chapter 22

Dress Rehearsals for the Twenty-First Century

SARS and Ebola

Rearmament

A major aspect of the official response to the challenge of emerging and re-emerging diseases is that microbes are regarded as threats to the security of states and to the international order. For the first time, not only public health authorities but also intelligence agencies and conservative think tanks have classified infectious diseases as a "nontraditional threat" to national and global security. A turning point came in 2000, when the CIA's national intelligence estimate for that year was devoted to the danger of epidemic disease, now viewed as a major security challenge.

In the first section of the report, "Alternative Scenarios," the CIA outlined three possible scenarios for the course of infectious diseases over the next twenty years: (1) the optimistic contemplation of steady progress in combating communicable disease; (2) the forecast of a stalemate, with no decisive gains either by microbes or by humans; and (3) the consideration of the most pessimistic prospect of deterioration in the position of humans, especially if the world population continues to expand and if megacities continue to grow with their attendant problems of overcrowding, poor sanitation, and unprotected drinking water. Unfortunately, the CIA regarded the optimistic first case as extremely unlikely.

Against this background, the following sections of the report, "Impact" and "Implications," outlined a series of likely economic, social, and political results that would occur in the new age of increasing disease burdens. In the most afflicted regions of the world, such as sub-Saharan Africa, the report anticipated "economic decay, social fragmentation, and political destabilization." The international consequences of these developments would be growing struggles to control increasingly scarce resources, accompanied by crime, displacement, and the degradation of familial ties. Disease, therefore, would heighten international tensions. Since the consequences of increasing burdens of communicable diseases in the developing world are certain to impede economic development, the report also predicted that democracy would be imperiled, that civil conflicts and emergencies would multiply, and that the tensions between North and South would deepen.[1]

Three years later, motivated by the CIA's report, the influential RAND Corporation turned to the intersection of disease and security when it attempted to provide "a more comprehensive analysis than has been done to date, encompassing both disease and security."[2] *The Global Threat of New and Reemerging Infectious Diseases* envisaged even more somber probabilities than the CIA in the new global environment. The intelligence report had two leading themes. The first was that in the postwar era, the importance of direct military threats to security has declined sharply. The second was that there has been a corresponding rise in the impact of "nontraditional challenges," of which diseases are the major component. The era of emerging and reemerging diseases marked the opening of a period in which infectious diseases would profoundly affect the ability of states to function and preserve social order.

The starting point of a plan to confront emerging diseases envisaged by the CDC, the National Institute of Allergy and Infectious Diseases, and the White House was the Institute of Medicine's description of the Darwinian struggle under way between humans and microbes. In the IOM's analysis, microbes possess formidable advantages: they outnumber human beings a billionfold, they enjoy enormous mutability, and they replicate a billion times more quickly than humans. In terms of evolutionary adaptation, microbes are genetically favored to win the contest. As Joshua Lederberg observed, "Pitted against microbial genes, we have mainly our wits."[3] Taking the IOM's analysis as its starting point, the US response to the new challenge is best seen as an attempt to organize and deploy human wit, backed by newly found financial resources, to counter the microbial challenge.

A 1996 White House "Fact Sheet" on the threat of emerging infectious diseases declared in clear alarm, "The national and international system of infectious disease surveillance, prevention, and response is inadequate to protect the health of U.S. citizens." To remedy the situation, the White House established six policy goals:

1. Strengthen the domestic infectious disease surveillance and response system, both at the Federal, State, and local levels and at ports of entry into the United States, in cooperation with the private sector and with public health and medical communities.
2. Establish a global infectious disease surveillance and response system, based on regional hubs and linked by modern communications.
3. Strengthen research activities to improve diagnostics, treatment, and prevention, and to improve the understanding of the biology of infectious disease agents.
4. Ensure the availability of the drugs, vaccines, and diagnostic tests needed to combat infectious diseases and infectious disease emergencies through public and private sector cooperation.
5. Expand missions and establish the authority of relevant United States Government agencies to contribute to a worldwide infectious disease surveillance, prevention, and response network.
6. Promote public awareness of emerging infectious diseases through cooperation with nongovernmental organizations and the private sector.[4]

In pursuit of goals 2, 3, and 4, the National Institute of Allergy and Infectious Diseases established a research agenda to develop new weapons to combat epidemic diseases, giving rise to an explosion in knowledge. In the decade after 1995 its budget quadrupled from $50 million in 1994 to more than $1 billion in 2005, while publications on infectious diseases burgeoned. Indeed, the agency director, Anthony S. Fauci, claimed in 2008 that HIV/AIDS in particular had become the most extensively studied disease in human history. The work of the federal agency, moreover, has been complemented by the activity of private organizations, most notably the Bill and Melinda Gates Foundation, and by university and pharmaceutical industry laboratories.

At the same time that the IOM stressed basic research, the CDC developed a defensive strategy against emerging pathogens in compliance with goal 1 of the White House directive. In two seminal works published in 1994 and 1998 it outlined its objectives in four principal areas: surveillance, applied research, prevention and control, and the enhancement of the infrastructure and trained personnel needed for diagnostic laboratories at the federal, state, local, and international levels. In addition, the CDC strengthened its links with the international public health community and with other surveillance agencies, such as the Food and Drug Administration and the Department of Defense; it enhanced its capacity to respond to outbreaks of disease; it launched the journal *Emerging Infectious Diseases* as a forum to pool information on communicable diseases; and it sponsored a series of major international conferences on the topic of emerging and reemerging diseases.

Following discussion with the National Intelligence Council, President George W. Bush took the further step of establishing the two most extensively funded initiatives ever launched to combat a single disease. The first, founded in 2003 and renewed as recently as 2018, was the President's Emergency Plan for AIDS Relief (PEPFAR), overseen by the State Department Office of the Global AIDS Coordinator. Concentrating on twelve sub-Saharan African countries plus Vietnam, Haiti, and Guyana, PEPFAR has provided billions of dollars for prophylactic measures and antiretroviral treatment as well as such actions as building health infrastructure, supporting AIDS orphans, and training medical personnel. Under the supervision of the AIDS coordinator, PEPFAR oversees the involvement of an array of federal agencies—the US Agency for International Development; the Departments of Health and Human Services, State, Defense, Commerce, and Labor; and the Peace Corps.

The second major program targeting a specific epidemic disease was the President's Malaria Initiative (PMI), which President Bush established under the directorship of Admiral Timothy Ziemer in 2005. Like PEPFAR, PMI combines humanitarianism with enlightened self-interest. Its purpose is to counter the ravages of malaria in sub-Saharan Africa with ample funding in order to develop health infrastructure and to support the deployment of such antimalarial tools as artemisinin-based combination therapy, insecticide-treated mosquito nets, health education, and vector control.

At the global level, WHO also took major steps to strengthen international preparedness for the ongoing siege by microbial pathogens. A first was the creation in 1996 of the disease-specific UNAIDS, whose functions are to raise awareness, to mobilize resources, and to monitor pandemic.

Funding levels in the fight against the disease increased from $300 million in 1996 to nearly $9 billion a decade later. A further step was that, like the United States, the United Nations announced that it regarded infectious diseases as threats to international security. In acknowledgment of this new development, the UN Security Council took the unprecedented step in June 2001 of devoting a Special Session to the HIV/AIDS crisis. The session adopted the "Declaration of Commitment on HIV/AIDS: Global Crisis—Global Action," which called the global epidemic a "global emergency and one of the most formidable challenges to human life and dignity."[5] Five years later, in June 2006, the UN General Assembly reaffirmed its commitment to the campaign and adopted the "2006 Political Declaration on HIV/AIDS," whose chief goal was the establishment of national campaigns to improve access to care and treatment.

A third step was the establishment in 2005 of a new set of International Health Regulations (IHR 2005) to replace the outdated IHR 1969. Whereas the old framework required notification only in the event of plague, yellow fever, and cholera, the new rules required notification for any public health emergency of international concern, including unknown pathogens and emerging infections. The 2005 regulations specified the nature of the events that should trigger international concern and committed all of the 193 WHO member states to improve their capacity for surveillance and response. In addition, recognizing that microbes do not acknowledge political frontiers, IHR 2005 called for effective responses wherever necessary to contain an outbreak on the basis of real-time epidemiological evidence instead of concentrating on taking defensive measures at international borders.

Finally, WHO organized a rapid response capacity. This was the Global Outbreak Alert and Response Network (GOARN), which was established in 2000 with the goal of ensuring that even the most resource-poor countries would have access to the experts and means needed to respond to an epidemic emergency. To that end, GOARN pooled the resources of sixty countries and organized five hundred experts in the field. In addition, it stockpiles vaccines and drugs and supervises their distribution during epidemic events.

Severe Acute Respiratory Syndrome—SARS

In practice, the first test of the new structures was the SARS pandemic of 2002–2003, which was the first major emerging disease threat of the twenty-first century. After appearing in the Chinese province of Guangdong in November 2002, SARS erupted as an international health threat in

March 2003, when WHO received notification and declared a global travel alert. Between March and the declaration on July 5 that the disease had been contained, SARS affected 8,098 people, caused 774 deaths, brought international travel to a halt in entire regions, and cost $60 billion in gross expenditure and business losses to Asian countries alone.

As retrospective studies have demonstrated, SARS presented many of the features that most severely expose the vulnerabilities of the global system. It is a respiratory disease capable of spreading from person to person without a vector; it has an asymptomatic incubation period of more than a week; it generates symptoms that closely resemble those of other diseases; it takes a heavy toll on caregivers and hospital staff; it spreads easily and silently by air travel; and it has a CFR of 10 percent. Moreover, at the time it appeared, its causative pathogen (SARS-associated coronavirus) was unknown, and there was neither a diagnostic test nor a specific treatment. For all of these reasons, it dramatically confirmed the IOM's 1992 prediction that all countries were more vulnerable than ever to emerging infectious diseases. SARS demonstrated no predilection for any region of the world and was no respecter of prosperity, education, technology, or access to health care. Indeed, after its outbreak in China, SARS spread by airplane primarily to affluent cities such as Singapore, Hong Kong, and Toronto, where it struck relatively prosperous travelers and their contacts and hospital workers, patients, and their visitors rather than the poor and the marginalized. More than half of the recognized cases occurred in well-equipped and technologically advanced hospital settings such as the Prince of Wales Hospital in Hong Kong, the Scarborough Hospital in Toronto, and the Tan Tock Seng Hospital in Singapore.

