

**More From Ideas 2018**[See Project](#)

The Next Plague Is Coming. Is America Ready?

The epidemics of the early 21st century revealed a world unprepared, even as the risks continue to multiply. Much worse is coming.



Workers at the University of Nebraska Medical Center's biocontainment unit practicing safe procedure on a mannequin

Story by Ed Yong

JULY/AUGUST 2018 ISSUE

HEALTH

Like *The Atlantic*? Subscribe to [The Atlantic Daily](#), our free weekday email newsletter.

Image above: Workers at the University of Nebraska Medical Center's biocontainment unit practicing safe procedure on a mannequin

AT 6 O'CLOCK IN THE MORNING, shortly after the sun spills over the horizon, the city of Kikwit doesn't so much wake up as ignite. Loud music blares from car radios. Shops fly open along the main street. Dust-sprayed jeeps and motorcycles zoom eastward toward the town's bustling markets or westward toward Kinshasa, the Democratic Republic of the Congo's capital city. The air starts to heat up, its molecules vibrating with absorbed energy. So, too, the city.

By late morning, I am away from the bustle, on a quiet, exposed hilltop some five miles down a pothole-ridden road. As I walk, desiccated shrubs crunch underfoot and butterflies flit past. The only shade is cast by two lines of trees, which mark the edges of a site where more than 200 people are buried, their bodies piled into three mass graves, each about 15 feet wide and 70 feet long. Nearby, a large blue sign says IN MEMORY OF THE VICTIMS OF THE EBOLA EPIDEMIC IN MAY 1995. The sign is partly obscured by overgrown grass, just as the memory itself has been occluded by time. The ordeal that Kikwit suffered has been crowded out by the continual eruption of deadly diseases elsewhere in the Congo, and around the globe.



TheAtlantic - When The Next Plague Hits - The Atlantic - Ed Yong

To hear more feature stories, see our full list or get the Audm iPhone app.

Emery Mikolo, a 55-year-old Congolese man with a wide, angular face, walks with me. Mikolo survived his own encounter with Ebola in 1995. As he looks at the resting place of those who didn't, his solemn demeanor cracks a bit. In the Congo, when people die, their bodies are meant to be cleaned by their families. They should be dressed, caressed, kissed, and embraced. These intense rituals of love and community were corrupted by Ebola, which harnessed them to spread through entire families. Eventually, of necessity, they were eliminated entirely. Until Ebola, "no one had ever taken bodies and thrown them together like sacks of manioc," Mikolo tells me.

The Congo—and the world—first learned about Ebola in 1976, when a mystery illness emerged in the northern village of Yambuku. Jean-Jacques Muyembe, then the country's only virologist, collected blood samples from some of the first patients and carried them back to Kinshasa in delicate test tubes, which bounced on his lap as he trundled down undulating roads. From those samples, which were shipped to the Centers for Disease Control and Prevention in Atlanta, scientists identified the virus. It took the name Ebola from a river near Yambuku. And, having been discovered, it largely vanished for almost 20 years.

In 1995, it reemerged in Kikwit, about 500 miles to the southwest. The first victim was 35-year-old Gaspard Menga, who worked in the surrounding forest raising crops and making charcoal. In Kikongo, the predominant local dialect, his surname means “blood.” He checked into Kikwit General Hospital in January and died from what doctors took to be shigellosis—a diarrheal disease caused by bacteria. It was only in May, after the simmering outbreak had flared into something disastrous, after wards had filled with screams and vomit, after graves had filled with bodies, after Muyembe had arrived on the scene and again sent samples abroad for testing, that everyone realized Ebola was back. By the time the epidemic abated, 317 people had been infected and 245 had died. The horrors of Kikwit, documented by foreign journalists, catapulted Ebola into international infamy. Since then, Ebola has returned to the Congo on six more occasions; the most recent outbreak, which began in Bikoro and then spread to Mbandaka, a provincial capital, is still ongoing at the time of this writing.

The ordeal Kikwit suffered has been crowded out by the continual eruption of deadly diseases elsewhere in the Congo.

Unlike airborne viruses such as influenza, Ebola spreads only through contact with infected bodily fluids. Even so, it is capable of incredible devastation, as West Africa learned in 2014, when, in the largest outbreak to date, more than 28,000 people were infected and upwards of 11,000 died. Despite the relative difficulty of transmission, Ebola still shut down health systems, crushed economies, and fomented fear. With each outbreak, it reveals the vulnerabilities

in our infrastructure and our psyches that a more contagious pathogen might one day exploit.

These include forgetfulness. In the 23 years since 1995, new generations who have never experienced the horrors of Ebola have been born in Kikwit. Protective equipment to shield doctors and nurses from contaminated blood has vanished, even as the virus has continued to emerge in other corners of the country. The city's population has tripled. New neighborhoods have sprung up. In one of them, I walk through a market, gazing at delectable displays of peppers, eggplants, avocados, and goat meat. Pieces of salted fish sell for 300 Congolese francs—about the equivalent of an American quarter. Juicy white grubs go for 1,000. And the biggest delicacy of all goes for 13,000—a roasted monkey, its charred face preserved in a deathly grimace.

The monkey surprises me. Mikolo is surprised to see only one. Usually, he says, these stalls are heaving with monkeys, bats, and other bushmeat, but rains the night before must have stranded any hunters in the eastern forests. As I look around the market, I picture it as an ecological magnet, drawing in all the varied animals that dwell within the forest—and all the viruses that dwell within them.

