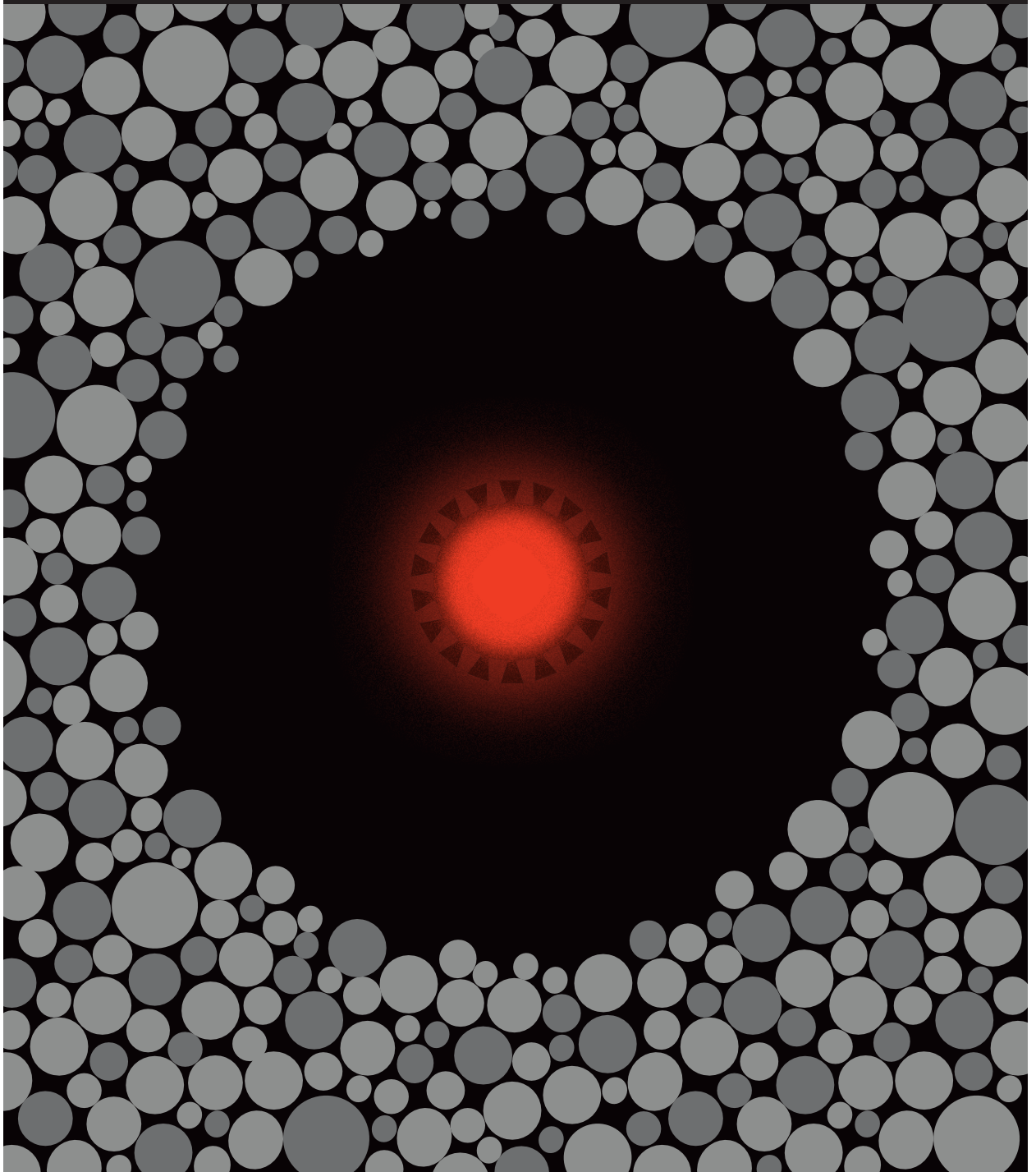




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Why the World Was
Not Prepared for COVID-19



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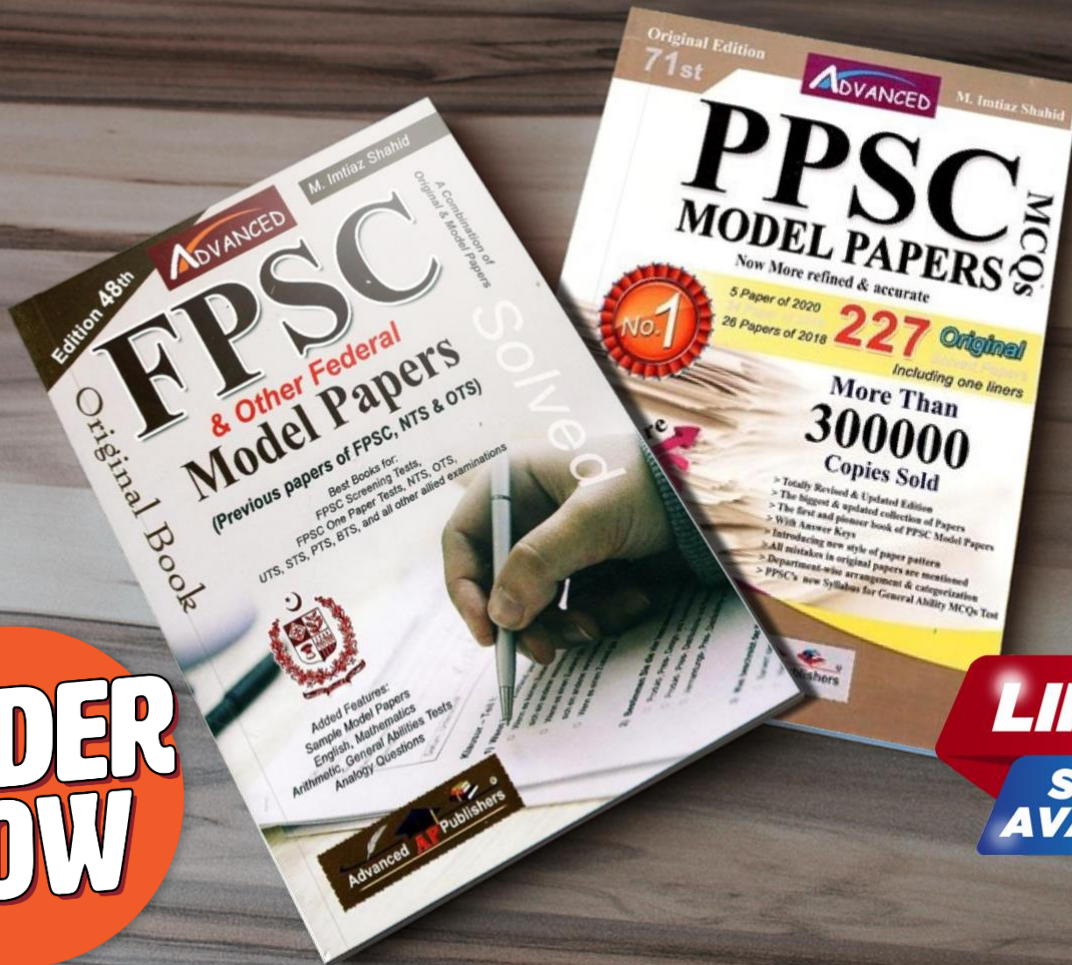
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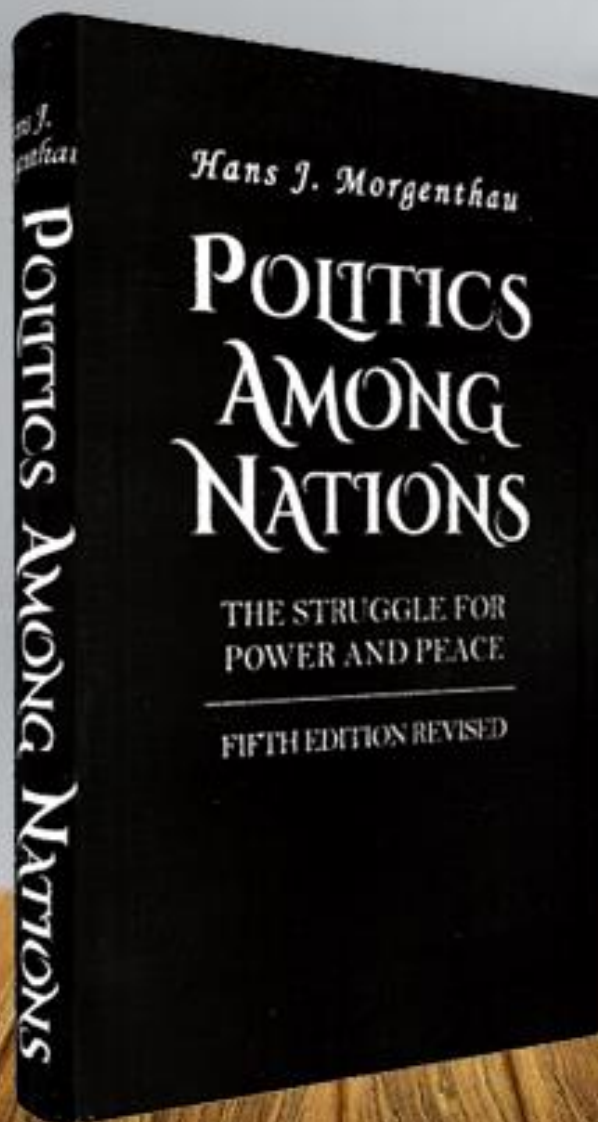
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The Next Pandemic

Why the World Was Not Prepared for COVID-19

May 2020

Introduction 1

RAISING THE ALARM

July/August 2020

Chronicle of a Pandemic Foretold 3

**Learning From the COVID-19 Failure—Before the Next
Outbreak Arrives**

Michael T. Osterholm and Mark Olshaker

January/February 1996

The Return of Infectious Disease 19

Laurie Garrett

July/August 2005

Preparing for the Next Pandemic 32

Michael T. Osterholm

July/August 2005

The Human-Animal Link 44

William B. Karesh and Robert A. Cook

March/April 2007

Unprepared for a Pandemic 56

Michael T. Osterholm

THE GLOBAL HEALTH RESPONSE

January/February 2007

The Challenge of Global Health 67

Laurie Garrett

September/October 2015

Ebola's Lessons 90

How the WHO Mishandled the Crisis

Laurie Garrett

August 6, 2018

How Congo Beat the Last Ebola Outbreak 118

The Crucial Role of International Cooperation

Ariana A. Berengaut

September/October 2017

Global Health Gets a Checkup 123

A Conversation With Tedros Adhanom Ghebreyesus

LESSONS LOST

November 21, 2017

Ready for a Global Pandemic? 129

The Trump Administration May Be Woefully Underprepared

Tom Inglesby and Benjamin Haas

March 3, 2020

Pandemic Disease Is a Threat to National Security 134

Washington Should Treat It Like One

Lisa Monaco

March 28, 2020

**Ebola Should Have Immunized the United States to the
Coronavirus** 138

**What Washington Failed to Learn From the National
Security Council's Ebola Report**

Christopher Kirchhoff

Introduction

May 2020

Why wasn't the world better prepared for the novel coronavirus? COVID-19, the disease caused by the virus, was first detected in Wuhan, China, in late 2019. By January 25, 2020, there were more than 1,000 reported cases in nearly a dozen countries. On March 11, the World Health Organization declared the outbreak a pandemic—at that point, the contagion had affected more than 100 countries. By early April, cases worldwide numbered in the millions.

The coronavirus spread rapidly and exponentially, and even in the countries hit late by the disease, governments had only a short window to try to boost health-care capacity, enact social-distancing measures, and brace for the economic shock. But the threat of pandemic disease is not new—for decades, public health experts warned that an outbreak of global proportions was on the horizon and that the world would not be equipped to fight it when it arrived.

In this anthology, *The Next Pandemic, Foreign Affairs* explores these early warnings of an impending health crisis, from Laurie Garrett's "The Return of Infectious Disease" in 1996 to Michael T. Osterholm's "Preparing for the Next Pandemic" in 2005. Next, we examine the responses to previous outbreaks, from HIV/AIDS to SARS to Ebola, and how many of those lessons failed to stick, leaving governments and international institutions to repeat past mistakes. We also turn to the outbreaks still to come. As Osterholm and Mark Olshaker write in "Chronicle of a Pandemic Foretold," planning for the next global health emergency should begin now. A new pathogen may be deadlier and more infectious than the novel coronavirus, and it could appear without notice. If the staggering toll of the current pandemic is any indication, most countries are far from ready to handle it when it does. Perhaps this time the world will heed the warning. 🌐



RAISING THE ALARM

Chronicle of a Pandemic Foretold

Learning From the COVID-19 Failure—
Before the Next Outbreak Arrives

Michael T. Osterholm and Mark Olshaker

JULY/AUGUST 2020

“**T**ime is running out to prepare for the next pandemic. We must act now with decisiveness and purpose. Someday, after the next pandemic has come and gone, a commission much like the 9/11 Commission will be charged with determining how well government, business, and public health leaders prepared the world for the catastrophe when they had clear warning. What will be the verdict?”

That is from the concluding paragraph of an essay entitled “Preparing for the Next Pandemic” that one of us, Michael Osterholm, published in these pages in 2005. The next pandemic has now come, and even though COVID-19, the disease caused by the new coronavirus that emerged in late 2019, is far from gone, it is not too soon to reach a verdict on the world’s collective preparation. That verdict is a damning one.

There are two levels of preparation, long range and short range, and government, business, and public health leaders largely failed on both. Failure on the first level is akin to having been warned by meteorologists that a Category 5 hurricane would one day make a direct hit on New Orleans and doing nothing to strengthen levies, construct water-

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They are the authors of *Deadliest Enemy: Our War Against Killer Germs*.

diversion systems, or develop a comprehensive emergency plan. Failure on the second is akin to knowing that a massive low-pressure system is moving across the Atlantic toward the Gulf of Mexico and not promptly issuing evacuation orders or adequately stocking emergency shelters. When Hurricane Katrina hit New Orleans on August 29, 2005, preparation on both levels was inadequate, and the region suffered massive losses of life and property as a result. The analogous failure both over recent decades to prepare for an eventual pandemic and over recent months to prepare for the spread of this particular pandemic has had an even steeper toll, on a national and global scale.

The long-term failure by governments and institutions to prepare for an infectious disease outbreak cannot be blamed on a lack of warning or an absence of concrete policy options. Nor should resources have been the constraint. After all, in the past two decades, the United States alone has spent countless billions on homeland security and counterterrorism to defend against human enemies, losing sight of the demonstrably far greater threat posed by microbial enemies; terrorists don't have the capacity to bring Americans' way of life to a screeching halt, something COVID-19 accomplished handily in a matter of weeks. And then, in addition to the preparations that should have been started many years ago, there are the preparations that should have started several months ago, as soon as reports of an unknown communicable disease that could kill started coming out of China.

The public health community has for years known with certainty that another major pandemic was on the way, and then another one after that—not if but when. Mother Nature has always had the upper hand, and now she has at her disposal all the trappings of the modern world to extend her reach. The current crisis will eventually end, either when a vaccine is available or when enough of the global population has developed immunity (if lasting immunity is even possible), which would likely require some two-thirds of the total population to become infected. Neither of those ends will come quickly, and the human and economic costs in the meantime will be enormous.

Yet some future microbial outbreak will be bigger and deadlier still. In other words, this pandemic is probably not “the Big One,” the prospect of which haunts the nightmares of epidemiologists and public health officials everywhere. The next pandemic will most likely be a novel influenza virus with the same devastating impact as the pandemic of 1918, which circled the globe two and a half times over the

course of more than a year, in recurring waves, killing many more people than the brutal and bloody war that preceded it.

Examining why the United States and the world are in this current crisis is thus not simply a matter of accountability or assigning blame. Just as this pandemic was in many ways foretold, the next one will be, as well. If the world doesn't learn the right lessons from its failure to prepare and act on them with the speed, resources, and political and societal commitment they deserve, the toll next time could be considerably steeper. Terrible as it is, COVID-19 should serve as a warning of how much worse a pandemic could be—and spur the necessary action to contain an outbreak before it is again too late.

WAKE-UP CALL

For anyone who wasn't focused on the threat of an infectious disease pandemic before, the wake-up call should have come with the 2003 outbreak of SARS. A coronavirus—so named because, under an electron microscope, the proteins projecting out from the virion's surface resemble a corona, a halo-like astronomical phenomenon—jumped from palm civets and ferret badgers in the markets of Guangdong, China, made its way to Hong Kong, and then spread to countries around the world. By the time the outbreak was stopped, the animal sources eliminated from the markets, and infected people isolated, 8,098 cases had been reported and 774 people had died.

Nine years later, in 2012, another life-threatening coronavirus, MERS, spread across the Arabian Peninsula. In this instance, the virus originated in dromedaries, a type of camel. (Since camel owners in the Middle East understandably will not kill their valuable and culturally important animals, MERS remains a regional public health challenge.) Both coronaviruses were harbingers of things to come (as we wrote in our 2017 book, *Deadliest Enemy*), even if, unlike COVID-19, which can be transmitted by carriers not even aware they have it, SARS and MERS tend not to become highly infectious until the fifth or sixth day of symptomatic illness.

SARS, MERS, and a number of other recent outbreaks—the 2009 H1N1 flu pandemic that started in Mexico, the 2014–16 Ebola epidemic in West Africa, the 2015–16 spread of the Zika flavivirus from the Pacific Islands to North and South America—have differed from one another in a number of ways, including their clinical presentation, their degree of severity, and their means of transmission. But all have had one notable thing in common: they all came as surprises, and they shouldn't have.

For years, epidemiologists and public health experts had been calling for the development of concrete plans for handling the first months and years of a pandemic. Such a “detailed operational blueprint,” as “Preparing for the Next Pandemic” put it in 2005, would have to involve everyone from private-sector food producers, medical suppliers, and health-care providers to public-sector health, law enforcement, and emergency-management officials. And it would have to anticipate “the pandemic-related collapse of worldwide trade . . . the first real test of the resiliency of the modern global delivery system.” Similar calls came from experts and officials around the world, and yet they largely went unheeded.

PREEXISTING CONDITIONS

If anything, despite such warnings, the state of preparedness has gotten worse rather than better in recent years—especially in the United States. The problem was not just deteriorating public health infrastructure but also changes in global trade and production.

During the 2003 SARS outbreak, few people worried about supply chains. Now, global supply chains are significantly complicating the U.S. response. The United States has become far more dependent on China and other nations for critical drugs and medical supplies. The Center for Infectious Disease Research and Policy at the University of Minnesota (where one of us, Osterholm, is the director) has identified 156 acute critical drugs frequently used in the United States—the drugs without which patients would die within hours. All these drugs are generic; most are now made overseas; and many of them, or their active pharmaceutical ingredients, are manufactured in China or India. A pandemic that idles Asian factories or shuts down shipping routes thus threatens the already strained supply of these drugs to Western hospitals, and it doesn’t matter how good a modern hospital is if the bottles and vials on the crash cart are empty. (And in a strategic showdown with its great-power rival, China might use its ability to withhold critical drugs to devastating effect.)

Financial pressure on hospitals and health systems has also left them less able to handle added stress. In any pandemic-level outbreak, a pernicious ripple effect disturbs the health-care equilibrium. The stepped-up need for ventilators and the tranquilizing and paralytic drugs that accompany their use produce a greater need for kidney dialysis and the therapeutic agents that requires, and so on down the line. Even speculation that the antimalarial hydroxy-

chloroquine might be useful in the treatment of COVID-19 caused a shortage of the drug for patients with rheumatoid arthritis and lupus, who depend on it for their daily well-being. It remains unclear what impact COVID-19 has had on the number of deaths due to other conditions, such as heart attacks. Even if it's mostly a matter of patients with severe or life-threatening chronic conditions avoiding care to minimize their risk of exposure to the virus, this could ultimately prove to be serious collateral damage of the pandemic.

In normal times, the United States' hospitals have little in the way of reserves and therefore little to no surge capacity for emergency situations: not enough beds, not enough emergency equipment such as mechanical ventilators, not enough N95 masks and other personal protective equipment (PPE). The result during a pandemic is the equivalent of sending soldiers into battle without enough helmets or rifles.

The National Pharmaceutical Stockpile was created during the Clinton administration and renamed the Strategic National Stockpile in 2003. It has never had sufficient reserves to meet the kind of crisis underway today, and it is fair to say that no administration has devoted the resources to make it fully functional in a large-scale emergency.

Even more of an impediment to a rapid and efficient pandemic response is underinvestment in vaccine research and development. In 2006, Congress established the Biomedical Advanced Research and Development Authority (BARDA). Its charge is to provide an integrated and systematic approach to the development and purchase of vaccines, drugs, and diagnostic tools that will become critical in public health emergencies. But it has been chronically underfunded, and the need to go to Congress and ask for new money every year has all but killed the possibility of major long-term projects.

Following the 2014–16 West African Ebola outbreak, there was a clear recognition of the inadequacy of international investment in new vaccines for regional epidemic diseases such as Ebola, Lassa fever, Nipah virus disease, and Zika, despite the efforts of BARDA and other international philanthropic government programs. To address this hole in preparedness, CEPI, the Coalition for Epidemic Preparedness Innovations, a foundation that receives support from public, private, philanthropic, and civil society organizations, was conceived in 2015 and formally launched in 2017. Its purpose is to finance independent research projects to develop vaccines against emerging infectious diseases. It was initially supported with \$460 million from the Bill &

Melinda Gates Foundation, the Wellcome Trust, and a consortium of nations, including Germany, Japan, and Norway. Although CEPI has been a central player since early this year in developing a vaccine for SARS-CoV-2, the virus that causes COVID-19, the absence of a prior major coronavirus vaccine initiative highlights the ongoing underinvestment in global infectious disease preparedness.

Had the requisite financial and pharmaceutical resources gone into developing a vaccine for SARS in 2003 or MERS in 2012, scientists already would have done the essential research on how to achieve coronavirus immunity, and there would likely be a vaccine platform on which to build (such a platform is a technology or modality that can be developed for a range of related diseases). Today, that would have saved many precious months or even years.

FIRST SYMPTOMS

By late 2019, the lack of long-range preparation had gone on for years, despite persistent warnings. Then, the short-range failure started. Early surveillance data suggested to epidemiologists that a microbial storm was brewing. But the action to prepare for that storm came far too slowly.

By the last week of December, reports of a new infectious disease in the Chinese city of Wuhan and surrounding Hubei Province were starting to make their way to the United States and around the world. There is no question that the Chinese government suppressed information during the first weeks of the outbreak, evident especially in the shameful attempt to silence the warnings of Li Wenliang, the 34-year-old ophthalmologist who tried to alert the public about the threat. Yet even with such dissembling and delay, the warning signs were clear enough by the start of this year. For example, the Center for Infectious Disease Research and Policy published its first description of the mystery disease on December 31 and publicly identified it as a novel coronavirus on January 8. And by January 11, China had published the complete genetic sequence for the virus, at which point the World Health Organization (WHO) immediately began developing a diagnostic test. By the second half of January, epidemiologists were warning of a potential pandemic (including one of us, Osterholm, on January 20). Yet the U.S. government at the time was still dismissing the prospect of a serious outbreak in the United States—despite valid suspicions that the Chinese government was suppressing information on the

Wuhan outbreak and underreporting case figures. It was the moment when preparation for a specific coming storm should have started in earnest and quickly shifted into high gear.

U.S. President Donald Trump would later proffer the twin assertions that he “felt it was a pandemic long before it was called a pandemic” and that “nobody knew there’d be a pandemic or an epidemic of this proportion.” But on January 29, Peter Navarro, Trump’s trade adviser, wrote a memo to the National Security Council warning that when the coronavirus in China reached U.S. soil, it could risk the health or lives of millions and cost the economy trillions of dollars. That same day, as reported by *The Wall Street Journal*, Alex Azar, the health and human services secretary, told the president that the potential epidemic was well under control. Navarro sent an even more urgent memo on February 23, according to *The New York Times*, pointing to an “increasing probability of a full-blown COVID-19 pandemic that could infect as many as 100 million Americans, with a loss of life of as many as 1–2 million souls.”

Washington’s lack of an adequate response to such warnings is by now a matter of public record. Viewing the initially low numbers of clinically recognized cases outside China, key U.S. officials were either unaware of or in denial about the risks of exponential viral spread. If an infectious disease spreads from person to person and each individual case causes two more, the total numbers will remain low for a while—and then take off. (It’s like the old demonstration: if you start out with a penny and double it every day, you’ll have just 64 cents after a week and \$81.92 after two weeks, and then more than \$5 million by the end of a month.) COVID-19 cases do not typically double overnight, but every five days is a pretty good benchmark, allowing for rapid growth even from just a few cases. Once the virus had spread outside East Asia, Iran and Italy were the first to experience this effect.

Even with the lack of long-range planning and investment, there was much that the U.S. government could and should have done by way of a short-range response. As soon as the novel and deadly coronavirus was identified, Washington could have conducted a quick but comprehensive review of national PPE requirements, which would have led to the immediate ramping up of production for N95 masks and protective gowns and gloves and plans to produce more mechanical ventilators. Relying on the experience of other countries, it should have put in place a comprehensive test-manufacturing capability and been ready to institute testing and contact tracing while the num-

ber of cases was still low, containing the virus as much as possible wherever it cropped up. It could have appointed a supply chain coordinator to work with governors, on a nonpartisan basis, to allocate and distribute resources. At the same time, Congress could have been drafting emergency-funding legislation for hospitals, to prepare them for both the onslaught of COVID-19 patients and the sharp drop in elective surgeries, routine hospitalizations, and visits by foreign visitors, essential sources of revenue for many institutions.

Instead, the administration resisted calls to advise people to stay at home and practice social distancing and was unable or unwilling to coordinate a government-wide effort among relevant agencies and departments. The Centers for Disease Control and Prevention initially shipped its own version of a test to state public health labs, only to find that it didn't work. This should have immediately triggered an elevation of the issue to a crisis-driven priority for both the CDC and the U.S. Food and Drug Administration, including bringing the private clinical laboratory industry into the process to help manufacture test kits. Instead, the problem languished, and the FDA took until the end of February to approve any independent tests. At that point, the United States had 100 or so recognized cases of COVID-19. A little over a week later, the number would break 1,000, and after that, the president declared a national emergency.

In 1918, cities that reacted to the flu early, preventing public gatherings and advising citizens to stay home, suffered far fewer casualties overall. But for this approach to work, they had to have reliable information from central authorities in public health and government, which requires honesty, responsiveness, and credibility from the beginning. In the current crisis, the output from the White House was instead—and continues to be—a stream of self-congratulatory tweets, mixed messages, and contradictory daily briefings in which Trump simultaneously asserted far-reaching authority and control and denied responsibility for anything that went wrong or didn't get done. Everything was the governors' responsibility and fault—including not planning ahead, the very thing the administration refused to do. Two years earlier, it had even disbanded the pandemic-readiness arm of the National Security Council.

"You go to war with the army you have, not the army you might want or wish to have at a later time," U.S. Secretary of Defense Don-

ald Rumsfeld famously declared in 2004, addressing U.S. troops on the way to Iraq, where the military's vehicles lacked armor that could protect the service members inside from explosive devices. That grim message could apply to the pandemic response, too, with, for example, frontline health-care workers going to war against COVID-19 without PPE. But in many ways, the current situation is even worse. The United States and other countries went to war against a rapidly spreading infectious disease without a battle plan, sufficient personnel, adequate facilities or stocks of equipment and supplies, a reliable supply chain, centralized command, or a public educated about or prepared for the struggle ahead.

In the absence of strong and consistent federal leadership, state governors and many large-city mayors have taken the primary responsibility of pandemic response on themselves, as they had to, given that the White House had even advised them to find their own ventilators and testing supplies. (And health-care workers, forced into frontline treatment situations without adequate respiratory protection, are of course the hero-soldiers of this war.) But fighting the virus effectively demands that decision-makers start thinking strategically—to determine whether the actions being taken right now are effective and evidence-based—or else little will be accomplished despite the best of intentions. In this regard, it is not too late for the United States to take on its traditional leadership role and be an example in this fight, rather than lagging behind, as it has so far, places such as Germany, Hong Kong, Singapore, and South Korea, and even, despite its initial missteps, China.

THE BIG ONE

Why did so many policymakers ignore the virus until it was too late to slow it down? It's not a failure of imagination that prevented them from understanding the dimensions and impact of a mass infectious disease outbreak. In the United States, numerous high-level simulated bioterror and pandemic tabletop exercises—from Dark Winter in 2001 through Clade X in 2018 and Event 201 in 2019—have demonstrated the confusion, poor decision-making, and lack of coordination of resources and messaging that can undermine a response in the absence of crisis contingency planning and preparation. The problem is mainly structural, one that behavioral economists call “hyperbolic discounting.” Because of hyperbolic discounting, explains Eric Dezen-

hall, a crisis manager and one-time Reagan White House staffer who has long studied the organizational reasons for action and inaction in government and business, leaders “do what is easy and pays immediate dividends rather than doing what is hard, where the dividends seem remote. . . . With something like a pandemic, which sounds like a phenomenon from another century, it seems too remote to plan for.”

The phenomenon is hardly new. Daniel Defoe relates in *A Journal of the Plague Year* that in 1665, municipal authorities in London first refused to accept that anything unusual was happening, then tried to keep information from the public, until the spike in deaths made it impossible to deny the much-feared bubonic plague. By that point, all they could do was lock victims and their families in their homes in a vain attempt to stop the spread.

Short of a global thermonuclear war and the long-term impact of climate change, an infectious disease pandemic has the greatest potential to devastate health and economic stability across the globe. All other types of disasters and calamities are limited in geography and duration—whether a hurricane, an earthquake, or a terrorist attack. A pandemic can occur everywhere at once and last for months or years.

Worldwide mortality estimates for the 1918 influenza pandemic range as high as 100 million—as a percentage of the global population, equivalent to more than 400 million people today—making it easily the worst natural disaster in modern times. So profound were the pandemic’s effects that average life expectancy in the United States immediately fell by more than ten years. Unlike a century ago, the world today has four times the population; more than a billion international border crossings each year; air travel that can connect almost any two points on the globe in a matter of hours; wide-scale human encroachment on forests and wildlife habitats; developing-world megacities in which impoverished people live in close confines with others and without adequate nutrition, sanitation, or medical care; industrial farming in which animals are kept packed together; a significant overuse of antibiotics in both human and animal populations; millions of people living cheek by jowl with domestic birds and livestock (creating what are essentially genetic reassortment laboratories); and a dependence on international just-in-time supply chains with much of the critical production concentrated in China.

The natural tendency might be to reassuringly assume that a century’s worth of medical progress will make up for such added vulner-

abilities. (The human influenza virus wasn't even discovered until 1933, when the virologists Wilson Smith, Christopher Andrewes, and Patrick Laidlaw, working at London's National Institute for Medical Research, first isolated the influenza A virus from the nasal secretions and throat washings of infected patients.) That would be a grave misconception. Even in a nonpandemic year, aggregated infectious diseases—including malaria, tuberculosis, HIV/AIDS, seasonal influenza, and diarrheal and other vector-borne illnesses—represent one of the major causes of death worldwide and by far the leading cause of death in low-income countries, according to the WHO.

In fact, given those realities of modern life, a similarly virulent influenza pandemic would be exponentially more devastating than the one a century ago—as the current pandemic makes clear. In the absence of a reliable vaccine produced in sufficient quantities to immunize much of the planet, all the significant countermeasures to prevent the spread of COVID-19 have been nonmedical: avoiding public gatherings, sheltering in place, social distancing, wearing masks of variable effectiveness, washing hands frequently. As of this writing, scientists and policymakers don't even have a good handle on how many of the RT-PCR tests that determine whether an individual has the virus and how many of the serology tests that detect antibodies and determine whether someone has already had it are even reliable. Meanwhile, international demand for reagents—the chemicals that make both kinds of tests work—and sampling swabs is already outstripping supply and production. It is hard to conclude that the world today is much better equipped to combat a massive pandemic than doctors, public health personnel, and policymakers were 100 years ago.

Some are calling the COVID-19 pandemic a once-in-100-year event, comparable to 100-year floods or earthquakes. But the fact that the world is enduring a pandemic right now is no more predictive of when the next one will occur than one roll of dice is of the result of the next roll. (Although the 1918 flu was the most devastating influenza pandemic in history, an 1830–32 outbreak was similarly severe, only in a world with around half of 1918's population.) The next roll, or the one after that, could really be “the Big One,” and it could make even the current pandemic seem minor by comparison.