In terms of response to the crisis, the SARS outbreak vindicated the reforms taken on both the national and international levels. After the debacle of Chinese obfuscation at the start of the epidemic, national governments cooperated fully with IHR 1969. The world's most equipped laboratories and foremost epidemiologists, working in real-time collaboration via the internet, succeeded, with unprecedented speed, in identifying the SARS coronavirus in just two weeks. At the same time the newly created GOARN, together with such national partners as the Public Health Agency of Canada, the CDC, and WHO's Global Influenza Surveillance Network, took rapid action to issue global alerts, monitor the progress of the disease, and supervise containment strategies before it could establish itself endemically. Ironically, given the high-tech quality of the diagnostic and monitoring effort, the containment policies were based on traditional methods dating from the public health strategies against bubonic plague of the seventeenth

century and the foundation of epidemiology as a discipline in the nineteenth century—case tracking, isolation, quarantine, the cancellation of mass gatherings, the surveillance of travelers, recommendations to increase personal hygiene, and barrier protection by means of masks, gowns, gloves, and eye protection. Although SARS affected twenty-nine countries and five continents, the containment operation successfully limited the outbreak primarily to hospital settings, with only sporadic community involvement. By July 5, 2003, WHO could announce that the pandemic was over.

Although the global sanitary defenses withstood the challenge of SARS, serious doubts surfaced. The Chinese policy of concealment between November 2002 and March 2003 had placed international health in jeopardy and revealed that even a single weak link in the response network could undermine the international emergency response system. For four months following the November outbreak of SARS in the province of Guangdong and its subsequent spread to Beijing, the Chinese authorities followed a policy of concealment and obfuscation. Given the extent of links connecting the People's Republic with Hong Kong and Taiwan—via trade, investment, family ties, and tourism—it was impossible to prevent all awareness of a new disease from reaching the outside world. A complete news blackout was especially difficult in the age of the internet and social media, as well as at the time of the lunar new year in February, which is the peak time for travel within China. On the other hand, the Chinese party-state was determined to project an imagine of mastery and control, both to its own people and to the outside world. The Communist Party also feared that too much information would expose the reality in the country of impoverished living standards, an inadequate health-care system, and a lack of preparedness for public health emergencies.

For those reasons, the regime led by Premier Wen Jiabao persisted, until March 2003, in resisting all international pressure for accurate and timely information. The Chinese instead minimized the extent of the crisis, manipulated figures for public consumption, banned all unfavorable news from appearing in the press, and denied WHO teams access to affected areas of the country. Only in March, when WHO assumed the role of whistleblower and released the partial information it possessed, did China lurch in a new direction. On April 17 the Politburo reversed course by promising timely notice of SARS cases, granting WHO access to Guangdong and Beijing, and setting up a SARS task force under Vice Premier Wu Yi. At the same time the official *People's Daily* admitted that the country had been poorly prepared, and the director of China's CDC apologized.

If the regime thus became more open, it did not become less heavy-handed and authoritarian. Indeed, the party imposed quasi-military measures of quarantine and isolation backed by severe sanctions that extended to capital punishment and rewards for informants willing to denounce violators to the authorities.

Chinese policies clearly reveal, therefore, that a major factor in the containment of SARS was serendipity. The world was fortunate that the disease is spread by droplets and therefore requires extended contact for transmission, unlike classic airborne diseases such as influenza and smallpox. It was relatively easy to contain because it is not readily communicable from person to person—except in the still poorly understood case of so-called super-shedders. Most SARS sufferers infect few if any secondary contacts. An epidemiological assumption that has rarely been challenged is that all patients are more or less equally infectious. In the case of SARS, however, an outsize role in the epidemic was played by a small group of patients who disproportionately affected large numbers of contacts and were therefore called super-shedders. Dependence for its transmission on a small proportion of those affected was a significant limitation in the propagation of SARS.

As poorly transmissible as it was, however, SARS exposed the absence of "surge capacity" in the hospitals and health-care systems of the prosperous and well-resourced countries it affected. The events of 2003 thereby raised the specter of what might have happened had SARS been pandemic influenza, and if it had traveled to resource-poor nations at the outset instead of mercifully visiting cities with well-equipped and well-staffed modern hospitals and public health-care systems. Furthermore, SARS arrived in peacetime rather than in the midst of the devastation and dislocations of war or a natural disaster. In that respect it did not repeat the challenge of the "Spanish Lady" of 1918–1919—the influenza pandemic that spread extensively with the movement of troops during World War I. SARS also appeared as a respiratory disease in Southeast Asia, where the WHO sentinel system had been created to monitor and respond to exactly such an emergency. The physician Paul Caulford, who fought the SARS epidemic on the front lines at Scarborough Hospital in Toronto, raised these matters. In December 2003, after the emergency had passed, he reflected:

> SARS must change us, the way we treat our planet, and how we deliver health care, forever. Will we be ready when it returns? SARS brought one of the finest publicly-funded health systems in the world to its knees in a matter of weeks. It has unnerved

> me to contemplate what the disease might do to a community without our resources and technologies. Without substantive changes to the way we manage the delivery of health care, both locally and on a worldwide scale, we risk the otherwise preventable annihilation of millions of people, either by this virus, or the next.[6]

At the end of the victory over SARS, the nagging question therefore remained: Even after the impressive efforts at rearmament against epidemic disease since 1992, how prepared is the international community for upcoming emerging diseases? Have we been "forever changed"?

The Challenge of Ebola

In December 2013 the small child Emile Ouamouno, who lived in a village in the forests of southeast Guinea, died of Ebola. His home was located in the Mano River Basin where the borders of three West African countries intersect—Guinea, Liberia, and Sierra Leone. When it was revealed months later, the location of Emile's death confounded the international public health community. Although there had been a long series of small outbreaks of the disease since 1976, all of them had occurred in Central Africa and especially the Democratic Republic of the Congo (or the Congo). The Congo even provided the name "Ebola," after the river that flows through the territory where the 1976 outbreak had occurred.

A highly virulent infectious disease whose initial appearance caused panic around the world had seemingly settled into a reassuring pattern. In all previous upsurges in the Congo and Uganda, Ebola, in the prose of the international press, always appeared suddenly "from the jungle" but then disappeared each time as rapidly as it arrived. The morbidity and mortality figures for all known outbreaks before 2013 taken together totaled 2,427 and 1,597, respectively. The largest single outbreak was that of Uganda from October 2000 to January 2001, which gave rise to 425 cases and 226 deaths.

International and local surveillance systems, focused on Central Africa, were therefore caught off guard. Unexpectedly, Ebola spread from the forested areas of Guinea throughout the Mano River Basin. By March 2014 it became a major international epidemic transmitted person-to-person in the overcrowded capitals and urban centers of three countries. There were even brief flare-ups in neighboring states such as Mali, Nigeria, and Senegal, where small clusters of victims contracted the disease. Of these, the largest

numbered twenty people in Senegal. Threatening to escape all control, the epidemic lasted for two years—until WHO finally declared it over in December 2016. By then, even on the basis of conservative official statistics that seriously understate the extent of the disaster, the epidemic had caused 28,652 cases and 11,325 deaths (40 percent).

This public health emergency radically transformed medical and epidemiological understandings of Ebola. It also tested the emergency response systems that were intended to cope with emerging infectious diseases after the inadequacies exposed by SARS. In Toronto, Dr. Caulford, as we have seen, had commented in 2003 that the world needed to be "forever changed." His hope was that no outbreak would ever again find the international public health system so unprepared. To be sure, resolutions had been passed and reforms promised. Sadly, however, West Africa from 2013 to 2016 demonstrated that, in matters of sickness and health, short-sightedness and cost-cutting had prevailed. On the ground in Guinea, Liberia, and Sierra Leone, the policies actually implemented were eerily reminiscent of the hasty improvisations of the Black Death.

Symptoms

Ebola virus is a member of the family of filiviruses (*Filoviridae*), and the disease it causes was originally classed as a hemorrhagic fever because bleeding was seen as a chief symptom and leading cause of death. The experience of large-scale case management, however, led to a change in terminology when "Ebola hemorrhagic fever" was rechristened "Ebola virus disease." It was discovered that in the course of this disease, bleeding is frequently entirely absent. In those cases where it does occur, it is seldom profuse but is limited to bleeding of the gums and nose, bleeding at injection sites, and blood in vomit or diarrhea. Such bleeding, furthermore, does not correlate with a negative prognosis as it rarely progresses to massive hemorrhaging, except among pregnant women, who are especially vulnerable.

After a variable incubation period of two to twenty-one days, the "dry stage" of the disease begins. The symptoms of this stage mark the onset of both the illness and the infectious period, but they are nonspecific and misleadingly similar to those of seasonal influenza—fever, headache, muscle pain, fatigue, and sore throat. After several days, the critical manifestation of Ebola begins. This is the "wet stage," characterized by unstoppable loss of fluid from vomiting, by diarrhea, and, in many cases, by the loss of blood from bodily orifices. Patients are also tormented by pain in the chest and

abdomen, violent hiccoughs, and conjunctivitis. In the majority of cases, the loss of fluid leads to death from multiple causes—dehydration, kidney failure, respiratory distress and asphyxia, severe cardiac arrhythmias, and heart failure. It is the loss of virus-bearing fluids that also makes the patient highly infectious during the wet stage and then just after death. In all cases, the prognosis is unfavorable because the CFR of Ebola ranges from 60 percent to 90 percent, depending on the virus strain and the availability of supportive therapy and nursing care. At the end of the seventh day the majority of sufferers lapse into coma, followed by death. A minority, however, begin slowly to recover step by step, with progressively less pain, less loss of fluid, and more energy.