The Congo is one of the most biodiverse countries in the world. It was here that HIV bubbled into a pandemic, eventually detected half a world away, in California. It was here that monkeypox was first documented in people. The country has seen outbreaks of Marburg virus, Crimean-Congo hemorrhagic fever, chikungunya virus, yellow fever. These are all zoonotic diseases, which originate in animals and spill over into humans. Wherever people push into wildlife-rich habitats, the potential for such spillover is high. Sub-Saharan Africa's population will more than double during the next three decades, and urban centers will extend farther into wilderness, bringing large groups of immunologically naive people into contact with the pathogens that skulk in animal reservoirs—Lassa fever from rats, monkeypox from primates and rodents, Ebola from God-knows-what in who-knows-where.



Survivors of the Kikwit Ebola epidemic (*from left*): Emilienne Luzolo, Shimene Mukungu, and Emery Mikolo in 1995. Mikolo, the first of the three to be infected, later donated his antibody-rich blood to Luzolo and Mukungu. (Emery Mikolo)

On average, in one corner of the world or another, a new infectious disease has emerged every year for the past 30 years: MERS, Nipah, Hendra, and many more. Researchers estimate that birds and mammals harbor anywhere from 631,000 to 827,000 unknown viruses that could potentially leap into humans. Valiant efforts are under way to identify them all, and scan for them in places like poultry farms and bushmeat markets, where animals and people are most likely to encounter each other. Still, we likely won't ever be able to predict which will spill over next; even long-known viruses like Zika, which was discovered in 1947, can suddenly develop into unforeseen epidemics.

The Congo, ironically, has a good history of containing its diseases, partly because travel is so challenging. Most of the country is covered by thick forest, crisscrossed by just 1,700 miles of road. Large distances and poor travel infrastructure limited the spread of Ebola outbreaks in years past.

But that is changing. A 340-mile road, flanked by deep valleys, connects Kikwit to Kinshasa. In 1995, that road was so badly maintained that the journey took more than a week. "You'd have to dig yourself out every couple of minutes,"

Mikolo says. Now the road is beautifully paved for most of its length, and can be traversed in just eight hours. Twelve million people live in Kinshasa—three times the combined population of the capitals affected by the 2014 West African outbreak. About eight international flights depart daily from the city’s airport.

If Ebola hit Kikwit today, “it would arrive here easily,” Muyembe tells me in his office at the National Institute for Biomedical Research, in Kinshasa. “Patients will leave Kikwit to seek better treatment, and Kinshasa will be contaminated immediately. And then from here to Belgium? Or the U.S.?” He laughs, morbidly.

“What can you do to stop that?” I ask.

“Nothing.”

ONE HUNDRED YEARS AGO, in 1918, a strain of H1N1 flu swept the world. It might have originated in Haskell County, Kansas, or in France or China—but soon it was everywhere. In two years, it killed as many as 100 million people—5 percent of the world’s population, and far more than the number who died in World War I. It killed not just the very young, old, and sick, but also the strong and fit, bringing them down through their own violent immune responses. It killed so quickly that hospitals ran out of beds, cities ran out of coffins, and coroners could not meet the demand for death certificates. It lowered Americans’ life expectancy by more than a decade. “The flu resculpted human populations more radically than anything since the Black Death,” Laura Spinney wrote in *Pale Rider*, her 2017 book about the pandemic. It was one of the deadliest natural disasters in history—a potent reminder of the threat posed by disease.

Humanity seems to need such reminders often. In 1948, shortly after the first flu vaccine was created and penicillin became the first mass-produced antibiotic, U.S. Secretary of State George Marshall reportedly claimed that the conquest of infectious disease was imminent. In 1962, after the second polio vaccine was formulated, the Nobel Prize-winning virologist Sir Frank Macfarlane Burnet asserted, “To write about infectious diseases is almost to write of something that has passed into history.”

Hindsight has not been kind to these proclamations. Despite advances in antibiotics and vaccines, and the successful eradication of smallpox, *Homo sapiens* is still locked in the same epic battle with viruses and other pathogens that we've been fighting since the beginning of our history. When cities first arose, diseases laid them low, a process repeated over and over for millennia. When Europeans colonized the Americas, smallpox followed. When soldiers fought in the first global war, influenza hitched a ride, and found new opportunities in the unprecedented scale of the conflict. Down through the centuries, diseases have always excelled at exploiting flux.

The White House is now home to an inattentive, conspiracy-minded president. We should not underestimate what that could mean.

Humanity is now in the midst of its fastest-ever period of change. There were almost 2 billion people alive in 1918; there are now 7.6 billion, and they have migrated rapidly into cities, which since 2008 have been home to more than half of all human beings. In these dense throngs, pathogens can more easily spread and more quickly evolve resistance to drugs. Not coincidentally, the total number of outbreaks per decade has more than tripled since the 1980s.

Globalization compounds the risk: Airplanes now carry almost 10 times as many passengers around the world as they did four decades ago. In the '80s, HIV showed how potent new diseases can be, by launching a slow-moving pandemic that has since claimed about 35 million lives. In 2003, another newly discovered virus, SARS, spread decidedly more quickly. A Chinese seafood seller hospitalized in Guangzhou passed it to dozens of doctors and nurses, one of whom traveled to Hong Kong for a wedding. In a single night, he infected at least 16 others, who then carried the virus to Canada, Singapore, and Vietnam. Within six months, SARS had reached 29 countries and infected more than 8,000 people. This is a new epoch of disease, when geographic barriers disappear and threats that once would have been local go global.

Last year, with the centennial of the 1918 flu looming, I started looking into whether America is prepared for the next pandemic. I fully expected that the

answer would be no. What I found, after talking with dozens of experts, was more complicated—reassuring in some ways, but even more worrying than I’d imagined in others. Certainly, medicine has advanced considerably during the past century. The United States has nationwide vaccination programs, advanced hospitals, the latest diagnostic tests. In the National Institutes of Health, it has the world’s largest biomedical research establishment, and in the CDC, arguably the world’s strongest public-health agency. America is as ready to face down new diseases as any country in the world.