When it comes, a novel influenza pandemic could truly bring the entire world to its knees—killing hundreds of millions or more, devastating commerce, destabilizing governments, skewing the course of

history for generations to come. Unlike COVID-19, which tends to most seriously affect older people and those with preexisting medical problems, the 1918 influenza took a particularly heavy toll on otherwise healthy men and women between the ages of 18 and 40 (thought to be a result of their more robust immune systems overreacting to the threat through a “cytokine storm”). There is no reason to think that the next big novel influenza pandemic couldn’t have similar results.

PLANS VS. PLANNING

Humans do not have the power to prevent all epidemics or pandemics. But with the sufficient will, resources, and commitment, we do have the power to mitigate their awesome potential for causing premature deaths and attendant misery.

To begin with, Americans must change how they think about the challenge. Although many people in the public health sphere don’t like associating themselves with the military—they heal rather than kill, the thinking goes—there is much that they can learn from military planning. The military focuses on flexibility, logistics, and maintaining readiness for any foreseeable situation. As U.S. General Dwight Eisenhower noted, “Peace-time plans are of no particular value, but peace-time planning is indispensable.”

The starting point should be to prioritize health threats in terms of their likelihood and potential consequences if unchecked. First on that list is a deadly virus that spreads by respiratory transmission (coughing, sneezing, even simple breathing). By far the most likely candidate would be another high-mortality influenza strain, like the 1918 one, although as revealed by SARS, MERS, Zika, and COVID-19, new and deadly noninfluenza microbes are emerging or mutating in unpredictable and dangerous ways.

Even before a specific threat has arisen, a broad group of actors should be brought together to develop a comprehensive strategy—with enough built-in flexibility that it can evolve as conditions demand—and then they should repeatedly review and rehearse it. That effort should involve everyone from high-level government and public health officials to emergency responders, law enforcement, medical experts and suppliers, food providers, manufacturers, and specialists in transportation and communications. (As emergency planners are fond of saying, you don’t want to be exchanging business cards at a disaster site.) The strategy should offer an operational blueprint for

how to get through the one or two years a pandemic would likely last; among the benefits of such a blueprint would be helping ensure that leaders are psychologically prepared for what they might face in a crisis, just as military training does for soldiers anticipating battlefield conditions. The Bipartisan Commission on Biodefense—jointly chaired by Tom Ridge, the first secretary of homeland security, under President George W. Bush, and a former Pennsylvania governor, and Joseph Lieberman, a former Democratic senator from Connecticut—has suggested that the operation could be located in the Office of the Vice President, with direct reporting to the president. Wherever it is based, it must be run by a smart and responsible coordinator, experienced in the mechanics of government and able to communicate effectively with all parties—as Ron Klain was as Ebola czar in the Obama administration.

In addition to the gaming out of various potential scenarios, adequate preparation must include a military-like model of procurement and production. The military doesn't wait until war is declared to start building aircraft carriers, fighter jets, or other weapons systems. It develops weapons over a period of years, with congressional funding projected over the entire development span. The same type of approach is needed to develop the weapons systems to fight potential pandemics. Relying solely on the market and the private sector to take care of this is a recipe for failure, because in many cases, there will be no viable customer other than the government to fund both the development and the manufacturing process.

That has proved particularly true when it comes to drug development, even when there is no pandemic. For many of the most critical drugs, a market-driven approach that relies on private pharmaceutical companies simply doesn't work. The problem is evident, for example, in the production of antibiotics. Because of the growing problem of antimicrobial resistance—which threatens to bring back a pre-antibiotic dark age, in which a cut or a scrape could kill and surgery was a risk-filled nightmare—it makes little sense for pharmaceutical companies to devote enormous human and financial resources to developing a powerful new antibiotic that might subsequently be restricted to use in only the most extreme cases. But in a flu pandemic, such highly effective antibiotics would be essential, since a primary cause of death in recent flu outbreaks has been secondary bacterial pneumonia infecting lungs weakened by the virus.

The same holds for developing vaccines or treatments for diseases such as Ebola. Such drugs have virtually no sales most of the time but are critical to averting an epidemic when an outbreak strikes. Governments must be willing to subsidize the research, development, clinical trials, and manufacturing capacity for such drugs the same way they subsidize the development and manufacture of fighter planes and tanks.

Preparation for pandemics and for the necessary surge of medical countermeasures will also require being more attentive to where drugs and medical supplies are produced. In times of pandemic, every nation will be competing for the same critical drugs and medical supplies at the same time, so it is entirely reasonable to expect that each will prioritize its own needs when distributing what it produces and controls. There is also the ongoing threat that a localized infectious hot spot will close down a manufacturing facility that produces critical drugs or medical supplies. Despite the higher costs that it would involve, it is absolutely essential that the United States lessen its dependence on China and India for its lifesaving drugs and develop additional manufacturing capacity in the United States itself and in reliably friendly Western nations.

The U.S. government must also get more strategic in overseeing the Strategic National Stockpile. Not only does it need to perform realistic evaluations of what should be on hand to meet surges in demand at any given time, in order to avoid repeating the current shame of not having enough PPE for health-care workers and first responders; supplies should also be rotated in and out on a regular basis, so that, for instance, the store doesn't end up including masks with degraded rubber bands or expired medications.

HOLISTIC TREATMENT

To make progress on either a specific vaccine or a vaccine platform for diseases of pandemic potential, governments have to play a central role. That includes funding basic research, development, and the Phase 3 clinical trials necessary for validation and licensing. (This phase is often referred to as “the valley of death,” because it is the point at which many drugs with early laboratory promise don't pan out in real-world applications.) It is also imperative that governments commit to purchasing these vaccines.

With its current concentration on the development of a vaccine for COVID-19 and other medical countermeasures, BARDA has had to put other projects on the back burner. For all the complaints about its

cumbersome contracting process and tight oversight controls (said by critics to stifle outside-the-box thinking and experimentation), BARDA is the closest thing the U.S. government has to a venture capital firm for epidemic response. COVID-19 should spur a commitment to upgrading it, and a panel of experts should undertake a review of BARDA's annual budget and scope to determine what the agency needs to meet and respond to future biomedical challenges.

Of all the vaccines that deserve priority, at the very top of the list should be a “universal” influenza vaccine, which would be game changing. Twice a year, once for the Northern Hemisphere and once for the Southern Hemisphere, through an observational and not very precise committee process, international public health officials try to guess which flu strains are likely to flare up the next fall, and then they rush a new vaccine based on these guesstimates into production and distribution. The problem is that influenza can mutate and reassort its genes with maddening ease as it passes from one living animal or human host to the next, so each year's seasonal flu vaccine is usually only partly effective—better than nothing, but not a precise and directly targeted bullet like the smallpox or the measles vaccine. The holy grail of influenza immunity would be to develop a vaccine that targets the conserved elements of the virus—that is, the parts that don't change from one flu strain to the next, no matter how many mutations or iterations the virus goes through.

A universal influenza vaccine would require a monumental scientific effort, on the scale of the billion-dollar annual investment that has gone into fighting HIV/AIDS. The price tag would be enormous, but since another population-devouring flu pandemic will surely visit itself on the globe at some point, the expense would be justified many times over. Such a vaccine would be the greatest public health triumph since the eradication of smallpox.

Of course, no single nation can fight a pandemic on its own. Microbes do not respect borders, and they manage to figure out workarounds to restrictions on international air travel. As the Nobel Prize-winning molecular biologist Joshua Lederberg warned, “The microbe that felled one child in a distant continent yesterday can reach yours today and seed a global pandemic tomorrow.” With that insight in mind, there should be a major, carefully coordinated disaster drill every year, similar to the military exercises the United States holds with its allies, but with a much broader range of partners. These should involve governments, public health and emergency-response institu-

tions, and the major medically related manufacturing industries of various nations that will need to work together quickly when worldwide disease surveillance—another vital component of pandemic preparedness—recognizes an outbreak.

The world was able to eradicate smallpox, one of the great scourges of history, because the two superpowers, the United States and the Soviet Union, both committed to doing so, following an appeal at the 1958 convening of the World Health Assembly, the decision-making body of the WHO. Today's tense geopolitics makes such a common commitment hard to achieve. But without it, there is little chance of adequate preparation for the next pandemic. The current global health architecture is far from sufficient. It has little hope of containing an even more threatening outbreak. Instead, something along the lines of NATO will be necessary—a public-health-oriented treaty organization with prepositioned supplies, a deployment blueprint, and an agreement among signatories that an epidemic outbreak in one country will be met with a coordinated and equally vigorous response by all. Such an organization could work in concert with the WHO and other existing institutions but act with greater speed, efficiency, and resources.

It is easy enough to dismiss warnings of another 1918-like pandemic: the next pandemic might not arise in our lifetimes, and by the time it does, science may have come up with robust medical countermeasures to contain it at lower human and economic cost. These are reasonable possibilities. But reasonable enough to collectively bet our lives on? History says otherwise. 🌐

The Return of Infectious Disease

Laurie Garrett

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THE POST-ANTIBIOTIC ERA

Since World War II, public health strategy has focused on the eradication of microbes. Using powerful medical weaponry developed during the postwar period—antibiotics, antimalarials, and vaccines—political and scientific leaders in the United States and around the world pursued a military-style campaign to obliterate viral, bacterial, and parasitic enemies. The goal was nothing less than pushing humanity through what was termed the “health transition,” leaving the age of infectious disease permanently behind. By the turn of the century, it was thought, most of the world’s population would live long lives ended only by the “chronics”—cancer, heart disease, and Alzheimer’s.

The optimism culminated in 1978 when the member states of the United Nations signed the “Health for All, 2000” accord. The agreement set ambitious goals for the eradication of disease, predicting that even the poorest nations would undergo a health transition before the millennium, with life expectancies rising markedly. It was certainly reasonable in 1978 to take a rosy view of *Homo sapiens’* ancient struggle with the microbes; antibiotics, pesticides, chloroquine and other powerful antimicrobials, vaccines, and striking improvements in water

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treatment and food preparation technologies had provided what seemed an imposing armamentarium. The year before, the World Health Organization (WHO) had announced that the last known case of smallpox had been tracked down in Ethiopia and cured.

The grandiose optimism rested on two false assumptions: that microbes were biologically stationary targets and that diseases could be geographically sequestered. Each contributed to the smug sense of immunity from infectious diseases that characterized health professionals in North America and Europe.

Anything but stationary, microbes and the insects, rodents, and other animals that transmit them are in a constant state of biological flux and evolution. Darwin noted that certain genetic mutations allow plants and animals to better adapt to environmental conditions and so produce more offspring; this process of natural selection, he argued, was the mechanism of evolution. Less than a decade after the U.S. military first supplied penicillin to its field physicians in the Pacific theater, geneticist Joshua Lederberg demonstrated that natural selection was operating in the bacterial world. Strains of staphylococcus and streptococcus that happened to carry genes for resistance to the drugs arose and flourished where drug-susceptible strains had been driven out. Use of antibiotics was selecting for ever-more-resistant bugs.

More recently scientists have witnessed an alarming mechanism of microbial adaptation and change—one less dependent on random inherited genetic advantage. The genetic blueprints of some microbes contain DNA and RNA codes that command mutation under stress, offer escapes from antibiotics and other drugs, marshal collective behaviors conducive to group survival, and allow the microbes and their progeny to scour their environments for potentially useful genetic material. Such material is present in stable rings or pieces of DNA and RNA, known as plasmids and transposons, that move freely among microorganisms, even jumping between species of bacteria, fungi, and parasites. Some plasmids carry the genes for resistance to five or more different families of antibiotics, or dozens of individual drugs. Others confer greater powers of infectivity, virulence, resistance to disinfectants or chlorine, even such subtly important characteristics as the ability to tolerate higher temperatures or more acidic conditions. Microbes have appeared that can grow on a bar of soap, swim unabashed in bleach, and ignore doses of penicillin logarithmically larger than those effective in 1950.

In the microbial soup, then, is a vast, constantly changing lending library of genetic material that offers humanity's minute predators myriad ways to outmaneuver the drug arsenal. And the arsenal, large as it might seem, is limited. In 1994 the Food and Drug Administration licensed only three new antimicrobial drugs, two of them for the treatment of AIDS and none an antibacterial. Research and development has ground to a near halt now that the easy approaches to killing viruses, bacteria, fungi, and parasites—those that mimic the ways competing microbes kill one another in their endless tiny battles throughout the human gastrointestinal tract—have been exploited. Researchers have run out of ideas for countering many microbial scourges, and the lack of profitability has stifled the development of drugs to combat organisms that are currently found predominantly in poor countries. "The pipeline is dry. We really have a global crisis," James Hughes, director of the National Center for Infectious Diseases at the Centers for Disease Control and Prevention (CDC) in Atlanta, said recently.

DISEASES WITHOUT BORDERS

During the 1960s, 1970s, and 1980s, the World Bank and the International Monetary Fund devised investment policies based on the assumption that economic modernization should come first and improved health would naturally follow. Today the World Bank recognizes that a nation in which more than ten percent of the working-age population is chronically ill cannot be expected to reach higher levels of development without investment in health infrastructure. Furthermore, the bank acknowledges that few societies spend health care dollars effectively for the poor, among whom the potential for the outbreak of infectious disease is greatest. Most of the achievements in infectious disease control have resulted from grand international efforts such as the expanded program for childhood immunization mounted by the U.N. Children's Emergency Fund and WHO's smallpox eradication drive. At the local level, particularly in politically unstable poor countries, few genuine successes can be cited.

Geographic sequestration was crucial in all postwar health planning, but diseases can no longer be expected to remain in their country or region of origin. Even before commercial air travel, swine flu in 1918–19 managed to circumnavigate the planet five times in 18 months, killing 22 million people, 500,00 in the United States. How

many more victims could a similarly lethal strain of influenza claim in 1996, when some half a billion passengers will board airline flights?

Every day one million people cross an international border. One million a week travel between the industrial and developing worlds. And as people move, unwanted microbial hitchhikers tag along. In the nineteenth century most diseases and infections that travelers carried manifested themselves during the long sea voyages that were the primary means of covering great distances. Recognizing the symptoms, the authorities at ports of entry could quarantine contagious individuals or take other action. In the age of jet travel, however, a person incubating a disease such as Ebola can board a plane, travel 12,000 miles, pass unnoticed through customs and immigration, take a domestic carrier to a remote destination, and still not develop symptoms for several days, infecting many other people before his condition is noticeable.

Surveillance at airports has proved grossly inadequate and is often biologically irrational, given that incubation periods for many incurable contagious diseases may exceed 21 days. And when a recent traveler's symptoms become apparent, days or weeks after his journey, the task of identifying fellow passengers, locating them, and bringing them to the authorities for medical examination is costly and sometimes impossible. The British and U.S. governments both spent millions of dollars in 1976 trying to track down 522 people exposed during a flight from Sierra Leone to Washington, D.C., to a Peace Corps volunteer infected with the Lassa virus, an organism that produces gruesome hemorrhagic disease in its victims. The U.S. government eventually tracked down 505 passengers, scattered over 21 states; British Airways and the British government located 95, some of whom were also on the U.S. list. None tested positive for the virus.

In the fall of 1994 the New York City Department of Health and the U.S. Immigration and Naturalization Service took steps to prevent plague-infected passengers from India from disembarking at New York's John F. Kennedy International Airport. All airport and federal personnel who had direct contact with passengers were trained to recognize symptoms of *Yersinia pestis* infection. Potential plague carriers were, if possible, to be identified while still on the tarmac, so fellow passengers could be examined. Of ten putative carriers identified in New York, only two were discovered at the airport; the majority had long since entered the community. Fortunately, none of the

ten proved to have plague. Health authorities came away with the lesson that airport-based screening is expensive and does not work.

Humanity is on the move worldwide, fleeing impoverishment, religious and ethnic intolerance, and high-intensity localized warfare that targets civilians. People are abandoning their homes for new destinations on an unprecedented scale, both in terms of absolute numbers and as a percentage of population. In 1994 at least 110 million people immigrated, another 30 million moved from rural to urban areas within their own country, and 23 million more were displaced by war or social unrest, according to the U.N. High Commissioner for Refugees and the Worldwatch Institute. This human mobility affords microbes greatly increased opportunities for movement.

THE CITY AS VECTOR

Population expansion raises the statistical probability that pathogens will be transmitted, whether from person to person or vector—insect, rodent, or other—to person. Human density is rising rapidly worldwide. Seven countries now have overall population densities exceeding 2,000 people per square mile, and 43 have densities greater than 500 people per square mile. (The U.S. average, by contrast, is 74.)

High density need not doom a nation to epidemics and unusual outbreaks of disease if sewage and water systems, housing, and public health provisions are adequate. The Netherlands, for example, with 1,180 people per square mile, ranks among the top 20 countries for good health and life expectancy. But the areas in which density is increasing most are not those capable of providing such infrastructural support. They are, rather, the poorest on earth. Even countries with low overall density may have cities that have become focuses for extraordinary overpopulation, from the point of view of public health. Some of these urban agglomerations have only one toilet for every 750 or more people.

Most people on the move around the world come to burgeoning metropolises like India's Surat (where pneumonic plague struck in 1994) and Zaire's Kikwit (site of the 1995 Ebola epidemic) that offer few fundamental amenities. These new centers of urbanization typically lack sewage systems, paved roads, housing, safe drinking water, medical facilities, and schools adequate to serve even the most affluent residents. They are squalid sites of destitution where hundreds of thousands live much as they would in poor villages, yet so jammed

together as to ensure astronomical transmission rates for airborne, waterborne, sexually transmitted, and contact-transmission microbes.

But such centers are often only staging areas for the waves of impoverished people that are drawn there. The next stop is a megacity with a population of ten million or more. In the nineteenth century only two cities on earth—London and New York—even approached that size. Five years from now there will be 24 megacities, most in poor developing countries: Sao Paulo, Calcutta, Bombay, Istanbul, Bangkok, Tehran, Jakarta, Cairo, Mexico City, Karachi, and the like. There the woes of cities like Surat are magnified many times over. Yet even the developing world's megacities are way stations for those who most aggressively seek a better life. All paths ultimately lead these people—and the microbes they may carry—to the United States, Canada, and Western Europe.

Urbanization and global migration propel radical changes in human behavior as well as in the ecological relationship between microbes and humans. Almost invariably in large cities, sex industries arise and multiple-partner sex becomes more common, prompting rapid increases in sexually transmitted diseases. Black market access to antimicrobials is greater in urban centers, leading to overuse or outright misuse of the precious drugs and the emergence of resistant bacteria and parasites. Intravenous drug abusers' practice of sharing syringes is a ready vehicle for the transmission of microbes. Underfunded urban health facilities often become unhygienic centers for the dissemination of disease rather than its control.

THE EMBLEMATIC NEW DISEASE

All these factors played out dramatically during the 1980s, allowing an obscure organism to amplify and spread to the point that who estimates it has infected a cumulative total of 30 million people and become endemic to every country in the world. Genetic studies of the human immunodeficiency virus that causes AIDS indicate that it is probably more than a century old, yet HIV infected perhaps less than .001 percent of the world population until the mid-1970s. Then the virus surged because of sweeping social changes: African urbanization; American and European intravenous drug use and homosexual bathhouse activity; the Uganda-Tanzania war of 1977-79, in which rape was used as a tool of ethnic cleansing; and the growth of the American blood products industry and the international marketing of its contaminated goods. Govern-

ment denial and societal prejudice everywhere in the world led to inappropriate public health interventions or plain inaction, further abetting HIV transmission and slowing research for treatment or a cure.

The estimated direct (medical) and indirect (loss of productive labor force and family-impact) costs of the disease are expected to top \$500 billion by the year 2000, according to the Global AIDS Policy Coalition at Harvard University. The U.S. Agency for International Development predicts that by then some 11 percent of children under 15 in sub-Saharan Africa will be AIDS orphans, and that infant mortality will soar fivefold in some African and Asian nations, due to the loss of parental care among children orphaned by AIDS and its most common opportunistic infection, tuberculosis. Life expectancy in the African and Asian nations hit hardest by AIDS will plummet to an astonishing low of 25 years by 2010, the agency forecasts.

Medical experts now recognize that any microbe, including ones previously unknown to science, can take similar advantage of conditions in human society, going from isolated cases camouflaged by generally high levels of disease to become a global threat. Furthermore, old organisms, aided by mankind's misuse of disinfectants and drugs, can take on new, more lethal forms.

A White House-appointed interagency working group on emerging and reemerging infectious diseases estimates that at least 29 previously unknown diseases have appeared since 1973 and 20 well-known ones have reemerged, often in new drug-resistant or deadlier forms. According to the group, total direct and indirect costs of infectious disease in the United States in 1993 were more than \$120 billion; combined federal, state, and municipal government expenditures that year for infectious disease control were only \$74.2 million (neither figure includes AIDS, other sexually transmitted diseases, or tuberculosis).

THE REAL THREAT OF BIOWARFARE

The world was lucky in the September 1994 pneumonic plague epidemic in Surat. Independent studies in the United States, France, and Russia revealed that the bacterial strain that caused the outbreak was unusually weak, and although the precise figures for plague cases and deaths remain a matter of debate, the numbers certainly fall below 200. Yet the epidemic vividly illustrated three crucial national security issues in disease emergence: human mobility, transparency, and tensions between states up to and including the threat of biological warfare.

When word got out that an airborne disease was loose in the city, some 500,000 residents of Surat boarded trains and within 48 hours dispersed to every corner of the subcontinent. Had the microbe that caused the plague been a virus or drug-resistant bacterium, the world would have witnessed an immediate Asian pandemic. As it was, the epidemic sparked a global panic that cost the Indian economy a minimum of \$2 billion in lost sales and losses on the Bombay stock market, predominantly the result of international boycotts of Indian goods and travelers.

As the number of countries banning trade with India mounted that fall, the Hindi-language press insisted that there was no plague, accusing Pakistan of a smear campaign aimed at bringing India's economy to its knees. After international scientific investigations concluded that *Yersinia pestis* had indeed been the culprit in this bona fide epidemic, attention turned to the bacteria's origin. By last June several Indian scientists claimed to have evidence that the bacteria in Surat had been genetically engineered for biowarfare purposes. Though no credible evidence exists to support it, and Indian government authorities vigorously deny such claims, the charge is almost impossible to disprove, particularly in a region rife with military and political tensions of long standing.

Even when allegations of biological warfare are not flying, it is often exceedingly difficult to obtain accurate information about outbreaks of disease, particularly from countries dependent on foreign investment or tourism or both. Transparency is a common problem; though there is usually no suggestion of covert action or malevolent intent, many countries are reluctant to disclose complete information about contagious illness. For example, nearly every country initially denied or covered up the presence of the HIV virus within its borders. Even now, at least ten nations known to be in the midst of HIV epidemics refuse to cooperate with WHO, deliberately obfuscating incidence reports or declining to provide any statistics. Similarly, Egypt denies the existence of cholera bacteria in the Nile's waters; Saudi Arabia has asked WHO not to warn that travelers to Mecca may be bitten by mosquitoes carrying viruses that cause the new, superlethal dengue hemorrhagic fever; few countries report the appearance of antibiotic-resistant strains of deadly bacteria; and central authorities in Serbia recently rescinded an international epidemic alert when they learned that all the scientists WHO planned to send to the tense Kosovo

region to halt a large outbreak of Crimean-Congo hemorrhagic fever were from the United States, a nation Serbia viewed with hostility.

The specter of biological warfare having raised its head, Brad Roberts of the Center for Strategic and International Studies is particularly concerned that the New Tier nations—developing states such as China, Iran, and Iraq that possess technological know-how but lack an organized civil society that might put some restraints on its use—might be tempted to employ bioweapons. The Federation of American Scientists has sought, so far in vain, a scientific solution to the acute weaknesses of verification and enforcement provisions in the 1972 Biological Weapons Convention, which most of the world's nations have signed.

That treaty's flaws, and the very real possibility of bioweapons use, stand in sharp focus today. Iraq's threat in 1990–91 to use biological weapons in the Persian Gulf conflict found allied forces in the region virtually powerless to respond: the weapons' existence was not verified in a timely manner, the only available countermeasure was a vaccine against one type of organism, and protective gear and equipment failed to stand up to windblown sand. Last June the U.N. Security Council concluded that Iraqi stocks of bioweaponry might have been replenished after the Gulf War settlement.

More alarming were the actions of the Aum Shinrikyo cult in Japan in early 1995. In addition to releasing toxic sarin gas in the Tokyo subway on March 18, cult members were preparing vast quantities of *Clostridium difficile* bacterial spores for terrorist use. Though rarely fatal, clostridium infections often worsen as a result of improper antibiotic use, and long bouts of bloody diarrhea can lead to dangerous colon inflammations. Clostridium was a good choice for biological terrorism: the spores can survive for months and may be spread with any aerosol device, and even slight exposure can make vulnerable people (particularly children and the elderly) sick enough to cost a crowded society like Japan hundreds of millions of dollars for hospitalizations and lost productivity.

The U.S. Office of Technology Assessment has calculated what it would take to produce a spectacular terrorist bioweapon: 100 kilograms of a lethal sporulating organism such as anthrax spread over Washington, D.C., by a crop duster could cause well over two million deaths. Enough anthrax spores to kill five or six million people could be loaded into a taxi and pumped out its tailpipe as it meandered through Manhattan. Vulnerability to terrorist attacks, as well as to the natural emergence of disease, increase with population density.

A WORLD AT RISK

A 1995 WHO survey of global capacity to identify and respond to threats from emerging disease reached troubling conclusions. Only six laboratories in the world, the study found, met security and safety standards that would make them suitable sites for research on the world's deadliest microbes, including those that cause Ebola, Marburg, and Lassa fever. Local political instability threatens to compromise the security of the two labs in Russia, and budget cuts threaten to do the same to the two in the United States (the army's facility at Fort Detrick and the CDC in Atlanta) and the one in Britain. In another survey, WHO sent samples of hantaviruses (such as Sin Nombre, which caused the 1993 outbreak in New Mexico) and organisms that cause dengue, yellow fever, malaria, and other diseases to the world's 35 leading disease-monitoring facilities. Only one—the CDC—correctly identified all the organisms; most got fewer than half right.

Convinced that newly emerging diseases, whether natural or engineered, could endanger national security, the CDC requested \$125 million from Congress in 1994 to bolster what it termed a grossly inadequate system of surveillance and response; it received \$7.3 million. After two years of inquiry by a panel of experts, the Institute of Medicine, a division of the National Academy of Sciences, declared the situation a crisis.

Today's reality is best reflected in New York City's battle with tuberculosis. Control of the W-strain of the disease—which first appeared in the city in 1991–92, is resistant to every available drug, and kills half its victims—has already cost more than \$1 billion. Despite such spending, there were 3,000 TB cases in the city in 1994, some of which were the W-strain. According to the Surgeon General's annual reports from the 1970s and 1980s, tuberculosis was supposed to be eradicated from the United States by 2000. During the Bush administration the CDC told state authorities they could safely lower their fiscal commitments to TB control because victory was imminent. Now public health officials are fighting to get levels down to where they were in 1985—a far cry from elimination. New York's crisis is a result of both immigration pressure (some cases originated overseas) and the collapse of the local public health infrastructure.

National preparedness has further eroded over the past five years in the face of budgetary constraints. Just as WHO cannot intercede in an epidemic unless it receives an invitation from the afflicted country, the

CDC may not enter a U.S. state without a request from the state government. The U.S. system rests on an increasingly shaky network of disease surveillance and response by states and territories. A 1992 survey for the CDC showed that 12 states had no one on staff to monitor microbial contamination of local food and water; 67 percent of the states and territories had less than one employee monitoring the food and water of every one million residents. And only a handful of states were monitoring hospitals for the appearance of unusual or drug-resistant microbes.

State capacity rests on county and municipal public health, and there too weaknesses are acute. In October, dengue hemorrhagic fever, which had been creeping steadily northward from Brazil over the past eight years, with devastating results, struck in Texas. Most Texas counties had slashed their mosquito control budgets and were ill prepared to combat the aggressive Tiger mosquitoes from Southeast Asia that carry the virus. In Los Angeles County that month, a \$2 billion budget shortfall drove officials to close all but 10 of the 45 public health clinics and to attempt to sell four of the county's six public hospitals. Congress is contemplating enormous cuts in Medicare and Medicaid spending, which the American Public Health Association predicts would result in a widespread increase in infectious disease.

PRESCRIPTIONS FOR NATIONAL HEALTH

Bolstering research capacity, enhancing disease surveillance capabilities, revitalizing sagging basic public health systems, rationing powerful drugs to avoid the emergence of drug-resistant organisms, and improving infection control practices at hospitals are only stopgap measures. National security warrants bolder steps.

One priority is finding scientifically valid ways to use polymerase chain reaction (popularly known as DNA fingerprinting), field investigations, chemical and biological export records, and local legal instruments to track the development of new or reemergent lethal organisms, whether natural or bioweapons. The effort should focus not only on microbes directly dangerous to humans but on those that could pose major threats to crops or livestock.

Most emerging diseases are first detected by health providers working at the primary-care level. Currently there is no system, even in the United States, whereby the providers can notify relevant authorities and be assured that their alarm will be investigated promptly. In much of the world, the notifiers' reward is penalties levied against

them, primarily because states want to hush up the problem. But Internet access is improving worldwide, and a small investment would give physicians an electronic highway to international health authorities that bypassed government roadblocks and obfuscation.

Only three diseases—cholera, plague, and yellow fever—are subject to international regulation, permitting U.N. and national authorities to interfere as necessary in the global traffic of goods and persons to stave off cross-border epidemics. The World Health Assembly, the legislative arm of WHO, recommended at its 1995 annual meeting in Geneva that the United Nations consider both expanding the list of regulated diseases and finding new ways to monitor the broad movement of disease. The Ebola outbreak in Kikwit demonstrated that a team of international scientists can be mobilized to swiftly contain a remote, localized epidemic caused by known nonairborne agents.

Were a major epidemic to imperil the United States, the Office of Emergency Preparedness and the National Disaster Medical System (part of the Department of Health and Human Services) would be at the helm. The office has 4,200 private-sector doctors and nurses throughout the 50 states who are at its disposal and committed to rapid mobilization in case of emergency. The system is sound but should be bolstered. Participants should be supplied with protective suits, respirators, mobile containment laboratories, and adequate local isolation facilities.

As for potential threats from biological weapons, the U.S. Department of Energy has identified serious lapses in Russian and Ukrainian compliance with the Biological Weapons Convention. Large stockpiles of bioweapons are believed to remain, and employees of the Soviet program for biological warfare are still on the state payroll. Arsenals are also thought to exist in other nations, although intelligence on this is weak. The location and destruction of such weapons is a critical priority. Meanwhile, scientists in the United States and Europe are identifying the genes in bacteria and viruses that code for virulence and modes of transmission. Better understanding of the genetic mechanisms will allow scientists to manipulate existing organisms, endowing them with dangerous capabilities. It would seem prudent for the United States and the international community to examine that potential now and consider options for the control of such research or its fruits.

To guard against the proliferation of blood-associated diseases, the blood and animal exports industries must be closely regulated, plasma donors must be screened for infections, and an internationally accept-

able watchdog agency must be designated to monitor reports of the appearance of new forms of such diseases. The export of research animals played a role in a serious incident in Germany in which vaccine workers were infected with the Marburg virus and in an Ebola scare in Virginia in which imported monkeys died from the disease.

Nobel laureate Joshua Lederberg of Rockefeller University has characterized the solutions to the threat of disease emergence as multitudinous, largely straightforward and commonsensical, and international in scope; “the bad news,” he says, “is they will cost money.”

Budgets, particularly for health care, are being cut at all levels of government. Dustin Hoffman made more money last year playing a disease control scientist in the movie *Outbreak* than the combined annual budgets for the U.S. National Center for Infectious Diseases and the U.N. Programme on HIV/AIDS. 🌐

Preparing for the Next Pandemic

Michael T. Osterholm

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FEAR ITSELF

Dating back to antiquity, influenza pandemics have posed the greatest threat of a worldwide calamity caused by infectious disease. Over the past 300 years, ten influenza pandemics have occurred among humans. The most recent came in 1957–58 and 1968–69, and although several tens of thousands of Americans died in each one, these were considered mild compared to others. The 1918–19 pandemic was not. According to recent analysis, it killed 50 to 100 million people globally. Today, with a population of 6.5 billion, more than three times that of 1918, even a “mild” pandemic could kill many millions of people.

A number of recent events and factors have significantly heightened concern that a specific near-term pandemic may be imminent. It could be caused by H5N1, the avian influenza strain currently circulating in Asia. At this juncture scientists cannot be certain. Nor can they know exactly when a pandemic will hit, or whether it will rival the experience of 1918–19 or be more muted like 1957–58 and 1968–69. The reality of a coming pandemic, however, cannot be avoided. Only its impact can be lessened. Some important prepara-

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tory efforts are under way, but much more needs to be done by institutions at many levels of society.