But even survivors face an extended ordeal. Convalescence is protracted, and the disease often leads to post-Ebola syndrome—an array of disabling symptoms including joint pain, headaches, memory loss, hearing deficits, tinnitus, depression, and posttraumatic stress accompanied by violent dreams and visions. Most common, however, is the ocular condition of uveitis that leads to blurry vision, light sensitivity, or permanent blindness. Since the virus is sequestered in the body for months after recovery, survivors also continue to be infectious through certain bodily fluids—breast milk, semen, vaginal secretions, tears, and spinal fluid. For these reasons, many recovered Ebola patients suffer not only physical pain, but also societal stigma on the part of frightened communities. Many lose their jobs and are shunned by friends and families and abandoned by partners.

In 2014–2016 this fear of Ebola was enhanced by the fact that no effective preventative or curative means were known. In well-resourced hospitals the standard of care involved what are termed "advanced life support therapies"—mechanical ventilation, hemodialysis, and intravenous rehydration, supplemented by medication to calm the purging and to relieve pain. In West Africa, experimental treatments were also adopted in desperation, all with disappointing results. These therapies included (1) the antiviral ZMapp and the antiretroviral lamivudine, which proponents hoped would prevent Ebola virus from replicating; (2) statins, such as Lipitor, which it was hoped would "calm" the immune system after infection; (3) the antimalarial drug amodiaquine, which potentially worked by mechanisms that were not understood; and (4) transfusions of the blood of convalescent patients in the hope that the donors' antibodies would enhance the immune response of recipients. Unfortunately, these strategies failed to save or prolong life, and supplies in any case were not adequate for the purpose of mass treatment.

Spillover to Humans

Ebola is now known to be a zoonotic disease whose natural hosts are fruit-eating bats (family Pteropodidae) in which the virus replicates easily but without giving rise to disease in the animal. Spillover into human populations from the reservoir among bats, however, is a rare event determined by the nature of both forest land use and human interactions with the environment. In principle, spillover can occur due to contaminated bush meat when forest dwellers hunt, butcher, and eat bats or other previously infected animals. A handful of instances of such transmission has been documented. In West Africa, however, an extensive and semicolonial mythology appeared in the press concerning the allegedly bizarre practices of African natives, their strange practices in the jungle, and their dietary predilection for roasted bat wings and bat stew. Even the health ministries of the affected countries took up this vision of the onset of the epidemic. In the early months they devoted energy and resources to a campaign to persuade villagers to alter their cuisine in the name of public health. In testimony to the US Congress on the medical emergency, the anthropologist and physician Paul Farmer, who had served as an emergency responder during the crisis, was emphatic on this point when he declared, "We should be very clear that the rapid spread of Ebola is not due to 15,000 episodes of bush meat eating frenzy."[7]

In fact, the spillover to which Emile Ouamouno fell victim had a far more complex gestation. In order to understand it, one needs to dispel another legend that shrouds the events in West Africa. In press accounts, two of the most frequent descriptors applied to the forested region that was "Ground Zero" are "remote" and "inaccessible." The implication is that the area was almost a virgin forest cut off from urban centers and the larger world beyond. In that description, the transmission of Ebola to the capital cities of Conakry in Guinea, Freetown in Sierra Leone, and Monrovia in Liberia is intelligible in terms of the tribalistic movements of the Kissi ethnic group. Since their forest homeland straddles all three countries that were infected, it was said that Ebola traveled with Kissi villagers as they "made kinship visits," or, in everyday parlance, dropped by to see relatives.

In reality, the forestlands of the three countries are not "remote" in any meaningful sense at all. On the contrary, the countries had been deeply integrated into world markets from the closing decades of the twentieth century through thick and overlapping networks of trade, investment, mining, logging, and agrobusiness. Not by accident, the three countries afflicted by Ebola were subject to a frenetic pace of deforestation and land clearance to

meet international demand for resources from the woods. Clearest and most illustrative is the example of the palm oil industry, which has been the most dynamic sector in world agriculture since the 1990s, when its production tripled, with the forests of West and Central Africa as an important center. A 2016 book described this upsurge of palm oil, alongside that of the soybean, as "the world's most recent agricultural revolution."[8]

The oil palm is native to West Africa, and its scientific name—*Elaeis guineensis*—even specifies its origins in Guinea. There, forest dwellers had long used it to produce the medicinal remedies employed by traditional healers; to cut fronds for thatching and fencing; to harvest the edible and prized palm heart; and to yield a range of culinary ingredients. What was new in the late twentieth century was the project to cut down the forests by clear cutting to establish a monoculture of large oil palm plantations. Capital for this project was provided by the World Bank, the African Development Bank, and the International Monetary Fund, together with their "partners"—the local governments of the three countries involved. Since the land was held by small subsistence-producing peasants, one of the great "external economies" that made the venture profitable was that the West African states undertook to dispossess the villagers, whose holdings were based on custom rather than legally recognized titles. This large-scale enclosure, which some sources describe as a "land grab," provided cheap and extensive acreage to plantation owners, while the army enforced the entrepreneurs' claims against rural resistance to mass dispossession. Driven off the land and into a choice between migration and employment at low plantation wages, peasants mounted a stubborn opposition to the onrush of "development."

For local governments, the oil palm was highly attractive. As a cash crop, palm oil targeted export markets, thereby alleviating foreign debt and providing foreign exchange. Companies involved also generated substantial profits, and they were willing to acknowledge officials who brokered deals and promoted their interests with generous rewards. Furthermore, in brochures, mission statements, and reports, the industry represented itself as environmentally sensitive in its promotion of an indigenous tree, as economically progressive in creating jobs, and as "modern" in its technology and management practices. Every concern found an answer in one or another company document. Plantations would yield jobs, infrastructure, vocational training, and education. In the gushing language of promoters of the industry, palm oil is nothing less than "liquid gold" that helps develop nations.

Actual implementation of the monocropping scheme was carried out by large companies such as the giant Guinean palm oil and rubber company

founded in 1987 known as SOGUIPAH (Société Guinéenne de Palmier à huile et d'Hévéa). This firm was partly state-owned and was based in Conakry. Palm oil was appealing to agrobusiness because it met a gamut of industrial and consumer uses. Oil from the palm kernel is a constituent element of biodiesel fuel, and it is used to produce cosmetics, soap, candles, detergent, and lubricants. Oil from the fruit is edible, and it is eagerly sought by the food industry to make margarine, ice cream, cookies, pizza, and an array of processed foods. Home cooks also use it abundantly as a cooking oil. It is estimated that half of the items for sale in a modern supermarket contain palm oil as an important component. Finally, the leftover kernel cake provides high-protein feed for livestock.

Favorable political conditions in West Africa, where agrobusiness found enticing subsidies in terms of capital, labor, land, and sympathetic access to government, attracted planters such as SOGUIPAH. Equally decisive was the fact that tropical forests such as those available in the Mano River Basin provide optimal environmental conditions for the oil palm to thrive. *Elaeis guineensis* grows most rapidly and produces the greatest abundance of fruit in the conditions of temperature, humidity, wind, and soil prevailing in the tropical rainforest. The combination of these circumstances placed the palm oil industry on a collision course with the primary forests of the region.

Palm oil companies comprehensively transformed the landscapes they encountered, and in ways that were not conducive to the health of the population or the environment. They began by destroying the existing primary forest by fire and bulldozer. Having cleared the land, they then established a monoculture of oil palm cultivated in large plantations. There is a burgeoning literature on the negative social, economic, and environmental impact of the new palm oil monoculture, and a vociferous opposition to it has been mounted by such "green" NGOs as the World Rainforest Movement, the Union of Concerned Scientists, and Greenpeace. They point to such negative features as the loss of biodiversity, the contribution of deforestation to the greenhouse effect and global warming, population displacement, the low wages and harsh working conditions of plantation workers, the unfavorable long-term position of nations that develop on the basis of producing raw materials in the global market, and the inability of perennial crops like palm oil to respond to market fluctuations.

In addition, the emergence of Ebola demonstrates that deforestation also has direct implications for health and disease. The areas where Ebola outbreaks have occurred since 1976 map perfectly onto the geography of

deforestation in Central and West Africa. The link between Ebola and deforestation is the fact that the fragmentation of African forests disrupts the habitat of fruit bats. Before the arrival of agrobusiness, the bats normally roosted high in the forest canopy, far from human activities. In the wake of clear-cutting, however, these "flying foxes," as they are known locally, forage ever closer to human settlements and grow dependent on household gardens with their scattered trees and crops. As more than three-quarters of the Mano River Basin primary forests have been destroyed since 1990, the bats have been brought progressively into much closer and more frequent contact with villagers. In the words of a 2009 report, "Three nations have deforested more than 75 percent of their land, forcing the inexorable meet-up between Ebola-carrying bats and people."[9]

This transformation allowed Ebola to "spill over" from bats to humans in West Africa in the wake of deforestation. And it proved fatal to Emile Ouamouno, a toddler who played in the hollow of a fruit tree adjacent to his home just as a child in the developed world might climb a nearby apple tree. It was his tragic misfortune that the tree stood on the edge of his village of Méliandou, which was no longer located in a forest area but was "surrounded by a landscape strongly reshaped by plantations."[10] As a consequence of this change from forest to palm oil plantation, the hollow of the tree in which Emile chose to play—just fifty yards from his home—harbored thousands of roosting fruit bats, whose droppings were almost certainly the source of his infection.

Furthermore, high-resolution satellite data have made it possible to correlate the index cases of all known outbreaks of Ebola virus disease since 2004 with changes in patterns of land use that have occurred during the same period. The results indicate that Emile's bad luck was part of a larger tendency at work in Central and West Africa. In the twelve outbreaks of Ebola known to have occurred between 2004 and 2016, the index cases have been consistently traced to the edges of forest fragmentation and deforestation that happened during the previous two years. Eight of the twelve confirmed index cases were traced to "fragmentation hot spots." In addition, of the three apparent exceptions, one occurred very close to an area of high fragmentation, and a second was associated with hunting and poaching in the forest. Only one of the twelve index cases was a genuine outlier.