Yet even the U.S. is disturbingly vulnerable—and in some respects is becoming quickly more so. It depends on a just-in-time medical economy, in which stockpiles are limited and even key items are made to order. Most of the intravenous bags used in the country are manufactured in Puerto Rico, so when Hurricane Maria devastated the island last September, the bags fell in short supply. Some hospitals were forced to inject saline with syringes—and so syringe supplies started running low too. The most common lifesaving drugs all depend on long supply chains that include India and China—chains that would likely break in a severe pandemic. “Each year, the system gets leaner and leaner,” says Michael Osterholm, the director of the Center for Infectious Disease Research and Policy at the University of Minnesota. “It doesn’t take much of a hiccup anymore to challenge it.”

Perhaps most important, the U.S. is prone to the same forgetfulness and shortsightedness that befall all nations, rich and poor—and the myopia has worsened considerably in recent years. Public-health programs are low on money; hospitals are stretched perilously thin; crucial funding is being slashed. And while we tend to think of science when we think of pandemic response, the worse the situation, the more the defense depends on political leadership.

When Ebola flared in 2014, the science-minded President Barack Obama calmly and quickly took the reins. The White House is now home to a president who is neither calm nor science-minded. We should not underestimate what that may mean if risk becomes reality.



A containment vessel for infected patients (Jonno Rattman)

Bill Gates, whose foundation has studied pandemic risks closely, is not a man given to alarmism. But when I spoke with him upon my return from Kikwit, he described simulations showing that a severe flu pandemic, for instance, could kill more than 33 million people worldwide in just 250 days. That possibility, and the world's continued inability to adequately prepare for it, is one of the few things that shake Gates's trademark optimism and challenge his narrative of global progress. "This is a rare case of me being the bearer of bad news," he told me. "Boy, do we not have our act together."

Preparing for a pandemic ultimately boils down to real people and tangible things: A busy doctor who raises an eyebrow when a patient presents with an unfamiliar fever. A nurse who takes a travel history. A hospital wing in which patients can be isolated. A warehouse where protective masks are stockpiled. A factory that churns out vaccines. A line on a budget. A vote in Congress. "It's like a chain—one weak link and the whole thing falls apart," says Anthony Fauci, the director of the National Institute of Allergy and Infectious Diseases. "You need no weak links."

AMONG ALL KNOWN PANDEMIC THREATS, influenza is widely regarded as the most dangerous. Its various strains are constantly changing, sometimes through subtle mutations in their genes, and sometimes through dramatic reshuffles. Even in nonpandemic years, when new viruses aren't sweeping the world, the more familiar strains kill up to 500,000 people around the globe. Their ever-changing nature explains why the flu vaccine needs to be updated annually. It's why a disease that is sometimes little worse than a bad cold can transform into a mass-murdering monster. And it's why flu is the disease the U.S. has invested the most in tracking. An expansive surveillance network constantly scans for new flu viruses, collating alerts raised by doctors and results from lab tests, and channeling it all to the CDC, the spider at the center of a thrumming worldwide web.

Yet just 10 years ago, the virus that the world is most prepared for caught almost everyone off guard. In the early 2000s, the CDC was focused mostly on Asia, where H5N1—the type of flu deemed most likely to cause the next pandemic—was running wild among poultry and waterfowl. But while experts fretted about H5N1 in birds in the East, new strains of H1N1 were evolving within pigs in the West. One of those swine strains jumped into humans in Mexico, launching outbreaks there and in the U.S. in early 2009. The surveillance web picked it up only in mid-April of that year, when the CDC tested samples from two California children who had recently fallen ill.

One of the most sophisticated disease-detecting networks in the world had been blindsided by a virus that had sprung up in its backyard, circulated for months, and snuck into the country unnoticed. “We joked that the influenza virus is listening in on our conference calls,” says Daniel Jernigan, who directs the CDC’s Influenza Division. “It tends to do whatever we’re least expecting.”

Video: Is Trump Ready for a Global Outbreak?

Is Trump Ready for a Global Outbreak?



The pandemic caused problems for vaccine manufacturers, too. Most flu vaccines are made by growing viruses in chicken eggs—the same archaic method that’s been used for 70 years. Every strain grows differently, so manufacturers must constantly adjust to each new peculiarity. Creating flu vaccines is an artisanal affair, more like cultivating a crop than making a pharmaceutical. The process works reasonably well for seasonal flu, which arrives on a predictable schedule. It fails miserably for pandemic strains, which do not.

In 2009, the vaccine for the new pandemic strain of H1N1 flu arrived slowly. (Then–CDC Director Tom Frieden told the press, “Even if you yell at the eggs, it won’t grow any faster.”) Once the pandemic was officially declared, it took four months before the doses even *began* to roll out in earnest. By then the disaster was already near its peak. Those doses prevented no more than 500 deaths—the fewest of any flu season in the surrounding 10-year period. Some 12,500 Americans died.

The egg-based system depends on chickens, which are themselves vulnerable to flu. And since viruses can mutate within the eggs, the resulting vaccines don’t always match the strains that are circulating. But vaccine makers have few incentives to use anything else. Switching to a different process would cost billions, and why bother? Flu vaccines are low-margin products, which only

about 45 percent of Americans get in a normal year. So when demand soars during a pandemic, the supply is not set to cope.

American hospitals, which often operate unnervingly close to full capacity, likewise struggled with the surge of patients. Pediatric units were hit especially hard by H1N1, and staff became exhausted from continuously caring for sick children. Hospitals almost ran out of the life-support units that sustain people whose lungs and hearts start to fail. The health-care system didn't break, but it came too close for comfort—especially for what turned out to be a training-wheels pandemic. The 2009 H1N1 strain killed merely 0.03 percent of those it infected; by contrast, the 1918 strain had killed 1 to 3 percent, and the H7N9 strain currently circulating in China has a fatality rate of 40 percent.

