government has been working to reduce the risk over the past five years. "Keeping China's Blood Supply Free of HIV/AIDS," U.S. Embassy, April 1997, available at

Although HIV/AIDS is the clearest example of how altered social and behavioral patterns have affected the occurrence and spread of infectious disease, it is not the only one. Changes in land use have also played a significant role. The emergence of Lyme disease in North America and Europe has been linked to reforestation and subsequent increases in the deer tick population, while conversion of grasslands to farming in Asia is believed to have encouraged the growth of rodents carrying hemorrhagic fever and other viral infections.[52] In the United States and United Kingdom, the development of large-scale factory farms and increased interactions between rural and urban populations have been linked to outbreaks of *Salmonella* and *cryptosporidiosis* as well as the general increased incidence of zoonotic diseases that are passed from livestock to humans (see Chapter Four).[53]

Finally, as society has moved into habitats requiring environmental modification, niches have been inadvertently created that are proving to be highly conducive for microbial growth and development. Heating and ventilation systems using water cooling processes, for instance, are now known to provide the perfect breeding ground and dissemination pathway for *Legionella pneumophila*, the causative agent of Legionnaires' disease.[54]

Medical science has come a long way in improving our basic understanding of the origin and effect of most infectious diseases humans may contract. Nevertheless, we have proven far less adept at recognizing and effectively dealing with the factors that facilitate the spread of viral and bacterial agents. Through such things as urbanization, climatic change, changing social and behavioral patterns, globalization, and misappropriate/misguided remedial procedures, humanity is rapidly approaching what one commentator has

---

http://www.usembassy-china.org.cn/english/sandt/webaids5.htm, accessed March 13, 2002.

[51]Rosenthal, "With Ignorance as the Fuel, AIDS Spreads Across China."

[52]NIC, "The Global Infectious Disease Threat and Its Implications for the United States," p. 22.

[53]See, for instance, Lawrence Gostin et al., "Water Quality Laws and Waterborne Diseases: Cryptosporidium and Other Emerging Pathogens," *American Journal of Public Health,* Vol. 90, 2000, pp. 847–853.

[54]Smith, "The Threat of New Infectious Diseases," p. 375.

referred to as the "twilight of the antibiotic era." Not only are we having trouble controlling age-old problems like TB, cholera, and malaria, but new, previously unimagined illnesses and viruses such as HIV/AIDS have emerged with a vengeance.

The impact of HIV/AIDS has been especially devastating and underscores, perhaps more than any other, the pervasive nature of the contemporary microbial challenge. To gain a better understanding of the virus and the disease implications of its spread for wider socio-economic and political stability, Chapter Three makes a detailed analysis of AIDS in one of the world's most severely affected states, South Africa.