A further consequence of forest fragmentation also became apparent. In comparison with bat populations in the canopies of primary forest, the fruit-eating species that are the reservoirs of Ebola virus are overrepresented

in fragmentation areas because the insect-eating species that do not transmit the disease are not drawn to the new habitat. This tendency may be the result of the destruction of insect habitat by deforestation. Therefore, not only does forest fragmentation bring humans into more frequent contact with bats, but it also ensures that such contact involves precisely those species that carry the disease. In the summary of a 2017 report:

> Our results indicate that *Ebolavirus* spillover events from wildlife reservoirs to humans preferentially occur in areas that are relatively populated and forested, yet where deforestation is reshaping the forest boundaries by increasing forest fragmentation. . . . High degrees of forest fragmentation and their increase over time can be good indicators of enhanced opportunities for human contact with wildlife . . . and, possibly, also improved habitat for some reservoir species.[11]

Human-to-Human Transmission

Ebola is highly infectious from person to person, but only through direct contact between a healthy person and an infected person's bodily fluids. The environments that patients occupy during their illness teem with viruses, including surfaces they have touched, bedclothes and linen, the insides of vehicles, and personal effects. The fact that patients are initially infective when their condition resembles flu rather than a more serious affliction increases the opportunities for the epidemic to spread, as the patient is still likely to underestimate the danger and to remain mobile rather than taking to bed. Sexual transmission and transmission from mother to child via breastfeeding are also possible for months after someone has recovered. Given these modes of transmission, the epidemic of 2013–2016 occurred most frequently via certain nodal points. Three were most significant: homes, burial grounds, and hospitals.

Patients in their homes posed a lethal danger to family, friends, and all who cared for them or entered their contaminated sickrooms. Ebola therefore initiated its onward spread not at a distance but through tightly linked networks of family members and caregivers who shared intimate domestic spaces with the sufferers. Thus Emile Ouamouno's death was soon followed by the demise of his mother, his three-year-old sister, his grandmother, a village nurse, and a midwife. The mourners at the grandmother's funeral and her caretakers then contracted Ebola.

Similar considerations made funerals and burials a second major site of transmission throughout the 2013–2016 epidemic (fig. 22.1). At no time does a victim of Ebola shed more virus particles than immediately after death. At that very time, however, local customs draw relatives and members of the community into the highly contaminated sickroom. Tradition and religion among the Kissi people of Guinea call for a series of funeral rituals that are highly dangerous in the midst of a spreading Ebola outbreak.

Figure 22.1. Gravedigger Saidu Tarawally in March 2015, Bombali Cemetery in Sierra Leone, located at the epicenter of the Ebola epidemic. Undertakers and gravediggers were at particular risk of developing the disease, as the viral load is highest just after death. (Photograph by Daniel Stowell, MPH, CDC Public Health Images Library.)

When a member of a community dies, the body is kept at home for several days in order to allow mourners time to visit and pay their last respects by touching or kissing the head of the deceased. Family members then ceremonially wash the body and wrap it in a winding sheet, and the community gathers to accompany its departed member to the grave.

Failure to observe these practices, it is thought, prevents the dead person's soul from proceeding in peace to the afterlife. Instead, the tormented spirit remains to haunt the living. Even after knowledge of the mechanisms of Ebola became more widespread, the disease was sometimes less feared than possible retribution from the dead and remorse over perceived injury to a deceased friend, neighbor, or relative. Indeed, the difficulty of establishing safe burial practices was one of the principal preoccupations of the effort to contain the disease. As Dr. Hilde de Clerck, an early responder, commented: "Often, convincing one member of the family is simply not enough. To control the chain of disease transmission it seems we have to earn the trust of nearly every individual in an affected family. This is a mammoth task, which is why greater involvement from the religious and political authorities in raising awareness about the disease is crucial."[12] For this reason, anthropologists and linguists were important as consultants to the public health movement.

The third major site for Ebola transmission was the treatment center or hospital. No job was more dangerous in West Africa during the epidemic than serving as a health-care worker—orderly, nurse, or physician. Those who staffed the front lines paid a heavy tribute to Ebola, certainly in death and disease, since 20 percent of the Ebola victims in the three countries of the Mano River Basin are estimated to have been health-care personnel. But caregivers also suffered severely from fear, overwork, and demoralization. There were many reasons for this, including the sheer infectivity and lethality of the disease. All direct contact with patients was hazardous.

But the specific conditions of the health-care systems in West Africa greatly magnified the inherent dangers involved. Guinea, Liberia, and Sierra Leone were among the world's poorest nations. The United Nations Human Development Report of 2016 estimated that Liberia ranked 177 out of 188 member nations in its "Human Development Index," which is a measure of overall economic well-being as assessed by a number of matrices. In terms of income alone, the per capita annual income of Guinean residents was US $1,058. Liberia, whose citizens earned US $683 per capita annually, was ranked 177; and Sierra Leone, with per capita earnings of $1,529, was ranked 179. The percentages of the population estimated to be living in "severe multidimensional poverty" were 49.8, 35.4, and 43.9, respectively.[13]

Poverty of such depths profoundly affected the ability of West Africa to build health-care infrastructures. This problem was compounded by the fact that the states in the region had different priorities. At the Abuja, Nigeria, summit of African health ministers in 2001, a widely applauded resolution pledged all participating countries to move rapidly toward a spending target of 15 percent of gross national product on health. But in 2014, Sierra Leone, Guinea, and Liberia lagged far behind that goal, with expenditures of only 1.9 percent, 2.7 percent, and 3.2 percent, respectively. Education, welfare, housing, and transport suffered from comparable neglect, and the only relatively well-funded institution was the army of each country. Far from moving toward the Abuja targets, Guinea and Sierra Leone actually reduced their budgets for the health ministry in the years following the conference, even though the expansion of palm oil and other industries brought economic growth and created pockets of wealth amidst the prevailing poverty. The story of Ebola is not only a narrative of poverty, but also one of the poor distribution of resources and the suspect quality of prevailing moral priorities.

As Ebola erupted, preparedness in all three countries was nonexistent. For example, there were virtually no health-care workers. West Africa had the world's fewest trained physicians, nurses, and midwives per capita. Liberia had 0.1 doctor per 10,000 citizens, and comparable figures for Sierra Leone and Guinea were 0.2 and 1.0, respectively, as contrasted, for example, with 31.9 doctors per 10,000 in France and 24.5 in the United States. A large Canadian hospital had more physicians than all of Liberia, where the severe shortage had been exacerbated by civil war at the turn of the twenty-first century. War drove a majority of the limited number of Liberian doctors away from the country; thus, as Ebola began, more Liberian physicians lived in the United States than in Liberia, where 218 doctors and 5,234 nurses remained to serve a population of 4.3 million. These caregivers, moreover, were concentrated in Monrovia, leaving the remainder of the country entirely without health-care provision except the arts of traditional healers.

Hospitals fared equally badly. They seldom possessed isolation wards, electricity, or running water and had no diagnostic facilities, protective equipment for staff, or training in response to a public health emergency. Already overcrowded, they also lacked surge capacity in the event of an emergency. In such conditions, morale was low, contributing during the emergency to large-scale desertion of hospitals by medical staff members who were frightened, poorly paid, and overworked. They were also overwhelmed by a

sense of despair at their inability to help sufferers and by the atmosphere of distrust by the general population, who regarded hospitals as places to die. Thus, when the virus appeared, one *New York Times* article described the health-care system in the three affected countries as "invisible."[14]

In such an environment, it was inevitable that many of the health-care workers who remained at their posts would contract the disease. Local medical staff had none of the tools, facilities, equipment, or training to protect themselves, and their high rate of contracting Ebola themselves further undermined a health-care system that was already crumbling.

All of the risk factors for Ebola would not have generated a major epidemic, however, if the disease had remained confined to the forest region. What transformed the epidemiological history of Ebola was the fact that West African forests are intimately linked to urban centers. Having established a focus in Méliandou among a stricken child and his family, the Ebola virus was well-positioned to spread throughout Guinea and the other two countries that abutted the prefecture where the eighteen-month-old Emile fell ill. By 2013 palm oil had established extensive connectivity between the forested area and the outside world. Labor migration on the part of dispossessed peasants and plantation workers; travel by company officials, government bureaucrats, and troops from Conakry; the increasing pace of the movement of goods by river upstream and downstream; and the opening of networks of dirt roads—all of these factors made the movement of people, goods, and equipment across borders and into cities a constant feature that bound the whole of the Mano River Basin into the web of globalization.

Furthermore, the interconnectedness of the forests with urban West Africa was established by multiple industries, not palm oil alone. During the decades preceding the outbreak of 2013, multiple businesses had invaded the forests of Guinea, Liberia, and Sierra Leone. Logging companies and rubber planters sought land, and mining firms were drawn by deposits of diamonds, gold, bauxite, and iron. Construction companies, accommodating the burgeoning demand for lumber that resulted from large-scale migration and urban growth, took their share of the trees. All of these forces set people, goods, and trade in motion, both within the forested prefectures and between the forests and the outside world. In an exception to the prevailing tale of a distant jungle inhabited by bush-meat hunters, the *Irish Times* noted that the explosion of Ebola revealed exactly the opposite. "Indeed," one reporter commented, "only a tiny proportion of the wider Upper Guinea rainforest belt remains unexploited after a deforestation process that has accelerated

considerably in recent decades. This has caused significant disturbance to bat populations, creating the preconditions it appears for an outbreak."[15]

Arriving as a volunteer on the front lines of the disease in the forest region, the Irish virologist Christopher Logue noted that the woods were not the unspoiled sylvan idyll he had expected. On the contrary, the landscape bore all the signs of bustling activity and commerce. The area, he wrote, "is a vast patchwork of bright green vegetation with terra-cotta-coloured dirt paths, that we later discovered were the roads, weaving in and around these forested areas, linking small villages to each other and to the network of estuaries and rivers."[16] Above all, mines were a school for migratory behavior. Probing ever deeper into the forests, they set in motion an immense movement of young men hungry for work and willing to travel.