“A lot of people said that we dodged a bullet in 2009, but nature just shot us with a BB gun,” says Richard Hatchett, the CEO of the Coalition for Epidemic Preparedness Innovations. Tom Inglesby, a biosecurity expert at the Johns Hopkins Bloomberg School of Public Health, told me that if a 1918-style pandemic hit, his hospital “would need in the realm of seven times as many critical-care beds and four times as many ventilators as we have on hand.”

That the U.S. could be so ill-prepared for flu, of all things, should be deeply concerning. The country has a dedicated surveillance web, antiviral drugs, and an infrastructure for making and deploying flu vaccines. None of that exists for the majority of other emerging infectious diseases.

AS I WALK DOWN a seventh-floor hallway of the University of Nebraska Medical Center, Kate Boulter, a nurse manager, points out that the carpet beneath my feet has disappeared, exposing bare floors that are more easily cleaned. In an otherwise unmarked corridor, this, she says, is the first sign that I am approaching the biocontainment unit—a special facility designed to treat the victims of bioterror attacks, or patients with a deadly infectious disease such as Ebola or SARS.

There is nothing obviously special about the 4,100 square feet, but every detail has been carefully designed to give patients maximal access to the best care, and viruses minimal access to anything. A supply room is stocked with scrubs, underwear, and socks, so that no piece of clothing staff members wear at work

will make its way home. There are two large autoclaves—pressure cookers that use steam to sterilize equipment—so that soiled linens and clothes can be immediately decontaminated. The space is under negative air pressure: When doctors enter the hallway, or any of the five patient rooms, air flows in with them, preventing viruses from drifting out. This also dries the air. Working here, I'm told, is murder on the skin.



Mother and baby mannequins used for practicing treatment (Jonno Rattman)

Almost everything in the unit is a barrier of some form. Floor seams are welded. Light and plumbing fixtures are sealed. The ventilation and air-conditioning systems are separate from those for the rest of the hospital, and rigorously filtered. Patients can be wheeled in on a tented gurney with built-in glove ports; it looks like a translucent caterpillar whose legs have been pushed inward. A separate storage room is stocked with full-body suits, tape for sealing the edges of gloves, and space-suit-like hoods with their own air filter. A videoconferencing system allows team members—and family—to monitor what happens in the

patient rooms without having to suit up themselves. A roll of heavy-duty metallic wrapping paper can be used to seal the body of anyone who dies.

The unit is currently empty, as it has been for most of its existence. The beds are occupied only by four hyperrealistic mannequins, upon which nurses can practice medical procedures while wearing cumbersome protective layers. “We’ve named all the mannequins,” Boulter tells me. Pointing to the largest one: “That one’s Phil, after Dr. Smith.”

Phil Smith began pushing the hospital to build the biocontainment unit in 2003, back when he was a professor of infectious diseases. SARS had emerged from nowhere, and monkeypox had broken out in the Midwest; Smith realized the U.S. had no facilities that could handle such diseases, beyond a few high-security research labs. With support from the state health department, he opened the unit in 2005.

And then, nothing happened.

For nine years, the facility was dormant, acting mostly as an overflow ward. “We didn’t know if it would be needed, but we planned and prepared as if it would,” says Shelly Schwedhelm, the head of the hospital’s emergency-preparedness program, who for years kept the unit afloat on a shoestring budget. Her efforts paid off in September 2014, when the State Department called, telling Schwedhelm and her team to prepare for possible Ebola patients. Over 10 weeks, the unit’s 40 staff members took care of three infected Americans who had been evacuated from West Africa. They worked around the clock in teams of six, some staffers treating the patients directly, others helping their colleagues put on and take off their gear, and still others supervising from the nurses’ station. Two of the patients—Rick Sacra, a physician, and Ashoka Mukpo, a journalist—were cured and discharged. The third—a surgeon named Martin Salia—was already suffering from organ failure by the time he arrived, and died two days later. A green-marble plaque now hangs in the unit to honor him.



A plaque memorializing Dr. Martin Salia, who died from Ebola at the University of Nebraska Medical Center in 2014 (Jonno Rattman)

The University of Nebraska Medical Center is one of the best in the country at handling dangerous and unusual diseases, Ron Klain, who was in charge of the Obama administration's Ebola response, tells me. Only the NIH and Emory

University Hospital have biocontainment units of a similar standard, he says, but both are smaller. Those three hospitals were the only ones ready to take patients when Ebola struck in 2014, but within two months, Klain's team had raised the number to 50 facilities. It was "a lot of hard work," he says. "But ultimately, we had 144 beds." A more contagious and widespread disease would have overwhelmed them all.

Preparing hospitals for new epidemics is challenging in the United States, Klain says, because health care is so decentralized: "You and I could decide that every hospital should have three beds capable of isolating people with a dangerous disease, and Trump could agree with us, and there's no way of making that happen." Hospitals are independent entities; in this fractured environment, preparedness is less the result of governmental mandate and more the product of individual will. It comes from dedicated visionaries like Smith and skilled managers like Schwedhelm, who can keep things going when there's no immediate need.

The trio of Ebola patients in 2014 produced 3,700 pounds of contaminated linens, gloves, and other waste among them, all of which demanded careful handling. Treating them cost more than \$1 million. That kind of care quickly reaches its limits as an epidemic spreads. In June 2015, the Samsung Medical Center, in Seoul—one of the most advanced medical centers in the world—was forced to suspend most of its services after a single man with MERS arrived in its overcrowded emergency room. American hospitals wouldn't fare much better. But at the very least, they can plan for the worst.

Schwedhelm, with a 100-person team, has been creating plans for how every aspect of hospital operation would need to work during a pandemic. How much should hospitals stockpile? How would they provide psychological support during a weeks-long crisis? How could they feed people working longer-than-usual shifts? When would they cancel elective surgeries? Where could they get extra disinfectant, mop heads, and other cleaning supplies?