THE BACKDROP

Of the three types of influenza virus, influenza type A infects and kills the greatest number of people each year and is the only type that causes pandemics. It originates in wild aquatic birds. The virus does not cause illness in these birds, and although it is widely transmitted among them, it does not undergo any significant genetic change.

Direct transmission from the birds to humans has not been demonstrated, but when a virus is transmitted from wild birds to domesticated birds such as chickens, it undergoes changes that allow it to infect humans, pigs, and potentially other mammals. Once in the lung cells of a mammalian host, the virus can “reassort,” or mix genes, with human influenza viruses that are also present. This process can lead to an entirely new viral strain, capable of sustained human-to-human transmission. If such a virus has not circulated in humans before, the entire population will be susceptible. If the virus has not circulated in the human population for a number of years, most people will lack residual immunity from previous infection.

Once the novel strain better adapts to humans and is easily transmitted from person to person, it is capable of causing a new pandemic. As the virus passes repeatedly from one human to the next, it eventually becomes less virulent and joins the other influenza viruses that circulate the globe each year. This cycle continues until another new influenza virus emerges from wild birds and the process begins again.

Some pandemics result in much higher rates of infection and death than others. Scientists now understand that this variation is a result of the genetic makeup of each specific virus and the presence of certain virulence factors. That is why the 1918–19 pandemic killed many more people than either the 1957–58 or the 1968–69 pandemic.

A CRITICAL DIFFERENCE

Infectious diseases remain the number one killer of humans worldwide. Currently, more than 39 million people live with HIV, and last year about 2.9 million people died of AIDS, bringing the cumulative total of deaths from AIDS to approximately 25 million. Tuberculosis (TB) and malaria also remain major causes of death. In 2003, about 8.8 million people became infected with TB, and the disease killed more than 2 mil-

lion. Each year, malaria causes more than 1 million deaths and close to 5 billion episodes of clinical illness. In addition, newly emerging infections, diarrheal and other vector-borne diseases, and agents resistant to antibiotics pose a serious and growing public health concern.

Given so many other significant infectious diseases, why does another influenza pandemic merit unique and urgent attention? First, of the more than 1,500 microbes known to cause disease in humans, influenza continues to be the king in terms of overall mortality. Even in a year when only the garden-variety strains circulate, an estimated 1–1.5 million people worldwide die from influenza infections or related complications. In a pandemic lasting 12 to 36 months, the number of cases and deaths would rise dramatically.

Recent clinical, epidemiological, and laboratory evidence suggests that the impact of a pandemic caused by the current H5N1 strain would be similar to that of the 1918–19 pandemic. More than half of the people killed in that pandemic were 18 to 40 years old and largely healthy. If 1918–19 mortality data are extrapolated to the current U.S. population, 1.7 million people could die, half of them between the ages of 18 and 40. Globally, those same estimates yield 180–360 million deaths, more than five times the cumulative number of documented AIDS deaths. In 1918–19, most deaths were caused by a virus-induced response of the victim's immune system—a cytokine storm—which led to acute respiratory distress syndrome (ARDS). In other words, in the process of fighting the disease, a person's immune system severely damaged the lungs, resulting in death. Victims of H5N1 have also suffered from cytokine storms, and the world is not much better prepared to treat millions of cases of ARDS today than it was 85 years ago. In the 1957–58 and 1968–69 pandemics, the primary cause of death was secondary bacterial pneumonias that infected lungs weakened by influenza. Although such bacterial infections can often be treated by antibiotics, these drugs would be either unavailable or in short supply for much of the global population during a pandemic.

The arrival of a pandemic influenza would trigger a reaction that would change the world overnight. A vaccine would not be available for a number of months after the pandemic started, and there are very limited stockpiles of antiviral drugs. Plus, only a few privileged areas of the world have access to vaccine-production facilities. Foreign trade and travel would be reduced or even ended in an attempt to stop the virus from entering new countries—even though such efforts would

probably fail given the infectiousness of influenza and the volume of illegal crossings that occur at most borders. It is likely that transportation would also be significantly curtailed domestically, as smaller communities sought to keep the disease contained. The world relies on the speedy distribution of products such as food and replacement parts for equipment. Global, regional, and national economies would come to an abrupt halt—something that has never happened due to HIV, malaria, or TB despite their dramatic impact on the developing world.

The closest the world has come to this scenario in modern times was the SARS (severe acute respiratory syndrome) crisis of 2003. Over a period of five months, about 8,000 people were infected by a novel human coronavirus. About ten percent of them died. The virus apparently spread to humans when infected animals were sold and slaughtered in unsanitary and crowded markets in China's Guangdong Province. Although the transmission rate of SARS paled in comparison to that of influenza, it demonstrated how quickly such an infectious agent can circle the globe, given the ease and frequency of international travel. Once SARS emerged in rural China, it spread to five countries within 24 hours and to 30 countries on six continents within several months.

The SARS experience teaches a critical lesson about the potential global response to a pandemic influenza. Even with the relatively low number of deaths it caused compared to other infectious diseases, SARS had a powerful negative psychological impact on the populations of many countries. In a recent analysis of the epidemic, the National Academy of Science's Institute of Medicine concluded: "The relatively high case-fatality rate, the identification of super-spreaders, the newness of the disease, the speed of its global spread, and public uncertainty about the ability to control its spread may have contributed to the public's alarm. This alarm, in turn, may have led to the behavior that exacerbated the economic blows to the travel and tourism industries of the countries with the highest number of cases."

SARS provided a taste of the impact a killer influenza pandemic would have on the global economy. Jong-Wha Lee, of Korea University, and Warwick McKibbin, of the Australian National University, estimated the economic impact of the six-month SARS epidemic on the Asia-Pacific region at about \$40 billion. In Canada, 438 people were infected and 43 died after an infected person traveled from Hong Kong to Toronto, and the Canadian Tourism Commission estimated that the epidemic cost the nation's economy \$419 million. The

Ontario health minister estimated that SARS cost the province's health-care system about \$763 million, money that was spent, in part, on special SARS clinics and supplies to protect health-care workers. The SARS outbreak also had a substantial impact on the global airline industry. After the disease hit in 2003, flights in the Asia-Pacific area decreased by 45 percent from the year before. During the outbreak, the number of flights between Hong Kong and the United States fell 69 percent. And this impact would pale in comparison to that of a 12- to 36-month worldwide influenza pandemic.

The SARS epidemic also raises questions about how prepared governments are to address a prolonged infectious-disease crisis—particularly governments that are already unstable. Seton Hall University's Yanzhong Huang concluded that the SARS epidemic created the most severe social or political crisis encountered by China's leadership since the 1989 Tiananmen crackdown. China's problems probably resulted less from SARS' public health impact than from the government's failed effort to allay panic by withholding information about the disease from the Chinese people. The effort backfired. During the crisis, Chinese Premier Wen Jiabao pointed out in a cabinet meeting on the epidemic that "the health and security of the people, overall state of reform, development, and stability, and China's national interest and image are at stake." But Huang believes that "a fatal period of hesitation regarding information-sharing and action spawned anxiety, panic, and rumor-mongering across the country and undermined the government's efforts to create a milder image of itself in the international arena."

Widespread infection and economic collapse can destabilize a government; blame for failing to deal effectively with a pandemic can cripple a government. This holds even more for an influenza pandemic. In the event of a pandemic influenza, the level of panic witnessed during the SARS crisis could spiral out of control as illnesses and deaths continued to mount over months and months. Unfortunately, the public is often indifferent to initial warnings about impending infectious-disease crises—as with HIV, for example. Indifference becomes fear only after the catastrophe hits, when it is already too late to implement preventive or control measures.

READY FOR THE WORST

What should the industrialized world be doing to prepare for the next pandemic? The simple answer: far more. So far, the World Health Or-

ganization and several countries have finalized or drafted useful but overly general plans. The U.S. Department of Health and Human Services has increased research on influenza-vaccine production and availability. These efforts are commendable, but what is needed is a detailed operational blueprint for how to get a population through one to three years of a pandemic. Such a plan must involve all the key components of society. In the private sector, the plan must coordinate the responses of the medical community, medical suppliers, food providers, and the transportation system. In the government sector, the plan should take into account officials from public health, law enforcement, and emergency management at the international, federal, state, and local levels.

At the same time, it must be acknowledged that such master blueprints may have their drawbacks, too. Berkeley's Aaron Wildavsky persuasively argued that resilience is the real key to crisis management—overly rigid plans can do more harm than good. Still, planning is enormously useful. It gives government officials, private-sector partners, and the community the opportunity to meet, think through potential dilemmas, purchase necessary equipment, and set up organizational structures for a 12- to 36-month response. A blueprint forces leaders to rehearse their response to a crisis, preparing emotionally and intellectually so that when disaster strikes the community can face it.

Influenza-vaccine production deserves special attention. An initiative to provide vaccine for the entire world must be developed, with a well-defined schedule to ensure progress. It is laudable that countries such as the United States and Vietnam are pursuing programs with long-term goals to develop and produce H5N1 vaccine for their respective populations. But if the rest of the world lacks supplies, even the vaccinated will be devastated when the global economy comes to an abrupt halt. Pandemic-influenza preparedness is by nature an international issue. No one can truly be isolated from a pandemic.

The pandemic-related collapse of worldwide trade and its ripple effect throughout industrialized and developing countries would represent the first real test of the resiliency of the modern global delivery system. Given the extent to which modern commerce relies on the precise and readily available international trade of goods and services, a shutdown of the global economic system would dramatically harm the world's ability to meet the surging demand for essential commodities such as food and medicine during a crisis. The business community can no longer afford to play a minor role in planning the response

to a pandemic. For the world to have critical goods and services during a pandemic, industry heads must stockpile raw materials for production and preplan distribution and transportation support. Every company's senior managers need to be ready to respond rapidly to changes in the availability, production, distribution, and inventory management of their products. There is no model for how to revive the current global economy were it to be devastated.

To truly be complete, all planning on international, regional, national, and local levels must consider three different scenarios: What if the pandemic begins tonight? What if it starts one year from now? What if the world is so fortunate as to have an entire decade to prepare? All are possible, but none is certain.

STARTING TONIGHT

What would happen today in the office of every nation's leader if several cities in Vietnam suffered from major outbreaks of H5N1 infection, with a five percent mortality rate? First, there would be an immediate effort to try to sort out disparate disease-surveillance data from a variety of government and public health sources to determine which countries might have pandemic-related cases. Then, the decision would likely be made to close most international and even some state or provincial borders—without any predetermined criteria for how or when those borders might be reopened. Border security would be made a priority, especially to protect potential supplies of pandemic-specific vaccines from nearby desperate countries. Military leaders would have to develop strategies to defend the country and also protect against domestic insurgency with armed forces that would likely be compromised by the disease. Even in unaffected countries, fear, panic, and chaos would spread as international media reported the daily advance of the disease around the world.

In short order, the global economy would shut down. The commodities and services countries would need to “survive” the next 12 to 36 months would have to be identified. Currently, most businesses' continuity plans account for only a localized disruption—a single plant closure, for instance—and have not planned for extensive, long-term outages. The private and public sectors would have to develop emergency plans to sustain critical domestic supply chains and manufacturing and agricultural production and distribution. The labor force would be severely affected when it was most needed. Over the course of the

year, up to 50 percent of affected populations could become ill; as many as five percent could die. The disease would hit senior management as hard as the rest of the work force. There would be major shortages in all countries of a wide range of commodities, including food, soap, paper, light bulbs, gasoline, parts for repairing military equipment and municipal water pumps, and medicines, including vaccines unrelated to the pandemic. Many industries not critical to survival—electronics, automobile, and clothing, for example—would suffer or even close. Activities that require close human contact—school, seeing movies in theaters, or eating at restaurants—would be avoided, maybe even banned.

Vaccine would have no impact on the course of the virus in the first months and would likely play an extremely limited role worldwide during the following 12 to 18 months of the pandemic. Despite major innovations in the production of most other vaccines, international production of influenza vaccine is based on a fragile and limited system that utilizes technology from the 1950s. Currently, annual production of influenza vaccine is limited to about 300 million trivalent doses—which protect against three different influenza strains in one dose—or less than one billion monovalent doses. To counter a new strain of pandemic influenza that has never circulated throughout the population, each person would likely need two doses for adequate protection. With today's limited production capacity, that means that less than 500 million people—about 14 percent of the world's population—would be vaccinated within a year of the pandemic. In addition, because the structure of the virus changes so rapidly, vaccine development could only start once the pandemic began, as manufacturers would have to obtain the new pandemic strain. It would then be at least another six months before mass production of the vaccine.

Even if the system functions to the best of its ability, influenza vaccine is produced commercially in just nine countries: Australia, Canada, France, Germany, Italy, Japan, the Netherlands, the United Kingdom, and the United States. These countries contain only 12 percent of the world's population. In the event of an influenza pandemic, they would probably nationalize their domestic production facilities, as occurred in 1976, when the United States, anticipating a pandemic of swine influenza (H1N1), refused to share its vaccine.

If a pandemic struck the world today, there would be another possible weapon against influenza: antiviral medicine. When taken daily during the time of exposure to influenza, antivirals have prevented individuals

from becoming ill. They have also reduced the severity of illness and subsequent complications when taken within 48 hours of onset. Although there is no data for H5N1, it is assumed antivirals would also prevent H5N1 infection if taken before exposure. There is no evidence, however, that current antiviral influenza drugs would help if the patient developed the kind of cytokine storm that has characterized recent H5N1 infections. But barring this complication, H5N1 should be treatable with Tamiflu (oseltamivir phosphate), which is manufactured by the Roche pharmaceuticals company in a single plant in Switzerland.

In responding to a pandemic, Tamiflu could have a measurable impact in the limited number of countries with sizable stockpiles, but for most of the world it would not be available. Although the company plans on opening another facility in the United States this year, annual production would still cover only a small percentage of the world's population. To date, at least 14 countries have ordered Tamiflu, but the amount of these orders is enough to treat only 40 million people. The orders take considerable time to be processed and delivered—manufacturing can take up to a year—and in an emergency the company's ability to produce more would be limited. As with vaccines, countries would probably nationalize their antiviral supplies during a pandemic. Even if the medicine were available, most countries could not afford to buy it. Critical antibiotics, for treatment of secondary bacterial infections, would also be in short supply during a pandemic. Even now, supplies of eight different anti-infective agents are limited in the United States due to manufacturing problems.

Aside from medication, many countries would not have the ability to meet the surge in the demand for health-care supplies and services that are normally taken for granted. In the United States, for example, there are 105,000 mechanical ventilators, 75,000 to 80,000 of which are in use at any given time for everyday medical care. During a routine influenza season, the number of ventilators being used shoots up to 100,000. In an influenza pandemic, the United States may need as many as several hundred thousand additional ventilators.

A similar situation exists in all developed countries. Virtually every piece of medical equipment or protective gear would be in short supply within days of the recognition of a pandemic. Throughout the crisis, many of these necessities would simply be unavailable for most health-care institutions. Currently, two U.S.-based companies supply most of the respiratory protection masks for health-care workers

around the world. Neither company would be able to meet the jump in demand, in part because the component parts for the masks come from multiple suppliers in multiple countries. With travel and transportation restricted, masks may not even be produced at all.

Health-care providers and managed-care organizations are also unprepared for an outbreak of pandemic influenza today. There would be a tremendous demand for skilled health professionals. New “hospitals” in high school gymnasiums and community centers would have to be staffed for one to three years. Health-care workers would probably get sick and die at the same rate as the general public—perhaps at an even higher rate, particularly if they lack access to protective equipment. If they lack such fundamental supplies, it is unclear how many professionals would continue to place themselves in high-risk situations by caring for the infected. Volunteers who are naturally immune as a result of having survived influenza infection would thus have to be found and employed. That means that the medical community’s strong resistance to using lay volunteers, which is grounded in both liability concerns and professional hubris, would need to be addressed.

Other unpleasant issues would also need to be tackled. Who would have priority access to the extremely limited antiviral supplies? The public would consider any ad hoc prioritization unfair, creating further dissent and disruption during a pandemic. In addition, there would not even be detailed plans for handling the massive number of dead bodies that would soon outstrip the ability to process them. Clearly, an influenza pandemic that struck today would demand an unprecedented medical and nonmedical response. This requires planning well beyond anything devised thus far by any of the world’s countries and organizations.

A YEAR FROM NOW

Even if an H5N1 pandemic is a year away, the world must plan for the same problems with the same fervor. Major campaigns must be initiated to prepare the nonmedical and medical sectors. Pandemic planning must be on the agenda of every school board, manufacturing plant, investment firm, mortuary, state legislature, and food distributor in the United States and beyond. There is an urgent need to reassess the vulnerability of the global economy to ensure that surges in demand can be met. Critical health-care and consumer products and commodities must be stockpiled. Health professionals must learn how to better communicate risk and must be

able to both provide the facts and acknowledge the unknowns to a frightened or panicked population.

If there is a year of lead-time before an H5N1 pandemic, vaccine could play a more central role in the global response. Although the world would still have a limited capacity to manufacture influenza vaccine, techniques that could allow scientists to get multiple doses from a current single dose may increase the supply. In addition to further research on this issue, efforts are needed to ensure the availability of syringes and equipment for delivering vaccine. There must also be an international plan for how the vaccine would be allocated. It is far better to struggle with the ethical issues involved in determining such priorities now, in a public forum, rather than to wait until the crisis occurs.

Prevention must also be improved. Priority should be placed on early intervention and risk assessment. And an aggressive and comprehensive research agenda must be launched immediately to study the ecology and biology of the influenza virus and the epidemiologic role of various animal and bird species.

TEN YEARS LATER

If developed countries begin to transform radically the current system of influenza-vaccine production, an influenza pandemic ten years from now could have a much less devastating outcome. The industrialized world must initiate an international project to develop the ability to produce a vaccine for the entire global population within several months of the start of a pandemic. The initiative must be a top priority of the group of seven industrialized nations plus Russia (G-8), because almost nothing could inflict more death and disruption than a pandemic influenza.

The current BioShield law and additional legislation recently submitted to Congress will act to enhance the availability of vaccines in the United States. This aim is laudable, but it does little to address international needs. The ultimate goal must be to develop a new cell-culture vaccine or comparable vaccine technology that works on all influenza subtypes and that can be made available on short notice to all the people of the world.

WHAT COURSE TO TAKE?

The world must form a better understanding of the potential for the emergence of a pandemic influenza strain. A pandemic is coming. It

could be caused by H5N1 or by another novel strain. It could happen tonight, next year, or even ten years from now.

The signs are alarming: the number of human and animal H5N1 infections has been increasing; small clusters of cases have been documented, suggesting that the virus may have come close to sustained human-to-human transmission; and H5N1 continues to evolve in the virtual genetic reassortment laboratory provided by the unprecedented number of people, pigs, and poultry in Asia. The population explosion in China and other Asian countries has created an incredible mixing vessel for the virus. Consider this sobering information: the most recent influenza pandemic, of 1968–69, emerged in China, when its population was 790 million; today it is 1.3 billion. In 1968, the number of pigs in China was 5.2 million; today it is 508 million. The number of poultry in China in 1968 was 12.3 million; today it is 13 billion. Changes in other Asian countries are similar. Given these developments, as well as the exponential growth in foreign travel over the past 50 years, an influenza pandemic could be more devastating than ever before.

Can disaster be avoided? The answer is a qualified yes. Although a coming pandemic cannot be avoided, its impact can be considerably lessened. It depends on how the leaders of the world—from the heads of the G-8 to local officials—decide to respond. They must recognize the economic, security, and health threat that the next influenza pandemic poses and invest accordingly. Each leader must realize that even if a country has enough vaccine to protect its citizens, the economic impact of a worldwide pandemic will inflict substantial pain on everyone. The resources required to prepare adequately will be extensive. But they must be considered in light of the cost of failing to invest: a global world economy that remains in a shambles for several years.

This is a critical point in history. Time is running out to prepare for the next pandemic. We must act now with decisiveness and purpose. Someday, after the next pandemic has come and gone, a commission much like the 9/11 Commission will be charged with determining how well government, business, and public health leaders prepared the world for the catastrophe when they had clear warning. What will be the verdict? 🌐

The Human-Animal Link

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ONE WORLD, ONE HEALTH

In recent years, outbreaks of diseases such as avian flu, severe acute respiratory syndrome (SARS), the Ebola virus, and mad cow disease have frightened the public, disrupted global commerce, caused massive economic losses, and jeopardized diplomatic relations. These diseases have also shared a worrisome key characteristic: the ability to cross the Darwinian divide between animals and people. None of these illnesses depends on human hosts for its survival; as a result, they all persist today, far beyond the reach of medical intervention.

Meanwhile, humanity has become vulnerable to cross-species illnesses, thanks to modern advances such as the rapid transportation of both goods and people, increasing population density around the globe, and a growing dependence on intensified livestock production for food. The global transport of animals and animal products, which includes hundreds of species of wildlife, also provides safe passage for the harmful bacteria, viruses, and fungi they carry, not to mention the

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prion proteins that cause insidious illnesses such as mad cow disease and chronic wasting disease in deer and elk.

Adding to the risks is the fact that while many people in the developed world would scarcely recognize meat if it did not come wrapped in clear plastic, the vast majority of people on the planet today still slaughter animals for meat themselves or buy it fresh, salted, or smoked in open-air markets. These markets generally go uninspected by health officials, and consumers rarely have access to good health care, education on hygiene, common vaccines, or antibiotics.

Not only is local and national health care often a problem; internationally, no agency is responsible for, or capable of, monitoring and preventing the myriad diseases that can now cross the borders between countries and species. More specifically, no organization has the mandate to pursue policies based on a simple but critically important concept: that the health of people, animals, and the environment in which we all live are inextricably linked.

Thus, for example, the U.S. Department of Agriculture works to protect only the U.S. livestock industry and has scaled back the attention it pays to animals outside the United States over the last two decades. Despite new concerns about terrorist attacks on the U.S. food supply, Washington has still made little attempt to research and reduce diseases overseas before they reach U.S. shores. Nor does the United Nations direct the resources necessary to do a better job. The UN Food and Agriculture Organization, for example, is mandated to monitor the production of livestock and crops but does little to track threats to and dangers from wild plants and animals. The World Animal Health Organization has a volunteer committee that considers wildlife-related diseases, but it consists of just six people and meets only three days a year. And the World Health Organization (WHO) can only get involved in a country if officially invited, leaving it helpless to intervene in countries with governments that either do not know about or do not want to reveal the presence of a disease within their borders. The U.S. Centers for Disease Control and Prevention (CDC) must similarly wait for an invitation before extending their reach outside the United States.

What all this means is that no government agency or multilateral organization today focuses on the numerous diseases that threaten people, domestic animals, and wildlife alike. Nor does any one body collect and collate data from across the scientific spectrum, to ensure that health

solutions are based on the input of professionals from all the various health fields working with humans, domestic animals, and wildlife.

Yet diseases pay no regard to the divisions among species or academic disciplines, and the failure to recognize this truth is placing humanity in great peril. As a recent outbreak of avian influenza reminded the world, what happens in one part of it—and to one species—can have a deadly serious impact on others. The planet clearly needs a new health paradigm that not only integrates the efforts of disparate groups but also balances their respective influences, to help bridge the gaps between them. This is especially so since the immediate effects of a particular illness are often the least of the problem. Diseases that attack people and animals also cause poverty and civil unrest, disrupt “free” ecosystem services such as drinking water and plant pollination, and threaten otherwise well-planned and sustainable economic development efforts, such as low-impact tourism. In short, the failure to adopt a planetwide and cross-species approach to health is getting costlier by the day; humanity cannot afford to pay the price much longer.

THE WORLD WE WERE GIVEN

According to recent analysis, more than 60 percent of the 1,415 infectious diseases currently known to modern medicine are capable of infecting both animals and humans. Most of these diseases (such as anthrax, Rift Valley fever, bubonic plague, Lyme disease, and monkeypox) are “zoonotic,” meaning that they originated in animals but have crossed the species barrier to infect people. The others, which receive less attention, are “anthropozoonotic,” meaning they are typically found in humans but can and do infect animals as well (examples include the human herpes virus, tuberculosis, and measles). Dividing infectious agents into these two groups is convenient for teaching purposes. But it overlooks the critically important fact that all of them can move back and forth among species, mutating and changing their characteristics in the process. Avian influenza—which started in birds but is now infecting humans as well—has recently highlighted the need for a more holistic view of disease.

It is probably just luck that has so far allowed scientists to maintain these distinctions. One of the greatest medical success stories of the last century was the eradication of smallpox. But this achievement was largely due to the fact that smallpox survives in only one host species, namely humans. If even one more type of animal had been able

to harbor the disease, there is a good chance that eradication would not have been accomplished, despite the Herculean global effort. When a pathogen can find refuge or a place to mutate in a range of hosts, controlling it becomes far more complex, requiring an integrated—and much more difficult—approach.

To get a sense of the breadth and the seriousness of the issue, consider HIV/AIDS, which most scientists now think arose in Africa as a result of the human consumption of primates that were infected with simian immunodeficiency viruses. Or consider the Ebola virus, which has a similar history. The disease first came to international attention in 1976, when it appeared around the Ebola River in what was then called Zaire. The virus infects people, gorillas, chimpanzees, and monkeys, causing severe internal and external hemorrhaging and leading to death in up to 90 percent of its human victims. Human infection spreads quickly, especially via caregivers and people who flee an area to escape the illness. Since the disease first appeared, successive human outbreaks have been recorded in Côte d'Ivoire, Gabon, Sudan, and Uganda. But humans have not been the only victims; lowland gorillas and chimpanzees in Gabon and Congo and chimpanzees in western equatorial Africa have been decimated by the sickness. Other forest animals, such as duikers (small antelopes) and bush pigs may also be affected. When subsistence hunters discover a sick or dead animal in the forest, they view it as good fortune and bring it home to feed their families or trade with their neighbors. The Ebola virus then easily infects those handling the meat, and a chain of contacts and infections ensue. Each of the human outbreaks in central Africa during the late 1990s and the first years of this century was traced to humans handling infected great apes.

SARS also arose from contact with wild animals. The illness first appeared in late 2002 in China's Guangdong Province, where people began complaining of high fever, cough, and diarrhea, and eventually developed severe pneumonia. The unknown disease was very contagious; within a matter of weeks, a visitor to Hong Kong helped spread it to five continents. By July of 2003, the WHO had tallied 8,437 cases and 813 deaths. Due mostly to a lack of understanding of the new disease, global travel and trade were disrupted as fear spread.

After four months, scientists eventually discovered that the mystery disease was caused by a coronavirus (a family of viruses found in many animal species). The virus, in turn, was traced back to a small

mammal called the palm civet, which is farmed in the Guangdong region and sold for human consumption. Later, evidence of the virus was also found in raccoon dogs, ferrets, and badgers being sold in Guangdong's wildlife markets, as well as in domestic cats living in the city. Epidemiological studies confirmed that the first human infections had indeed come through animal contact, although the exact species responsible has not been definitively identified.

In the months after SARS first appeared, the Chinese government closed down its live wildlife markets. Within ten days of linking the disease to the wild animal trade, the government also confiscated close to a million animals, many of which had been brought into the area from other parts of the world and which hosted a variety of exotic viruses and bacteria. But the damage had already been done. Prior to the government action, the animals were often housed together, exposed to one another's waste, and sometimes even fed to one another. For a virus or bacteria capable of jumping between species, the markets had provided the perfect place to reproduce.

THE WORLD'S NOT FLAT, IT'S A MIXING BOWL

China, however, is far from the only country where people risk infection from animal-borne diseases. The West is also in danger, as was discovered in late May 2003, when the first cases of a mysterious illness were reported in hospitals in Illinois, Indiana, and Wisconsin. Patients, many of whom had been in close contact with pet prairie dogs, started coming down with skin ulcers and fevers. It was soon discovered that a prairie-dog dealer in Wisconsin had let a number of his animals mix with rodents recently imported from Ghana that happened to be carrying the monkeypox virus. An animal distributor had then sold the infected prairie dogs to pet stores in Milwaukee and at an animal swap meet in northern Wisconsin. Within about a month, 71 human cases of monkeypox in six Midwestern states had been reported to the CDC; luckily, no one died.

It remains unknown how or where waste from the infected prairie dogs was dumped or whether owners released any infected prairie dogs into the wild during the scare. Moreover, U.S. laws remain dangerously lax. At the time of the monkeypox outbreak, it was legal to import any nonendangered African rodent into the United States as a pet—despite the fact that the risk of bringing in foreign diseases in the process was predictable and could have been avoided through in-

ternational surveillance and information-sharing programs. (Wildlife health experts and human health workers in central Africa have long associated human monkeypox infections with rodent and squirrel contact.) Since the U.S. outbreak, Washington has imposed restrictions on the import of African rodents, but it remains legal to bring in rodents from other continents, and many other species from around the world continue to be shipped into the United States and many other countries, largely without oversight.

Determining the exact scale of the global wildlife trade is impossible, since the operations range from the extremely local to the international, and are often illegal and informal. Part of the picture, however, can be glimpsed from figures compiled by the Wildlife Conservation Society from a variety of sources. According to these numbers, the annual global trade in live wild animals includes roughly 4 million birds, 640,000 reptiles, and 40,000 primates. Following the SARS outbreak that began in 2002, the Chinese government reportedly confiscated 838,500 wild animals from the markets of Guangdong. But every year, tens of millions of wild mammals, birds, and reptiles continue to flow through these and other trading centers, where they make contact with humans and dozens of other species before being shipped elsewhere, sold locally, or sometimes freed back into the wild—often carrying new and dangerous pathogens. The number of these animals that end up as food is staggering; indeed, experts estimate that in central Africa alone consumers eat 579 million individual wild animals a year, for a total of more than a billion kilograms of meat. Meanwhile, people in the Amazon basin are thought to consume between 67 and 164 million kilograms of wild animal meat a year, accounting for between 6.4 million and 15.8 million individual mammals alone.

Before these animals (with whatever diseases they may be carrying) are eaten, they encounter—and possibly transmit pathogens to—hunters and marketers. They also risk infecting domestic animals and wild scavengers in villages and market areas that consume the remnants and waste of wildlife eaten by humans. All considered, at least a billion direct and indirect contacts among wildlife, humans, and domestic animals result from the handling of wildlife and the wildlife trade annually.

Such contact does not just endanger humans and their pets; the pathogens inadvertently transported around the globe can also devastate local wildlife, disrupting the environment and causing enormous

economic harm. In October 2004, avian flu (specifically, the H5N1 type A influenza virus) was detected in two mountain hawk-eagles that were smuggled from Thailand into Belgium in airline carry-on baggage. Last year, another deadly virus entered Italy via a shipment of Pakistani parrots, lovebirds, and finches. Chytridiomycosis, a fungal disease responsible for the extinction of 30 percent of the world's amphibian species, has been spread by the international trade and subsequent release of African clawed frogs (a popular laboratory animal). Tuberculosis originating from domestic cattle has now infected herds of wild bison in Canada, deer in Michigan, and cape buffalo and lions in South Africa. In 1999, rinderpest, a disease originally introduced to Africa by the importation of domestic cattle from India, killed more wild buffalo in Kenya than had been slain by poachers during the previous two decades.

The increasing movement of animals and humans around the world and their greater exposure to the many diseases that dance between them have also placed domesticated livestock at increasing risk. This is especially so since the ravenous international demand for animal meat has turned livestock production into an ultraintensive industry, with swine, poultry, and cattle operations now packing huge numbers of animals into limited spaces. Moreover, projections by the International Food Policy Research Institute indicate a doubling of animal production in developing countries over the next 20 years. Although modern factory-farm practices maximize food production, they also make livestock more susceptible to illness. Infection spreads quickly through crowded animal pens, and growing antibiotic resistance makes fighting disease more difficult. Many farms now routinely mix antibiotics with animal feed to avoid transmitting illnesses, and selective breeding for specific traits often predisposes animals to conditions requiring repeated antibiotic treatment. Such increased antibiotic use is helping to create dangerous drug-resistant superbugs that may endanger both animals and humans.

High-volume food production has also prompted the livestock industry to adopt other dangerous practices, which have already led to at least one high-profile disaster: the outbreak of bovine spongiform encephalopathy (BSE), or mad cow disease, in the United Kingdom. Mad cow disease is a chronic, degenerative disorder that affects the central nervous system of cattle. The disease, known as scrapie in sheep, had existed for hundreds of years without infecting other spe-

cies. It only crossed over to cattle when British farmers started feeding infected sheep byproducts to their herds in the 1980s. Once BSE jumped to cows it started spreading rapidly, with 182,745 documented cases occurring between 1986 and 2002 in the United Kingdom. In response to the outbreak, European countries banned all imports of British cattle. But BSE has nonetheless been found in Europe, Canada, and the United States since then. It has also jumped to people, and a new human variant of the illness, known as Creutzfeldt-Jakob disease, is believed to be responsible for 150 deaths since 1995.

