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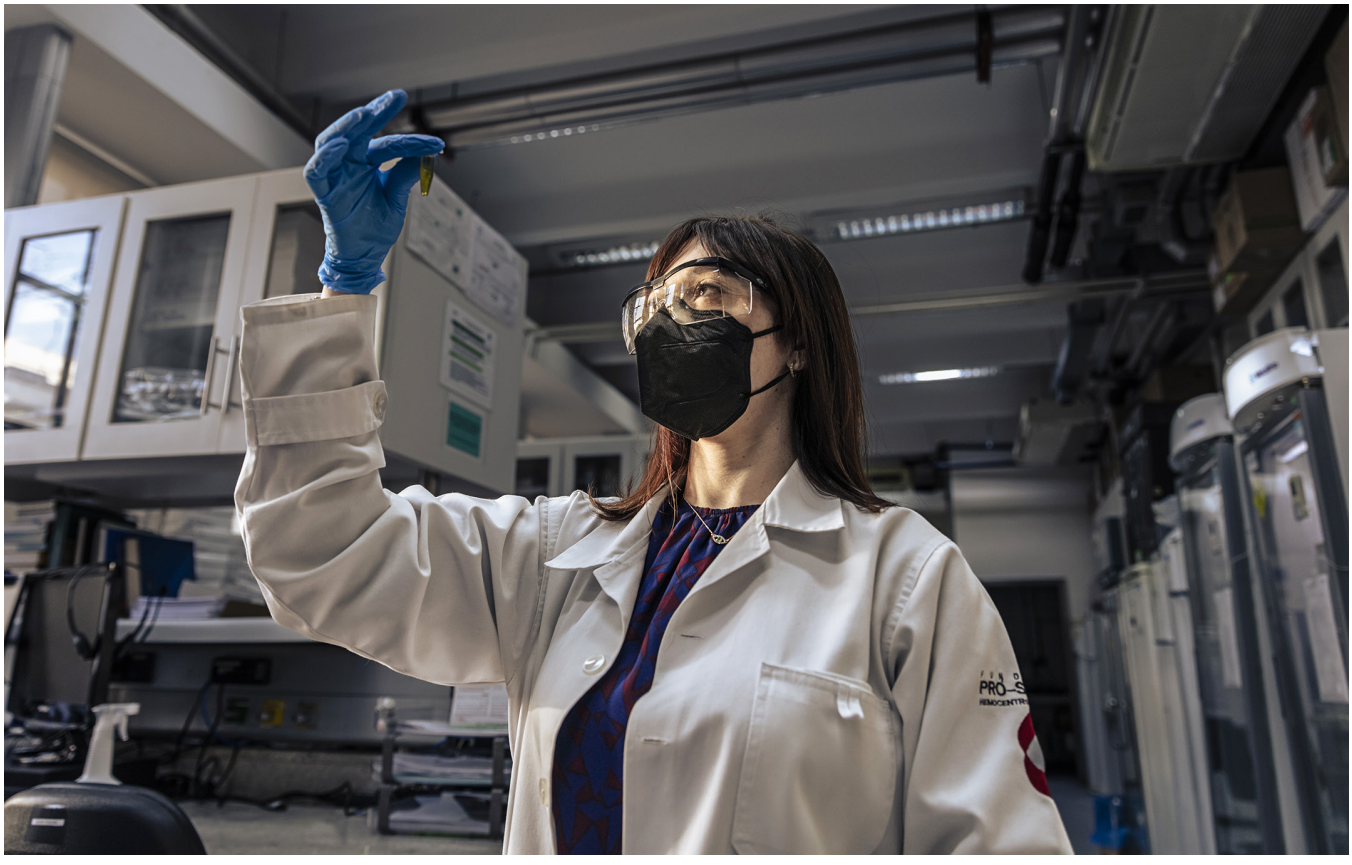

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A researcher at the University of São Paulo examines a blood sample