At a single meeting, I hear two dozen people discuss how they would care for the 400 or so patients on the hospital's organ-transplant list. How would they get such patients into the facility safely? At what point would it become too risky to

pump them with immunosuppressants? If ICUs are full, where could they create clean spaces for post-transplant recovery? It matters that the hospital has considered these questions. It matters just as much that the people in charge have met, talked, and established a bond.

The members of the team running the biocontainment unit all work in different parts of the hospital, as pediatricians, critical-care specialists, obstetricians. But even during the unit's long dormancy, Schwedhelm would gather them for quarterly training sessions. That's why, when the moment came, they were ready. When they escorted the Ebola patients off their respective planes, the staff members recalled what they had learned during practice drills.

Shelly Schwedhelm, who directs Nebraska's emergency-preparedness program, and Phil Smith, who opened the hospital's biocontainment unit in 2005 (Jonno Rattman)

"We do a lot of team building," Boulter says, showing me a photo of the group at a ropes course.

"It was the scariest thing I've ever done," Schwedhelm says. They followed that up with something more sedate—a movie night in the hospital auditorium. They watched *Contagion*.

KIKWIT GENERAL HOSPITAL has no biocontainment unit. Instead, it has Pavilion 3.

Emery Mikolo, who works at the hospital as a nurse supervisor, takes me into the blue-walled, open-windowed building that is now the pediatrics ward. In one room, mosquito nets are suspended hammocklike over 16 closely packed beds, on which mothers care for young children and newborn babies. This is a place of new life. But in 1995, it was the infamous “death ward,” where Ebola patients were treated. Exhausted doctors struggled to control the outbreak; outside the hospital, the military established a perimeter to turn back fleeing patients. The dead were laid in a row on the pavement.

We walk into another room, which is largely empty except for a poster of a cartoonish giraffe, a few worn mattresses, and some old bed frames. Mikolo touches one of them. It was his, he says. He looks around quietly and shakes his head. Many of the people who shared this room with him were his colleagues who had become infected while they cared for patients. Ebola’s symptoms are sometimes mythologized: Organs don’t liquefy; blood seldom pours from orifices. But the reality is no less gruesome. “It was like a horror movie,” he says. “All these people I worked with—my friends—throwing up, screaming, dying, falling out of bed.” At one point, delirious with fever, he too rolled off his mattress. “There was vomit and piss and shit on the ground, but at least it was cool.”

Many of the people who worked at the hospital during the outbreak are still there. Jacqui, a nurse, worked in Pavilion 3 and returned there only three years ago. She was terrified at first, but she soon habituated. I ask whether she’s worried that Ebola might return. “I’m not afraid,” she says. “It’s never coming back.”

If it does, is there any protective equipment at the hospital? “No,” she tells me.

Mikolo laughs. “Article 15,” he says.

Article 15 is something of a Congolese catchphrase, referring to a fictional but universally recognized 15th article of the country’s constitution, “*Débrouillez-vous*”—“figure it out yourself.” I hear it everywhere. It is simultaneously a testament to the Congolese love for droll humor, a weary acknowledgment of

hardship, a screw-you to the establishment, and a motivational mantra. *No one's going to fix your problems. You must make do with what you've got.*

Though the U.S. is vastly wealthier than the Congo, the laments I heard in both countries about how things could go wrong were uncannily similar.

In a nearby room, dried blood dots the floor around an old operating table, where a sick lab technician once passed Ebola to five other medical staff members, starting a chain of transmission that eventually enveloped Mikolo and many of his friends. The phlebotomist who drew the blood samples that were used to confirm Ebola also still works at the hospital. I watch as he handles a rack of samples with his bare hands. “Ask someone here, ‘Where are the kits that protect you from Ebola?’ ” Donat Kuma-Kuma Kenge, the hospital’s chief coordinator, tells me. “There aren’t any. I know *exactly* what I’m meant to do, but there are no materials—here, in the place where there was Ebola.

“*Débrouillez-vous,*” he adds.

The hospital’s challenges are considerable, but as I walk around, I realize that they are familiar. Even though the United States is 500 times as wealthy as the Congo, the laments I heard from people in both countries were uncannily similar—different in degree, but not in kind. Protective equipment is scarce in the Congo, but even America’s stockpiles would quickly be depleted in a serious epidemic. Unfamiliarity with Ebola allowed the virus to spread among the staff of Kikwit’s hospital, just as it did among nurses in Dallas, where an infected patient landed in September 2014. In Kikwit, a lack of running water makes hygiene a luxury, but even in the U.S., getting medical professionals to wash their hands or follow other best practices is surprisingly hard; every year, at least 70,000 Americans die after picking up infections in hospitals. And most of all, the people in both countries worry that brief spates of foresight and preparedness will always give way to negligence and entropy.

In the U.S., attention and money have crested and then crashed with each new crisis: anthrax in 2001, SARS in 2003. Resources, hurriedly assembled, dwindle.

Research into countermeasures fizzles. “We fund this thing like Minnesota snow,” Michael Osterholm says. “There’s a lot in January, but in July it’s all melted.”

Take the Hospital Preparedness Program. It’s a funding plan that was created in the wake of 9/11 to help hospitals ready themselves for disasters, run training drills, and build their surge capacity—everything that Shelly Schwedhelm’s team does so well in Nebraska. It transformed emergency planning from an after-hours avocation into an actual profession, carried out by skilled specialists. But since 2003, its \$514 million budget has been halved.

Another fund—the Public Health Emergency Preparedness program—was created at the same time to help state and local health departments keep an eye on infectious diseases, improve their labs, and train epidemiologists. Its budget has been pruned to 70 percent of its \$940 million peak. Small wonder, then, that in the past decade, local health departments have cut more than 55,000 jobs. That’s 55,000 people who won’t be there to answer the call when the next epidemic hits.