For twelve weeks after the death of Emile Ouamouno in December 2013, Ebola circulated silently in the forested region, unseen by a health system that wasn't there. Health officials in the capitals noticed an uptick in mortality, but they attributed it to gastroenteritis and cholera, which are endemic to the region. Thus misdiagnosed, Ebola reached Conakry, Monrovia, and Freetown unopposed. Retrospective investigation determined that the disease reached Conakry, a city of 2 million people that is located about 250 miles from Méliandou, on February 1, 2014. The route the virus took—via an infected member of Emile's extended family who traveled to the capital—illustrates the connections between forest and city. Thereafter, Ebola erupted in slums that, like the hospitals within them, lacked sanitation, adequate space, and facilities of every kind. If transformation of the forest environment allowed Ebola to break out, the degraded and overcrowded conditions of the built environment of West Africa's cities enabled it to spread exponentially.

The Early Emergency Response

In March 2014 the response to Ebola began as the first diagnosed cases in Conakry attracted concern—but not on the official level. It was the private-sector charities Samaritan's Purse and, above all, Médecins Sans Frontières (MSF, or Doctors without Borders) that intervened in March. With laboratory confirmation that the "mysterious cases" reported by the ministry of health in Guinea were actually Ebola, MSF responded immediately. On March 25 the Paris-based NGO deployed sixty health-care workers immediately and dispatched tons of medical equipment and supplies to support them.

By the end of the epidemic MSF had strained its resources to a breaking point. As 2014 began, the agency had prioritized the need to confront humanitarian crises in Sudan, Syria, and the Central African Republic. Suddenly the international charity was confronted with the need to control a public health emergency on an unprecedented scale. MSF rapidly devoted itself to four principal tasks in West Africa: (1) to open and equip a network of Ebola treatment centers, (2) to staff them with volunteer medical personnel from abroad, (3) to treat victims of the disease, and (4) to contain the spread of the epidemic while it sounded the alarm in order to secure the intervention of WHO and various governments. Overwhelmed by patient numbers, MSF by midsummer took another unprecedented step. Regarding the absence of hospitals in West Africa as an "emergency within the emergency," the philanthropic organization built and equipped large-scale treatment centers where volunteers operated reception and triage units, diagnostic labs, isolation wards, and recovery rooms—all functioning within wooden sheds and tents enclosed within perimeter fencing.

MSF doctors immediately recognized the threat that Ebola posed to spiral out of control. Having reached the capital cities of three West African countries, this highly virulent and untreatable disease presented an immediate danger. Already overrunning the originally afflicted nations, it was poised to travel via the region's international airports to other countries both in Africa and abroad. MSF had never imagined confronting the emergency alone and knew that the unfolding disaster was beyond its resources and experience. The organization had been formed in 1971 to deliver, as it says on its website, "emergency aid to people affected by armed conflict, epidemics, healthcare exclusion and natural or man-made disasters." Its mission was to act as a first responder in humanitarian crises while galvanizing local governments, WHO, and First World states to assume major responsibility.

The situation in West Africa, however, was different. As the title of MSF's report on its first year dealing with Ebola in the Mano River Basin announced, the organization was "pushed to the limit and beyond." By the end of its mission, it had treated more than five thousand Ebola patients, or a quarter of the total reported by WHO. Its institutional problem was that it rapidly found itself immersed in the crisis but without a viable "exit strategy" because the international response to its cry of alarm was lamentably tardy, half-hearted, and disorganized.

In theory, WHO had responsibility for leading the campaign to contain and eliminate Ebola. In practice, however, it proved unequal to the task.

On March 31, 2014—three months after the outbreak began—MSF declared that the crisis in West Africa was an "unprecedented emergency" demanding an immediate and coordinated international effort. Far from acting, WHO engaged in a war of words with the messenger bearing bad news it preferred not to hear. Gregory Hartl, the Geneva-based agency's spokesman, minimized the escalating calamity. Safely seated at a desk in Switzerland, Hartl contradicted the MSF assessment and the view of all experts, announcing: "The fortunate thing with Ebola is that it's quite difficult to transmit. You have to touch someone. Fortunately for the greater population, the risks are quite small."[17] Furthermore, in defiance of all the evidence, WHO reported in late May that Ebola had not reached the cities of Sierra Leone and that there was no reason to station international health workers in the country.

The background to Hartl's extraordinary comments, and the inaction that followed, was that WHO was far from learning the lessons of the SARS crisis. Adopting instead the perspective of the industrial world, it decided no longer to prioritize infectious diseases. Accordingly, it drastically cut its budget for surveillance and response and dismissed senior and experienced experts in the field. The organization therefore lacked the competence, staff, and will to confront Ebola. Furthermore, WHO was paralyzed by a bureaucratic turf war between its headquarters in Geneva and the Regional Office for Africa in Brazzaville, Congo. Like the Swiss head office, the African regional office had more than halved its budget for epidemic disease preparedness from US $26 million in fiscal 2010–2011 to US $11 million in fiscal 2014–2015. When officials in Brazzaville, now without seasoned experts to advise them, chose to believe that the epidemic in West Africa was no more serious than prior outbreaks in the Congo and would soon burn itself out spontaneously, the Geneva office deferred to their views without investigation.

As people continued to die by the thousands in three countries and the epidemic spread, the standoff continued. In June 2014 MSF announced that Ebola was "out of control," with more than sixty infectious hot spots, and it again denounced what it had already criticized in March as a "global coalition of inaction."[18] In reply, WHO organized a conference of West African health ministers at Accra, the capital of Ghana, where it offered bland reassurance. Without evidence, the hapless UN spokesman opined, "This is not a unique situation—we have faced it many times—so I'm quite confident that we can handle this."[19] MSF officials were aghast. Dr. Brice de la Vigne, the MSF operations director, was appalled that "the response of the international community is almost zero."[20] Even voices outside MSF now began to

be raised. The *New York Times,* for example, was scathing in its comments on WHO "leadership" as the disease worsened during July and August. The agency, it noted, "has snoozed on the sidelines for months"; its response was "shamefully slow"; and its African regional office was "ineffective, politicized, and poorly managed by staff members who are often incompetent."[21]

Governments both in the afflicted area and abroad were no more forthcoming. Locally, authorities in the three besieged countries heeded the reassurances from WHO and the supposed lessons of Ebola in the Congo, but they did so for reasons that had far more to do with economics than with either science or concern for the health of their populations. Their great fear was that the outbreak of a dreaded disease in West Africa would cause investors to rethink their commitment to the development plans that were under way; that it would cause international airlines to cancel flights to the region, crippling tourism; that lucrative kickbacks from mining companies and agrobusiness would dry up; and that the disease would taint the infected countries with the stigma of backwardness and tribal practices. Prevarication and concealment were therefore the strategies of choice.

In this spirit, President Alpha Condé of Guinea opted to paint a rose-tinted picture of events in order to avoid alarming mining and palm oil companies: his government reported only a fraction of the known and suspected cases. Instead, it gave priority to a campaign to encourage villagers to change their culinary habits by banning the sale and consumption of bush meat. He thereby lowered the public profile of the emergency, but he also eliminated the standard public health strategy of tracing contacts. Furthermore, Condé made no concerted effort to recruit personnel to staff hospitals and treatment centers. On the contrary, during the early months of the epidemic, he adopted the alternative strategy, it was said, of applying quarantine not to the virus, but to journalists who reported its predations. His police censored and warned reporters who depicted medical matters truthfully. Condé was as resolutely upbeat and optimistic as WHO. In a visit to Geneva at the end of April, when MSF had proclaimed a global emergency, Condé explained his nonchalant view to the press. "The situation," he declared, "is well in hand. And we touch wood that there won't be any more cases."[22]

Farther afield, medical authorities and political leaders in the developed world adopted a laissez-faire policy. The European Union, Russia, and China, for example, folded their hands while somber statistics accumulated and physicians on the front lines appealed for help. And everywhere, politicians looked to the United States because it was the sole remaining superpower and it possessed in abundance the resources that were needed in the

Mano River Basin. Furthermore, the Atlanta-based CDC set the international standard for all organizations intended to carry out medical surveillance and emergency epidemic response.

Inaction on the part of the United States was due to a form of public health isolationism. What America wanted to know was whether the epidemic in West Africa posed a direct threat of crossing the Atlantic and causing death, not in Monrovia or Conakry, but in New York, Houston, and Los Angeles. Until July 2014 the consensus regarding the answer to that question was a resounding "no!" Screening at West African airports, reinforced by disease surveillance in the US; the reassuring abundance of physicians and nurses; and robust American sanitary infrastructures gave the nation a sense of invulnerability. In the *New York Times,* David Quammen spoke for those who felt safely ensconced behind the bulwarks of American modernity, science, and civilization, penning an article complacently titled "Ebola Is Not the Next Pandemic." Quammen acknowledged that Ebola was a terrible and excruciating disease for its victims, but he was confident that it had no relevance to the United States. It was, frankly, a rare disease caused by the "grim and local misery" endured by a small number of Africans who "are obliged by scarcity of options to eat bats, apes and other wild creatures, found dead or captured alive."[23]

A sea change in attitudes occurred in July 2014, shattering Americans' confident sense of distance from African maladies, after two US medical volunteers, Kent Brantly and Nancy Writebol, contracted Ebola. They were the first foreigners to develop the disease and were evacuated to Emory University Hospital in Atlanta, where they received the "advanced supportive therapy" available only at technologically equipped medical centers. They also received fast-tracked and still experimental antiviral medication and symptomatic treatment to lower fever, reduce pain, and slow the vomiting and diarrhea. Both survived, but their plight attracted endless international attention. Brantly and Writebol literally brought the disease home to the United States and revealed that white people, too, were vulnerable to the deadly disease.

The illness of Brantly and Writebol was a politically transformative experience, as fear spread across the United States with the realization that the country could be in danger from Ebola. As Dr. Joanne Liu, the international president of MSF, said: "The fact that we had some foreigners infected, that drew a lot of attention. All of a sudden, people said, 'On my God, it's knocking at my doorstep.' All of a sudden, people are paying attention."[24] Opinion polls conducted in mid-August demonstrated a sea change in

attitudes. By that date 39 percent of Americans polled were convinced that a large outbreak would occur in the United States, and 25 percent that either they or a family member would contract the disease. The message was reinforced throughout the summer and fall. In September and October, eight additional heath-care workers who had volunteered in West Africa contracted the disease. Then every American's worst fears materialized in September 2014. A traveler not involved in patient care, the Liberian Thomas Eric Duncan, flew to Dallas from West Africa. There he fell ill, was misdiagnosed as having sinusitis, and discharged from Texas Health Presbyterian Hospital. He was readmitted and died on October 8, but only after infecting two nurses who treated him (they both recovered). In addition, thirty European medical volunteers were infected and transported to Spain, the United Kingdom, France, Germany, and Italy for care.