Malaysia has also fallen victim to a disease spread by new farming techniques: the Nipah virus, which appeared in the country's pig and human populations in 1998, killing 105 people and forcing the Malaysian government to cull more than one million pigs to stop the spread. Five species of fruit bats were later also found to carry the virus, suggesting a wide prevalence of the pathogen among healthy bats. It seems that people had acquired the virus from handling infected pigs, which had contracted the disease from bats feeding in fruit trees standing in newly developed pig farms.

The Nipah outbreak highlights what can happen when people and domestic animals modify previously undisturbed wild habitats. Within natural ecosystems, microbes and wildlife tend to exist more or less in balance. But the introduction of new species—such as cows, pigs, dogs, or humans—can allow pathogens to jump into these new hosts, which may have no natural immunity or evolved resistance. The results, predictably, can be devastating.

In addition to the direct health damage they have caused people and animals, animal-related pathogens have destabilized international trade and caused hundreds of billions of dollars of economic damage globally. The report of the U.S. National Intelligence Council's 2020 Project, *Mapping the Global Future*, has identified a global pandemic as the single most important threat to the global economy. In early 2003, the UN Food and Agriculture Organization reported that more than one-third of the global meat trade was being embargoed as a result of mad cow disease, avian influenza, and other livestock illnesses. According to Bio Economic Research Associates, the rash of emerging or reemerging livestock diseases that have cropped up around the world since the mid-1990s (illnesses that include mad cow disease, foot-and-mouth disease, avian influenza, swine fever, and others) has caused losses of an estimated \$100 billion; SARS alone cost the global

economy half that amount. The pain caused by such crises, moreover, has spread far beyond those responsible; wildlife market traders were not the ones who paid for the SARS outbreak, and the African rodent importer in Texas did not reimburse the U.S. and local governments for the millions of dollars spent to contain monkeypox in 2003.

Nor can these dollar figures adequately reflect the often devastating effect outbreaks can have on some of the poorest people on the planet. Since 2003, for example, efforts to control the spread of avian influenza in Asia have required the culling of more than 140 million chickens. In countries such as Thailand and Vietnam, the vast majority of these animals were not owned by large, industrial producers but by small farmers and peasants. Losing their livestock was painful indeed, especially since financial compensation schemes for rural poultry owners are rare to nonexistent in much of Southeast Asia. Not only did this lack of compensation increase the damage done by the disease; it also created a serious disincentive for bird owners to report suspicious illnesses among their flocks.

RISING TO THE OCCASION

As many of these examples suggest, preventing or controlling future outbreaks of animal-borne diseases and mitigating their impact will require a far broader approach than has so far been attempted by the generally isolated health systems of highly developed countries. Too often, the global response to new pathogens has been driven by fear, which has only magnified the economic and other costs of disease control.

That said, a few brave individuals have already begun the process of creating a new international and interdisciplinary approach to disease control. Working in some of the most remote places on earth, they have slowly established knowledge-sharing networks, such as the World Conservation Union's Veterinary Specialist Group. And their contributions have already been significant. For example, when avian influenza first appeared, much attention was mistakenly directed at controlling its spread among wild birds in Northeast and Southeast Asia. It was these new informal participants in health discussions—such as conservation biologists and veterinarians working with the Wildlife Conservation Society in Cambodia and linked to staff at the Food and Agriculture Organization—who were the first to point out that the migratory routes and timing of wild birds did not actually correspond with the spread of the disease and that domestic birds were more likely the culprit.

Without this insight, valuable resources would have been wasted trying to control the disease among the wrong animal population.

As important as such contributions have been, however, many individuals trying to develop a new global approach to health-care work for nongovernmental organizations or for local governments lack the resources and a larger, formal network that could fill in the gaps in health care as it relates to wildlife and humanity. Were their resources improved, the results would be enormously beneficial; building bridges across disciplines to solve health problems can have simple but profound effects.

For example, studies in South America have shown that, contrary to common opinion, livestock diseases pose many more threats to wildlife than the other way around. In much of the world, reducing disease in domestic animals would benefit several industries, improve human health and livelihoods, and help safeguard wild animals. As this suggests, strategically increasing protections in one area of health care can benefit another. For example, gorillas and chimpanzees in central Africa have little to no immunity to common human diseases, and so they are endangered by contact with local people and tourists. This risk could be dramatically reduced by implementing good preventive health programs and practices in local villages, which would benefit both people and wildlife. Already, work with the Ebola virus in gorillas and chimpanzees has shown that investments in wildlife health can protect urban human populations; in Africa, animal health workers detected the presence of Ebola in wildlife months before the first human cases occurred, providing critical lead-time to warn villagers not to hunt or handle the animals that were a source of the infection. Such a broad, “one health” approach to disease can be much more effective and inexpensive than the traditional “quarantine and stamping out” strategy for fighting an illness after an outbreak has already begun. Specialists in human and animal health, in conjunction with wildlife conservation professionals, have already developed a set of guiding concepts on these themes, called the Manhattan Principles. But the ideas still need much broader acceptance to be more effective.

To further improve the chances of heading off and limiting the effect of animal-related diseases, a number of additional steps are necessary. To begin with, better worldwide surveillance to detect infectious diseases among wildlife is needed to improve response time and reduce the costs of new outbreaks. Such surveillance differs from traditional hypothesis-driven disease research because it

involves very broad searching rather than attempts to answer a highly focused question. Investment in gathering advance information can pay off handsomely; early warning of how diseases work and of their normal characteristics among animals can help limit the damage when the illnesses start to spread.

New public-private partnerships could also be hugely helpful. Currently, the failure of public-sector programs to comprehensively monitor, prevent, and respond to unusual diseases is being compensated for by the private sector. Coordination between these efforts and governments remains limited—in some cases due to regulations and restrictions that prevent such collaboration. For example, under its agreement with member states, the World Animal Health Organization cannot accept information on wildlife diseases in a country unless that information has been submitted officially by a national agricultural authority—few of which are mandated or organized to monitor wildlife diseases. These policies should be reformulated to facilitate cooperation among governments, corporations, and nonprofit organizations, and formal mechanisms for sharing information should be established.

It would also help to shift responsibility for the costs of outbreak prevention and control to animal traders, since this would provide them with incentives for reducing disease and would lower the costs of disease surveillance, control, and prevention by third parties. One way to force traders to shoulder more of the costs would be to require them to buy disease outbreak insurance on all animal imports or shipments. Doing so would discourage dangerous activities among animal traders by hitting them where it hurts: in their wallets.

Financial incentives are not enough, however; the World Trade Organization and other appropriate international bodies must also start requiring governments to better regulate the health aspects of international trade in wild and domestic animals. Individual states also need to implement new laws to prevent the spread of diseases within their borders. There is now plenty of evidence to suggest that human trade and consumption of wildlife have led to global health disasters; governments must therefore immediately start making serious efforts both to reduce and to regulate properly the trade of such animals internationally, regionally, and even locally.

On the health-care side, decisions still tend to be made without sufficient input from all appropriate stakeholders. For example, the decision of a Southeast Asian government in 2004 to control avian

influenza by culling wild migratory birds failed to identify the real source of the problem (domestic livestock) or to recognize that the wild birds were protected by at least two separate international conventions. Involving experts in public health, agriculture, and environmental conservation, as well as legal counsel, in such decisions would help governments avoid repeating these mistakes and adopt more sound strategies in the future.

Finally, greater bilateral and multilateral aid is needed for efforts to gather, evaluate, and share information on infectious diseases that affect the wide range of living organisms present around the world. Too often, health experts focus on human health and agriculture alone, missing a huge part of the picture. More money must be spent on initiatives that include wildlife health and conservation in discussions of human health care; more money would also help stimulate the development of holistic efforts in areas of the world where they are most critically needed.

The obstacles to identifying, understanding, and sharing information about all infectious diseases on the planet may appear daunting. But they are no excuse for not trying. New, holistic approaches should be started at local and regional levels; such efforts are already proving efficient and cost-effective and are advertising the benefits of the new paradigm. Such small- and medium-scale efforts can be built up over time and run in parallel with higher-order, global coordination.

The time to launch such initiatives is now, before the next global pandemic occurs. Bridges must be built between different scientific disciplines, and trade in wildlife must be dramatically reduced and, like the livestock industry, properly regulated. Global health will not be achieved without a philosophical shift from the expert-controlled, top-down paradigm that still dominates both science and medicine. A broader, more democratic approach is needed, one based on the understanding that there is only one world—and only one health. 🌍

Unprepared for a Pandemic

Michael T. Osterholm

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SOUNDING THE ALARM, AGAIN

More than a year and a half ago, *Foreign Affairs* published three articles that sounded a clarion call to prepare for the next pandemic. They warned that another pandemic could occur at any time and at a staggering cost to human health and the world economy. These facts remain incontrovertible. At the time, many public health scientists believed that recent outbreaks of the H5N1 influenza virus in birds in Asia, Europe, and Africa, with occasional infections in humans, were precursors to the next pandemic. They still do today.

Like earthquakes, hurricanes, and tsunamis, influenza pandemics are recurring natural disasters. The natural reservoir of influenza virus is wild aquatic birds. But for a human influenza pandemic to occur, a strain of an avian influenza virus must develop to which humans have no preexisting immunity and undergo critical genetic changes that allow it to be readily transmitted from person to person. The H5N1 strain of the influenza virus has had a limited impact on human health so far, but a human influenza pandemic could occur—and be devastating—if a current strain underwent the right genetic changes.

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For decades, scientists believed that the only way for an avian influenza virus to become transmittable between humans was through a process known as reassortment. Reassortment occurs when an avian virus and a human virus both infect the same cells of an animal (a pig, for example) or a person and swap genes, creating a new virus adapted to humans. (This is how the 1957 and 1968 influenza pandemics began.) Over the past two years, however, studies of tissue samples from 1918–19 influenza victims have suggested that an influenza virus can also become a pandemic strain after undergoing genetic mutations of its own. Recent studies of the virus' genetic material have demonstrated that the 1918–19 virus likely evolved by a process known as adaptation, a series of critical mutations that rendered it capable of being transmitted between humans.

Although it is impossible to know for sure whether H5N1 will ever evolve into the next human pandemic virus, more and more of the genetic changes documented in the 1918–19 virus have also been found to have occurred in recent H5N1 strains affecting both birds and people. Meanwhile, the spread of H5N1 infections to more avian species and to more humans continues to point to H5N1 as a likely strain of the next pandemic.

No one can predict when the next pandemic will occur or how severe it will be. But it will occur for sure, and because of the interdependence of the global economy today, its implications will reach far beyond its toll on human health. A recent study by the Lowy Institute for International Policy, which provides the most comprehensive estimate yet, found that a mild pandemic similar to that of 1968 would kill 1.4 million people and cost approximately \$330 billion (or 0.8 percent of global GDP) in lost economic output. Were a pandemic as severe as that of 1918–19 to occur, over 142.2 million people would die, and the world's GDP would suffer a loss of \$4.4 trillion.

Yet the issue has generated only limited attention in both the public and the private sectors worldwide because preparing for a pandemic is a daunting challenge to begin with and because disaster has not yet struck. But that good news could turn into very bad news if it leads to slacking off on preparedness activities today. In a world filled with competing international priorities, preparing for something that may not happen in the next year may seem hard to justify in terms of both financial resources and time, but that is no excuse for inaction.

FOWL PLAY

Avian influenza caused by H5N1 first received widespread attention in 1997, when an outbreak in poultry in Hong Kong subsequently spread the virus to humans. Eighteen human cases were recognized; six of the patients died. (There was no evidence of person-to-person transmission.) In the fall of 2003, H5N1 avian influenza appeared in domestic poultry farms in Asia. After subsiding briefly, it reemerged in the summer of 2004 in Cambodia, China, Laos, Thailand, and Vietnam, where it persists today despite the widespread vaccination of poultry. Studies of recent H5N1 isolates in Southeast Asia have indicated that the virus' predominant lineage today originated in southern China. Other lineages are believed to have emerged in Southeast Asia, which suggests that the virus has been present in the region for a long time. A report by the UN Food and Agricultural Organization published in 2004 found that existing reservoirs of the H5N1 influenza virus in ducks, wild birds, and—potentially—pigs are already resilient enough to “pose a serious challenge to eradication.”

In 2005, H5N1 expanded beyond Asia. It was identified in Kazakhstan, Mongolia, and Russia in July, and in Turkey and western Europe in October. By February 2006, it had reached northern Nigeria; it has since been documented in several other African nations. As of August 2006, over 220 million birds had been killed by H5N1 or culled to prevent its spread.

H5N1 is believed to spread geographically mostly through the movement of domestic poultry and wild migratory birds. Wild birds are thought to be the principal transporters of H5N1 from infected areas to new geographic locations. Once introduced, the virus is then disseminated more widely by poultry, especially domestic ducks and geese. (According to the World Health Organization, mallard ducks are the “champion” vectors of its spread.) The spread of H5N1 from Siberia to the Black Sea basin is consistent in time and location with the movements of migratory birds. In Africa, it most likely spread through the trade of poultry for human consumption, although migratory birds may have contributed to the problem there as well. There has been no documented spread of H5N1 to migratory birds or poultry in the Americas, but that may change: Asian and European flyways overlap in the Arctic regions of North America, and the importation of poultry and other birds from Asia and Europe into any American country could result in the infection of indigenous bird populations.

SPREAD THICK

The H5N1 virus has also been spreading to more humans. As of January 15, 2007, it had infected 265 people, 159 of whom died, in ten countries over the previous three years. Cases of human infection have occurred in Azerbaijan, Cambodia, China, Djibouti, Egypt, Indonesia, Iraq, Thailand, Turkey, and Vietnam. Seventy-nine fatalities were confirmed in 2006, compared with 42 in 2005, 32 in 2004, and 4 in 2003. As the number of cases has risen, the mortality rate has remained stable, at roughly 60 percent.

Several studies have now confirmed that H5N1 infection in humans is fundamentally different from infections caused by the current seasonal influenza strains. H5N1 infection typically involves progressive primary viral pneumonia, acute respiratory distress, and liver and kidney damage. Some studies have suggested that in contrast to seasonal influenza, which primarily involves lung infection, the H5N1 virus might be disseminated throughout the body and affect multiple organs thanks in part to a condition of the immune system known as a cytokine storm. This is a significant finding since clinical studies of cases from the 1918–19 pandemic have indicated that the presence of cytokine storms helps explain why that pandemic was so deadly.

H5N1 has several other alarming features. Studies comparing samples over time have indicated that the virus has become progressively more pathogenic for poultry. The current strain of the virus can survive in the environment several days longer than could earlier strains. Its range of mammalian hosts appears to be expanding. It has been found in more and more dead migratory birds, which supports the conclusion that it is becoming more virulent. Recent genetic work performed on viral isolates from Turkey found evidence of two mutations that may enhance its transmission from birds to humans and between humans.

One critical question that remains is whether the virus would become less lethal if its ability to spread among humans developed. According to a September 2006 report by the World Health Organization, “Should the virus improve its transmissibility by acquiring, through a reassortment event, internal human genes, then lethality of the virus would most likely be reduced. However, should the virus improve its transmissibility through adaptation as a wholly avian virus [as what occurred with the 1918 pandemic strain], then the present high lethality could be maintained during a pandemic.” Even the former outcome is no reason for comfort: with six in ten infected people currently

dying from the virus, an H5N1 pandemic caused by a virus that had lost much of its disease-causing characteristics as it adapted to humans would still have catastrophic consequences.

THE FOG OF WAR

The *Foreign Affairs* articles published in July 2005 contributed to a flurry of calls to prepare for a pandemic. In September 2005, President George W. Bush announced an international partnership on avian and pandemic influenza before the General Assembly of the United Nations, and in November of that year he issued the National Strategy for Pandemic Influenza, setting out measures to prepare the United States for a pandemic. President Bush also submitted a request to Congress for a \$7.1 billion emergency budget supplement to invest in, among other things, international health surveillance and containment efforts, medical stockpiles, and the production of emergency supplies of vaccines and antiviral medications. (In the end, the Pandemic Influenza Act, which was signed into law in 2006, only provided \$3.8 billion.) In May 2006, the White House released the Implementation Plan for the National Strategy for Pandemic Influenza—more than 300 recommendations to coordinate the federal government’s response to the threat of pandemic influenza. A month later, Congress passed the president’s budget for fiscal year 2007, which includes a \$2.3 billion allowance for implementing the next phase of the Bush administration’s pandemic preparedness strategy. Australia, Canada, France, Israel, Japan, New Zealand, Singapore, Switzerland, and the United Kingdom have announced similar plans.

As positive as these steps may seem, there are critical problems with the preparedness plans worldwide. Many crucial questions remain unanswered and even unaddressed. What are the technological challenges and barriers to achieving a higher state of preparedness? What steps should be taken to significantly reduce the impact of a global pandemic? How does one measure preparedness? Who should pay for it? What are the economic costs of being more prepared compared to the costs of being less prepared? In some ways, a fog of confusion has settled over these issues. Like soldiers in battle, policymakers and planners in the private sector are overwhelmed by the many uncertainties and complexities surrounding the threat and by the question of how to anticipate and respond to such a catastrophe.

Partly as a result, the issue has not retained people's attention as much as it should have (or as much as, say, terrorism has), and preparedness continues to compete for priority on the agendas of policy-makers. President Bush and other U.S. officials held numerous conferences and meetings on pandemic preparedness throughout 2005, but in 2006 discussion of the issue all but disappeared. No major midterm election debates or position papers mentioned it, and Congress held no relevant hearings. (In the last months of 2006, the media lost interest, too. A LexisNexis search of general news articles on H5N1 in 50 major international newspapers yielded more than 850 articles for October 2005 but fewer than 75 articles for November 2006.) The same is true in virtually all developed countries. And it is unclear whether the surge in H5N1 activity in birds and humans documented in Asia in January 2007 will increase awareness among the media, governments, private-sector leaders, and the public of the urgent need for pandemic preparedness.

Some public health experts had anticipated that planning fatigue would quickly set in if a pandemic did not materialize shortly after the first warnings. Lassitude is a normal reaction to the perception that public health experts have been crying wolf and to the challenge of staying on high alert over a sustained period of time. But the price of such apathy will be very high, because avoiding the consideration of key issues will compound the devastating effects of the next pandemic. For one thing, not enough attention is being paid to developing an effective vaccine and an effective way to produce it and deliver it to both developed and developing countries. For another, little thought is being given to what effects the structure of the world economy will have on the spread of a pandemic—and, in turn, what effects a pandemic will have on the basic functioning of the world economy. Meanwhile, the private sector has been largely left to its own devices as it prepares for a calamity, even though its collaboration with the public sector will be critical to any prevention campaign or emergency response.

HIT ME WITH YOUR BEST SHOT

Ideally, the risk of pandemic influenza could be eliminated today with a protective vaccine available to everyone that could be administered in advance of the pandemic. But that possibility is years away at best. Currently, licensed influenza vaccines are produced using chicken eggs, and output is limited to approximately 350 million doses a year.

To supplement production down the road, more than a dozen international drug companies are researching new vaccines (27 human clinical trials of new vaccines against several strains of avian influenza are under way). But most of them, although using cell cultures rather than egg cultures, are growing a vaccine antigen similar to that grown in chicken eggs. In other words, these second-generation vaccines are just a fancy way of producing the antiquated first-generation vaccines used over the last 50 years. Moreover, cell-culture vaccines, like egg-culture vaccines, provide maximum protection against a pandemic when they are produced using the virus strain causing it. This means that although cell-culture vaccines can supplement egg-culture vaccines during the first three or four months of a pandemic, no production can start until after the pandemic itself has begun. And it will take years of research and clinical trials before cell-culture vaccines are approved and years after that before they can be widely produced. Then, because the H5N1 virus is rapidly changing, it is unclear whether the vaccines now in research and development—which are based on strains of the H5N1 virus that have circulated in Vietnam, Indonesia, and Turkey—will offer any protection against new strains of the virus. A working group of the World Health Organization recently cautioned countries purchasing “prepandemic vaccines” that these may offer only limited, if any, benefit.

Unfortunately, the U.S. and other governments have not made a major financial commitment to the research and development of new kinds of influenza vaccines and to building extensive production capacity; they are treating vaccine research and development as though it were about business as usual, not a pending catastrophe. Over the past two years, all the governments in the world have collectively invested less than \$2.5 billion in developing new influenza vaccine technologies, including third-generation, or universal, vaccines. This is too little, but it is hoped that ongoing research will demonstrate that it might be possible to develop such vaccines, which would be effective against an array of influenza viruses, and to start doing so before a pandemic strain is at hand.

The availability of an increasing amount of antiviral drugs, particularly Tamiflu, represents welcome news for preparedness. Roche, the pharmaceutical company that makes Tamiflu, recently announced that it will be able to make up to 400 million doses per year beginning in 2007. Although it remains unclear whether the drug will be as

effective against H5N1 as it is against current seasonal influenza, it appears to be effective in preventing H5N1 infections in animal subjects when taken before exposure.

Unfortunately, even if enough of the right kind of vaccines were produced, most of the world's population would not have access to them in the throes of a pandemic. In the United States, the effects of a pandemic would likely be compounded by the country's ailing health-care system—which itself would be further weakened by the crisis. More than 30 percent of the 5,000 hospitals in the United States are losing money. Almost half of all emergency departments report being continually at or over capacity; 100,000 additional registered nurses are needed. Last year, some 550,000 critically ill or injured Americans—an average of one person every minute—were diverted from the emergency rooms nearest to them because these were full. It would take only a mild pandemic to overwhelm the United States' health-care system. And in many communities it is unclear whether even basic nursing care would be available during a severe one.

IT'S A SMALL WORLD

The interconnectedness of the global economy today could make the next influenza pandemic more devastating than the ones before it. Even the slightest disruption in the availability of workers, electricity, water, petroleum-based products, and other products or parts could bring many aspects of contemporary life to a halt. The global economy has required wringing excess costs out of the production, transport, and sale of products. Inventories are kept to a minimum. Virtually no production surge capacity exists. As a consequence, most of the developed world depends on the last-minute delivery of many critical products (such as pharmaceuticals, medical supplies, food, and equipment parts) and services (such as communications support). In the United States, approximately 80 percent of all prescription drugs come from offshore and are delivered to pharmacies just hours before they are dispensed. An increasing number of U.S. hospitals now receive three rounds of deliveries of drugs and supplies a day to meet their needs. With such long and thin supply chains, a pandemic that closed borders, caused worker attrition, and suspended travel or the transport of commercial goods would seriously disrupt the delivery of everyday essentials.

Yet the consideration of such disturbances has been largely absent from preparedness planning. This oversight is partly due to past ex-

perience with disasters, such as earthquakes or hurricanes, for which relief supplies from nonimpacted areas were quickly available for impacted ones. Such disasters are limited in time, meaning that rescue and recovery can begin in short order. A pandemic, on the other hand, would affect the whole world for months, and relief efforts would put a strain on resources everywhere. Unfortunately, there are no easy answers to solve the supply-chain problem; it may simply be too big. None of the published models estimating the macroeconomic consequences of pandemic influenza fully account for it, reflecting a lack of imagination on the part of both the private and the public sectors.

A related problem is the lack of planning for business continuity in the event of a pandemic. The private sector has been involved to varying degrees in pandemic preparedness planning. Some companies have attempted to account for all the contingencies that could affect their employees, their supply chains, and even their customers. Typically, the biggest challenge they face is anticipating how workers, suppliers, buyers, infrastructure providers, and the government would respond. Given the interdependence of all those players, figuring out what would happen if disaster struck and how to prepare for it is a Rubik's Cube-like brainteaser. With so many unknowns, one leading business continuity planner said at an off-the-record meeting at Harvard University recently, "Planning for a pandemic is so different from anything we've done in business before that we're writing the book as we go—and it won't be finished until the virus is finished." Some companies require their suppliers to sign affidavits indicating that they have a workable pandemic plan in place. But most of these statements are barely worth the paper they are printed on, because suppliers are in no better position to prepare for a pandemic than are their buyers. Even well-intentioned efforts, in other words, have been largely ineffectual. As a September 2006 report by the Department of Homeland Security put it, "Eighty-five percent of critical infrastructure resources reside in the private sector, which generally lacks individual and system-wide business continuity plans specifically for catastrophic health emergencies such as pandemic influenza."

Many questions remain. Would consumers willingly pay a higher price for products sold by a company that invested substantially in pandemic preparedness, or would competitors gain market share by taking advantage of its increased costs? How should the stockpiling of critical emergency products be promoted in this global just-in-time

economy? If solutions to these problems cannot be developed, expectations about how much can be done should be revised.

NOW OR LATER

The world will experience another pandemic, and it will get through it, as it has all previous ones. The challenge is to figure out now how to minimize the number of deaths and the economic and psychological devastation it will cause. It is a particularly complicated problem because preparing for a pandemic challenges the very basis of the global just-in-time economy. Recent scientific findings about H5N1 infection in animals and humans have also challenged a number of facts about influenza that scientists had previously held sacred. So one must expect the unexpected. Winston Churchill once said, "It is no use saying, 'We are doing our best.' You have got to succeed in doing what is necessary." The difficulty in confronting the possibility of an H5N1 pandemic is figuring out what is necessary.

In the short term, people around the world must understand that when a pandemic unfolds, their communities will largely be on their own to get through the crisis. They should plan now and learn to depend on themselves, their families, their neighbors, and their co-workers. In the medium term, governments should devise national strategies. In the United States, either President Bush or Congress should create a national commission of elected officials and senior leaders in the fields of public health, vaccine and drug research, emergency management, law enforcement, business continuity, and economics, and it should issue, within 120 days of its creation, a report on the status of pandemic preparedness in the public and private sectors in the United States. It should also detail an aggressive agenda for additional investment.

Finally, the long-term goal must be to develop universal influenza vaccines. The impetus must come from an initiative as bold as the man-on-the-moon agenda that President John F. Kennedy articulated in May 1961. The fact that no world leader has called for such an effort reflects a lack of comprehension about the devastation an influenza pandemic would wreak. The opportunity to save millions of lives cannot be passed up. Even if such efforts come too late to stave off the next pandemic, at least they would help in the one after that. 🌐



**THE GLOBAL HEALTH
RESPONSE**

The Challenge of Global Health

Laurie Garrett

JANUARY/FEBRUARY 2007

BEWARE WHAT YOU WISH FOR

Less than a decade ago, the biggest problem in global health seemed to be the lack of resources available to combat the multiple scourges ravaging the world's poor and sick. Today, thanks to a recent extraordinary and unprecedented rise in public and private giving, more money is being directed toward pressing health challenges than ever before. But because the efforts this money is paying for are largely uncoordinated and directed mostly at specific high-profile diseases—rather than at public health in general—there is a grave danger that the current age of generosity could not only fall short of expectations but actually make things worse on the ground.

This danger exists despite the fact that today, for the first time in history, the world is poised to spend enormous resources to conquer the diseases of the poor. Tackling the developing world's diseases has become a key feature of many nations' foreign policies over the last five years, for a variety of reasons. Some see stopping the spread of HIV, tuberculosis (TB), malaria, avian influenza, and other major killers as a moral duty. Some see it as a form of public diplomacy. And some see it as an investment in self-protection, given that microbes

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know no borders. Governments have been joined by a long list of private donors, topped by Bill and Melinda Gates and Warren Buffett, whose contributions to today's war on disease are mind-boggling.

Thanks to their efforts, there are now billions of dollars being made available for health spending—and thousands of nongovernmental organizations (NGOs) and humanitarian groups vying to spend it. But much more than money is required. It takes states, health-care systems, and at least passable local infrastructure to improve public health in the developing world. And because decades of neglect there have rendered local hospitals, clinics, laboratories, medical schools, and health talent dangerously deficient, much of the cash now flooding the field is leaking away without result.

Moreover, in all too many cases, aid is tied to short-term numerical targets such as increasing the number of people receiving specific drugs, decreasing the number of pregnant women diagnosed with HIV (the virus that causes AIDS), or increasing the quantity of bed nets handed out to children to block disease-carrying mosquitoes. Few donors seem to understand that it will take at least a full generation (if not two or three) to substantially improve public health—and that efforts should focus less on particular diseases than on broad measures that affect populations' general well-being.

The fact that the world is now short well over four million health-care workers, moreover, is all too often ignored. As the populations of the developed countries are aging and coming to require ever more medical attention, they are sucking away local health talent from developing countries. Already, one out of five practicing physicians in the United States is foreign-trained, and a study recently published in *JAMA: The Journal of the American Medical Association* estimated that if current trends continue, by 2020 the United States could face a shortage of up to 800,000 nurses and 200,000 doctors. Unless it and other wealthy nations radically increase salaries and domestic training programs for physicians and nurses, it is likely that within 15 years the majority of workers staffing their hospitals will have been born and trained in poor and middle-income countries. As such workers flood to the West, the developing world will grow even more desperate.

Yet the visionary leadership required to tackle such problems is sadly lacking. Over the last year, every major leadership position on the global health landscape has turned over, creating an unprecedented

moment of strategic uncertainty. The untimely death last May of Dr. Lee Jong-wook, director general of the World Health Organization (WHO), forced a novel election process for his successor, prompting health advocates worldwide to ask critical, long-ignored questions, such as, Who should lead the fight against disease? Who should pay for it? And what are the best strategies and tactics to adopt?

The answers have not been easy to come by. In November, China's Dr. Margaret Chan was elected as Lee's successor. As Hong Kong's health director, Chan had led her territory's responses to SARS and bird flu; later she took the helm of the WHO's communicable diseases division. But in statements following her election, Chan acknowledged that her organization now faces serious competition and novel challenges. And as of this writing, the Global Fund to Fight AIDS, Tuberculosis, and Malaria remained without a new leader following a months-long selection process that saw more than 300 candidates vie for the post and the organization's board get mired in squabbles over the fund's mission and future direction.

Few of the newly funded global health projects, meanwhile, have built-in methods of assessing their efficacy or sustainability. Fewer still have ever scaled up beyond initial pilot stages. And nearly all have been designed, managed, and executed by residents of the wealthy world (albeit in cooperation with local personnel and agencies). Many of the most successful programs are executed by foreign NGOs and academic groups, operating with almost no government interference inside weak or failed states. Virtually no provisions exist to allow the world's poor to say what they want, decide which projects serve their needs, or adopt local innovations. And nearly all programs lack exit strategies or safeguards against the dependency of local governments.

As a result, the health world is fast approaching a fork in the road. The years ahead could witness spectacular improvements in the health of billions of people, driven by a grand public and private effort comparable to the Marshall Plan—or they could see poor societies pushed into even deeper trouble, in yet another tale of well-intended foreign meddling gone awry. Which outcome will emerge depends on whether it is possible to expand the developing world's local talent pool of health workers, restore and improve crumbling national and global health infrastructures, and devise effective local and international systems for disease prevention and treatment.

SHOW ME THE MONEY

The recent surge in funding started as a direct consequence of the HIV/AIDS pandemic. For decades, public health experts had been confronted with the profound disparities in care that separated the developed world from the developing one. Health workers hated that inequity but tended to accept it as a fact of life, given that health concerns were nested in larger issues of poverty and development. Western AIDS activists, doctors, and scientists, however, tended to have little experience with the developing world and were thus shocked when they discovered these inequities. And they reacted with vocal outrage.

The revolution started at an international AIDS meeting in Vancouver, Canada, in 1996. Scientists presented exhilarating evidence that a combination of anti-HIV drugs (known as antiretrovirals, or ARVs) could dramatically reduce the spread of the virus inside the bodies of infected people and make it possible for them to live long lives. Practically overnight, tens of thousands of infected men and women in wealthy countries started the new treatments, and by mid-1997, the visible horrors of AIDS had almost disappeared from the United States and Europe.

But the drugs, then priced at about \$14,000 per year and requiring an additional \$5,000 a year for tests and medical visits, were unaffordable for most of the world's HIV-positive population. So between 1997 and 2000, a worldwide activist movement slowly developed to address this problem by putting pressure on drug companies to lower their prices or allow the generic manufacture of the new medicines. The activists demanded that the Clinton administration and its counterparts in the G-8, the group of advanced industrial nations, pony up money to buy ARVs and donate them to poor countries. And by 1999, total donations for health-related programs (including HIV/AIDS treatment) in sub-Saharan Africa hit \$865 million—up more than tenfold in just three years.