These sums of money are paltry compared with what another pandemic might cost the country. Diseases are exorbitantly expensive. In response to just 10 cases of Ebola in 2014, the U.S. spent \$1.1 billion on domestic preparations, including \$119 million on screening and quarantine. A severe 1918-style flu pandemic would drain an estimated \$683 billion from American coffers, according to the nonprofit Trust for America’s Health. The World Bank estimates that global output would fall by almost 5 percent—totaling some \$4 trillion.

The U.S. is not unfamiliar with the concept of preparedness. It currently spends roughly half a trillion dollars on its military—the highest defense budget in the world, equal to the combined budgets of the next seven top countries. But against viruses—more likely to kill millions than any rogue state is—such consistent investments are nowhere to be found.

A worker sealing her gloves (Jonno Rattman)

AT A MODERN BUILDING in Holly Springs, on the outskirts of Raleigh, North Carolina, I walk down a wide corridor where the words IT REALLY IS A MATTER OF LIFE AND DEATH have been stenciled on a yellow wall. The walkway leads to a refrigerator-cool warehouse, where several white containers sit

on a blue pallet. The containers are full of flu vaccine, and each holds enough to immunize more than 1 million Americans. When their contents are ready to be used, they head toward a long, Rube Goldberg–esque machine that dispenses the vaccine into syringes—more than 400,000 a day.

Instead of eggs, the facility grows flu viruses in lab-grown dog cells, which fill 5,000-liter steel vats one floor above. The cells are infected with flu viruses, which quickly propagate. The technique is faster than using eggs, and produces vaccines that are a closer match to circulating strains.

This facility is the result of a partnership between the pharmaceutical company Seqirus and a government agency called the Biomedical Advanced Research and Development Authority. Established in 2006, BARDA acts more or less as a venture-capital firm, funding the development of vaccines, drugs, and other epidemic countermeasures that would otherwise be unprofitable. In 2007, it entered into a \$1 billion partnership to create the Holly Springs plant, which started making vaccines in 2011. “No one would have taken the risk of disposing of egg manufacturing unless they could reach the scale we have here,” says Marie Mazur, Seqirus’s vice president of pandemic response.

The facility will soon be able to make 200 million doses of vaccine within the first six months of a new pandemic—enough to immunize more than one in every three Americans. Six months is still a long time, though, and there are limits to how quick the process can be. To vaccinate people during that window, Seqirus also prepares vaccines against the flu strains that BARDA deems most likely to cause a pandemic. Those doses are stockpiled, and can be used to immunize health-care workers, government employees, and the military while the Holly Springs plant churns out more.

Yet even this strategy is imperfect. When H7N9 first appeared in China, in 2013, the plant did its job, creating a vaccine that was then stockpiled. Since then, H7N9 has mutated, and the hoarded doses may be ineffective against the current strains. “We occasionally have to chase a pre-pandemic,” says Anthony Fauci, the National Institute of Allergy and Infectious Diseases (NIAID) director. “We have to do it,” but the strategy remains wasteful and reactive.

What society really needs, Fauci tells me, is a universal flu vaccine—one that protects against every variant of the virus and provides long-term protection, just as the vaccines against measles and mumps do. One vaccine to bind them all: It's hard to overstate what a win that would be. No more worrying about strain mismatches or annual injections. "It would be the epitome of preparedness," Fauci says, and he has committed his institute to developing one.

Anthony Fauci, who as head of the National Institute of Allergy and Infectious Diseases has, until now, helped every president starting with Ronald Reagan manage pandemic risk, says the responses of the presidents varied widely. He has yet to meet with Donald Trump. (Jonno Rattman)

Flu viruses are studded with a molecule called hemagglutinin (the *H* in H1N1 and other such names), which looks like a stumpy Pez dispenser. Vaccines target

the head, but that's the part that varies most among strains, and evolves most quickly. Targeting the stem, which is more uniform and stable, might yield better results. The stem, however, is usually ignored by the immune system. To draw attention to it, Fauci's team decapitates the molecule and sticks the stem onto a nanoparticle. The result looks like a flu virus, but encourages the immune system to go after the stable stem instead of the adaptable head. In a preliminary study, his team used this approach to build a vaccine using an H1 virus, which then protected ferrets against a very different H5N1 strain.

This type of work is promising, but flu is such an adaptive adversary that the quest for a universal vaccine might take years, even decades, to fulfill. Progress will be incremental, but each increment will have value in itself. A universal-ish vaccine that, say, protected against all H1N1 strains would have prevented the 2009 pandemic. And reducing flu's menace, even in some of its variants, would free up resources and intellectual capacity for dealing with other deadly diseases for which no vaccines exist at all.

Many of those diseases strike poor countries first and are—for now—rare. Creating vaccines for them is painstaking and often unprofitable, and therefore little gets done. Last year, to help change that, the Coalition for Epidemic Preparedness Innovations was created, and now has \$630 million pledged by governments and nonprofits. It will focus first on Lassa fever, Nipah, and MERS, and its ambition is to yank promising vaccines out of developmental purgatory, push them through trials, and stockpile them by the hundreds of thousands. (One goal is to avoid a repeat of 2014, when Ebola ravaged West Africa while an experimental vaccine that could potentially have stopped it was languishing in a freezer, where it had been for a decade.)

More important, the coalition is looking to fund so-called platform technologies that could create a vaccine against any new virus far more quickly than can be done today: within 16 weeks of its discovery. Most current vaccines work by presenting the immune system with dead, weakened, or fragmented microbes. Every microbe is unique, so every vaccine must be unique, which is one reason they're so time-consuming to create. But by loading key parts of a given microbe onto a standard molecular chassis, scientists could build plug-and-play vaccines that could be swiftly customized.