CDC director Thomas Frieden also contributed to the tide of opinion favoring intervention. At the end of August he made a fact-finding trip to Liberia to assess the situation. His account of what he found was devastating. The situation, he said, was an absolute emergency, and only massive and prompt outside help could prevent disaster.

Foreign Assistance

A full 180-degree turnaround occurred in August 2014—eight months after the onset of Ebola. On the first of the month, Margaret Chan, WHO's director-general at the time, held a meeting with the presidents of Guinea, Liberia, and Sierra Leone. She informed them that the disease was moving more quickly than the efforts to contain it and warned of "catastrophic" consequences. Then, for the third time ever, WHO declared a Public Health Emergency of International Concern (PHEIC), its highest level of alarm and its call to action. After a further six long weeks of preparation, the agency set up the UN Mission for Ebola Emergency Response, which was tasked with coordinating policy and managing the campaign to defeat the disease. Officially at least, WHO had taken charge.

Other nations followed suit. In West Africa, the three presidents of the countries directly involved experienced a change of heart and declared states of emergency. They also appealed for assistance from abroad. President Ellen Johnson Sirleaf of Liberia directly implored President Barack Obama for help. The US president was stunned by a wave of criticism in Congress and in the press, which described his administration as "rudderless" and "inadequate."[25] In early September the *Washington Post* denounced a US response

that it deemed "feeble" and "irresponsible." The United States had a moral imperative to act, the paper said, because no one else had the resources and organization to mount an effective and immediate campaign.[26]

Meanwhile, President Obama was convinced that the epidemic constituted a risk to the United States, first as a medical threat that could—and did—reach American shores. In addition, he realized that it could also precipitate the political failure of three West African states, and perhaps eventually their neighbors as well. Serious diplomatic, medical, and security complications therefore loomed. Ebola was no longer simply a humanitarian crisis in distant lands but a matter of national security. As the first week of September ended, Obama declared the epidemic a national security crisis and directed the Department of Defense to deploy three thousand US soldiers to Liberia in engineering and logistical support roles—a mission termed Operation United Assistance. The US Army would secure the shipment of medical supplies to the epicenter of the outbreak, and it would construct and equip large treatment facilities.

In the meantime, the CDC started training courses in Alabama to prepare volunteer medical personal in the use of personal protective equipment (PPE), which consisted of gloves, goggles, face shields, rubber gowns, biohazard overalls, and rubber boots—the modern-day equivalent of the plague costumes that physicians wore to confront the Black Death (fig. 22.2). Intensive instruction in the use of these suits was needed because wearing the outfit was difficult. Karen Wong, a medical volunteer and CDC official, compared working with protective equipment to scuba diving, which requires careful predive planning. Donning and doffing the equipment correctly while following a precise sequence was essential to preventing exposure to the virus. Furthermore, while imprisoned within the suit, caregivers were overwhelmed by heat and knew that dehydration, prostration, and oxygen hunger were immediate dangers. It was safe to wear the modern plague costume for only fifteen minutes at a time. Another challenge was that the equipment muffled sound, so it was complicated to communicate with patients and co-workers, and to avoid colliding with them and equipment. The CDC courses also provided instruction in the diagnosis and treatment of Ebola patients.

Meanwhile the World Bank, the International Monetary Fund, and UNICEF designated money to support the relief effort. More quietly than the Department of Defense, the CDC intervened directly in West Africa, initiating its largest effort ever in combating an epidemic. It mobilized and deployed teams of responders, set up diagnostic and surveillance facilities,

Figure 22.2. The CDC trained physicians, nurses, and other providers in the use of the personal protective equipment needed to interact with Ebola patients safely. (Photograph by Nahid Bhadelia, M.D., CDC Public Health Images Library.)

provided epidemiologists to collect and analyze statistical data, and opened instructional courses on Ebola for medical and public health personnel. It also furnished logistical support and instituted exit screening at West African airports.

Other nations made parallel interventions. France deployed response teams in Guinea, as the United Kingdom did in Sierra Leone. Canada donated supplies and medical personnel, while Cuba, Ethiopia, and China sent teams of doctors and nurses. Strikingly, the aid of Western countries followed the geography of colonial connections and present-day national interests. Thus the United States intervened to assist Liberia, which had been founded by former US slaves; the United Kingdom aided its ex-colony Sierra Leone; and France did the same in its former possession of Guinea. Cuba stood apart as a resource-poor nation that both intervened beside the major powers and sent its aid—4,651 trained doctors and nurses—without regard to national borders. By early 2015, a total of 176 organizations participated in the international effort.

Apart from the tardiness with which foreign assistance arrived, the principal criticism made regarding it was that it was given in accord with priorities determined in Washington, London, Geneva, and Paris rather than in harmony with the evolving experience on the ground in West Africa. MSF,

the agency with the longest history of confronting Ebola, felt that US intervention was top-down and took little account of what MSF had learned and what its needs were at various stages of the epidemic. In the spring of 2014, for instance, MSF was primarily concerned with the inadequacy of the West African hospital system and its collapse under the strain. Indeed, at that time the agency even undertook the construction of temporary hospital complexes of its own, including the Kailahun Ebola treatment center near the epicenter of the epidemic in Liberia.

By the summer and autumn, however, MSF priorities had changed. By then it was alarmed above all by the proliferation of epidemic hot spots at multiple locations. The agency had also learned that, as a result of distance, distrust, and poor communications, patients frequently never reached treatment facilities at all, or arrived only when the disease was far advanced and after they had transmitted the infection to others en route. MSF therefore felt the need not for large hospital-like centers such as Kailahun, but rather for a multiplicity of rapid-response medical teams linked electronically with advanced diagnostic laboratories. Such teams, it argued, provided the best means of snuffing out disease foci as they erupted and before further transmission could occur. It therefore protested that US intervention was clumsy, unresponsive to the ever-changing situation in the field, and therefore largely obsolete even as it got under way in October. It was a medical version of the tendency of generals to fight the battles of the previous war. A quip made at the time was that the US had taken a knife to a gunfight.

The Anti-Ebola Campaign

Inevitably, West African governments shaped the nature of the anti-Ebola campaign as it mustered a major effort in the fall, following broadly similar trajectories in all three countries. A principal determinant of the response that unfolded was the quality and availability of the instruments at hand. One resource that the three nations deployed was communications. The governments of Guinea, Liberia, and Sierra Leone all had access to the airwaves, the press, billboards, leaflets, loudspeakers, and megaphones that could deliver messages in marketplaces where people gathered and along city streets. In the spring, the message delivered by these means was heavy-handed, bombastic, and attuned to First World perceptions rather than those rooted in West African reality.

Thus the early medical propaganda aimed to persuade the population that Ebola was real, present, and dangerous. Unfortunately, this message pri-

marily delivered fear. Early placards proclaimed, "Ebola spreads quickly, and it kills!," thereby spreading a frenzy of Ebola phobia that was unhelpful. Terror fostered counterproductive behaviors such as the avoidance of treatment centers. It also promoted stigma toward patients, recovered sufferers, and health-care workers. State messages also stressed the need for giving up the now infamous dietary recourse to bush meat. Since such official notices provided so little genuinely helpful information, residents devised their own measures of safety—avoiding handshakes, wearing gloves whenever possible, and carrying small bottles of bleach with them.

The state also depended on the army, which many observers viewed as the most reliable tool available, rather than the health-care system, to deal with the crisis. Not surprisingly, therefore, the campaign at the outset was thoroughly militarized. Many of the coercive means adopted echoed early modern Europe's effort to defend itself against bubonic plague, such as extraordinary executive powers, sanitary cordons, quarantines, curfews, and lockdowns. Compulsory treatment facilities surrounded by troops even closely resembled lazarettos. Daniel Defoe would have found the response familiar.

Interestingly, presidents Condé, Johnson Sirleaf, and Ernest Bai Koroma implemented these policies against the advice of their own health ministries and the consensus opinion of Ebola experts. Health ministers and Ebola-trained physicians deployed exactly the same arguments that plague and cholera doctors had made in their time, reasoning that coercion would cause the epidemic to spread (1) by severing communication between the population and the state as people resorted to concealment to protect family members, (2) by causing people to take flight, (3) by triggering civil disorder and riot, and (4) by breaking the trust between communities and the medical profession. For besieged chiefs of state, however, the exceptional nature of the threat seemed to justify energetic countermeasures that gave the appearance that they were in control. There was also understandable doubt about what else to do, and generals assured presidents that they had the means to bring the situation under control. In the words of a *New York Times* reporter in Sierra Leone, "The government here is left to pursue the only means at its disposal: coercion."[27]

Liberia's Johnson Sirleaf led the way in deploying force soon after Margaret Chan's terrifying warning in early August and after WHO's PHEIC declaration. This bewildering acronym was all the more concerning because so few knew what the letters signified, except that they announced an emergency. Taking her cue, Johnson Sirleaf proclaimed a full state of emergency

and deployed the police and army in force and combat gear. She then curtailed civil liberties, closed schools, banned assemblages of people, instituted a three-day work week, curbed press freedoms, and announced that Liberia's land borders were sealed. This was the launching of her "action plan"—as two journalists called it, "the toughest measures yet imposed by a West African government to halt the worst Ebola outbreak on record."[28]

Famously, Liberia then quarantined strategic urban communities, in particular the slum neighborhood in Monrovia named West Point because of its location on a sandy peninsula. There, Ebola virus was widely circulating among its seventy thousand residents, who lived in congested plywood shacks with corrugated metal roofs. These structures lacked all sanitary facilities such as running water and flushing toilets, and they faced onto unpaved streets covered in all manner of refuse.