In 2000, some 20,000 activists, scientists, doctors, and patients gathered in Durban, South Africa, for another international AIDS conference. There, South Africa's former president, Nelson Mandela, defined the issue of ARV access in moral terms, making it clear that the world should not permit the poor of Harare, Lagos, or Hanoi to die for lack of treatments that were keeping the rich of London, New York, and Paris alive. The World Bank economist Mead Over told the gathering that donations to developing countries for dealing with HIV/AIDS had reached \$300 million in 1999—0.5 percent of all development assistance. But he characterized that sum as “pathetic,” claiming that the HIV/AIDS pan-

demic was costing African countries roughly \$5 billion annually in direct medical care and indirect losses in labor and productivity.

In 2001, a group of 128 Harvard University faculty members led by the economist Jeffrey Sachs estimated that fewer than 40,000 sub-Saharan Africans were receiving ARVs, even though some 25 million in the region were infected with HIV and perhaps 600,000 of them needed the drugs immediately. Andrew Natsios, then director of the U.S. Agency for International Development (USAID), dismissed the idea of distributing such drugs, telling the House International Relations Committee that Africans could not take the proper combinations of drugs in the proper sequences because they did not have clocks or watches and lacked a proper concept of time. The Harvard faculty group labeled Natsios' comments racist and insisted that, as Sachs put it, all the alleged obstacles to widespread HIV/AIDS treatment in poor countries "either don't exist or can be overcome," and that three million people in Africa could be put on ARVs by the end of 2005 at "a cost of \$1.1 billion per year for the first two to three years, then \$3.3 billion to \$5.5 billion per year by Year five."

Sachs added that the appropriate annual foreign-aid budget for malaria, TB, and pediatric respiratory and diarrheal diseases was about \$11 billion; support for AIDS orphans ought to top \$1 billion per year; and HIV/AIDS prevention could be tackled for \$3 billion per year. In other words, for well under \$20 billion a year, most of it targeting sub-Saharan Africa, the world could mount a serious global health drive.

What seemed a brazen request then has now, just five years later, actually been eclipsed. HIV/AIDS assistance has effectively spearheaded a larger global public health agenda. The Harvard group's claim that three million Africans could easily be put on ARVs by the end of 2005 proved overoptimistic: the WHO's "3 by 5 Initiative" failed to meet half of the three million target, even combining all poor and middle-income nations and not just those in Africa. Nevertheless, driven by the HIV/AIDS pandemic, a marvelous momentum for health assistance has been built and shows no signs of abating.

MORE, MORE, MORE

In recent years, the generosity of individuals, corporations, and foundations in the United States has grown by staggering proportions. As of August 2006, in its six years of existence, the Bill and Melinda Gates Foundation had given away \$6.6 billion for global health pro-

grams. Of that total, nearly \$2 billion had been spent on programs aimed at TB and HIV/AIDS and other sexually transmitted diseases. Between 1995 and 2005, total giving by all U.S. charitable foundations tripled, and the portion of money dedicated to international projects soared 80 percent, with global health representing more than a third of that sum. Independent of their government, Americans donated \$7.4 billion for disaster relief in 2005 and \$22.4 billion for domestic and foreign health programs and research.

Meanwhile, the Bush administration increased its overseas development assistance from \$11.4 billion in 2001 to \$27.5 billion in 2005, with support for HIV/AIDS and other health programs representing the lion's share of support unrelated to Iraq or Afghanistan. And in his 2003 State of the Union address, President George W. Bush called for the creation of a \$15 billion, five-year program to tackle HIV/AIDS, TB, and malaria. Approved by Congress that May, the President's Emergency Plan for AIDS Relief (PEPFAR) involves assistance from the United States to 16 nations, aimed primarily at providing ARVs for people infected with HIV. Roughly \$8.5 billion has been spent to date. PEPFAR's goals are ambitious and include placing two million people on ARVs and ten million more in some form of care by early 2008. As of March 2006, an estimated 561,000 people were receiving ARVs through PEPFAR-funded programs.

The surge in giving has not just come from the United States, however. Overseas development assistance from every one of the nations in the Organization for Economic Cooperation and Development (OECD) skyrocketed between 2001 and 2005, with health making up the largest portion of the increase. And in 2002, a unique funding-dispersal mechanism was created, independent of both the UN system and any government: the Global Fund to Fight AIDS, Tuberculosis, and Malaria. The fund receives support from governments, philanthropies, and a variety of corporate-donation schemes. Since its birth, it has approved \$6.6 billion in proposals and dispersed \$2.9 billion toward them. More than a fifth of those funds have gone to four nations: China, Ethiopia, Tanzania, and Zambia. The fund estimates that it now provides 20 percent of all global support for HIV/AIDS programs and 66 percent of the funding for efforts to combat TB and malaria.

The World Bank, for its part, took little interest in health issues in its early decades, thinking that health would improve in tandem with general economic development, which it was the bank's mission to promote.

Under the leadership of Robert McNamara (which ran from 1968 to 1981), however, the bank slowly increased direct investment in targeted health projects, such as the attempted elimination of river blindness in West Africa. By the end of the 1980s, many economists were beginning to recognize that disease in tropical and desperately poor countries was itself a critical impediment to development and prosperity, and in 1993 the bank formally announced its change of heart in its annual World Development Report. The bank steadily increased its health spending in the following decade, reaching \$3.4 billion in 2003 before falling back to \$2.1 billion in 2006, with \$87 million of that spent on HIV/AIDS, TB, and malaria programs and \$250 million on child and maternal health. The bank, along with the International Monetary Fund (IMF), the OECD, and the G-8, has also recently forgiven the debts of many poor nations hard-hit by AIDS and other diseases, with the proviso that the governments in question spend what would otherwise have gone for debt payments on key public services, including health, instead.

When the Asian tsunami struck in December 2004, the world witnessed a profound level of globalized generosity, with an estimated \$7 billion being donated to NGOs, churches, and governments, largely by individuals. Although health programs garnered only a small percentage of that largess, many of the organizations that are key global health players were significantly bolstered by the funds.

In January 2006, as the threat of avian influenza spread, 35 nations pledged \$1.9 billion toward research and control efforts in hopes of staving off a global pandemic. Since then, several G-8 nations, particularly the United States, have made additional funding available to bolster epidemiological surveillance and disease-control activities in Southeast Asia and elsewhere.

And poor nations themselves, finally, have stepped up their own health spending, partly in response to criticism that they were under-allocating public funds for social services. In the 1990s, for example, sub-Saharan African countries typically spent less than 3 percent of their budgets on health. By 2003, in contrast, Tanzania spent nearly 13 percent of its national budget on health-related goods and services; the Central African Republic, Namibia, and Zambia each spent around 12 percent of their budgets on health; and in Mozambique, Swaziland, and Uganda, the figure was around 11 percent.

For most humanitarian and health-related NGOs, in turn, the surge in global health spending has been a huge boon, driving expansion in

both the number of organizations and the scope and depth of their operations. By one reliable estimate, there are now more than 60,000 AIDS-related NGOs alone, and there are even more for global health more generally. In fact, ministers of health in poor countries now express frustration over their inability to track the operations of foreign organizations operating on their soil, ensure those organizations are delivering services in sync with government policies and priorities, and avoid duplication in resource-scarce areas.

PIPE DREAMS

One might think that with all this money on the table, the solutions to many global health problems would at least now be in sight. But one would be wrong. Most funds come with strings attached and must be spent according to donors' priorities, politics, and values. And the largest levels of donations are propelled by mass emotional responses, such as to the Asian tsunami. Still more money is needed, on a regular basis and without restrictions on the uses to which it is put. But even if such resources were to materialize, major obstacles would still stand in the way of their doing much lasting good.

One problem is that not all the funds appropriated end up being spent effectively. In an analysis prepared for the second annual meeting of the Clinton Global Initiative, in September 2006, Dalberg Global Development Advisors concluded that much current aid spending is trapped in bureaucracies and multilateral banks. Simply stripping layers of financing bureaucracy and improving health-delivery systems, the firm argued, could effectively release an additional 15–30 percent of the capital provided for HIV/AIDS, TB, and malaria programs.

A 2006 World Bank report, meanwhile, estimated that about half of all funds donated for health efforts in sub-Saharan Africa never reach the clinics and hospitals at the end of the line. According to the bank, money leaks out in the form of payments to ghost employees, padded prices for transport and warehousing, the siphoning off of drugs to the black market, and the sale of counterfeit—often dangerous—medications. In Ghana, for example, where such corruption is particularly rampant, an amazing 80 percent of donor funds get diverted from their intended purposes.

Another problem is the lack of coordination of donor activities. Improving global health will take more funds than any single donor can provide, and oversight and guidance require the skills of the many,

not the talents of a few compartmentalized in the offices of various groups and agencies. In practice, moreover, donors often function as competitors, and the only organization with the political credibility to compel cooperative thinking is the WHO. Yet, as Harvard University's Christopher Murray points out, the WHO itself is dependent on donors, who give it much more for disease-specific programs than they do for its core budget. If the WHO stopped chasing such funds, Murray argues, it could go back to concentrating on its true mission of providing objective expert advice and strategic guidance.

This points to yet another problem, which is that aid is almost always "stovepiped" down narrow channels relating to a particular program or disease. From an operational perspective, this means that a government may receive considerable funds to support, for example, an ARV-distribution program for mothers and children living in the nation's capital. But the same government may have no financial capacity to support basic maternal and infant health programs, either in the same capital or in the country as a whole. So HIV-positive mothers are given drugs to hold their infection at bay and prevent passage of the virus to their babies but still cannot obtain even the most rudimentary of obstetric and gynecological care or infant immunizations.

Stovepiping tends to reflect the interests and concerns of the donors, not the recipients. Diseases and health conditions that enjoy a temporary spotlight in rich countries garner the most attention and money. This means that advocacy, the whims of foundations, and the particular concerns of wealthy individuals and governments drive practically the entire global public health effort. Today the top three killers in most poor countries are maternal death around childbirth and pediatric respiratory and intestinal infections leading to death from pulmonary failure or uncontrolled diarrhea. But few women's rights groups put safe pregnancy near the top of their list of priorities, and there is no dysentery lobby or celebrity attention given to coughing babies.

The HIV/AIDS pandemic, meanwhile, continues to be the primary driver of global concern and action about health. At the 2006 International AIDS Conference, former U.S. President Bill Clinton suggested that HIV/AIDS programs would end up helping all other health initiatives. "If you first develop the health infrastructure throughout the whole country, particularly in Africa, to deal with AIDS," Clinton argued, "you will increase the infrastructure of dealing with maternal and child health, malaria, and TB. Then I think you have to look at nutri-

tion, water, and sanitation. All these things, when you build it up, you'll be helping to promote economic development and alleviate poverty."

But the experience of bringing ARV treatment to Haiti argues against Clinton's analysis. The past several years have witnessed the successful provision of antiretroviral treatment to more than 5,000 needy Haitians, and between 2002 and 2006, the prevalence of HIV in the country plummeted from six percent to three percent. But during the same period, Haiti actually went backward on every other health indicator.

Part of the problem is that most of global HIV/AIDS-related funding goes to stand-alone programs: HIV testing sites, hospices and orphanages for people affected by AIDS, ARV-dispersal stations, HIV/AIDS education projects, and the like. Because of discrimination against people infected with HIV, public health systems have been reluctant to incorporate HIV/AIDS-related programs into general care. The resulting segregation has reinforced the anti-HIV stigma and helped create cadres of health-care workers who function largely independently from countries' other health-related systems. Far from lifting all boats, as Clinton claims, efforts to combat HIV/AIDS have so far managed to bring more money to the field but have not always had much beneficial impact on public health outside their own niche.

DIAMONDS IN THE ROUGH

Arguably the best example of what is possible when forces align properly can be found in the tiny African nation of Botswana. In August 2000, the Gates Foundation, the pharmaceutical companies Merck and Bristol-Myers Squibb, and the Harvard AIDS Initiative announced the launching of an HIV/AIDS treatment program in collaboration with the government of Botswana. At the time, Botswana had the highest HIV infection rate in the world, estimated to exceed 37 percent of the population between the ages of 15 and 40. The goal of the new program was to put every single one of Botswana's infected citizens in treatment and to give ARVs to all who were at an advanced stage of the disease. Merck donated its anti-HIV drugs, Bristol-Myers Squibb discounted its, Merck and the Gates Foundation subsidized the effort to the tune of \$100 million, and Harvard helped the Botswanan government design its program.

When the collaboration was announced, the target looked easily attainable, thanks to its top-level political support in Botswana, the plentiful money that would come from both the donors and the coun-

try's diamond wealth, the free medicine, and the sage guidance of Merck and Harvard. Unlike most of its neighbors, Botswana had an excellent highway system, sound general infrastructure, and a growing middle class. Furthermore, Botswana's population of 1.5 million was concentrated in the capital city of Gaborone. The national unemployment rate was 24 percent—high by Western standards but the lowest in sub-Saharan Africa. The conditions looked so propitious, in fact, that some activists charged that the parties involved had picked an overly easy target and that the entire scheme was little more than a publicity stunt, concocted by the drug companies in the hopes of deflecting criticism over their global pricing policies for AIDS drugs.

But it soon became apparent that even comparatively wealthy Botswana lacked sufficient health-care workers or a sound enough medical infrastructure to implement the program. The country had no medical school: all its physicians were foreign trained or immigrants. And although Botswana did have a nursing school, it still suffered an acute nursing shortage because South Africa and the United Kingdom were actively recruiting its English-speaking graduates. By 2005, the country was losing 60 percent of its newly trained health-care workers annually to emigration. (In the most egregious case, in 2004 a British-based company set up shop in a fancy Gaborone hotel and, in a single day, recruited 50 nurses to work in the United Kingdom.)

By 2002, the once-starry-eyed foreigners and their counterparts in Botswana's government had realized that before they could start handing out ARVs, they would have to build laboratories and clinics, recruit doctors from abroad, and train other health-care personnel. President Festus Mogae asked the U.S. Peace Corps to send doctors and nurses. Late in the game, in 2004, the PEPFAR program got involved and started working to keep HIV out of local hospitals' blood supplies and to build a network of HIV testing sites.

After five years of preparation, in 2005 the rollout of HIV treatment commenced. By early 2006, the program had reached its goal of treating 55,000 people (out of an estimated HIV-positive population of 280,000) with ARVs. The program is now the largest such chronic-care operation—at least per capita—in the world. And if it works, Botswana's government will be saddled with the care of these patients for decades to come—something that might be sustainable if the soil there continues to yield diamonds and the number of people newly infected with HIV drops dramatically.

But Kwame Ampomah, a Ghana-born official for the Joint UN Program on HIV/AIDS, based in Gaborone, now frets that prevention efforts are not AIDS much success. As of 2005, the incidence of new cases was rising eight percent annually. Many patients on ARVs may develop liver problems and fall prey to drug-resistant HIV strains. Ndwapi Ndwapi, a U.S.-trained doctor who works at Princess Marina Hospital, in Gaborone, and handles more of the government's HIV/AIDS patients than anyone else, also frets about the lack of effective prevention efforts. In slums such as Naledi, he points out, there are more bars than churches and schools combined. The community shares latrines, water pumps, alcohol—and HIV. Ndwapi says Botswana's future rests on its ability to fully integrate HIV/AIDS care into the general health-care system, so that it no longer draws away scarce doctors and nurses for HIV/AIDS-only care. If this cannot be accomplished, he warns, the country's entire health-care system could collapse.

Botswana is still clearly somewhat of a success story, but it is also a precariously balanced one and an effort that will be difficult to replicate elsewhere. Ampomah says that other countries might be able to achieve good results by following a similar model, but “it requires transparency, and a strong sense of nationalism by leaders, not tribalism. You need leaders who don't build palaces on the Riviera. You need a clear health system with equity that is not donor-driven. Everything is unique to Botswana: there is a sane leadership system in Gaborone. So in Kenya today maybe the elite can get ARVs with their illicit funds, but not the rest of the country. You need a complete package. If the government is corrupt, if everyone is stealing money, then it will not work. So there is a very limited number of African countries that could replicate the Botswana experience.” And despite the country's HIV/AIDS achievements and the nation's diamond wealth, life expectancy for children born in Botswana today is still less than 34 years, according to CIA estimates.

BRAIN DRAIN

As in Haiti, even as money has poured into Ghana for HIV/AIDS and malaria programs, the country has moved backward on other health markers. Prenatal care, maternal health programs, the treatment of guinea worm, measles vaccination efforts—all have declined as the country has shifted its health-care workers to the better-funded projects and lost physicians to jobs in the wealthy world. A survey of

Ghana's health-care facilities in 2002 found that 72 percent of all clinics and hospitals were unable to provide the full range of expected services due to a lack of sufficient personnel. Forty-three percent were unable to provide full child immunizations; 77 percent were unable to provide 24-hour emergency services and round-the-clock safe deliveries for women in childbirth. According to Dr. Ken Sagoe, of the Ghana Health Service, these statistics represent a severe deterioration in Ghana's health capacity. Sagoe also points out that 604 out of 871 medical officers trained in the country between 1993 and 2002 now practice overseas.

Zimbabwe, similarly, trained 1,200 doctors during the 1990s, but only 360 remain in the country today. In Kadoma, eight years ago there was one nurse for every 700 residents; today there is one for every 7,500. In 1980, the country was able to fill 90 percent of its nursing positions nationwide; today only 30 percent are filled. Guinea-Bissau has plenty of donated ARV supplies for its people, but the drugs are cooking in a hot dockside warehouse because the country lacks doctors to distribute them. In Zambia, only 50 of the 600 doctors trained over the last 40 years remain today. Mozambique's health minister says that AIDS is killing the country's health-care workers faster than they can be recruited and trained: by 2010, the country will have lost 6,000 lab technicians to the pandemic. A study by the International Labor Organization estimates that 18–41 percent of the health-care labor force in Africa is infected with HIV. If they do not receive ARV therapy, these doctors, nurses, and technicians will die, ushering in a rapid collapse of the very health systems on which HIV/AIDS programs depend.

Erik Schouten, HIV coordinator for the Malawi Ministry of Health, notes that of the country's 12 million people, 90,000 have already died from AIDS and 930,000 people are now infected with HIV. Over the last five years, the government has lost 53 percent of its health administrators, 64 percent of its nurses, and 85 percent of its physicians—mostly to foreign NGOs, largely funded by the U.S. or the British government or the Gates Foundation, which can easily outbid the ministry for the services of local health talent. Schouten is now steering a \$270 million plan, supported by PEPFAR, to use financial incentives and training to bring back half of the lost health-care workers within five years; nearly all of these professionals will be put to use distributing ARVs. But nothing is being done to replace the health-care

workers who once dealt with malaria, dysentery, vaccination programs, maternal health, and other issues that lack activist constituencies.

Ibrahim Mohammed, who heads an effort similar to Schouten's in Kenya, says his nation lost 15 percent of its health work force in the years between 1994 and 2001 but has only found donor support to rebuild personnel for HIV/AIDS efforts; all other disease programs in the country continue to deteriorate. Kenya's minister of health, Charity Kaluki Ngilu, says that life expectancy has dropped in her country, from a 1963 level of 63 years to a mere 47 years today for men and 43 years for women. In most of the world, male life expectancy is lower than female, but in Kenya women suffer a terrible risk of dying in childbirth, giving men an edge in survival. Although AIDS has certainly taken a toll in Kenya, Ngilu primarily blames plummeting life expectancy on former President Daniel arap Moi, who kept Kenyan spending on health down to a mere \$6.50 per capita annually. Today, Kenya spends \$14.20 per capita on health annually—still an appallingly low number. The country's public health and medical systems are a shambles. Over the last ten years, the country has lost 1,670 physicians and 3,900 nurses to emigration, and thousands more nurses have retired from their profession.

Data from international migration-tracking organizations show that health professionals from poor countries worldwide are increasingly abandoning their homes and their professions to take menial jobs in wealthy countries. Morale is low all over the developing world, where doctors and nurses have the knowledge to save lives but lack the tools. Where AIDS and drug-resistant TB now burn through populations like forest fires, health-care workers say that the absence of medicines and other supplies leaves them feeling more like hospice and mortuary workers than healers.

Compounding the problem are the recruitment activities of Western NGOs and OECD-supported programs inside poor countries, which poach local talent. To help comply with financial and reporting requirements imposed by the IMF, the World Bank, and other donors, these programs are also soaking up the pool of local economists, accountants, and translators. The U.S. Congress imposed a number of limitations on PEPFAR spending, including a ceiling for health-care-worker training of \$1 million per country. PEPFAR is prohibited from directly topping off salaries to match government pay levels. But PEPFAR-funded programs, UN agencies, other rich-country government agencies, and NGOs routinely augment the base salaries of local

staff with benefits such as housing and education subsidies, frequently bringing their employees' effective wages to a hundred times what they could earn at government-run clinics.

USAID's Kent Hill says that this trend is "a horrendous dilemma" that causes "immense pain" in poor countries. But without tough guidelines or some sort of moral consensus among UN agencies, NGOs, and donors, it is hard to see what will slow the drain of talent from already-stressed ministries of health.

GOING DUTCH?

The most commonly suggested solution to the problematic pay differential between the wages offered by local governments and those offered by international programs is to bolster the salaries of local officials. But this move would be enormously expensive (perhaps totaling \$2 billion over the next five years, according to one estimate) and might not work, because of the problems that stem from injecting too much outside capital into local economies.

In a recent macroeconomic analysis, the UN Development Program (UNDP) noted that international spending on HIV/AIDS programs in poor countries doubled between 2002 and 2004. Soon it will have doubled again. For poor countries, this escalation means that by the end of 2007, HIV/AIDS spending could command up to ten percent of their GDPs. And that is before donors even begin to address the health-care-worker crisis or provide subsidies to offset NGO salaries.

There are three concerns regarding such dramatic escalations in external funding: the so-called Dutch disease, inflation and other economic problems, and the deterioration of national control. The UNDP is at great pains to dismiss the potential of Dutch disease, a term used by economists to describe situations in which the spending of externally derived funds so exceeds domestic private-sector and manufacturing investment that a country's economy is destabilized. UNDP officials argue that these risks can be controlled through careful monetary management, but not all observers are as sanguine.

Some analysts, meanwhile, insist that massive infusions of foreign cash into the public sector undermine local manufacturing and economic development. Thus, Arvind Subramanian, of the IMF, points out that all the best talent in Mozambique and Uganda is tied up in what he calls "the aid industry," and, he says, foreign-aid efforts suck all the air out of local innovation and entrepreneurship. (See Footnote

1.) A more immediate concern is that raising salaries for health-care workers and managers directly involved in HIV/AIDS and other health programs will lead to salary boosts in other public sectors and spawn inflation in the countries in question. This would widen the gap between the rich and the poor, pushing the costs of staples beyond the reach of many citizens. If not carefully managed, the influx of cash could exacerbate such conditions as malnutrition and homelessness while undermining any possibility that local industries could eventually grow and support themselves through competitive exports.

Regardless of whether these problems proliferate, it is curious that even the most ardent capitalist nations funnel few if any resources toward local industries and profit centers related to health. Ministries of health in poor countries face increasing competition from NGOs and relief agencies but almost none from their local private sectors. This should be troubling, because if no locals can profit legitimately from any aspect of health care, it is unlikely that poor countries will ever be able to escape dependency on foreign aid.

Finally, major influxes of foreign funding can raise important questions about national control and the skewing of health-care policies toward foreign rather than domestic priorities. Many governments and activists complain that the U.S. government, in particular, already exerts too much control over the design and emphasis of local HIV/AIDS programs. This objection is especially strong regarding HIV-prevention programs, with claims that the Bush administration has pushed abstinence, fidelity, and faith-based programs at the expense of locally generated condom- and needle-distribution efforts.

Donor states need to find ways not only to solve the human resource crisis inside poor countries but also to decrease their own dependency on foreign health-care workers. In 2002, stinging from the harsh criticism leveled against the recruitment practices of the NHS (the United Kingdom's National Health Service) in Africa, the United Kingdom passed the Commonwealth Code of Practice for the International Recruitment of Health Workers, designed to encourage increased domestic health-care training and eliminate recruitment in poor countries without the full approval of host governments. British officials argue that although the code has limited efficacy, it makes a contribution by setting out guidelines for best practices regarding the recruitment and migration of health-care personnel. No such code exists in the United States, in the EU more generally, or in Asia—but it should.

Unfortunately, the U.S. Congress has gone in the opposite direction, acceding to pressure from the private health-care sector and inserting immigration-control exemptions for health-care personnel into recent legislation. In 2005, Congress set aside 50,000 special immigration visas for nurses willing to work in U.S. hospitals. The set-aside was used up by early 2006, and Senator Sam Brownback (R-Kans.) then sponsored legislation eliminating all caps on the immigration of nurses. The legislation offers no compensation to the countries from which the nurses would come—countries such as China, India, Kenya, Nigeria, the Philippines, and the English-speaking Caribbean nations.

American nursing schools reject more than 150,000 applicants every year, due less to the applicants' poor qualifications than to a lack of openings. If it fixed this problem, the United States could be entirely self-sufficient in nursing. So why is it failing to do so? Because too few people want to be nursing professors, given that the salaries for full-time nurses are higher. Yet every year Congress has refused to pass bills that would provide federal support to underfunded public nursing schools, which would augment professors' salaries and allow the colleges to accept more applicants. Similar (although more complex) forms of federal support could lead to dramatic increases in the domestic training of doctors and other health-care personnel.

Jim Leach, an outgoing Republican member of the House of Representatives from Iowa, has proposed something called the Global Health Services Corps, which would allocate roughly \$250 million per year to support 500 American physicians working abroad in poor countries. And outgoing Senator Bill Frist (R-Tenn.), who volunteers his services as a cardiologist to poor countries for two weeks each year, has proposed federal support for sending American doctors to poor countries for short trips, during which they might serve as surgeons or medical consultants.

Although it is laudable that some American medical professionals are willing to volunteer their time abroad, the personnel crisis in the developing world will not be dealt with until the United States and other wealthy nations clean up their own houses. OECD nations should offer enough support for their domestic health-care training programs to ensure that their countries' future medical needs can be filled with indigenous personnel. And all donor programs in the developing world, whether from OECD governments or NGOs and foundations, should have built into their funding parameters ample money to cover

the training and salaries of enough new local health-care personnel to carry out the projects in question, so that they do not drain talent from other local needs in both the public and the private sectors.

WOMEN AND CHILDREN FIRST

Instead of setting a hodgepodge of targets aimed at fighting single diseases, the world health community should focus on achieving two basic goals: increased maternal survival and increased overall life expectancy. Why? Because if these two markers rise, it means a population's other health problems are also improving. And if these two markers do not rise, improvements in disease-specific areas will ultimately mean little for a population's general health and well-being.

Dr. Francis Omaswa, leader of the Global Health Workforce Alliance—a WHO-affiliated coalition—argues that in his home country of Zambia, which has lost half of its physicians to emigration over recent years, “maternal mortality is just unspeakable.” When doctors and nurses leave a health system, he notes, the first death marker to skyrocket is the number of women who die in childbirth. “Maternal death is the biggest challenge in strengthening health systems,” Omaswa says. “If we can get maternal health services to perform, then we are very nearly perfecting the entire health system.”

Maternal mortality data is a very sensitive surrogate for the overall status of health-care systems since pregnant women survive where safe, clean, round-the-clock surgical facilities are staffed with well-trained personnel and supplied with ample sterile equipment and antibiotics. If new mothers thrive, it means that the health-care system is working, and the opposite is also true.

Life expectancy, meanwhile, is a good surrogate for child survival and essential public health services. Where the water is safe to drink, mosquito populations are under control, immunization is routinely available and delivered with sterile syringes, and food is nutritional and affordable, children thrive. If any one of those factors is absent, large percentages of children perish before their fifth birthdays. Although adult deaths from AIDS and TB are pushing life expectancies down in some African countries, the major driver of life expectancy is child survival. And global gaps in life expectancy have widened over the last ten years. In the longest-lived society, Japan, a girl who was born in 2004 has a life expectancy of 86 years, a boy 79 years. But in Zimbabwe, that girl would have a life expectancy of 34 years, the boy 37.

The OECD and the G-8 should thus shift their targets, recognizing that vanquishing AIDS, TB, and malaria are best understood not simply as tasks in themselves but also as essential components of these two larger goals. No health program should be funded without considering whether it could, as managed, end up worsening the targeted life expectancy and maternal health goals, no matter what its impacts on the incidence or mortality rate of particular diseases.

Focusing on maternal health and life expectancy would also broaden the potential impact of foreign aid on public diplomacy. For example, seven Islamic nations (Afghanistan, Egypt, Iraq, Pakistan, Somalia, Sudan, and Yemen) lose a combined 1.4 million children under the age of five every year to entirely preventable diseases. These countries also have some of the highest maternal mortality rates in the world. The global focus on HIV/AIDS offers little to these nations, where the disease is not prevalent. By setting more encompassing goals, government agencies such as USAID and its British counterpart could both save lives in these nations and give them a legitimate reason to believe that they are welcome members of the global health movement.

Legislatures in the major donor nations should consider how the current targeting requirements they place on their funding may have adverse outcomes. For example, the U.S. Congress and its counterparts in Europe and Canada have mandated HIV/AIDS programs that set specific targets for the number of people who should receive ARVs, be placed in orphan-care centers, obtain condoms, and the like. If these targets are achievable only by robbing local health-care workers from pediatric and general health programs, they may well do more harm than good, and should be changed or eliminated.

In the philanthropic world, targeting is often even narrower, and the demand for immediate empirical evidence of success is now the norm. From the Gates Foundation on down to small family foundations and individual donors, there is an urgent need to rethink the concept of accountability. Funders have a duty to establish the efficacy of the programs they support, and that may require use of very specific data to monitor success or failure. But it is essential that philanthropic donors review the relationship between the pressure they place on recipients to achieve their narrow targets and the possible deleterious outcomes for life expectancy and maternal health due to the diversion of local health-care personnel and research talent.

SYSTEMS AND SUSTAINABILITY

Perched along the verdant hillsides of South Africa's KwaZulu-Natal Province are tin-roofed mud-and-wood houses, so minimal that they almost seem to shiver in the winter winds. An observant eye will spot bits of carved stone laying flat among the weeds a few steps from the round houses, under which lay the deceased. The stones are visible evidence of a terrifying death toll, as this Zulu region may well have the highest HIV prevalence rate in the world.

At the top of one hill in the Vulindlela area resides Chief Inkosi Zondi. A quiet man in his early 40s, Zondi shakes his head over the AIDS horror. "We can say there are 40,000 people in my 18 subdistricts," he says. "Ten thousand have died. So about 25 percent of the population has died." In this rugged area, only about ten percent of the adults have formal employment, and few young people have much hope of a reasonable future. Funerals are the most commonplace form of social gathering. Law and order are unraveling, despite Chief Zondi's best efforts, because the police and the soldiers are also dying of AIDS.

In such a setting, it seems obvious that pouring funds into local clinics and hospitals to prevent and treat HIV/AIDS should be the top priority. For what could be more important than stopping the carnage?

But HIV does not spread in a vacuum. In the very South African communities in which it flourishes, another deadly scourge has emerged: XDR-TB, a strain of TB so horribly mutated as to be resistant to all available antibiotics. Spreading most rapidly among people whose bodies are weakened by HIV, this form of TB, which is currently almost always lethal, endangers communities all over the world. In August 2006, researchers first announced the discovery of XDR-TB in KwaZulu-Natal, and since then outbreaks have been identified in nine other South African provinces and across the southern part of the continent more generally. The emergence of XDR-TB in KwaZulu-Natal was no doubt linked to the sorry state of the region's general health system, where TB treatment was so poorly handled that only a third of those treated for regular TB completed the antibiotic therapy. Failed therapy often promotes the emergence of drug-resistant strains.

There is also an intimate relationship between HIV and malaria, particularly for pregnant women: being infected with one exacerbates cases of the other. Physicians administering ARVs in West Africa have noticed a resurgence of clinical leprosy and hepatitis C, as latent infections paradoxically surge in patients whose HIV is controlled by medicine. HIV-

positive children face a greater risk of dying from vaccine-preventable diseases, such as measles, polio, and typhoid fever, if they have not been immunized than do those nonimmunized children without HIV. But if financial constraints force health-care workers to reuse syringes for a mass vaccination campaign in a community with a Vulindlela-like HIV prevalence, they will almost certainly spread HIV among the patients they vaccinate. And if the surgical instruments in clinics and hospitals are inadequately sterilized or the blood-bank system lacks proper testing, HIV can easily spread to the general population (as has happened in Canada, France, Japan, Kazakhstan, Libya, Romania, and elsewhere).