In the same way that movable type revolutionized printing by allowing people to rapidly set up new pages without carving bespoke woodblocks, such vaccines could greatly accelerate the defense against emerging infections. In 2016, a team of researchers used the concept to create a vaccine against Zika that is now being tested in clinical trials across the Americas. The process took four months—the shortest development time in vaccinology’s 222-year history.

The possibilities of vaccine science—a universal flu vaccine, plug-and-play platforms—are exciting. But they are only possibilities. No matter how brilliant and dedicated the people involved, they face a long and uncertain road. Missteps and failures are assured along the way; dogged effort and consistent support are essential to sustain the journey. These latter necessities, unavoidably, bring us to politics—where they are, predictably, in short supply.

ANTHONY FAUCI’S OFFICE WALLS are plastered with certificates, magazine articles, and other mementos from his 34-year career as NIAID director, including photos of him with various presidents. In one picture, he stands in the Oval Office with Bill Clinton and Al Gore, pointing to a photo of HIV latching onto a white blood cell. In another, George W. Bush fastens the Presidential Medal of Freedom around his neck. Fauci has counseled every president from Ronald Reagan through Barack Obama about the problem of epidemics, because each of them has needed that counsel. “This transcends administrations,” he tells me.

Reagan and the elder Bush had to face the emergence and proliferation of HIV. Clinton had to deal with the arrival of West Nile virus. Bush the younger had to contend with anthrax and SARS. Barack Obama saw a flu pandemic in his third month in office, MERS and Ebola at the start of his second term, and Zika at the dusk of his presidency. The responses of the presidents varied, Fauci told me: Clinton went on autopilot; the younger Bush made public health part of his legacy, funding an astonishingly successful anti-HIV program; Obama had the keenest intellectual interest in the subject.

And Donald Trump? “I haven’t had any interaction with him yet,” Fauci says. “But in fairness, there hasn’t been a situation.”

There surely will be, though. At some point, a new virus will emerge to test Trump's mettle. What happens then? He has no background in science or health, and has surrounded himself with little such expertise. The President's Council of Advisers on Science and Technology, a group of leading scientists who consult on policy matters, is dormant. The Office of Science and Technology Policy, which has advised presidents on everything from epidemics to nuclear disasters since 1976, is diminished. The head of that office typically acts as the president's chief scientific consigliere, but to date no one has been appointed.

Other parts of Trump's administration that will prove crucial during an epidemic have operated like an Etch A Sketch. During the nine months I spent working on this story, Tom Price resigned as secretary of health and human services after using taxpayer money to fund charter flights (although his replacement, Alex Azar, is arguably better prepared, having dealt with anthrax, flu, and SARS during the Bush years). Brenda Fitzgerald stepped down as CDC director after it became known that she had bought stock in tobacco companies; her replacement, Robert Redfield, has a long track record studying HIV, but relatively little public-health experience.

Rear Admiral Tim Ziemer, a veteran malaria fighter, was appointed to the National Security Council, in part to oversee the development of the White House's forthcoming biosecurity strategy. When I met Ziemer at the White House in February, he hadn't spoken with the president, but said pandemic preparedness was a priority for the administration. He left in May.

Organizing a federal response to an emerging pandemic is harder than one might think. The largely successful U.S. response to Ebola in 2014 benefited from the special appointment of an "Ebola czar"—Klain—to help coordinate the many agencies that face unclear responsibilities. In 2016, when Obama asked for \$1.9 billion to fight Zika, Congress devolved into partisan squabbling. Republicans wanted to keep the funds away from clinics that worked with Planned Parenthood, and Democrats opposed the restriction. It took more than seven months to appropriate \$1.1 billion; by then, the CDC and NIH had been forced to divert funds meant to deal with flu, HIV, and the next Ebola.

Ron Klain was appointed the “Ebola czar” by President Obama in 2014 to provide speed and order to a federal response that required many agencies and was marked by unclear lines of responsibility. (Jonno Rattman)

How will Trump manage such a situation? Back in 2014, he called Obama a “psycho” for not banning flights from Ebola-afflicted countries, even though no direct flights existed, and even though health experts noted that travel restrictions hadn’t helped control SARS or H1N1. Counterintuitively, flight bans increase the odds that outbreaks will spread by driving fearful patients underground, forcing them to seek alternative and even illegal transport routes. They also discourage health workers from helping to contain foreign outbreaks, for fear that they’ll be denied reentry into their home country. Trump clearly felt that such Americans

should be denied reentry. “KEEP THEM OUT OF HERE!” he tweeted, before questioning the evidence that Ebola is not as contagious as is commonly believed.

Trump called Obama “dumb” for deploying the military to countries suffering from the Ebola outbreak, and he now commands that same military. His dislike of outsiders and disdain for diplomacy could lead him to spurn the cooperative, outward-facing strategies that work best to contain emergent pandemics.

Perhaps the two most important things a leader can personally provide in the midst of an epidemic are reliable information and a unifying spirit. In the absence of strong countermeasures, severe outbreaks tear communities apart, forcing people to fear their neighbors; the longest-lasting damage can be psychosocial. Trump’s tendency to tweet rashly, delegitimize legitimate sources of information, and readily buy into conspiracy theories could be disastrous.

EMERY MIKOLU GREETES ME WARMLY, with one outstretched hand. We shake, do a little ankle tap, and say, “*Nous sommes ensemble*”—“we are together.” This is the greeting of the Kikwit Ebola Survivors’ Association, of which Mikolo is a co-founder and the vice president. Fifteen of the 42 members file into the breakfast room of Hotel Kwilu, the men in simple shirts and the women in glorious kaleidoscopic dresses. The youngest are in their mid-30s, the oldest in their late 70s. They speak softly as they reconnect over plates of bread, cheese, and Nutella.