Coincidentally, West Point was also a stronghold of opposition to Johnson Sirleaf's political party. Deploying a military cordon there on August 20, sending coast guard cutters to patrol the waters, and cutting the area off from the outside world generated fear and resistance. For some, it bore the hallmarks of a settling of political scores; for all, it entailed shortages, steep rises in the cost of necessities, and hunger. The cordon seemed especially harsh since the presidential office announced that it would remain in force for ninety days. A boiling point was reached when the quarantine was followed by the opening of a "holding camp," in effect, a lazaretto, for patients transported there from the rest of Monrovia. The perception was that West Point had been chosen for sacrifice. Corruption further heightened tensions because numerous residents were able to cross the line of soldiers by bribes or as a result of cronyism.

Such conditions remind us of similar circumstances in the history of plague and cholera, when military measures of public health gave rise to violence, as they did again in India during the late nineteenth and early twentieth centuries. They also created large-scale upheavals when implemented against cholera wherever they were attempted, from Moscow to Naples. So it is hardly surprising that violence broke out in West Point in the summer of 2014 when frightened and hungry residents were trapped behind military lines.

Especially dangerous flashpoints were the distribution areas for emergency food supplies trucked into West Point by the military. Crowds gathered in the heat, and emotions boiled as people jostled one another and pressed forward to gain access to foodstuffs in case supplies ran out. All the while they also worried about the invisible and poorly understood dangers

of touching one another. Suddenly shockwaves overcame the throng as they discovered that the price of rice had mysteriously tripled, from $0.30 to $0.90 per bag, or the supply of prized necessities had in fact run short. Then, members of the crowd began to pelt the soldiers with rocks and bottles, and pistol shots rang out. Running battles ensued as young men turned in fury against soldiers they saw as their tormentors, bombarding them with every missile they could locate. Residents also stormed the holding camp, liberating patients, destroying equipment, and distributing contaminated mattresses, linen, and instruments that they seized in their frenzy. Ebola thus found new means of spreading. The security forces reasserted control with baton charges, tear gas, and sudden bursts of rifle fire that left people wounded and bleeding on the ground.

Tensions were not limited to West Point and greater Monrovia. Concerned by proliferating epidemic hot spots, as MSF was, the government decided to root out and sequester suspiciously ill patients who had not been reported to the authorities. To implement this plan, Johnson Sirleaf declared a nationwide lockdown and dusk-to-dawn curfew beginning September 19. To enforce the action plan, long convoys of troops fanned out across the country, setting up roadblocks and checkpoints, where they stopped everyone, monitored their temperatures, and took into custody anyone with a temperature higher than 98.6°F. Armed platoons patrolled the streets to detain anyone found out of doors in violation of the lockdown. Then seven thousand teams of health officials and community workers, sardonically dubbed "health sensitizers," set out on their mission. Accompanied by the police, they performed house-to-house searches to hunt down unreported patients in their hiding places. Meanwhile, the military stationed guards at treatment centers to prevent patients and people taken into compulsory surveillance from escaping.

In the countryside the resistance was smaller in scale and attracted less press coverage than riots in the slums of Monrovia, but it was no less tenacious. The international media often chose to portray opposition as the backward-looking resistance of an illiterate populace to modern medicine and science and its atavistic attachment to ancient rituals and tribal customs. The arrival of armed soldiers sent from the capital, however, built on the tensions that surrounded land enclosure. Outsiders, particularly when armed, were deeply suspect, given a long history of unhappy encounters with officialdom and a searing memory of the civil conflicts of the recent past. As in West Point, there were especially sensitive flashpoints in rural areas. The most important was burial. New state decrees included provisions that the

dead be unceremoniously disinfected, packed into double body bags, and hastily buried—normally in unmarked graves—by officially appointed gravediggers wearing protective equipment. This new regulation prevented family members and friends from honoring loved ones, and it negated religious observance. The discovery of a body by a search team thus furnished ample potential for physical confrontations, just as a similar decree had led to clashes in plague-stricken Bombay in 1897–1898.

This tense atmosphere was inflamed by multiple conspiracy theories. One Canadian reporter wrote that people "tell me stories about witchcraft, Ebola witch guns, crazy nurses injecting neighbours with Ebola and government conspiracies."[29] *Untori*, or plague spreaders, were said to be at work, as in the days of the Black Death described by Alessandro Manzoni. Some regarded health-care workers as cannibals or harvesters of body parts for the black market in human organs. The state, rumor also held, had embarked on a secret plot to eliminate the poor. Ebola perhaps was not a disease but a mysterious and lethal chemical. Alternatively, the ongoing land grab was deemed to have found ingenious new methods. Perhaps whites were orchestrating a plan to kill African blacks, or mine owners had discovered a deep seam of ore nearby and wanted to clear the surrounding area.

With this background, resistance in many forms flared up, not as the pitched battles of West Point, but as the guerrilla actions of small rural communities. Villagers erected barriers to prevent army vehicles from advancing, and they fired upon all who approached. Elsewhere, armed with machetes, terrified peasants raided treatment centers to snatch away their relatives, killing or wounding the staff and all who opposed them. In other places, afraid of quarantine more than of the spirits of the dead, people brought out bodies and left them in the streets so that they could not be traced as the deceased patients' contacts. In a number of villages, residents attacked burial teams, forced them to drop their body bags, and chased them away. Everywhere people avoided seeking medical treatment and hid whatever ailments they had in order not to be taken into custody.

In two respects, the preponderance of evidence suggests that popular resistance prevailed. First, it is clear that the state did not emerge from its "action plan" better informed about the true extent of Ebola than it had been before. Second, the action plan did not run its course of ninety days but was set aside in October because it was recognized to be ineffective and counterproductive. Coercion threatened to complicate the task of governance, and it was of no visible use in containing the epidemic. In September and Octo-

ber, the graphs of mortality and morbidity spiked as Ebola reached its height instead of falling.

Even more persuasively, perhaps, after October, coercion lost its raison d'être. The belated but massive international effort to support, and substitute for, local health systems that had collapsed arrived just in time. In August and September the consensus among agencies assessing Ebola in West Africa was that the disease had reached a tipping point where it was poised to escalate out of all control and to create a far larger international pandemic. Already overcrowded treatment centers found themselves forced to turn away infected patients. Joanne Liu commented: "It is impossible to keep up with the sheer number of infected people pouring into facilities. In Sierra Leone, infectious bodies are rotting in the streets. Rather than building new care centers in Liberia, we are forced to build crematoria."[30]

The sudden intervention of major outside powers with trained medical personnel, diagnostic facilities, protective equipment, and an array of well-supplied and well-staffed treatment centers transformed the situation. In October it was possible to abandon coercion and turn instead to strategies based on science—rapid diagnosis, contact tracing, and isolation. In addition, it proved important to persuade communities of the wisdom of having special teams take over burial functions to provide what was termed "safe and dignified burials." Wearing the personal protective equipment, they disinfected and bagged dead bodies. MSF had practiced these functions from the outset, but its resources were unequal to the scale of the emergency.

Results were quickly forthcoming. By November 2015 it became apparent that the international effort was beginning to break chains of transmission. The incidence of new cases trended downward for the first time, and mortality figures declined with them. This downward trend continued without interruption. In the spring of 2015 the campaign was largely one of extinguishing the remaining foci rather than seeking any longer to contain an expanding epidemic. By May Liberia considered itself the first West African country to be free of Ebola. Unfortunately, the announcement was premature as several clusters of cases flared up subsequently, and only at the end of the year was the disease genuinely eliminated. On January 14, 2016, Liberia declared victory. The other two countries followed in its wake. Sierra Leone declared victory on March 7 and Guinea in June. A milestone was passed on March 29 when WHO lifted its PHEIC. Then in December 2016 the United Nations declared the epidemic officially over.

Effects of the Epidemic

From 1976 to 2014, Ebola has appeared in various areas of West and Central Africa (fig. 22.3). But the impact of the 2014 epidemic on West Africa was particularly immense on multiple fronts, most obviously in terms of the burden of death and suffering it imposed on the three nations it ravaged. Patients who survived are often still suffering from the enduring effects of post-Ebola syndrome, and many thousands lost husbands, wives, parents, and other family members. But the indirect medical costs are perhaps far greater, as the epidemic destroyed the already inadequate health-care systems of all three countries.

When Ebola arrived in the Mano River Basin, it forced the closing of the few hospitals and clinics that existed; it decimated the tiny numbers of trained health-care personnel the region possessed; and it entirely monopolized the time and energy of all health-care personnel. As a result, all medical services other than those directed toward Ebola were suspended. Vaccinations were not administered to children, and mathematical models have suggested that as many as sixteen thousand children may have died as a result. At the same time trauma victims injured in road traffic or industrial accidents were turned away; pregnant women received no care before, during, or after birthing; and the campaigns set up to confront other infectious diseases—especially malaria, tuberculosis, and HIV/AIDS—were halted. Those great infections, already prevalent in West Africa, experienced a fearful upsurge during the two years of Ebola. Since agriculture was decimated by the dislocations imposed by both the disease and the coercive measures to combat it, and since real wages tumbled in three of the world's poorest nations, hunger and malnutrition resulted, severely compromising immune systems and preventing normal childhood development. These costs cannot be measured with accuracy, but health officials concur that they are several times higher than the direct costs of fighting Ebola. Maternal deaths alone, resulting from the lack of medical care, are thought to be severalfold higher than the deaths that Ebola caused directly.