As concern regarding the threat of pandemic influenza has risen worldwide over the last two years, so has spending to bolster the capacities of poor countries to control infected animal populations, spot and rapidly identify human flu cases, and isolate and treat the people infected. It has become increasingly obvious to the donor nations that these tasks are nearly impossible to perform reliably in countries that lack adequate numbers of veterinarians, public health experts, laboratory scientists, and health-care workers. Moreover, countries need the capacity to coordinate the efforts of all these players, which requires the existence of a public health infrastructure.

At a minimum, therefore, donors and UN agencies should strive to integrate their infectious-disease programs into general public health systems. Some smaller NGOs have had success with community-based models, but this needs to become the norm. Stovepiping should yield to a far more generalized effort to raise the ability of the entire world to prevent, recognize, control, and treat infectious diseases—and then move on to do the same for chronic killers such as diabetes and heart disease in the long term. Tactically, all aspects of prevention and treatment should be part of an integrated effort, drawing from countries' finite pools of health talent to tackle all monsters at once, rather than dueling separately with individual dragons.

David de Ferranti, of the Brookings Institution, reckons that meeting serious health goals—such as getting eight million more people on ARVs while bringing life expectancies in poor countries up to at least the level of middle-income nations and reducing maternal mortality by 15–20 percent—will cost about \$70 billion a year, or more than triple the current spending.

Even if such funds could be raised and deployed, however, for the increased spending to be effective, the structures of global public

health provision would have to undergo a transformation. As Tore Godal, who used to run the neglected-diseases program at the WHO, recently wrote in *Nature*, “There is currently no systemic approach that is designed to match essential needs with the resources that are actually available.” He called for a strategic framework that could guide both donations and actions, with donors thinking from the start about how to build up the capabilities in poor countries in order to eventually transfer operations to local control—to develop exit strategies, in other words, so as to avoid either abrupt abandonment of worthwhile programs or perpetual hemorrhaging of foreign aid.

In the current framework, such as it is, improving global health means putting nations on the dole—a \$20 billion annual charity program. But that must change. Donors and those working on the ground must figure out how to build not only effective local health infrastructures but also local industries, franchises, and other profit centers that can sustain and thrive from increased health-related spending. For the day will come in every country when the charity eases off and programs collapse, and unless workable local institutions have already been established, little will remain to show for all of the current frenzied activity.

DOC-IN-A-BOX

As a thought experiment, the Council on Foreign Relations’ Global Health Program has conceived of Doc-in-a-Box, a prototype of a delivery system for the prevention and treatment of infectious diseases. The idea is to convert abandoned shipping containers into compact transportable clinics suitable for use throughout the developing world.

Shipping containers are durable structures manufactured according to universal standardized specifications and are able to be transported practically anywhere via ships, railroads, and trucks. Because of trade imbalances, moreover, used containers are piling up at ports worldwide, abandoned for scrap. Engineers at Rensselaer Polytechnic Institute converted a sample used container into a prototype Doc-in-a-Box for about \$5,000, including shipping. It was wired for electricity and fully lit and featured a water filtration system, a corrugated tin roofing system equipped with louvers for protection during inclement weather, a newly tiled floor, and conventional doors and windows. Given economies of scale and with the conversions performed in the developing world rather than New York, it is estimated that large numbers of Doc-in-a-Boxes could be produced and delivered for about \$1,500 each.

Staffed by paramedics, the boxes would be designed for the prevention, diagnosis, and treatment of all major infectious diseases. Each would be linked to a central hub via wireless communications, with its performance and inventory needs monitored by nurses and doctors.

Governments, donors, and NGOs could choose from a variety of models with customizable options, ordering paramedic training modules, supplies, and systems-management equipment as needed. Doc-in-a-Boxes could operate under a franchise model, with the paramedics involved realizing profits based on the volume and quality of their operations. Franchises could be located in areas now grossly underserved by health clinics and hospitals, thus extending health-care opportunities without generating competitive pressure for existing facilities.

On a global scale, with tens of thousands of Doc-in-a-Boxes in place, the system would be able to track and respond to changing needs on the ground. It would generate incentives to pull rapid diagnostics, easy-to-take medicines, new types of vaccines, and novel prevention tools out of the pipelines of biotechnology and pharmaceutical companies. Supplies could be purchased in bulk, guaranteeing low per-unit costs. And the sorts of Fortune 500 companies that now belong to the Global Business Coalition on HIV/AIDS, TB, and Malaria would be able to provide services and advice.

Over time, Doc-in-a-Boxes could emerge as sustainable local businesses, providing desperately needed health-care services to poor communities while generating investment and employment, like branches of Starbucks or McDonald's.🌐

FOOTNOTE 1

In the original version of “The Challenge of Global Health,” the view that “foreign aid efforts suck all the air out of local innovation and entrepreneurship” was incorrectly attributed to Steven Radelet.

Ebola's Lessons

How the WHO Mishandled the Crisis

Laurie Garrett

SEPTEMBER/OCTOBER 2015

In a biological sense, last year's Ebola epidemic, which struck West Africa, spilled over into the United States and Europe, and has to date led to more than 27,000 infections and more than 11,000 deaths, was a great surprise. Local health and political leaders did not know of the presence of the hemorrhagic fever virus in the 35,000-square-mile Guinea Forest Region, and no human cases had ever been identified in the region prior to the outbreak. Its appearance in the tiny Guinean village of Meliandou in December 2013 went unnoticed, save as a domestic tragedy for the Ouamouno family, who lost their toddler son Emile to a mysterious fever. Practically all the nonbiological aspects of the crisis, however, were entirely unsurprising, as the epidemic itself and the fumbling response to it played out with deeply frustrating predictability. The world has seen these mistakes before.

Humanity's first known encounter with Ebola occurred in 1976, with an outbreak in the village of Yambuku, Zaire (now the Democratic Republic of the Congo), and surrounding areas. A horrible unknown disease suddenly started causing internal bleeding, high fevers, sometimes hallucinations and deranged behavior, and often death; it was eventually named Ebola after a nearby river. Back then, science lacked

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today's tool kit for the rapid identification and genetic analysis of viruses, not to mention meaningful antivirus treatments, biotechnology, sophisticated HAZMAT suits, and cell phones. Considerable courage, combined with a fair amount of swagger and medical savvy, was the key trait of the couple of dozen foreigners who swooped in to assist the local disease fighters. Most were veterans of battles against other microbes, such as smallpox or yellow fever, but had not previously worked together. Karl Johnson, a virologist at the U.S. Centers for Disease Control and Prevention (CDC), took charge, and the multinational group operated as a team of rivals, jockeying for their respective institutional or national stature in the loosely governed investigation.

Conducting its work under the brutal dictatorship of Mobutu Sese Seko, the group's every small achievement, from corralling air transport to communicating with the CDC's headquarters in Atlanta, was a near miracle. But within a few months, the virus was identified, the Belgian Catholic mission hospital at the center of the outbreak was closed, quarantines were enacted, and the epidemic ended. Almost 300 people had died.

The world's second serious confrontation with Ebola came 19 years later, in 1995, when the disease again broke out in Zaire—this time in Kikwit, a community of nearly half a million people spread out along the edges of a vast rainforest in what amounted to a giant village of mud roads, with no running water, no electricity, no phones, no media of any kind, and only the crudest of medical facilities. I took up temporary residence in Kikwit during the epidemic, reporting on how it played out. There was (and still is) only one paved road out of town, the N1, heading around 300 miles due west to Kinshasa and 550 miles southeast to Mwene-Ditu. At the time, Mobutu held Zaire in his clutches and used its national treasury as his family's personal account; he would die two years later, and the nation would discover its bank vaults were empty. When the mysterious disease plaguing the community was finally confirmed as Ebola, the despot had his military cut off access to the highway, leaving the people of Kikwit to suffer on their own.

The global response boiled down to the Zairean doctor Jean-Jacques Muyembe-Tamfun and his medical team; three physicians from Médecins Sans Frontières (MSF, or Doctors Without Borders); three World Health Organization (WHO) officials; and about two dozen clinicians and scientists from the CDC, France's Institut Pasteur, Belgium's Institute of Tropical Medicine, South Africa's National Institute

for Virology (now the National Institute for Communicable Diseases), and other Western agencies and academic centers. Supplies and funds were scarce, electricity was available only by using generators, and there were no rapid diagnostic tools, medicines, or vaccines available.

The Kikwit epidemic ended after around nine months, having killed 250 people. Afterward, the leader of the global response, David Heymann, an American employed by the CDC but temporarily working at the WHO's headquarters in Geneva, returned to Switzerland with a list of frustrations. Some of his concerns mirrored those of Johnson in fighting Ebola 19 years earlier: there was still no vaccine, no treatment, no field diagnostic tools, limited supplies of protective gear, nearly nonexistent local health-care systems and trained medical personnel, no clear lines of national and global authority for epidemic response, few qualified scientists capable of and interested in being deployed, no international law governing actions inside countries lacking the capacity to stop epidemics on their own, and no money. Heymann had scoured Europe looking for funds to get his team and supplies to Kikwit. The WHO had not been able to help much, and in the end, the German airline Lufthansa provided free travel and logistical support.

Yet another 19 years on, when I visited Liberia in late 2014, I found that little had improved. Although there had been at least 16 more Ebola outbreaks across the Congo basin and Uganda in the interim, the world had not developed any new technical or medical tools for addressing the virus. Treatment was only incrementally more sophisticated than it had been back in 1995, it was still impossible to rapidly diagnose infections, and there was still no vaccine.

SAME OLD STORY

The 1976 Yambuku outbreak came at a time of tremendous optimism in the fields of global health and Western medicine. The previous decades had seen the development and widespread use of a host of remarkably effective vaccines. They had brought horrors such as diphtheria, measles, pertussis, polio, rubella, and tetanus down to insignificant levels in rich countries, offering the hope that immunization campaigns in poor countries could eliminate the diseases entirely. New antibiotics kept appearing on the market, pushing the prices of older stalwarts, such as penicillin and tetracycline, further down toward affordability in poor countries. The medical establishment in the United States was growing in size and sophistication, producing spe-

cialists offering treatments for rare forms of cancer, obscure inherited disorders, and deep psychiatric afflictions. The pharmaceutical industry was at the beginning of an enormous boom. And the WHO was successfully straddling both sides of the Cold War, garnering support from the Soviet Union and the United States.

But 1976 was also a year of harbingers of bad things to come. There was not just Ebola's emergence in Yambuku. The United States struggled with two strange new outbreaks of its own, of swine flu and Legionnaires' disease. In addition, the sexual revolution was spreading across Europe and North America, with increases in unprotected sex leading to a rising incidence of sexually transmitted diseases such as gonorrhea, herpes, and syphilis. Within five years, physicians in the United States would note a set of new, fatal symptoms among hemophiliacs, gay men, and intravenous drug users; the disease would eventually be called acquired immune deficiency syndrome, or AIDS, caused by the human immunodeficiency virus, or HIV.

In what became known as the swine flu fiasco, the Ford administration and the American public health establishment overreacted to the death of a U.S. Army private from the disease. The fatality was isolated, but it led to a panic and a national immunization campaign. Convinced that a massive pandemic was on the way, Congress indemnified the vaccine industry. Immunizations were hastily rushed into production; amid claims of contamination and side effects, years of lawsuits followed. The episode left policymakers skeptical about trusting their health-care professionals and determined never again to indemnify drug makers; manufacturers, in turn, ran for cover, and some drug companies shed their vaccine production lines entirely. An infuriated Congress convened hearings to rake the CDC over the coals, forcing the resignation of the agency's director.

Six months after the death of the army private, 34 hotel guests attending an American Legion convention in Philadelphia died from a mysterious illness (later dubbed Legionnaires' disease). The inability of the CDC and Pennsylvania health authorities to rapidly determine what had happened further undermined policymakers' confidence, and when the cause of the disease turned out to be a previously unknown species of bacteria lurking in the air-conditioning system, the public was shocked. If the age of infectious diseases was past, how could a new bacterial ailment appear, go undiagnosed for months, and prove tough to treat with antibiotics?

AIDS would, of course, prove the greatest challenge—to human hubris, the pharmaceutical and research communities, and international global health governance. Shortly after his first visit to Liberia to see the Ebola epidemic firsthand last August, the CDC's current director, Thomas Frieden, told reporters, "I will say that in the 30 years I've been working in public health, the only thing like this has been AIDS. And we have to work now so that this is not the world's next AIDS." Frieden was referring not to the disease itself but to the world's disastrous response to it. For two decades, as the AIDS pandemic unfolded in country after country, governments and general populations almost always proved more interested in attacking the subpopulations at greatest risk for the disease than in fighting the virus itself. Children infected by HIV-contaminated blood transfusions were banned from schools, the homes of hemophiliacs were burned, masses of gay men died with little attention from the heterosexual communities around them, intravenous drug users were denied sterile syringes, female prostitutes were imprisoned or denied access to health care, and many medical and dental providers refused to allow HIV-positive individuals access to care unrelated to their infections.

From the perspective of HIV prevention, in nearly every country in the world, the 1980s and 1990s were long, ugly decades during which the virus spread relentlessly, with AIDS eventually ranking as the third-largest pandemic in world history (after the Black Death and the 1918 influenza pandemic). In comparing Ebola and AIDS, Frieden was not forecasting that Ebola would infect 60 million people, as HIV has; rather, he was indicating that the ignorant, inept, and cruel response to AIDS was being mirrored by events unfolding in West Africa in 2014.

During the 1980s, the WHO failed to recognize the importance of HIV and AIDS. Inside its Geneva headquarters, some experts exhibited as much prejudice against the populations at great risk for AIDS—especially homosexuals—as did the general public. For a brief time in the mid-1980s, its Global Program on AIDS (GPA) thrived, led by the epidemiologist Jonathan Mann. But WHO insiders grumbled and complained about the millions of dollars in AIDS funds Mann was raising and about the dire (and, in retrospect, mostly accurate) forecasts his group was issuing. A common refrain among insider critics was, "Since more people die of diarrhea—or cancer, or hypertension, or malaria, or whatever—than of AIDS, why is it getting so much money and media attention?" Heeding the grousing, the WHO's director general, Hi-

roshi Nakajima, forced Mann's resignation, slashed the AIDS budget, and eventually shut down the GPA, essentially walking away from the largest pandemic in modern history.

Since then, the global response to the rise of new pathogens has continued to be limited, uncoordinated, and dysfunctional. From SARS to MERS, H5N1 to H1N1 to H7N9, the story has been similar. Poor nations are unable to detect new diseases quickly and bring them swiftly under control. Rich nations generally show only marginal interest in outbreaks until the microbes seem to directly threaten their citizens, at which point they hysterically overreact. Governments look after their own interests, cover up outbreaks, hoard scarce pharmaceutical supplies, prevent exports of life-saving medicines, shut borders, and bar travel.

The global health infrastructure has shown itself to be weak, fractured, prone to infighting, and more interested in searching for technological silver bullets than engaging in the hard slog of social mobilization and classic local public health work. And through it all, the WHO has struggled to remain credible, as its financial resources have shrunk, tensions have grown between its Geneva headquarters and its regional offices, and rival multilateral organizations have taken control over much of the global health action and agenda.

"I THOUGHT I KNEW FEAR"

By now, in mid 2015, the nation of Liberia is returning to its normal, pre-Ebola life. This is in sharp contrast to the horrors of last fall, when every nook and cranny of the country was in the grip of the disease and people were literally dying in the streets of Monrovia for lack of hospital beds and treatment centers. Nearly 500 new cases a week were detected in the country during late September and early October. Toward the end of the year, Liberia seemed to have its epidemic under control, with fewer than five new cases found each day, and it seemed reasonable to think, as Liberian President Ellen Johnson Sirleaf publicly did, that the epidemic might end before Christmas. Sadly, the virus skirted that final elimination, stubbornly spreading inside Monrovia. By mid-March 2015, Liberia once again seemed poised to declare victory, having gone more than 21 days without a new case anywhere in the nation. But on March 27, a 44-year-old woman living in Monrovia died of the disease. Authorities determined that her boyfriend, an Ebola survivor, had the virus in his semen, and a shocked nation learned that Ebola could be transmitted

sexually by a man some six months after he was healed. The WHO officially declared Liberia free of Ebola on May 9, and the country began to focus on economic recovery while remaining on alert for Ebola reentry from neighboring Guinea and Sierra Leone, where control over the disease has proved substantially more elusive. (Ominously, in late June, the cadaver of a 17-year-old Liberian boy tested positive for Ebola, and since then, a handful of other cases have come to light.)

Charts of the rates of infection and fatalities show that Liberia's plague was on its downward course before the world mobilized to help. With heroic assistance from MSF, the International Committee of the Red Cross, a few other foreign humanitarian and religious organizations, and small teams of foreign scientists and public health experts, Liberia was able to turn the tide of its epidemic largely without the UN Mission for Ebola Emergency Response (UNMEER), the U.S. military, or the promised hundreds of millions of dollars' worth of World Bank and multinational aid. As late as the end of February 2015, after the worst of the crisis had passed, less than half of the finances, personnel, and supplies promised by the global community had actually materialized on the ground. If the aid had arrived earlier, the epidemic would undoubtedly have been contained faster and with fewer fatalities.

There was no good reason to believe that Liberia would be able to acquit itself so well in managing its catastrophe. When the crisis struck, Liberia, one of the poorest nations on earth, barely had a health-care and hospital system or even a method for processing public-sector payrolls. It ranked 175 out of 187 countries in the UN's Human Development Index, had an official unemployment rate of more than 80 percent, and a total GDP of only \$1.95 billion. Less than half of the population was functionally literate, a third of the country's women had never set foot in a classroom, and fewer than five percent of households could, by African Development Bank standards, be labeled middle class. And in fact, if not for a smattering of dedicated officials and medical personnel, together with the good sense of local villagers, Liberia might still be in crisis.

Miatta Zenabu Gbanya is a perfect example of the expertise that came to Liberia's rescue. Smart, hard-working, and resilient, Gbanya, a nurse, returned to her Liberian home in mid-2013 after nearly a decade of grueling relief work in such hellholes as Darfur, South Sudan, and contested zones of the Democratic Republic of the Congo.

Like most Liberians, Gbanya had toughened up at an early age as a matter of survival through her country's civil wars, which began in 1989 and spanned the 1990s and beyond, and she had seen rough times since. While she was working in Darfur for a British medical relief group in 2007, for example, members of her team were carjacked by Khartoum-backed Janjaweed militants, and in subsequent months, Gbanya "spent many nights—night after night—laying in fear." She said, "I thought I knew fear very well." Until, that is, she faced the Ebola epidemic. "I thought fear in Darfur was the worst feeling," she told me when I spoke with her recently. "But no—it's Ebola."

Given her years of relief work, Gbanya was assigned by Sirleaf to head up a new entity called the Health Sector Pool Fund,* a health-care-financing scheme that combined resources from about a dozen donors into a single pot of carefully monitored funds for the nation's desperate government health-care system. Liberia had few doctors, horribly rundown medical facilities, few supplies, and no money. Like its neighbors Guinea and Sierra Leone, moreover, Liberia had seen what institutions it did have collapse during the civil war years, to be replaced by a smattering of disconnected clinics and hospitals funded and operated by foreign missionaries and aid organizations. But Sirleaf felt Liberians should control and provide for their health themselves, and so after coming to power in 2006, her government had negotiated with donors, Gbanya said, and gotten them to agree to pool the funds they spent in the country into a single account. (The U.S. Congress will not permit the pooling of American financial resources, and so U.S. agencies operate in parallel to the fund, with the United States having a seat at the fund's boardroom table.) By the time Gbanya took the helm in late 2013, the organization was ready to roll.

When she arrived, the Health Sector Pool Fund had about \$65 million in the bank, she told me, enough to support the payroll and supplies for only a quarter of the country's health establishment.* Even when this money was combined with support from the U.S. government and the Global Fund to Fight AIDS, Tuberculosis and Malaria, Gbanya said she had no more than a third of the money needed to make full payroll, and she had to root out corruption inside Liberia's Ministry of Finance to ensure that even those funds were properly allocated. From distant rural clinics to the top tiers of the Ministry of Health, many employees were going unpaid. Remarkably, the unpaid staff kept coming to work, and throughout the sys-

tem, paid health-care workers shared their salaries with the unpaid, on the assumption that someday their clinical comrades would finally earn enough money to reimburse them.

By the most generous estimates, when Ebola struck, there were fewer than 250 physicians in Liberia, or fewer than two doctors for every 100,000 Liberians; the United States, in contrast, enjoys roughly 245 doctors for every 100,000 Americans. Nurses and midwives were similarly burdened, with three of them per every 10,000 Liberians. And the country had a hospital bed ratio of 0.8 beds per 1,000 Liberians. All of this meant long waits for treatments and exhausting hours of work for health-care providers. “We were dealing with a tough work force that was dissatisfied, from top to bottom,” Gbanya told me. She set to work searching for cost efficiencies, begging donors for more resources, and sniffing out corruption.* But as the end of 2013 approached, Gbanya knew that tensions were rising inside the Liberian health-care system, and she simply didn’t have the money to do much about it.

POROUS BORDERS

Meanwhile, hundreds of miles away from the Liberian capital of Monrovia, at the edge of a great rainforest where Guinea, Liberia, and Sierra Leone meet, a two-year-old boy named Emile crawled about a water-soaked tree stump with other toddlers and discovered a bunch of little, furry winged creatures. Grabbing at them and poking them with a stick, Emile reportedly played with the nest of *lolibelo*—the name locals use to describe musk-smelling, dark gray bats with bodies about the size of a child’s open hand. Many months later, a team of German anthropologists and biologists would visit the Guinean village of Meliandou and determine that Emile’s *lolibelo* were Angolan free-tailed bats or perhaps members of a similar species of mammal found across most of sub-Saharan Africa. Surviving children in the village told visiting scientists and reporters that youngsters had smoked *lolibelo* out of the tree, filled up sacks with the flying mammals, and eaten them. The men in the village often hunted larger fruit bats with roughly foot-long wingspans, called little collared fruit bats—one of only three bat species thought to carry the Ebola virus.

Whether he caught something from a tiny *lolibelo* or from a bigger fruit bat, on December 26, 2013, Emile came down with a soaring fever, bloody diarrhea, and nausea, and soon others in the village got sick, too. Emile died on December 28, and over the following six weeks, at

least ten other villagers succumbed. Before dying, a Meliandou midwife went to seek help from her family in the nearby village of Dandou Pombo, passing the strange disease on. She then died in a hospital in the town of Guéckédou, after infecting one of her attending traditional healers. That ailing health-care worker went to a government clinic in the town of Macenta; after he died, four members of his family who had prepared his body for burial brought the disease home with them to a fourth area, Guinea's Farako District. Back in Meliandou, baby Emile's grandmother died of the disease on January 11, 2014. Relatives from Dawa village attended her funeral, returning home before dying themselves. Soon, a primary chain of transmission was spreading the still-unidentified disease throughout Guinea and into Sierra Leone.

By February, terrified villagers were pouring into medical facilities across the region, including an MSF malaria clinic in Guéckédou, close to the Liberian border, where the 36-year-old Guinean physician Marie-Claire Lamah and her colleagues struggled to figure out what was wrong. "When I arrived the mortality toll was between 80 and 90 percent," Lamah told *Le Nouvel Observateur*. Villagers and health-care workers could already see a pattern emerging, with the people who cared for their ailing loved ones and prepared their bodies for burial being the most likely to contract the mysterious disease. But the villagers continued to wash the cadavers, dress them in finery, ritually kiss and caress the deceased to wish them well in the afterlife, and bury the dead, all according to ancient traditions meant to ensure that angry spirits would not return to haunt the families of the dead for failing to provide proper entry for them to heaven. (People across the region later whispered to me that they were more afraid of angering their ancestors than they were of the disease.)

Meanwhile, near Guéckédou, a second line of transmission went untraced by health officials for weeks. It began, according to an investigation by *The New York Times*, with a woman named Sia Wanda Koniono, who visited the Guéckédou area and died after returning to her home across the border in Sierra Leone, on March 3. Although Guinean authorities knew about Koniono's death, they apparently made no attempt to notify their Sierra Leonean counterparts. The second line of transmission spread, unobserved, from Koniono's funeral across a broad swath of Sierra Leone and eventually into Liberia.

At this point, Gbanya knew nothing about Meliandou, the deaths in Guinea, or the strange outbreak that had crossed into Sierra Leone.

What she did know was that all the doctors and nurses in Liberia were demanding that she somehow raise enough funds to put everybody on the payroll. Negotiations with health-care workers and their unions broke down when Gbanya tried to explain how the pool fund worked and why she had enough money to pay only a quarter of them. “We had many discussions with health workers,” Gbanya recalled. “But it’s complex. They don’t get it.” So Liberia’s government health work force went on strike. Gbanya pleaded for understanding, and eventually the disgruntled doctors, nurses, midwives, lab technicians, ambulance drivers, hospital managers, and Ministry of Health personnel returned to work, tentatively accepting vague promises of future payment. But it was a challenge. “I’m used to coping,” Gbanya told me last December, shaking her head. “But from the moment of that health-care worker crisis in February, we haven’t stopped. Not for one minute.”

On March 12, 2014, Liberia’s traditional Decoration Day, Gbanya joined thousands of fellow citizens to honor ancestors by festooning their graves with flowers and memorabilia—not realizing the epidemic had now crossed into Liberia, striking Foya, a town of 20,000 people in Lofa County. A week later, Guinea’s top health officials released their first official statement on the mysterious Meliandou outbreak, with the Ministry of Health saying that 35 cases of a hemorrhagic ailment had been confirmed. The statement made no mention of the Koniono case or of evidence that infected individuals were crossing back and forth across the porous borders between Guinea, Liberia, and Sierra Leone, giving rise to the first multinational Ebola epidemic in history. A Health Ministry spokesperson, Sakoba Keita, told local reporters that most of Guinea’s victims had been in contact with dead bodies and suffered “diarrhea and vomiting, with a very high fever. Some cases showed relatively heavy bleeding.” He went on: “We thought it was Lassa fever or another form of cholera but this disease seems to strike like lightning. We are looking at all possibilities, including Ebola.”

Finally, on March 23, the WHO announced that the cause of the outbreak had been conclusively identified as Ebola by France’s Institut Pasteur. By then, the epidemic had already sickened many people in Guinea’s capital city, Conakry, marking the first time in history that the disease had spread to a metropolitan center with an international airport. On March 24, in Guéckédou, MSF opened the first of what would become several Ebola treatment centers and began calling for international help to find and isolate infected individuals so as to stop

the outbreak. Because it had carried out such actions in Kikwit in 1995 and for a dozen other Congo basin Ebola outbreaks since, the organization was able to mobilize quickly. But little help was forthcoming. The WHO reported that two suspected Ebola patients in Conakry had tested negative for the virus. But the next day, the organization acknowledged that 86 cases of the disease, including 59 deaths, had occurred in Guinea; that labs in Europe had confirmed the presence of the Ebola virus in 13 samples; and that it was investigating rumored cases in Liberia and Sierra Leone. At the same time, the Liberian Ministry of Health confirmed the country's first Ebola cases. The next day, a WHO field investigator sent a memo, later obtained by the Associated Press, to the WHO's African regional office, in Brazzaville, Congo, calling for urgent help, as "there is evidence of cross-border transmission." Then, on March 27, the WHO issued health alerts for all of Guinea, Liberia, and Sierra Leone, as panic took hold in Conakry. On the last day of March, Senegal closed its borders with all three countries, foreign businesses began withdrawing their expatriate employees, commercial air carriers started negotiations that would lead to a cessation of services, and the EU made the first pledge of international funds in response to the Ebola outbreak: \$690,000.

By April 1, the number of cases in Guinea had jumped by almost 50 percent, to 122, with 80 deaths. Liberia now had eight confirmed cases. The WHO mobilized protective equipment for health-care workers in Conakry, but local health-care providers complained that what they really needed was water, electricity, basic medical equipment, and sanitation supplies, none of which were available. Air France began quarantining flights from the region, and a mob attacked an MSF treatment center in Macenta, Guinea, accusing the foreign doctors and nurses of bringing the disease to Africa and forcing MSF to abandon the clinic.

By mid-April, the WHO's Global Outbreak Alert and Response Network (GOARN) was overseeing 65 foreign epidemic experts working in Guinea and Liberia, with some 220 cases of Ebola identified and 135 deaths. According to the Associated Press, in a frightening e-mail to the WHO's headquarters in Geneva, a field investigator in Guinea called for "a drastic . . . change [of] course," warning that health-care workers were "gripped by fear and panic. . . . We need to change strategy urgently." The WHO focused the international efforts on educating the Guinean population and rapidly isolating known cases, and by April 27, experts both in Geneva and at the CDC's head-

quarters in Atlanta were convinced that the tide had been turned: case loads were falling, and the situation appeared to be under control. The foreigners, with the exception of MSF and the missionary aid group Samaritan's Purse, began to withdraw.

In Monrovia, Gbanya sighed with relief. She knew that some of the health-care workers fighting the relatively few cases in Lofa County were unpaid, and her pool fund budget had no flexibility to allow for an unexpected catastrophe such as an epidemic. Sirleaf, who told me that by that point she had been assured that the Ebola threat had passed, left the country to attend international finance meetings, and officials inside the Ministry of Health returned to business as usual. Retrospective charts of Ebola cases in the spring of 2014 show a mid-March uptick, followed by a plummet in early April, which the WHO and the CDC both misinterpreted as the beginning of the end of the outbreak; in fact, it was just a lull. The virus was lurking far from the watchful eyes of health authorities, poised to precipitate the worst Ebola crisis in history.

UNDER CONTROL

In Geneva, meanwhile, the WHO leadership was fixated on the organization's annual World Health Assembly, coming up in May. The WHA is a one-country, one-vote legislature that governs the WHO, deciding its budgets and key policy initiatives. WHA gatherings are typically grueling affairs that everybody dreads, with delegates bickering over obscure paragraphs in proposed resolutions at 3 AM, as tiny nations such as Kiribati or Paraguay have the same say as behemoths such as China, India, and the organization's major donors, the EU countries and the United States. Weeks of preparation, including advance private negotiations with key countries, are necessary to make sure anything gets done, and there is even recurrent debate about the fundamental mission and role of the WHO.

Since its creation as part of the United Nations system in 1948, the WHO has served as a clearinghouse for technical advice, providing member nations with guidance and expertise on everything from the dangers of smoking and the safety of measles vaccines to health-care-financing mechanisms and the sociopolitical determinants of heart disease. That alone would be more than enough for any entity to handle, but over the years, the WHA has pushed the organization to take on tough policy positions as well. Countries in trouble want the WHO to mobilize the world's top technical expertise to vaccinate Syrian refugees, stop chol-

era in post-earthquake Haiti, erect emergency trauma centers across Typhoon Haiyan–devastated Philippine islands, and so forth. But WHA delegates also insist on introducing countless resolutions on issues such as international recognition of Palestine and Taiwan, the banning of tobacco and fast-food company employees from public health meetings, and sex education, gay rights, and family planning.

Every WHA has had political surprises, and the list of mandates is always far in excess of the budgetary authority conferred to accomplish them. The 2013 WHA, for example, was sidetracked by an unexpected outburst from the delegation from Saudi Arabia, which complained about the patenting by a Dutch scientist of a sample of a new virus (MERS). The assembly descended into a frenzy of oration denouncing the patenting of viruses, even though the issue, however ethically dubious, was entirely irrelevant to the actual course of the virus' spread inside Saudi Arabia, which the kingdom's scientists had done little to counter. Meanwhile, assembly delegates declined to raise revenues in order to address a massive budget crisis, accelerating the WHO's decline as a player on the global health stage relative to better-funded, more effective, and less politicized institutions, such as the Global Fund; Gavi, the Vaccine Alliance; the U.S. President's Emergency Plan for AIDS Relief; and the Bill and Melinda Gates Foundation. And they dramatically rearranged the WHO's priorities, shifting resources away from combating infectious diseases.

A year later, as staffers prepared for the 2014 WHA, they were still grappling with the consequences of the previous one, trying to fight a raging Ebola epidemic in West Africa with a meager budget and scarce personnel. More than 130 people had lost their jobs in GOARN, leaving the WHO with a skeleton crew of fewer than 35 outbreak fighters and clerical support personnel. In Saudi Arabia, meanwhile, MERS was spreading out of control inside the country's largest public hospital, its animal origins remained unclear, no point-of-care diagnostics existed to quickly determine whom the virus had infected, and there were no cures or vaccines available. And the virulent H7N9 bird flu was moving rapidly across mainland China, Hong Kong, and Taiwan.