There is still no definitive treatment for Ebola. In 1995, like most of the survivors, Mikolo fought the virus off on his own, over three grueling weeks. After he recovered, he donated his blood—and the virus-fighting antibodies within it—to others, saving the lives of Shimene Mukungu and Emilienne Luzolo, who are also here today. Blood spreads Ebola. Sometimes, blood cures it.

The outbreak destroyed entire families. Afterward, some of the survivors found themselves the sole providers for several children. Others were orphans. Worst of all, they became pariahs. “Here, for we who live in communities, it is solitude that kills us,” Mikolo says. He rolls up his trouser leg and shows me the scars inflicted by fearful neighbors, who hurled stones at him when he tried to return home. Like others, he discovered that his house and belongings had been burned.

Emery Mikolo in March 2018 in Pavilion 3, which housed Kikwit's Ebola patients in 1995 and is now a pediatrics ward (Ed Yong)

The survivors banded together. “We had to take care of ourselves,” Norbert Mabanza, the association’s president, tells me. “Those with a little bit of strength could support those who were weaker. *Débrouillez-vous*.”

I listen to their stories in the company of Anne Rimoin, an epidemiologist from UCLA. During her 16 years working in the Congo, Rimoin has shown that monkeypox is on the rise, helped discover a new virus, and worked to create the first truly accurate maps of the country, down to the most-isolated villages. The Congo is a second home for her. When Rimoin’s father died shortly before her wedding, Muyembe, the virologist who first encountered Ebola, flew to Los Angeles to walk her down the aisle.

Rimoin emphasized to me the social rupture that disease outbreaks wreak on unprepared communities, and the difficulty of repair. She also said that until the Congo and other developing countries can control the diseases at their doorsteps, it is imperative for richer nations like the United States to help them. That was a

truth acknowledged by every expert I spoke with: The best way to prevent pandemics is to contain outbreaks at their source. The U.S. cannot possibly consider itself protected if other nations are not.

America's prior investments in global health preparedness—the largest of any nation's—have already made a tangible difference. In 2010, the CDC helped Uganda set up a new surveillance system for viral hemorrhagic fevers like Ebola and Marburg. Health workers there are now trained to recognize these diseases, and have tools for collecting samples safely. Labs have diagnostic equipment. Response teams are ready to go. “It's been incredible to watch,” says Inger Damon, who oversaw the CDC's 2014 Ebola response. “It used to take two weeks to respond to an outbreak. By the time you understood what was going on, you'd have 20 to 30 cases, and eventually hundreds. Now they can respond in two days.” Sixteen outbreaks have been detected since 2010, but they were typically much smaller and shorter than before. Half of them involved just one case.

And in July 2014, in the midst of the West African Ebola outbreak, those investments very likely prevented a horrific catastrophe that might otherwise still be unfolding today. A Liberian American man brought the virus into Lagos, Nigeria, home to 21 million people and one of Africa's busiest airports. “If it had gone out of control in Lagos, it would have gone all over Africa for years,” Tom Frieden, the former CDC director, says. “We were right on the edge of the abyss.”

But Nigeria responded quickly. For years, it had used investments from the U.S. and other countries to build infrastructure for eradicating polio. It had a command center and a crack team of CDC-trained epidemiologists. When Ebola hit Lagos, the team dropped its polio work. It found every person who'd contracted Ebola, and every person with whom those infected had had contact. In only three months, after just 19 cases and eight deaths, it brought Ebola to heel and stopped it from spreading to any other country.

With patience and money—not even very much money compared with the vastness of rich-country spending—this kind of victory could be commonplace. An international partnership called the Global Health Security Agenda has already laid out a road map for nations to plug their vulnerabilities against infectious threats. Back in 2014, the U.S. committed \$1 billion to the effort over

five years. With it came a clear, if implicit, statement: Pandemic threats should be a global priority. *Nous sommes ensemble*.

Given that sense of commitment, and with the related funding in hand, the CDC made a large bet: It began helping 49 countries improve their epidemic preparedness, on the assumption that demonstrating success would assure a continued flow of money. But that bet now looks uncertain. Trump's budget for 2019 would cut 67 percent from current annual spending.

If investments start receding, the CDC will have to wind down its activity in several countries, and its field officers will look for other jobs. Their local knowledge will disappear, and the relationships they have built will crumble. Trust is essential for controlling outbreaks; it is hard won, and not easily replaced. "In an outbreak, there's so little time to learn things, make connections, learn how to not offend people," Rimoin tells me. "We're here in the Congo all the time. People know us."

Until Rimoin arrived in Kikwit last summer, the Ebola survivors had for decades refused to collaborate with outsiders. "Others see us as people to study," Mikolo tells her. "But you came to us with friendship and humanity. You haven't abandoned us." Indeed, while Rimoin is studying the blood of the survivors, she is also trying to set up a clinic where survivors, half of whom are medically trained, can provide primary care to one another and to their communities. She has used donations and some of her own money to help Mabanza, the association's president, get a master's degree in public health.

Rimoin and I take the same flight out of Kinshasa; she will likely be back in a few months. I think about her ties to the Congo as our plane soars over one of the most biodiverse rain forests in the world, on the first of three legs that will put me back within a stone's throw of the White House in 28 hours. Below my flight path, the sparks of a new Ebola outbreak are flickering, unbeknownst to me or any of the scientists with whom I'd spoken. (It would be discovered in the weeks that followed.)

I think about the survivors of Kikwit, and how our connectedness is both the source of our greatest vulnerability and the potential means of our salvation. I think about whether it is possible to break the old cycle of panic and neglect, to

fully transition from *Débrouillez-vous* to *Nous sommes ensemble*. I think about this amid bouts of restless sleep, as the plane flies westward across the Atlantic, stuck in the shadow of the world, until finally, dawn catches up.

This article appears in the July/August 2018 print edition with the headline “When the Next Plague Hits.”