Clearly, however, not all costs are medical. The economic effects of the epidemic were also profound. Economists estimate that the direct cost of containing and extinguishing the epidemic of 2013–2016 was approximately US $4.3 billion. But that figure does not measure important secondary effects. Some sectors of the economy were devastated, with tourism the clearest and most evident example. During the epidemic many airlines, including British, Emirates, and Kenya Airways, canceled their flights for a period, and

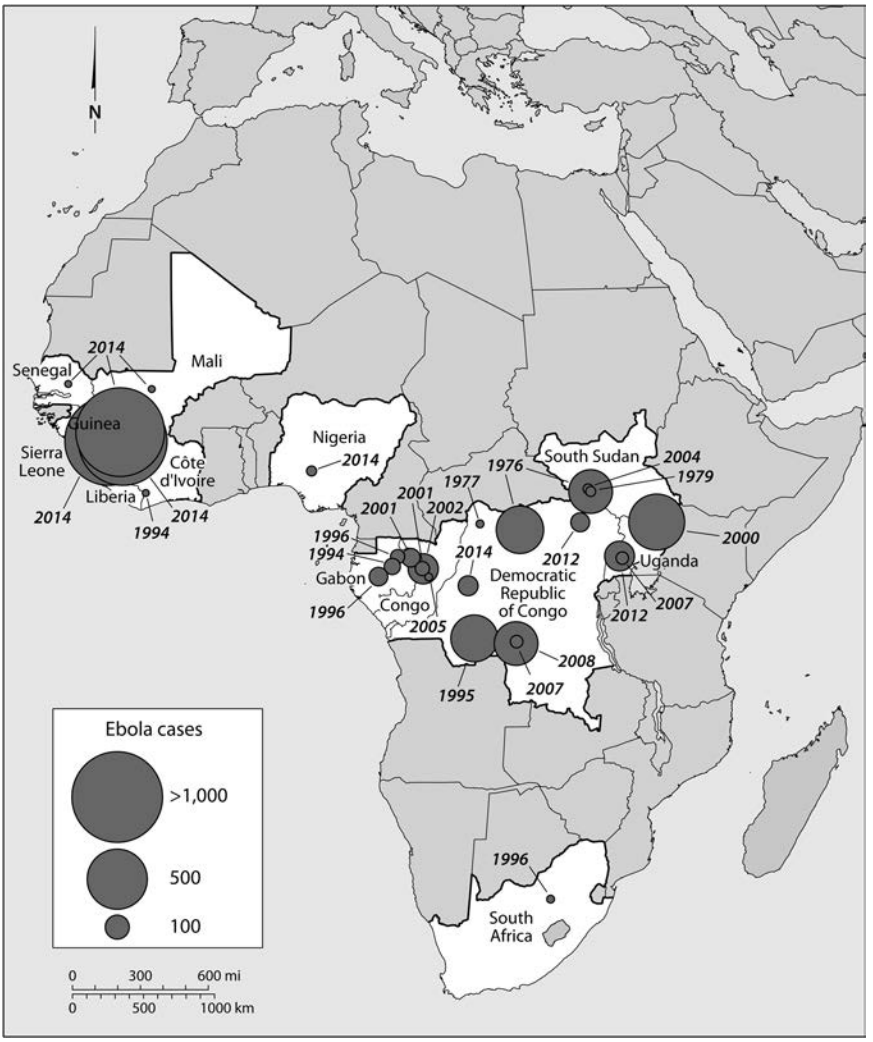

Figure 22.3. Ebola in Africa, 1976–2014. (Map adapted by Bill Nelson.)

travelers, advised by their governments and by common sense, stayed away. Similarly, investment dried up, with significant consequences for employment, growth, and foreign exchange. Businesses closed to protect their employees, and retailers lost their customers. Agriculture was so devastated that production levels were halved in 2015 and unemployment surged, together with poverty and inequality. Since the preexisting health-care infrastructure was shattered, the states also face the expenses of rebuilding hospitals,

training medical personnel to replace those who had died or fled, and confronting the needs of a population that is further impoverished, undernourished, and stricken with infectious diseases. Since schools in the three countries were closed for a year, governments also face the expense of making good the educational deficit.

It is too early to predict what long-term results will follow with regard to such additional considerations as political stability, the development of civil society, and the vulnerability of the countries to civil strife and the ongoing challenge of infectious diseases. The renewed outbreak of Ebola in 2018 is a reminder that, especially in nations of such severe deprivation, continued challenges are inevitable. Indeed, in that context one of the bitterest ironies of the 2013–2016 crisis is that the expense of combatting the epidemic is estimated to be threefold the cost of setting up a functioning health infrastructure. Such an infrastructure perhaps could have prevented the outburst altogether while providing access to care for other afflictions. Emergency response to contain a conflagration already under way is expensive, inefficient, and inhumane.

Conclusion

Ebola painfully exposed the extent of global unpreparedness to face the challenge of epidemic disease despite the warning provided by SARS. But however heavy the burden of suffering in West Africa was, the world was fortunate that the calamity was not greater. By a consensus of informed opinion, Ebola reached the brink of spreading uncontrollably and internationally; it was on the verge of being transmitted across Africa and beyond, with incalculable consequences.

Such a degree of unpreparedness resulted from a combination of circumstances, which are still in effect today. One is the treatment of health as a commodity in the market rather than as a human right. Well before Ebola erupted, market decisions prevented West Africa from having tools to confront the emergency. Pharmaceutical companies prioritize treating the chronic diseases of industrialized nations, where profits are to be made, over the development of drugs and vaccines for the infectious diseases of the impoverished. As a result, tools to deal with diseases like Ebola lag far behind in the pipeline.

A further consequence of the perspective of health-for-profit was painfully evident in 2013–2016. This was the absence of functioning health-care systems accessible to everyone. Ebola circulated silently for months in West

Africa because no means of surveillance were in place. A public health infrastructure and guaranteed access to it are the essential means needed to sound the alarm, provide timely information, isolate infectious cases, and administer treatment. In Guinea, Liberia, and Sierra Leone, no sentinels had been posted, so Ebola, undetected for months, circulated freely.

Treating health as a commodity implies that decisions affecting the life and health of millions are placed in the hands of politicians whose power depends on generating development, trade, and profit. In theory, the nations of West Africa espoused the lofty goal of health for all as embodied in idealistic declarations such as the Millennium Development Goals of 2000, and they pledged themselves to creating health infrastructures at the Abuja conference of 2001. Those objectives were dear to spokespeople for public health, and to medical and humane interests. For political leaders, however, the very different principles enunciated by the World Bank, the International Monetary Fund, and the G8 countries—economic growth, privatization, and unfettered markets rather than public spending—took precedence. In practice, therefore, public health was abandoned. The siren song of military expenditure further completed the diversion of resources away from the construction of a robust health-care infrastructure, leaving West Africa perilously vulnerable.

Finally, Ebola was able to cause an epidemic because of the prevailing illusion that national borders matter in a globalized medical environment. As epidemic disease erupted in the "distant" Mano River Basin, the developed world slumbered in the peaceful belief that disease in Africa was a humanitarian issue at most, not one that raised the dismaying prospect that lives everywhere were directly at stake. But epidemic diseases are an ineluctable part of the human condition, and modernity, with its vast population, teeming cities, and rapid means of transport between them, guarantees that the infectious diseases that afflict one country have the potential to affect all. The public health disaster of West Africa was founded on the failure to make decisions regarding health from the perspective of the sustainable welfare of the human species as a whole rather than the unsustainable interests of individual nations. To survive the challenge of epidemic disease, humanity must adopt an internationalist perspective that acknowledges our inescapable interconnectedness.

The analysis here leads to a disconcerting corollary. The ongoing assault on tropical forests in Central and West Africa explains the fact that, since the emergence of Ebola in 1976, outbreaks of the disease have become more numerous and larger in scale. Nor is there any indication of a halt to

the progression. Indeed, at the time of this book's conclusion in the fall of 2018, the Congo was experiencing yet another outbreak that was rapidly becoming the most extensive in the history of the country. This upsurge began on August 1, 2018—this time in the northeast province of Kivu where the country's borders intersect with those of Rwanda, Burundi, and Uganda.

A hopeful factor in the emergency anti-Ebola response is the availability of a trial vaccine that offers promise and is being administered to healthcare personnel and people at serious risk. Unfortunately, however, the development of such a potentially useful tool is outweighed by powerful negative considerations in addition to the continuing advance of deforestation and the unpreparedness of Congo for a humanitarian emergency. One of these is the presence in Kivu Province of a million refugees from civil disorder. This large population is mobile, highly susceptible to infectious disease, and far beyond the surveillance of a fragile and crumbling health-care system. A further discouraging factor is the fact that Kivu is a war zone torn by strife among rival militias that make the attempt to provide medical care dangerous and largely impracticable. Indeed, the CDC has found it necessary to withdraw its emergency response personnel because they have come under fire and their safety cannot be guaranteed. For these reasons, the virologist Robert Redfield, the director of the CDC at the end of 2018, has warned that he fears two possible consequences that cannot be excluded. One is that, by escaping all control, Ebola for the first time may establish its presence as an endemic disease in Central Africa—with consequences that are unknowable. Redfield's second anxiety is that the epidemic may spread beyond the Congo, with serious international repercussions. It seems likely that the human experience with Ebola virus disease is far from over.

For these reasons, the experience of Ebola clearly indicates three initial steps that urgently need to be taken to prepare for the inevitable—and possibly far greater—next health challenge, whether from Ebola virus or from a different microbe. The first is the establishment of functioning healthcare systems everywhere. As former CDC director William Foege argues, public health is the protection of the health of all, and it therefore implies measures of social justice. Second, it is essential to ensure direction and coordination from an internationalist perspective through a well-funded, competently staffed, and ever-vigilant World Health Organization. The West African epidemic revealed that neither measure has yet been implemented and that, in their absence, the world runs a severe risk of tragic and avoidable suffering.

Lastly, the relationship between the global international system and public health cannot be ignored. An economic system that neglects what economists euphemistically call "negative externalities" will ultimately exact a heavy cost in terms of public health. Chief among these externalities are the negative effects of certain models of development on the relationship between human beings and their natural and societal environments. The establishment of oil palm monocropping and chaotic, unplanned urbanization in West and Central Africa are just two examples among many. Epidemic diseases are not random events. As we have seen throughout this book, they spread along fault lines marked by environmental degradation, overpopulation, and poverty. If we wish to avoid catastrophic epidemics, it will therefore be imperative to make economic decisions that give due consideration to the public health vulnerabilities that result and to hold the people who make those decisions accountable for the foreseeable health consequences that follow. In the ancient but pertinent wisdom, *salus populi suprema lex esto*—public health must be the highest law—and it must override the laws of the marketplace.

This page intentionally left blank