Further compounding the organization's problems were two internal policy matters. Margaret Chan, the WHO's director general, had recently won reelection, and to many observers, she seemed to defer too much to national governments' wishes and agendas, even when they were in conflict with the organization's primary mission. During

Chan's tenure, which began in 2006, the WHO's regional offices had gained power and autonomy at the expense of the organization's central headquarters. This was fine for those parts of the world with strong regional health-care institutions, such as the Americas. But it was a disaster for a continent such as Africa, whose regional WHO office had scant resources and a poor reputation. Throughout the spring of 2014, as MSF was trying to draw attention to the worsening situation, reports from the WHO office in Brazzaville were downright cheery. On April 25, for example, the office reported that "overall, the epidemiological situation in Guinea has improved significantly over the last few weeks." A few weeks later, the office issued a similar assessment: "The overall Ebola outbreak in Guinea continues to improve." These rosy views were echoed by Guinean President Alpha Condé, who, during a visit to Geneva in early May, vaguely commented to reporters that "there haven't been any new cases." Owing in part to such reassurances, WHO and CDC officials in Geneva and Washington concluded that the West African Ebola epidemic was coming to an end.

Unfortunately, it wasn't.

OUT OF CONTROL

MSF officials were convinced that the decline in reported cases was a product not of a fading epidemic but of a reluctance by local villagers to engage with foreigners or national institutions. After the MSF clinic in Macenta was attacked by a mob on April 4, MSF officials tried in vain to get the WHO to change its mind about withdrawing. When the 2014 WHA convened in Geneva in late May, the Ebola epidemic garnered only a smattering of references in speeches. It was not on the agenda, and no resolutions were passed concerning it. As the delegates conversed, however, the virus was continuing to spread across Guinea, Liberia, and Sierra Leone, undetected by authorities for precisely the reasons MSF had identified: locals were not reporting their illnesses, and families were burying their dead in secret.

According to internal WHO documents obtained and published by the Associated Press, a June 2 meeting of GOARN team members in Geneva revealed a radically increased sense of urgency; one scientist on the team noted that the West African countries were "overwhelmed with outbreaks" and that "outbreak vigilance [was] down to a minimum." Two days later, a WHO scientist suggested internally that it was time to declare a public health emergency under the International Health Regulations,

an international legal framework that provides guidelines to prevent the spread of infectious diseases. But in response, Sylvie Briand, the head of the Pandemic and Epidemic Diseases Department at the WHO, said that the invocation of the IHR should be considered only as “a last resort.” And a June 10 memo prepared for Chan by senior WHO officials warned that invoking the IHR “could be seen as a hostile act in the current context and may hamper collaboration between WHO and the affected countries.” In contrast, in mid-June, the leaders of MSF declared the Ebola situation “out of control” and begged the world to pay heed. According to a report that MSF later published, some WHO officials responded to those entreaties by accusing MSF of exaggerating the risk and encouraging panic.

In Liberia, Luke Bawo was heading up a small team in the Ministry of Health tracking Ebola. “We thought we were down to zero back in April—we couldn’t find any cases—but then the epidemic surged and overwhelmed us,” he told me.

There was a lull, 21 days with no cases. Everybody let their guard down. Then a Ugandan physician at Redemption Hospital [in Monrovia] got infected, and the minister of health called me and said, “We need your help to manage data.” I had no idea what I was getting into. I read and studied about Ebola, and I thought in 40 days it will go away. But that did not happen with Ebola here—not like [in the past] in Uganda. And then this Liberian guy [Patrick Sawyer] exported the virus to Nigeria, and that woke the whole world up. Since then, I have been working seven days a week, no holidays. I start calling all the counties at 8 PM, until 10, maybe midnight. Catch a couple hours of sleep. And then up at 5 AM to prepare the [daily] situation report and have it ready to present at 9 AM. It’s never-ending.

Sirleaf took charge of her country’s response to the epidemic in early June; she began, she told me, by begging for the CDC and the WHO to return. But the CDC’s leadership was preoccupied with a succession of scandals back home involving inappropriately handled samples of dangerous pathogens; Congress was investigating, and in July, the CDC temporarily shut down some of the labs where work on the Ebola virus could have been carried out. Then came the long European summer holidays and the monsoons in West Africa.

With the rains came tremendous logistical challenges, as the countries in question have few paved roads outside of their capital cities. On average, Monrovia gets 202 inches of rainfall annually, most of it pouring

down between June and October. (In contrast, moist Bangkok averages 55 inches, and Seattle, 33.) Many of Liberia's poor roads are transformed by rain into seas of mud, bringing transport to a near standstill. Scattered reports from the hinterlands came into Monrovia indicating that Ebola was spreading out of control, and by mid-July, its presence in the capital itself was undeniable as patients turned up in local hospitals and beloved doctors and nurses perished. Their losses, in a country of so few skilled health-care workers, "felt like a stab in our hearts," Gbanya told me. "July, August, September—hoo! We lost the best we had. We spent a lot of nights crying and a lot of mornings saying, 'We must go ahead.' Even at the ministry, there were days when we were just too worried. There were dead bodies everywhere! Our phones never stopped ringing. Ambulances all night! For eight months, none of us has slept."

Ministry of Health Ebola meetings, usually attended by the president herself, became deeply emotional. "There were days we used to sit around the table and couldn't find a way out," Gbanya said. At one such meeting, on July 22, a young man shouted at Sirleaf, accusing her of running a government that had denied hospital care to his dying relative. The next day, the man returned and set off a firebomb inside the conference room, destroying computers that stored valuable information and sending terrified staff scrambling. It would be one of many violent episodes in Monrovia—and Conakry and Freetown—spawned by fear and rage among populations unable to comprehend why their governments could not stop the plague.

NOTHING TO SEE HERE

On July 20, an American financial consultant to the Liberian government, Patrick Sawyer, flew from Monrovia to Lagos, unintentionally taking Ebola to Nigeria. In response, Sirleaf ordered most of the country's borders sealed and banned its diplomats from traveling abroad. The Sawyer case elevated the Ebola crisis on the international agenda, prompting some major airlines to cancel flights to Guinea, Liberia, and Sierra Leone and leading a number of countries, including France, Germany, and the United States, to issue travel warnings advising their citizens to stay away. The Ebola-hit countries descended into a period of almost complete economic and political isolation from the rest of the world, one that continues today.

Still, the WHO declined to declare an emergency. An expert panel of advisers told the Geneva headquarters in July that it would be

wrong to divert scarce medical resources in the three impoverished countries to the Ebola crisis. “If you want to blame somebody for this epidemic, blame me. It was my mistake,” the statistician and doctor Hans Rosling later told me, speaking so earnestly that his voice broke. A leading analyst of global health trends at Sweden’s Karolinska Institute and a member of the expert panel, Rosling argued in July that a diversion of scarce national health talent in the three nations to address the “small problem” of Ebola would doom a far larger number of people in the countries to die of the greater threats of malaria, pregnancy complications, diarrheal diseases, and bacterial infections. Rosling was persuasive—although hardly alone in making an argument that echoed claims made by the WHO in the 1980s regarding the relative importance of AIDS versus other diseases. (Unlike others who offered the same advice, Rosling later recognized his terrible mistake as the number of Ebola cases skyrocketed throughout the summer and volunteered to do penance, working beside Bawo, the Liberian Health Ministry official, for three months, counting Liberia’s sick and dead.)

By the first week of August, overstuffed hospitals were turning away patients and corpses were being left unattended on the streets of Monrovia. On August 6, Sirleaf declared a national state of emergency, calling on her people to fast and pray from 6 AM to 6 PM for three days: “Relying on his divine guidance for our survival as a nation,” she said, “I call on all Liberians to observe three days of national fast and prayer to seek God’s face, to have mercy on us and forgive our sins and heal our land.” Given the dire situation, Sirleaf decided not to attend U.S. President Barack Obama’s U.S.-Africa Leaders Summit later that month in Washington, sending in her place Liberian Vice President Joseph Boakai and relying to some extent on the U.S. ambassador to Liberia, Deborah Malac, to be an advocate for her views. Malac told me that she tried to raise alarms within the Obama administration and Congress about the crisis. But despite her efforts, the subject took a back seat to economic development during the summit—this despite the fact that two American aid workers had contracted the disease in Liberia and were undergoing experimental treatments in the United States, causing considerable American media hysteria.

It was not until August 8 that the WHO declared the Ebola situation a “public health emergency of international concern,” an official designation previously invoked in 2009 in reference to the H1N1

swine flu. But by then, Rosling's fears had ironically been borne out: routine health care had collapsed in all three affected countries, and even minor medical complications, in childbirth, car accidents, and simple falls, were proving lethal.

By that point, the epidemic was of such staggering proportions, and the panic it was producing so great, that Guinea, Liberia, and Sierra Leone seemed on the edge of collapse. Riots broke out, bodies were hidden, health-care workers were attacked, and food supplies dwindled. In an interview with National Public Radio, Lindis Hurum, MSF's emergency coordinator in Liberia, said, "We've reached our limit. . . . We certainly have the motivation, but I don't have enough people to deal with this."

UN Secretary-General Ban Ki-moon, seeming to have lost faith in the WHO, appointed David Nabarro as the UN's special envoy on Ebola and sent him to assess the situation in the Ebola-stricken region. Nabarro later told me it was one of the gravest situations he had ever witnessed. He set to work mobilizing resources and institutions to stop the epidemic. He initially reckoned that a successful effort would cost at least \$600 million.

Frieden, the CDC's director, also visited the region, in late August, telling Obama on his return that the epidemic was even worse than he'd feared. On September 1, Sirleaf went on CNN, pleading for help: "Our health delivery system is under stress. . . . It could easily become a global crisis. . . . We need that hope; we need that assistance. We need for the Liberians to know that this war can be won." The next day, Liberian health-care workers went on strike again, this time arguing that physicians, nurses, ambulance drivers, and other health-care employees should be receiving extra hazard and overtime pay. MSF's international president, Joanne Liu, spoke at a UN briefing that day and placed the situation in stark relief. "To curb the epidemic, it is imperative that states immediately deploy civilian and military assets with expertise in biohazard containment," she said. "We cannot cut off the affected countries and hope this epidemic will simply burn out. To put out this fire, we must run into the burning building."

Gbanya turned to her donors, she told me, and begged them to increase their support for the Health Sector Pool Fund, pleading in vain with the World Bank and the WHO. There were murmurs that Monrovia's large soccer stadium ought to simply be filled with cots and all those suspected of being infected with Ebola loaded inside.

Distraught Ministry of Health staff members worked relentlessly, took catnaps in their offices, and attended funerals. "I was so sad; everybody was so sad," Gbanya recalled. "We just cried and cried every day and then tried to go on working. Just cry, and push on, cry, and push on." Soon, the very people leading Liberia's Ebola fight were suffering losses in their own families and among their staffs, and a sort of mass-scale traumatic shock hit the nation's leadership.

In the middle of all of this, Sirleaf summoned Gbanya and told her that the whole country was listening to the striking workers' complaints about corruption and conspiracies, and so she needed to explain to the public just how the pool fund worked. After hearing an hour of details about its operations and shortfall, Gbanya recalls, the president shook her head sadly and said that the situation was too complex and depressing for people to accept. So Sirleaf dropped the idea of mass public education about the fund and instead went to hospitals and Ebola treatment centers herself and begged medical workers to stay on the job for the good of the nation.

NOT IN MY BACKYARD

On September 16, Obama announced his decision to deploy around 3,000 U.S. military personnel to West Africa to fight the epidemic and committed \$750 million to the effort. On a visit to the CDC's headquarters, Obama pledged a series of additional commitments from Washington, pointedly adding, "But this is a global threat, and it demands a truly global response. International organizations just have to move faster than they have up until this point. More nations need to contribute experienced personnel, supplies, and funding that's needed, and they need to deliver on what they pledge quickly. Charities and individual philanthropists have given generously, and they can make a big difference."

It was the middle of September when the world finally began to reckon with the reality of what was happening in West Africa. The UN Security Council declared Ebola an international threat, the General Assembly echoed the cry the next day, and the CDC released a forecast predicting exponential growth to more than a million cases by February absent major international intervention. The World Bank and the White House pressured countries around the world to pony up resources; the UN estimated the costs of stopping the epidemic at just under \$1 billion and created a new Ebola task force,

UNMEER; and according to a report in *The New York Times*, the World Bank's president, Jim Yong Kim, chastised Chan for the WHO's failed response during a meeting of international health officials at the bank's headquarters. (Through a WHO spokesperson, Chan declined a request to be interviewed for this article.)

The first small U.S. Army team arrived in Liberia on September 17 to assess the situation; hundreds more U.S. military personnel would arrive in October, and a field hospital dedicated to the care of health-care workers themselves would open in early November. In Sierra Leone, the British military mobilized, deploying at about the same time as the U.S. Army did in Liberia. Both built elite-care Ebola treatment facilities. But the U.S. Army's facilities went operational only after Liberia's epidemic had started winding down, and most received no patients. The Sierra Leone epidemic, in contrast, lagged months behind Liberia's, and British forces saw many Ebola patients, including at least one from their own ranks. UNMEER, meanwhile, put its first official boots on the ground in the region on September 29, coordinating humanitarian activities akin to those executed by UN agencies during famines and after natural disasters.

While all of this was happening, however, attention in the West shifted away from Africa and toward the enemy within. On September 24, a Liberian man named Thomas Duncan came down with Ebola while visiting his fiancée in Dallas, Texas, and soon two of Duncan's attending nurses were infected. (Duncan died on October 8; both nurses were eventually cured.) A nurse in Spain, meanwhile, contracted the disease from a patient who had been brought home from Africa for treatment, showing that both the United States and Europe were potentially at risk. The reaction was swift and hysterical, with a host of prominent Americans issuing calls to ban travelers from the three Ebola-afflicted countries and self-proclaimed experts warning about the possibility that the virus might be able to spread through the air. Ebola coverage became a staple of cable television and talk radio and even figured prominently in the U.S. midterm elections (as a telling sign of the global chaos supposedly sparked by Obama's foreign policy failures).

African observers hardly knew what to think. "We were saddened by the reaction in America," Sirleaf later told me. "We understand the fear. We live with fear. But the risk was minimal [for Americans]." To put the world reaction in perspective, on September 28, when the Liberian epidemic was at what later proved to be its peak, Twitter us-

ers were posting Ebola-related messages at the rate of about a few dozen per minute. In the days after Duncan was officially diagnosed, on September 30, the rate rose to around 6,300 messages per minute.

Ironically, it was during just this period that Liberia's epidemic started to abate. Many factors played a role in defeating it, including a remarkable U.S. mobilization; great improvements in laboratory testing and diagnostic speed; the construction of Ebola treatment units, which allowed infected individuals to be isolated; and the virtual elimination of unsafe burials and the imposition of mandatory cremations. But officials in the Sirleaf government repeatedly acknowledged actions taken by the Liberian citizenry at large. "We need to give credit to the public for what has been done," one of Sirleaf's political advisers, Emmanuel Dolo, told me. "And we have to say that we cannot let that go."

For example, rural communities realized that Ebola was coming from outsiders, especially villagers returning from Monrovia and other big cities. So without any push from the government, communities took matters into their own hands, setting up temporary isolation places (usually designated houses or sheds), in which they ordered visitors and returnees from the cities to be quarantined. After months of struggling with traditional burial practices, rural residents began bringing their dead to authorities. And the Liberian Ministry of Health deployed an army of thousands of contact tracers—young men and women hired temporarily to track down all known associates of confirmed Ebola patients and fatalities. In local villages, I found village chiefs taking control: ordering families to bring out their sick and dead, commanding safe burials, and searching for ways to feed quarantined households.

When I visited the Liberian town of Jene-Wonde, nestled along the border with Sierra Leone, the chief was ordering young men to dig a well and build a fence to enclose a newly refurbished clinic, made of wattle and thatch. Chebe Sano, a middle-aged woman with a quiet, commanding presence, was the chief of the roughly 700 residents and led the creation of a three-room Ebola community care center, designed to house a dozen people in quarantine. Sano didn't wait for the Liberian government or a group of nonexistent doctors to take action. She knew that her people's plague could be stopped only if the infected were separated from the rest of the population. With advice from a handful of the CDC's Epidemic Intelligence Service officers, Sano simply took tough quarantine steps that eventu-

ally stopped Jene-Wonde's horror.

"It is the communities in Liberia that turned this around. The thing that kept us going," Gbanya explained to the WHO in Geneva in May 2015, "is we knew, we need to do the best we can to save Mama Liberia." But she admonished the delegates from 194 nations to maintain international vigilance. "It's not over until it's over in our sister countries, Guinea and Sierra Leone," she said. "When a disease hits your neighbor's front door, be aware that it can come to your backdoor."

WHO NEEDS THE WHO?

The WHO performed so poorly during the crisis that there is a question of whether the world actually needs it. The answer is yes, it does—but in a revised form, with a clearer mandate, better funding, more competent staff, and less politicization. The agency should be clearly at the apex of the global health architecture, not jockeying for command of epidemic response with other organizations, as happened last year. But with power comes responsibility, and the WHO needs to merit its position, not simply assume it. If the WHO is going to remain the world's central authority on global health issues—which it should, because there needs to be one, and it has the most legitimate claim to perform such a role—it needs to concentrate on its core competencies and be freed from the vast array of unrealistic, unprioritized, and highly politicized mandates that its member states have imposed. Rather than wasting resources duplicating the responsibilities and expertise of other agencies, it should scale back to providing technical expertise and advice in areas such as tuberculosis, malaria, HIV/AIDS, and child immunizations. And although the World Bank offers financial backing and advice on many programs having to do with health, its own expertise is primarily about money: it should not be competing with the WHO on providing guidance for handling outbreaks of infectious diseases but rather be helping finance the measures a competent WHO argues are necessary. Ban, the UN secretary-general, should convene private meetings with the leaders of the World Bank, the WHO, and several dozen other relevant agencies and institutions to develop plans for a more coherent and efficient response to future epidemics.

This year's WHO was obsessed with trying to learn lessons from the crisis and featured a great deal of questioning of the WHO's basic credibility, given the organization's inadequate response. It may not represent an existential crisis, but as the former Oxfam chief executive Barbara Stocking told the gathering, it is surely the WHO's "defining

moment.” Stocking is chair of the Ebola Interim Assessment Panel, which Chan created to offer an objective appraisal of the organization’s response to the outbreak. If the director general had hoped for a mild rebuke, she must have been sorely disappointed. In July, the panel published its final report; it was devastating.

The Ebola outbreak revealed, Stocking’s panel concluded, that the WHO was incapable of responding to emergencies in a timely fashion and lacked the credibility to enforce the IHR, its own instrument. The WHO’s leadership was alarmingly slow to respond to the unfolding crisis, the panel reported, because the organization “does not have a culture of rapid decision-making and tends to adopt a reactive, rather than a proactive, approach to emergencies.” The panel lamented that senior WHO officials failed to adequately react to warnings of the outbreak’s growing seriousness that they received from within the organization and from outside sources, especially MSF. “WHO must re-establish its pre-eminence as the guardian of global public health; this will require significant changes throughout WHO,” the panel’s report stated. It went on to recommend 21 major reforms, affecting nearly every aspect of the organization, including strengthening GOARN, significantly increasing funding to improve the ability of member countries to respond to disease emergencies, and placing all of the WHO’s disparate emergency-response units into a single chain of command.

The WHO’s executive board, meanwhile, had delivered its own harsh critique of the agency back in January. There is a “clear gap in the WHO’s mission and structure,” it stated, with “no clear lines of decision-making or dedicated funding in place [leading to] a slow, uncoordinated response to the Ebola outbreak.” Not only did the WHO fail to implement the IHR in a timely fashion, the executive board concluded, but it also did too little to prevent nations from taking steps in violation of the IHR that isolated and stigmatized the affected countries. At the height of the crisis, most other African countries banned people from and trade with Guinea, Liberia, and Sierra Leone; Australia and Canada declined all visa requests from the region; all but two commercial air carriers and all airfreight services ceased flights to the area; and insurance companies declined to pay for air rescue services. All such actions were in violation of the IHR, yet the WHO appeared powerless and inept in response, unable to enforce its own regulations.

The executive board’s and the assessment panel’s reports both insist that epidemic prevention should be the core function of the WHO:

if the agency cannot credibly lead in a disease crisis, it might not merit donor support. But as MSF's Liu said on the sidelines of an Ebola meeting in Dakar in June, "The reality today is if Ebola were to hit on the scale it did in August and September, we would hardly do much better than we did the last time around."

In response to the assessment panel's report, the WHO issued a statement claiming that it was "already moving forward on some of the panel's recommendations." A few days later, I spoke with Bruce Aylward, a WHO assistant director general who was deeply involved in the Ebola response and who distinguished himself as one of the first members of the senior leadership to realize that the organization's response was lagging. Aylward acknowledged the validity of many of the complaints lodged by the executive board and the assessment panel but argued that many of the WHO's critics fail to appreciate just how difficult a position the WHO is in and underestimate how much the organization relies on buy-in and consensus from its member states. "I think the issue is, what is the purpose [of the WHO]? And are the member states in agreement on that purpose? Where do they want the organization to land?" he said. "We're in an extremely dangerous position, being pressured to make incremental changes until member states are assuaged, but not so much change that the organization, internally, revolts." But he conceded that the WHO "has got to evolve, to be more than a mere technical organization. It must be a health emergency manager."

That idea is now the subject of heated debate among global health experts and policymakers. Some argue that the WHO cannot credibly fulfill its role as an emergency manager. But no one has identified an alternative agency that could realistically take on the job. The only way the WHO can hope to do so is by enlarging GOARN and expanding its mandate, allowing it to operate as a semiautonomous unit that controls its own budget, overseen by an independent governing board and protected by a firewall separating its science-based decisions from the vagaries of international politics.

Another important step the WHO should take is to plan for a competent, quickly deployable, international volunteer medical corps. Composed of doctors, nurses, lab technicians, epidemiologists, and other professionals necessary for handling a humanitarian crisis, such a corps should be voluntary and multinational, with thousands of trained and registered people ready to be summoned into service on short notice when the next emergency arises. When crises are so ob-

viously recurring and predictable, there is simply no reason that each one should be met with a similarly ad hoc, uncoordinated, amateurish response, sluggish when it matters most and panicked when problems have already escalated.

Even were such a corps to exist, however, it would still need to get to the crisis quickly, something that is a much greater problem than most people realize. As soon as the Ebola epidemic was confirmed, the only air travel of any kind between the affected countries was provided by the UN Humanitarian Assistance Service, which was available only to UN agencies and authorized others. Under the 1944 Convention on International Civil Aviation, sovereign states may close their airspace due to adverse conditions such as bad weather or conflict, and airlines may cancel flights for their own marketing or risk-assessment rationales. The convention offers no means for a sovereign state to compel airlines to service it, nor for an airline to override an airspace closure. The International Civil Aviation Organization should revisit these issues, paying special attention to encouraging airlines to maintain reasonable services to countries facing health crises.

As a result of these difficulties with air travel, it was hard for people and supplies to get to the epidemic and practically impossible to coordinate responses across all three countries. Medical volunteers from the developed world who tried to help out, meanwhile, found themselves discriminated against by airlines or subject to mandatory quarantines when they tried to come home, which was not only unfair but also a clear deterrent to such help, rather than the facilitation and support of it that the situation required.

The WHO and the U.S. State Department, accordingly, should figure out how to ensure that such problems do not arise in future crises. Among other things, this will mean scrutinizing the air transport agreements the CDC has with commercial carriers for the emergency transport of personnel, supplies, and dangerous microbe samples. The world cannot rely on standard market operations to proceed as usual during a crisis, and so authorities need to lock in appropriate arrangements beforehand.

Another area requiring advance attention is the availability and use of experimental medicines, vaccines, and rapid diagnostic tools. All three were lacking during the recent crisis, even though promising drugs, immunizations, and point-of-care instant diagnostics are in various stages of development. The WHO's innovation team has been bogged down for months in ethics debates and arguments over how

vaccine trials might be properly executed, and with the epidemic waning, it is possible that nothing will actually get into field trials in time to be tested against actually existing Ebola. Together with the pharmaceutical, scientific, medical ethics, and biotechnology communities, the WHO should create policy templates for future rapid action—now, before the next crisis hits, rather than being forced to deal with such matters in the heat of the moment.

In the end, the world must come to grips with the fact that future epidemics are not just likely but also inevitable and prepare to deal with them more effectively. As Nabarro, the UN's special envoy on Ebola, recently put it to me, "There will be more: one, because people are moving around more; two, because the contact between humans and the wild is on the increase; and maybe because of climate change. The worry we always have is that there will be a really infectious and beastly bug that comes along."

Some major authorities have argued that the real problem is less epidemic response than the availability of basic public health programs—that the Ebola crisis would never have developed to catastrophic proportions if Guinea, Liberia, and Sierra Leone had universally accessible health-care systems. This is simply not true. Good health care should indeed be considered a basic human right, but even if it were available everywhere, outbreaks of strange new diseases and viruses would still occur—just look at SARS in Toronto and Singapore in 2003, MRSA and other drug-resistant bacterial diseases in hospitals across the United States today, and MERS in Saudi Arabia, to name a few.

On the other hand, there is simply no question that the problems Gbanya and her colleagues have had to grapple with go well beyond crisis response. The health-care systems of Guinea, Liberia, and Sierra Leone were in terrible shape before the Ebola epidemic struck, and they will be in worse shape after the epidemic has passed, having lost a significant number of health-care professionals to the disease. Across Liberia now stand empty Ebola treatment units that are little more than tented wooden platforms wrapped in plastic sheets. With the return of the rainy season this summer, those expensive emergency isolation facilities will be washed away, leaving no permanent improvement in local medical systems.

"A weak health system was struggling before Ebola," Gbanya told me. "After Ebola, health-care service delivery will be difficult. And the costs will be three times as high. Why? Because of all the protec-

tive equipment, all the training, the emergency-response system. At this stage, we have the opportunity to think what sort of investment can equal medium-term improvement in Liberia. We're not going to have a country anymore if we keep getting Ebola." And so it comes back to money. The world will get what it pays for—and right now, that is not very much. 🌐

CORRECTION APPENDED (DECEMBER 11, 2015)

This article mischaracterized a number of issues relating to the Liberian government's health system and its response to the outbreak of Ebola. Miatta Zenabu Gbanya, who manages Liberia's Health Sector Pool Fund, was not assigned to her job by Liberian President Ellen Johnson Sirleaf; she was hired as a contractor by the Liberian Ministry of Health, which oversees the fund. The fund did not have around \$65 million on hand when Gbanya took her position in 2013; that, instead, is the total amount that the fund had raised by that point since 2008. Gbanya was not solely responsible for negotiating with the fund's donors and with the Liberian health professionals whom the fund helps pay, as the article suggests; although Gbanya played a key role, those were collective efforts led by the Ministry of Health. And although others have complained about corruption in the Liberian Ministry of Finance, Gbanya never had to contend with it herself, as the article states.

How Congo Beat the Last Ebola Outbreak

The Crucial Role of International Cooperation

Ariana A. Berengaut

AUGUST 6, 2018

On July 24, the World Health Organization announced the end of an Ebola outbreak in the Democratic Republic of the Congo's Equateur Province that had infected 54 people and killed 33. Eight days later, the Congolese government reported that the virus had struck again, some 1,500 miles away, in North Kivu, an active conflict zone. As health officials race to assess the complexity of this new threat, the rare occurrence of back-to-back outbreaks underscores the growing danger that infectious diseases like Ebola pose to humanity.

The new outbreak is Congo's tenth scrap with Ebola since the virus was discovered in 1976, and experience has been an exacting but effective teacher. In May, the Congolese government recognized the risk in Equateur immediately and alerted the WHO. Within hours of receiving laboratory confirmation, the WHO activated its emergency management system, which directs resources and personnel from across its organization to where they are needed. Within days, the UN began ferrying health-care workers and supplies to the center of the outbreak, and donor nations, including the United States, released emergency funds. Less than two weeks after the outbreak began, frontline health-care workers received the protection of a new tool: an

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Ebola vaccine. And perhaps most significant, the response demonstrated the value of investing in local health-care systems, as more than three-quarters of those deployed came from within the region. As a result, in less than three months, the disease had been detected in remote villages, tracked to Mbandaka, a city of more than one million people on the banks of the Congo River, and contained before it could spread to Kinshasa, Congo's capital, or neighboring countries.

That response required global cooperation, international institutions, and far-sighted investments in science, health, and governance that have enabled countries to tackle their own problems before they become everyone else's. The work under way in North Kivu will require the same. As U.S. President Donald Trump and like-minded demagogues undermine the global order, defenders of liberal internationalism would do well to highlight the efforts in Congo as an example of what nations can achieve by working together.

It is often difficult to make the case for the international system, an imperfect composition of institutions, norms, and rules built over seven decades to guide an unruly planet toward greater peace, prosperity, and freedom. The system's components are diffuse and feel disconnected from everyday life. Even its name, the liberal international order, is devoid of inspiration and common meaning. In the United States, it is hard to explain how the day-to-day lives of Americans would change if NATO splintered, the UN withered, countries closed their borders, or democracy lost its appeal. But one thing is clear: without this system and countries willing to stand up for it, many more people would be dead from infectious diseases such as Ebola.

THE FIRE LAST TIME

The world does not need to imagine what this nightmare scenario looks like. It happened just four years ago, when the international community missed a narrow window to stop an Ebola outbreak before it became an epidemic. In 2014, as the virus swept through Guinea, Liberia, and Sierra Leone, health-care systems collapsed and contagious bodies lay abandoned in the streets. Mismanaged and underfunded, the WHO ignored repeated warnings of a mounting crisis. It did not declare an international public health emergency until weeks after the disease had reached capital cities with populations in the millions.

In early September, the United States recognized the risk of a global pandemic and stepped forward to lead the response, deploying some

3,000 U.S. troops and 10,000 civilians, including volunteers, and mobilizing dozens of other countries. By the time the virus was beaten back, it had killed 11,300 people, infected 28,600 people, orphaned more than 17,300 children, devastated local economies, and caused a wave of fear in the outside world that manifested in rabid hostility toward returning health-care workers and immigrant communities.

The crisis was a wake-up call. It was a reminder that the protection everyone derives from the international system requires continuous investment. Instead of decrying the burdens of global leadership, U.S. President Barack Obama embraced the unique role that the United States plays in bringing the world together, even as a chorus of voices rose in opposition to his approach.

Although the actual risk to Americans from Ebola was negligible, the sense of alarm grew as three cases were diagnosed in the United States that October. In the lead-up to the 2014 midterm elections, politicized panic surged. Lawmakers called for a travel ban on people from the affected areas. General John F. Kelly, then chief of U.S. Southern Command, now White House Chief of Staff, warned of a stampede across the U.S. southern border if the disease reached Central America. Trump, who tweeted roughly 100 times about Ebola between July and November, called for flights to be stopped and American health-care workers to be cut loose if they became infected abroad.

Yet Obama stayed the course, resisting calls for travel restrictions and quarantines that would have made it harder to recruit volunteers, deliver medical assistance, and end the epidemic. And even as it dealt with the current crisis, the Obama administration began to plan for the next one. Washington and its partners around the world resolved to make new investments in the international system, from supporting the development of Ebola vaccines, therapeutics, and diagnostics to strengthening the resilience of health-care systems in vulnerable countries. In September 2014, at the height of the crisis, Obama hosted senior officials from 44 countries in Washington to advance the Global Health Security Agenda, an initiative the administration had unveiled nine months earlier.

TEAMWORK

Countries have to cooperate on global health because epidemics resist unilateral solutions. Governments cannot build walls tall enough or seal their borders tight enough to keep diseases out. Obama's decision

to make the crisis in West Africa a U.S. responsibility and the international investments that followed have shown that the only way to beat diseases such as Ebola is to work together.

The Global Health Security Agenda, which still exists under the Trump Administration, has strengthened the capacity of countries to prevent, detect, and respond to public health threats. One of those countries is Congo, where the U.S. Centers for Disease Control and PATH, an international global health NGO, have helped the Ministry of Health establish the country's first Emergency Operations Center, the hub from which officials are tracking the spread of Ebola and coordinating the response.

The new Ebola vaccine, which only works for the Zaire species of the virus, is another monument to global partnership. Developed by the Public Health Agency of Canada and licensed by Merck, it was supported in early trials during the 2014 epidemic by the WHO, the Norwegian Institute of Public Health, Médecins Sans Frontières, and Canada's department of public health. Amid fears that development of the vaccine would stall after the emergency had ended and the world had moved on, Gavi, the Vaccine Alliance, which works to immunize children in poor countries, promised to buy \$5 million worth of vaccines from Merck if the company would create an emergency supply. When health officials sounded the alarm in Congo in May, a stockpile of 300,000 doses was already available.

The occurrence of two separate Ebola outbreaks in such rapid succession foreshadows the peril the world will face from the next big pandemic. Yet in the United States, the global health security agenda has an uncertain future. The 2018 U.S. National Security Strategy identifies biological threats and pandemics as dangers to the U.S. homeland and pledges to work with other countries to detect and contain disease outbreaks and invest in basic health-care systems. In March, Congress gave the Trump administration six months to draft a comprehensive plan to strengthen global health security. While they await the report, advocates worry that the administration does not see global health security as a priority. On May 8, the same day the ninth Ebola outbreak was confirmed in Congo, Rear Admiral Tim Ziemer, the widely respected White House official responsible for global health security, was quietly ousted. The Global Health Security and Biodefense Directorate at the White House National Security Council was disbanded, and its

responsibilities split between other offices responsible for development and weapons of mass destruction.

More broadly, the Trump administration has eroded trust in government, disregarded scientific expertise, adopted punitive immigration policies, and abdicated global leadership. It is doubtful whether the United States could or would respond to a serious global health emergency today. A well-functioning international system may not sound exciting when you have it, but Americans will not like what happens when you do not. 🌐

Global Health Gets a Checkup

A Conversation With Tedros Adhanom Ghebreyesus

SEPTEMBER/OCTOBER 2017

The World Health Organization was established in 1948 as a specialized agency of the United Nations charged with improving global public health, coordinating the international response to epidemics, and the like. In the ensuing decades, its dedicated staff has served on the frontlines of public health battles, from the eradication of smallpox to the fight against AIDS to the challenges of non-communicable diseases. In May, the WHO's member countries elected Tedros Adhanom Ghebreyesus as its new director general. A malaria researcher, Tedros, as he is known, served as the health minister of Ethiopia from 2005 to 2012 and as foreign minister from 2012 to 2016. He spoke with *Foreign Affairs'* deputy managing editor Stuart Reid in New York in July.

What keeps you up at night?

Epidemics or pandemics. Immediately after the First World War, in 1918, the world encountered the Spanish flu. It

was airborne and killed more than 50 million people. Ebola is lousy compared to that. That sometimes keeps me awake at night, because we have to do a lot, especially considering the serious gaps we have. I think the world should unite and focus on strong health systems to prepare the whole world to prevent epidemics—or if there is an outbreak, to manage it quickly—because viruses don't respect borders, and they don't need visas.

What do you see as the WHO's core mission?

The WHO has a responsibility to prevent, early-detect, and manage outbreaks, and it can do this by strengthening countries' capacity. But we have to do more. Ebola has already shown the weaknesses that we have. So the WHO should start by strengthening epidemiological surveillance and investing in countries' health systems.

You've identified health coverage as one of your top priorities. What does that mean in practice?

This interview has been edited and condensed.

About a third of countries are covered, a third are progressing towards universal health coverage, and the last third haven't started. We will focus on speeding up the progress of those who are making progress and influencing those who haven't started. The aim of the SDGs [the UN's Sustainable Development Goals] is to leave no one behind by 2030.

Political commitment is very important here. Expanding health coverage is not a technical issue but a political one; it should be seen as a right and a means to development.

What role does the WHO have when it comes to noncommunicable diseases?

First of all, it's important to recognize that noncommunicable diseases are on the increase globally, both in developing countries and in the developed world, due to urbanization and changing lifestyles. We know many noncommunicable diseases are related to risk factors such as smoking, alcohol consumption, inactivity, and diet. We can address them by building or strengthening health systems focused on prevention and health promotion. Primary health care is especially important. Using the media is important. And in the education sector, it's important to, as part of the curriculum, educate children on risk factors and help them choose a healthy lifestyle.

Another threat to public health is irrational beliefs. In some of the richest communities, parents don't vaccinate their children because they falsely

believe vaccines cause autism. What can be done about the spread of misinformation?

Governments have to communicate well with the community, and the WHO can help. In addition to that, we have to use the media. The media is very important on this. And we can use faith-based organizations and civil society to teach the society to accept vaccination as an important part of child development.

Resources—both attention and money—are finite. Is there anything the WHO does now that it should not be in the business of doing?

Of course, the WHO should prioritize. I've said we need to focus on universal health coverage, emergency response, women and children in adolescence, and climate change and health. So anything outside this will be less of a priority and get fewer resources.

You've also said that you want to professionalize the WHO's fundraising operations. But how can the WHO get more funding from countries when officials in those countries often can't get the resources they need to run their own health ministries properly?

I think the WHO in this case is shy. The WHO only contacts ministries of health, but it should also work with other ministries, like the ministry of finance, the ministry of foreign affairs—even heads of state and government. The WHO should play its technical leadership role but at the same time its political leadership role. If

you say, “health for all,” it’s political. And unless you take it to the highest level possible, it cannot happen.

What do you plan to do to increase the funds available to the WHO from governments and private groups that are not earmarked for specific projects? Take those earmarked for polio. Seventy-four percent of your employees in Africa get their salaries from polio funds. We’re now on the verge of eradicating polio, but after the eradication of smallpox—arguably the WHO’s greatest success—the infrastructure and funding sources used in that effort fell apart. How do you make sure that doesn’t happen again?

We should be creating value for money—using all the available money wisely. We should expand the donor base. We need to look for new donors apart from the traditional donors, not only governments but foundations and the private sector, as well. We should ask for flexible funding rather than earmarked funding. We also need to strengthen our resource-mobilization capacity. If we can address these key areas, then we can reduce our dependency on earmarked funding. For polio, we have already developed an exit strategy.

But donors might walk away after victory is declared. What rationale would you give to, say, the Rotary Club, to keep giving money to the WHO? Or to the Bill and Melinda Gates Foundation?

Polio is being finished, but there are other areas that need a joint effort. The same children saved from polio will need

support for other health problems—could be measles, malaria, or other problems.

Another relevant nonstate actor is the pharmaceutical industry. Some have criticized its priorities—for instance, producing drugs for restless leg syndrome while tuberculosis still kills more than a million people every year. Should more pressure be placed on the industry?

The private sector will always go for profits. If you put pressure on [companies not to do this], I don’t think they will succumb. It doesn’t work that way.

They should see in their business plan whether or not they can get funding, so one area to consider is what Gavi [the Vaccine Alliance] does, with an advance market commitment that helps pharmaceutical companies invest in vaccines that are only important for the developing world. The other option is for governments to invest, because it’s a public good.

Many feel that the WHO responded too slowly to the 2014–15 Ebola outbreak. How can it respond faster in the next emergency?

My predecessor, Dr. Margaret Chan, worked on reforming emergency response, and a new program for it is now in place. One good experience with using the new system is the recent report of Ebola from the DRC [Democratic Republic of the Congo]. It was detected early and reported immediately, and the country mobilized partners and addressed it. We need to

make the program even stronger, and we should build it up with a sense of urgency. We have learned a lot from Ebola. We have to implement those lessons aggressively.

Some also feel that the WHO has been too accommodating of governments. Is that accurate?

I don't agree that the WHO only follows what the members states say. It goes both ways. Member states should listen to what the WHO says, and at the same time, the WHO should listen to them.

But sometimes a government may not want to raise the alarm about an outbreak because it fears a drop in tourism. What can be done in cases like that?

On that one, it's not an issue between the WHO and the member state in question; it's about the overall implementation of the International Health Regulations [the rules that govern how states respond to outbreaks]. That involves not only the country in question but other countries, as well. For instance, a country may fear the impact on the economy if it reports a certain disease. And if the other countries, instead of banning travel or other measures, could be supportive and implement the IHR, then the country could be encouraged to report immediately.

What were your biggest accomplishments and challenges during your time as Ethiopia's health minister and foreign minister?

Our biggest achievement was health-sector reform. The success was in making sure that primary health care was the center of gravity in our health system. People prefer to focus on building hospitals and so on, so it was difficult to convince many to accept primary health care as a priority. Ethiopia achieved most of the MDGs [the UN's Millennium Development Goals] because it focused on health promotion and prevention.

You said earlier that the media is crucial to the spread of public health information. According to the Committee to Protect Journalists, in 2016, Ethiopia imprisoned 16 journalists, making it one of the five worst countries in the world in terms of jailing reporters.

This interview is of me representing the WHO. So do you think it's a good idea to talk about [something] country specific? It's unrelated to the job I'm doing now.

What is your response to people who say that in your current role, your association with the Ethiopian government could undermine your work?

It's not related, but I can answer. First of all, when I was there, as far as I know, journalists were not jailed because they spoke their mind. It was because they trespassed. We have rules and laws, like any country. Journalists may or may not like a particular law, including in the U.S., but even if you don't like a law, you don't break it. That was the problem.

Otherwise, the media is actually important. It's the eyes and ears of the society. And the government uses this as feedback to intervene where there are problems, and that's how we used to see it when I was part of the government. But be it a journalist or a politician or a businessman, no one can be above the law, because if you do that, it's very difficult to govern a country.

Critics have also accused you of covering up cholera epidemics in Ethiopia. Neighboring countries have tens of thousands of cases, and experts say that Ethiopia is currently suffering from an outbreak. Why not just admit it?

I think you have read in *The New York Times* what Tom Frieden [the former director of the Centers for Disease Control and Prevention] said [in a letter to the editor responding to an article about the allegations]. It doesn't even make any difference whether you call it "cholera," because the management is the same. The most important thing is to respond immediately.

You're the first African head of the WHO. Should developing countries get a greater voice in global institutions more generally?

I think any position in any international organization should be merit-based. When I competed, that was my platform. It's not about developing or developed world; it's about selecting the right people for the position, and there are many able people from the developing world who can run organizations.

By the way, the UN has been run by Africans before: Kofi Annan and Boutros Boutros-Ghali.

The World Bank has been getting increasingly involved in public health, not just in funding but also in directing policy—developing its own guidelines for universal health coverage, for instance. Shouldn't that fall under the WHO's mandate?

The global challenges we are facing are getting more complex, so having more players is not a problem. I don't think the WHO should compete with the World Bank, and the World Bank doesn't need to compete with the WHO. We can work together. On many of the things that the WHO does, if the World Bank has a competitive advantage, the WHO should let the World Bank do it. If the Global Fund [to Fight AIDS, Tuberculosis and Malaria] has a better comparative advantage, the Global Fund can do it, or Gavi can do it. At the end of the day, the important thing is building effective partnerships to achieve our global health objectives.

U.S. President Donald Trump's proposed budget cuts include a 17 percent decrease for the Centers for Disease Control and Prevention and an 18 percent cut for the National Institutes of Health. What would that mean for global public health?

That's not yet finalized. The United States normally takes a bipartisan position on these issues. I expect that the U.S. will contribute its share. 🌐



LESSONS LOST

Ready for a Global Pandemic?

The Trump Administration May Be Woefully Underprepared

Tom Inglesby and Benjamin Haas

NOVEMBER 21, 2017

Almost a century ago, a new and deadly strain of influenza spread around the world, shutting down schools and businesses and filling hospitals well beyond their capacity. In the end, the 1918 flu pandemic claimed the lives of approximately 50 to 100 million people, and it infected about one-third of the global population. Since then, medical care has vastly improved, and science has made major gains in vaccines and medicines. Yet the potential remains for a lethal strain of influenza or other contagious pathogen to overwhelm global health care systems by spreading at a rate that outpaces our ability to respond. In such a calamitous scenario, neither the United States nor other countries would be well enough equipped to contain it, increasing the potential for a true national or global catastrophe.

Consider the current H7N9 bird flu epidemic in China. It has infected more than 1,600 people since 2013, with a fatality rate of 40

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percent. Although humans have contracted it mostly through contact with infected poultry, it is possible that limited person-to-person transmission has taken place but has yet to be detected. The great concern at the moment is that the virus will adapt, allowing for more efficient transmission; this would enable it to transform from a local outbreak to a global one.

Modern conditions make the scenario of a global pandemic more likely. Humans are encroaching on animal environments, raising chances for pathogens to adapt from animals to people. An increasing share of the planet lives in megacities, heightening the likelihood of person-to-person transmission of pathogens. The movement of people and microbes around the globe is more efficient than ever. The recent outbreaks of SARS, MERS, and Ebola are only small glimpses of how quickly a deadly virus can spread. Imagine if it were to happen with an even more fatal and more contagious pathogen.

Beyond these naturally occurring events, there is also the potential for terrorists or rogue nations to deliberately release dangerous microbes and trigger lethal epidemics or even pandemics. It is easier and cheaper than ever to create biological weapons. New bioengineering tools will make possible various kinds of previously unforeseen changes to pathogens. They could be manipulated to be more communicable among humans or more resistant to vaccines. Animal viruses could be modified to infect humans. Benign viruses could be engineered to be lethal or to transmit cancers.

So what has the U.S. government done to prepare for such scenarios? Since 2003–4, when the H5N1 bird flu spread around the globe, the American response to these health threats has been to establish a range of preparedness programs intended to prevent and respond to pandemics and other biological dangers. For instance, the U.S. government funded research by the National Institutes of Health (NIH) into threatening pathogens, which is crucial for the development of new medicines and vaccines. To aid this effort, the government created a body called BARDA (Biomedical Advanced Research and Development Authority) to focus on finding treatments. The federal government fortified its Strategic National Stockpile, a storehouse for vaccines, antidotes, antibiotics, and other critical medicines, and developed procedures for distributing these supplies to cities in the event of a crisis. It launched an initiative at the Food and Drug Administration to help untangle the regulatory issues that complicate

the delivery of these medicines and vaccines to the public. It also established a range of preparedness programs at the local and federal levels and strengthened their ability to detect threats early on and issue appropriate warnings.

Unfortunately, President Donald Trump has not indicated so far that his administration takes this issue seriously. Initially, his 2018 budget proposed slashed funding for such programs by nine percent, or \$1.25 billion, from the preceding year, which would be the largest reduction in over a decade. If this budget had been enacted, it would have imposed a 13 percent cut to the Centers for Disease Control and Prevention's (CDC) preparedness and response programs, an 11 percent cut to the hospital-preparedness program, and hundreds of millions of dollars in cuts to state grants from the Federal Emergency Management Agency. Other cuts would have hurt or entirely eliminated related programs at the Department of Homeland Security, the NIH, the FBI, and USAID, among others. Fortunately, Congress reversed many of the proposed cuts during its appropriations process.

Although the civil-servant workforce has continued to make progress in important programs, it remains to be seen whether the administration's political leadership will push biosecurity efforts forward in a meaningful way. In the months ahead, there are four elements to look for in evaluating just how seriously the Trump administration will pursue these issues: its budget priorities for the new fiscal year, its impending biodefense strategy, its approach to overseeing research on novel and highly dangerous pathogens, and its level of engagement in the Biological Weapons Convention (BWC) process.

In its 2019 budget proposal, the administration will have an opportunity to support programs that prepare hospitals to care for large numbers of infected people. It could seek funding for public health programs to detect and respond to new outbreaks. It can request money to help accelerate research and development of new medical countermeasures for epidemic threats, including continued research into a universal flu vaccine. It can use the budget to support law enforcement and intelligence efforts to find and prevent threats as well as forensics programs aimed at identifying those responsible for biological attacks. Furthermore, it can back programs intended to strengthen Defense and State Department efforts to address biological threats overseas. It is important that the administration consider these options carefully. Even if Congress can again rescue key programs next year, an admin-

istration budget proposal that cuts initiatives designed to protect against pandemic and biological risks will serve as a statement of the administration's priorities and values—one that will resonate among professionals working diligently on these issues.

One program that should be a funding priority is the Global Health Security Agenda (GHSA). This multinational program was established in 2014 and now involves over 50 countries that collaborate to enhance the detection, prevention, and response to biological threats. To this end, it has provided funding and technical assistance to build labs for disease detection, to train public health officials, to establish emergency operation centers, and to improve vaccination programs and other key capabilities needed to prepare for and respond to biological threats in countries around the world. The U.S. government initially supported the GHSA with a pledge of more than \$1 billion. But that source of money is quickly disappearing, and without a 2019 budget commitment or a supplemental bill sometime over the next year, U.S. programs supporting the international initiative will soon need to start shutting down. Although several administration leaders—including the CDC director, the secretary of State, and senior officials from the National Security Council—have made clear that they support the GHSA, it has not been confirmed that sufficient funding for the effort will continue beyond its initial allotment.

The yet to be released national biodefense strategy, which was called for in the 2017 National Defense Authorization Act, is required to address natural, deliberate, and accidental pandemic threats, international and domestic. The administration has publicly committed to establishing this strategy. But the key here, too, will be whether the administration provides the financial resources to successfully implement it. Otherwise, it will be a plan with a set of unreachable goals.

Another test of the administration's commitment is its approach to certain types of scientific research that can increase pandemic risks. In the last month of President Barack Obama's administration, the White House Office of Science and Technology Policy published guidance on how the U.S. government should handle the creation of novel and dangerous pathogens for research purposes. For example, it advised scientists to conduct special biosafety reviews and risk-benefit assessments for experiments that could jeopardize public health. Proponents argue that such efforts are worth the risk because they help prepare for pandemics. Opponents, on the other hand, are concerned that this

type of research could lead to the accidental or deliberate spread of pandemic pathogens. The Obama administration's guidance helped clarify the debate and proposed additional controls. The Trump administration, however, has so far remained silent on the issue.

A final indicator of the White House's commitment to preparing for pandemic threats is how it deals with the BWC, the international treaty banning biological weapons. The vast majority of countries are parties or signatories to it, and the agreement offers the most significant global norm against biological threats. Last year's Review Conference was a setback, with no forward movement in considering new and emerging biological risks. When the state parties convene in December, the international community will need to push for progress on this front. But it will be difficult to do so without key U.S. representatives. At the U.S. State Department, offices that cover issues related to the treaty—and other key arms-control agreements—still await senior appointees. It is important for the Trump administration to fill these posts, installing leaders who will champion vital interests within the U.S. government and in international channels.

The administration has opportunities to make substantial headway on pandemic risks at the national and international levels. Its budget, biodefense strategy, approach to high-consequence research, and engagement on the BWC are all key. The means exist to diminish the spread of pandemics—through science, intelligence, medical and public health preparedness, diplomacy, and smart governance. For the national security and health of the country, the Trump administration should fully commit to these efforts. 🌐

CORRECTION APPENDED (NOVEMBER 22, 2017)

An earlier version of this article incorrectly stated that the H7N9 virus had infected more than 1,600 people this year when it had in fact infected that amount over the last four years.

Pandemic Disease Is a Threat to National Security

Washington Should Treat It Like One

Lisa Monaco

MARCH 3, 2020

On January 13, 2017, national security officials assembled in the White House to chart a response to a global pandemic. A new virus was spreading with alarming speed, causing global transportation stoppages, supply-chain disruptions, and plunging stock prices. With a vaccine many months away, U.S. health-care infrastructure was severely strained.

No, I didn't get that date wrong. This happened: it was part of a transition exercise that outgoing officials from the administration of President Barack Obama convened for the benefit of the incoming team of President Donald Trump. As Homeland Security and Counterterrorism Adviser to President Obama, I led the exercise, in which my colleagues and I sat side by side with the incoming national security team to discuss the most pressing homeland security concerns they would face. Obama and Vice President Joseph Biden made ensuring a professional transition a top priority, so we followed the excellent example of our predecessors, who held a similar exercise in 2009. After 9/11, congressional legislation mandated such efforts in order to safeguard the country's security through presidential transitions.

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During the exercise, we put together plausible scenarios and offered lessons learned. Although the exercise was required, the specific scenarios we chose were not. We included a pandemic scenario because I believed then, and I have warned since, that emerging infectious disease was likely to pose one of the gravest risks for the new administration.

As the United States now grapples with the 2019 novel coronavirus (COVID-19) epidemic, the time is long past to make pandemic disease a national security priority commensurate with the threat it poses to global security and stability. The United States should organize its government to reflect this understanding and build its capacity to deal with new outbreaks—not if, but when, they occur.

A NATIONAL SECURITY ISSUE

There is ample reason to treat pandemic disease as a national security priority. In its annual worldwide threat assessment, the U.S. intelligence community ranked vulnerability to a large-scale outbreak of contagious disease among the top threats facing the country.

Since COVID-19 emerged in China, nearly 3,000 people have died and close to 90,000 have been infected (likely an undercount) across dozens of countries, with community transmission now reported in multiple locations in the United States. Already, the United States has felt a wide impact—through job cuts, the disruption of global transportation and supply chains, a decline in corporate earnings, and last week’s record-setting plunge in the stock market.

Some will recoil at applying the national security label to yet another issue and will object to “securitizing” public health. Such concerns are fair. An appropriate strategy should be tailored to the multifaceted nature of the threat pandemics pose and should include diplomacy and foreign aid along with public health preparedness.

Above all, making pandemic disease a national security issue means getting organized. The government’s halting response to COVID-19 is the foreseeable result of neglect. The White House is on its third attempt to define a structure for the U.S. response. First, the president announced a coronavirus task force. Then, amid the global spread of the disease and plummeting stock markets, he designated Vice President Mike Pence to lead the U.S. effort. Less than 24 hours later, the administration announced a different White House coronavirus coordinator. Assigning high-level responsibility and accountability is critical. But the administration is wasting precious time shifting titles around and reinventing the wheel.

The Obama administration took valuable lessons from the Ebola crisis in West Africa in 2014. One was that the National Security Council, which for decades has been the focal point for national security crisis response and decision-making, should include a dedicated group of experts on pandemic disease. To that end, we established a global health security and biodefense directorate, headed by a career expert. But that unit was dismantled in 2018, and its well-regarded leader was reassigned.

Moreover, for the first time since 9/11, the White House lacks a Homeland Security Adviser empowered to oversee its response to the top transnational threats of terrorism, cyberwarfare, and pandemic disease. The government needs to restore permanent leadership within the White House and build a dedicated staff of experts who can plan and prepare for crises like the one now confronting the country.

THE LONG HAUL

As it responds to COVID-19, the U.S. government must take immediate action to remedy some preventable problems. In an outbreak, the first priority should be to test, isolate, and treat patients. With such needs in mind, in 2014, the Obama administration established a network of Ebola and other special pathogen hospitals equipped to provide the highest standard of care and safety to patients with highly infectious diseases. But funding for the network is set to expire in May and would in any case cover only some of the most advanced hospitals. Many of the facilities that screen, test, and provide initial treatment for infectious diseases are not included in this funding. The government should be strengthening the network and further providing frontline facilities and responders the clarity and protection they deserve.

There is a great deal that is still unknown about today's threat, and that lack of knowledge can limit the government's response. The United States has conducted only a fraction of the number of diagnostic tests for the coronavirus that other countries have run, which means that the reported number of infections may not be reliable. The true scope of the problem will be known only after working test kits are rapidly developed and distributed and clear and consistent guidance is given to those deploying them.

These problems can and must be addressed in the coming weeks. But the United States needs to think both locally and globally if it is to be prepared for pandemic disease over the long haul. In the wake of 9/11, the federal government established state and local grant fund-

ing to prepare law enforcement officers, firefighters, and other first responders across the country to deal with new threats. Public health workers at the state and local levels are on the frontline of the pandemic threat and are first responders, too; the federal government should treat them that way by funding and reinforcing a sustained program of state and local pandemic preparedness.

Ultimately, the best way to protect the United States is to stop outbreaks at their source, and that is where the global response comes in. Skyrocketing population growth, mass migration, and urbanization make the whole world vulnerable to rapidly transmitted, deadly diseases. In 2014, nearly 70 countries together with international organizations and private-sector companies formed the Global Health Security Agenda with the aim of preventing and mitigating disease around the world. A bipartisan study has called for fully funding the GHSA and for long-term planning and investments to stave off health crises before they reach American shores, in part by incentivizing countries to invest in their own health-care systems through a new international fund for that purpose. Rather than responding to each pandemic as if it were a black swan event, the United States should prepare for a threat that will be with us for as long as there are organisms on the planet.

SCIENCE NOT SPIN

The first casualty in a crisis is reason. Mixed messages and confusion fuel panic. The American public needs facts from experts whose agenda is science, not spin. Public health experts must be able to speak their minds—unmuzzled—to offer the community valuable information about how to stay safe. If the American people lose confidence in the veracity of their government during a public health crisis, the damage will extend beyond any news cycle. It can cost lives.

The time has not come to panic. But it is well past time to prepare—and, to borrow a medical metaphor, to make preparedness and response to pandemic disease part of our national security DNA. 🌐

Ebola Should Have Immunized the United States to the Coronavirus

What Washington Failed to Learn From the National Security Council's Ebola Report

Christopher Kirchhoff

MARCH 28, 2020

In international crises, policymakers and politicians rarely have a dress rehearsal before their debut on the main stage. Yet in retrospect, the Ebola outbreak of 2013–15 amounts to exactly that—a real-life test of Washington’s ability to detect and contain an infectious disease that threatens global security. Precisely because those who fought the spread of the Ebola virus knew how close we came to global catastrophe, the National Security Council initiated a detailed study of the successes and failures of the international and domestic responses. Starting in February 2015, 26 departments and agencies across the U.S. government participated in a “lessons learned” process headed by the White House that produced a 73-page analysis with 21 findings and recommendations. I led this effort, under the stewardship of National Security Adviser Susan Rice and Ebola czar Ron Klain, and I authored the NSC report recently made public by *The New York Times*.

CHRISTOPHER KIRCHHOFF served as a member of the White House Ebola Task Force in 2015 and as the lead for the Chairman of the Joint Chiefs of Staff on Operation United Assistance, the U.S. military mission to combat the Ebola virus.

It was clear to those who responded to the Ebola outbreak that the response system of the United States and the international response system would risk collapse if faced with a more dire scenario. It was equally clear that a more dire scenario taking place was a question of when, not if. As the NSC report concluded, “future epidemics, especially those that are airborne and transmissible before symptoms appear, are plausibly far more dangerous.” It continued: “An appropriate minimum planning benchmark . . . might be an epidemic an order of magnitude or two more difficult . . . with much more significant domestic spread.”

Although the costs of the current pandemic will not be fully measurable for some time, what was done and what was left undone in the nearly four years between the end of the Ebola crisis and the first appearance of COVID-19 is now in the public domain. It is all too clear how and when the United States failed to better prepare.

THE OUTBREAK LAST TIME

The Ebola virus dominated headlines in the United States in the summer and fall of 2014, as it spread uncontrollably across West Africa; Thomas Duncan became the first infected person to die of the disease on U.S. soil. Ultimately, Ebola claimed the lives of over 11,000 people worldwide and two people in the United States. But those who participated in the response overwhelmingly came away with the view that it could have been exponentially worse.

With Ebola, we got lucky twice over: the deadly hemorrhagic pathogen, a filovirus, was not airborne, and the outbreak occurred in a remote region of the world with few linkages to population centers in Africa and no direct air routes to global cities. We also knew that we wouldn’t get lucky twice again. With urbanization and deforestation driving together species that don’t normally interact and “wet markets” selling wild animal meat across Africa and Asia, the world is developing in ways that significantly increase the likelihood that a zoonotic virus will jump from an animal host to a human. Biotech lab accidents, terrorists, and offensive bioweapons programs are also possible sources of mass infection. When a virus makes the jump for whatever reason, intercontinental air travel ensures that it spreads with spectacular speed.

Even though the Ebola virus is far harder to catch or transmit than the new coronavirus (and easier to test for, since a test had already been developed), Ebola was its own harsh teacher. With the number of people infected doubling every three weeks at the epidemic’s peak,

there was a tremendous penalty for inaction. Either Ebola was contained early, while it still was an “away game,” to use the parlance of counterterrorism, or it would quickly become a “home game,” threatening the security of the U.S. population and the global economy. U.S. President Barack Obama ordered a response for which the government had no playbook: a military mobilization of 2,800 troops, who worked in support of tens of thousands of civilian health responders in Guinea, Liberia, and Sierra Leone. Together, they built thousands of beds in Ebola treatment units to isolate and care for those who were infected, supported contact tracing to limit transmission, and led community education campaigns about how Ebola is spread. The last major transmission chains were stopped in late 2015, just over a year after the U.S. military deployed.

Although Americans can be justifiably proud of the role their nation played at a moment of global peril, the response to Ebola exposed gaps in preparedness and capability in every agency in the U.S. government tasked with health and security. The same was true for the international system. Shortfalls appeared in a bewildering array of places, from the U.S. Public Health Service not having enough yellow fever vaccines on hand to deploy personnel to West Africa to the U.S. Africa Command not having an updated pandemic plan. At home, single Ebola cases swamped the public health and hazardous waste disposal systems of New York and Texas. Washington also presumed a degree of competence in the ability of the World Health Organization (WHO) to respond to a major epidemic—a degree of competence that it turned out not to have. Once the magnitude of the crisis came into full view and the United States and its partners rushed capacity to West Africa, the failure to initially field adequate testing capacity and personal protective equipment to frontline medical personnel presaged the crisis now playing out with COVID-19.

AFTER EBOLA

Even before the Ebola epidemic ended, the U.S. government began pursuing a three-pronged strategy to contain a more dangerous outbreak. First, it doubled down on the Global Health Security Agenda, an initiative the Obama administration launched before the Ebola crisis to expand capabilities around the world to prevent, detect, and rapidly respond to infectious disease threats. Through this initiative, the United States forged partnerships with over 60 countries around

the world and used \$1 billion of the Ebola Response Supplemental passed by Congress in December 2014 to establish dozens of specialty labs around the world to detect novel outbreaks and to organize country-by-country programs to deepen preparedness.

The strategy's second prong was to further build out the network of hospitals and testing centers in the United States designated to treat Ebola and to increase the size of the national medical stockpile with more of the personal protective equipment and materials needed to fight highly lethal pathogens.

The third prong was to designate a health emergency response coordinator and create a new Directorate for Global Health Security and Biodefense within the National Security Council. It would be the job of this White House office to monitor biological threats and coordinate future responses. Crucially, this office would lead post-Ebola reforms, using its perch in the White House to ensure structural changes within agencies and departments.

Because combating a dangerous pathogen requires the close cooperation of parts of the government that don't ordinarily work together, increasing U.S. capacity would necessitate a willingness to direct changes that might go against the culture of federal departments, agencies, and the U.S. military. It would require cajoling Congress to increase budgets, add mandates, and adjust missions. And given the magnitude of the changes, it would require the personal leadership of the president. The seriousness of the threat of an infectious disease led the outgoing Obama national security team to include an influenza pandemic scenario in a joint exercise held with the incoming Trump team. To ensure that the new Global Health Security and Biodefense Directorate's mission would survive into the new administration intact, the outgoing White House team selected a career civil servant—a respected Pentagon biodefense expert named Elizabeth Cameron—to lead it, providing continuity from one administration to the next.

LESSONS UNLEARNED

As 2017 turned to 2018 and 2018 turned to 2019, each prong of this strategy fell away like wheels off a bus. When the money provided by the Ebola Response Supplemental ran out, the new administration continued to fund the Global Health Security Agenda. But the overall budget for the Centers for Disease Control was cut, and no robust, new investments were made in greater deployable capability in the

United States or other countries. At home, the envisioned expansion of the original 35-hospital Ebola Treatment Network did not take place; the \$259 million appropriated for the network in 2014 was not followed by meaningful infusions of funds, setting it on track to expire in May 2020 and leading the Department of Health and Human Services to warn in November 2017 that “the current capacity of this system is not likely to be sufficient for many types of infectious disease outbreaks (e.g., pandemic influenza and other respiratory pathogens).” Nor was the national medical stockpile significantly bolstered. Congressional leaders passed budgets that had none of the vision or scale of the \$5.4 billion Ebola Response Supplemental.

The third prong of the strategy was the last to go. In his first month as National Security Adviser, John Bolton shuttered the new NSC Directorate for Global Health Security and Biodefense. Its leader departed the NSC staff just one day after the WHO declared a new outbreak of Ebola in the Democratic Republic of the Congo that to date has killed over 5,000 people.

Historians looking back at the period between the Ebola and COVID-19 outbreaks will note a haunting sequence to events. The two-year-old boy named Emile who became the first known victim of Ebola in West Africa died in the Guinean village of Meliandou in December 2013. Six years later to the month, doctors in Wuhan Central Hospital noticed clusters of severe pneumonia that was unresponsive to treatment, a clinical development that evoked the SARS outbreak of 2002–3. The NSC Ebola Lessons Learned report was completed almost exactly between these two events, in the summer of 2016.

The focus now must be looking forward, not back. Still, an accounting of the current outbreak and the U.S. response to it will be necessary, as it was after the Ebola crisis, so that lessons do not go unheeded yet again. Combating epidemics in the best of circumstances is hard, and even well-tested systems never perform as planned. It will never be known how much better prepared the nation and the world might have been for a coronavirus pandemic had the infrastructure called for by policymakers who fought Ebola been fully built. But the nation will ultimately have a sense of the cost to lives and livelihoods of its absence. 🌐