Photograph by Gui Christ for TIME

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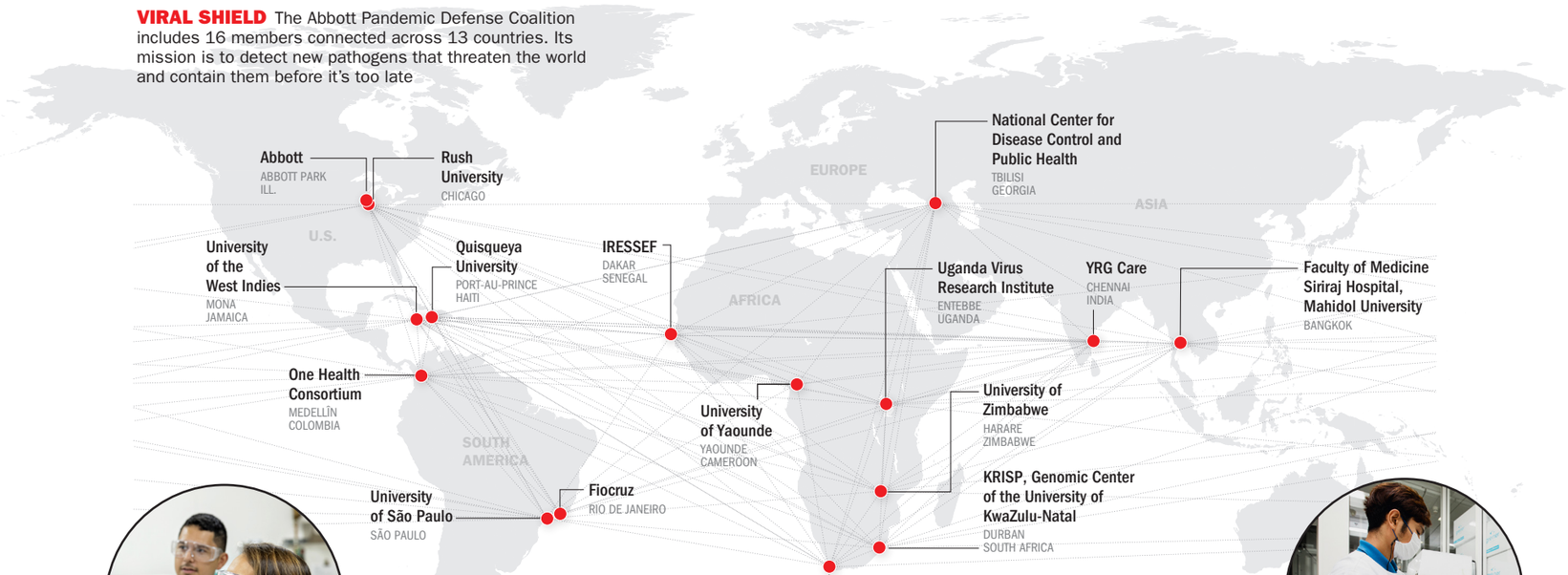
Researchers at the Institute of Tropical Medicine of São Paulo ready DNA samples to add to the group's library

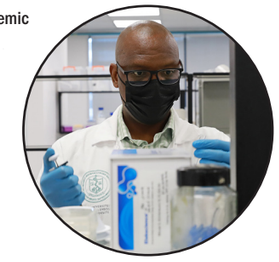
The Virus Hunters

PRIVATE COMPANIES, ACADEMIC CENTERS, AND GOVERNMENTS ARE TEAMING UP TO SPOT EMERGING HEALTH THREATS BY ALICE PARK

PHOTOGRAPH BY GUI CHRIST FOR TIME

VIRAL SHIELD The Abbott Pandemic Defense Coalition includes 16 members connected across 13 countries. Its mission is to detect new pathogens that threaten the world and contain them before it's too late





Scientists at a training session at Abbott's U.S. labs (left), *and a researcher at the University of São Paulo* (right)

Researchers at University of KwaZulu-Natal (left) *and Siriraj Hospital, Mahidol University* (right)

FROM LEFT: ABBOTT; GUI CHRIST FOR TIME; NARDUS ENGELBRECHT; FACULTY OF MEDICINE SIRIRAJ HOSPITAL, MAHIDOL UNIVERSITY

EVEN THOUGH EXPERTS HAD LONG warned that the next pandemic was imminent, few saw SARS-CoV-2 coming. In the early days of the outbreak, researchers scrambled to collect samples from people who had mysteriously developed fevers, coughs, and breathing problems. Pretty soon, they realized that the disease-causing culprit was a new virus humans hadn't seen before.

Lacking a coordinated global response, some countries acted quickly to develop tests for the novel coronavirus, while others with fewer resources were left behind. But with global travel (100,000 flights a day in 2019) far more common than when past plagues had hit, these inequities meant everyone was vulnerable. The solution? Shutting the world down, closing borders, and asking people to stay safely indoors.

It soon became clear that the world would weather this pandemic only by working together, and that governments alone couldn't necessarily save us. Surveillance into the microbial world was necessary in order to predict coming outbreaks—or at least detect them more quickly after they hit. Some in the private sector saw an opportunity to harness their expertise and resources in testing and manufacturing to benefit both public health and their businesses. In 2021, the global health care company Abbott started the Abbott Pandemic Defense Coalition (APDC), the first convergence of public-health and academic experts led by a private company. It now includes 16 members based in 13 countries. Its mission: to detect new pathogens that threaten to wreak havoc on the world and contain them before it's too late.

The experiment is just beginning, but it's already paying off. APDC partners were among the first in the world to spot several dangerous mutations of the COVID-19 virus—including Omicron—just as they were emerging, which allowed countries to prepare by increasing testing, doubling down on vaccine programs, and advising infected people to isolate. It was a big change from being blindsided by the original version of the virus.

The virus hunters are not only watching out for new versions of SARS-CoV-2, but also continuing their search for the next potentially dangerous bugs. In June, as monkeypox began infecting people around the world, the network monitored genetic sequences of the virus that showed it had came from the less virulent of two strains endemic in Africa, and that existing vaccines would continue to be effective. Using that data, Abbott has developed a monkeypox PCR test (for research purposes only) that coalition members are using to track the virus, contain its spread, and detect any changes in the viral genome as soon as they appear. APDC is also continuing to monitor other emerging infectious diseases, including hepatitis, Zika, dengue, meningitis, and yellow fever. As humans continue to encroach on previously wild geographical regions, we're more likely to come into contact with pathogens that can pose a threat to health. Climate change is also raising the risk of infectious diseases as species that carry viruses or bacteria expand to broader geographic areas.

The coalition's goal is "to build the next generation of virologists, virus hunters, and epidemiologists," says Gavin Cloherty, who leads APDC. "Preventing the next pandemic is a team sport, and collaboration is the only way we win."

COVID-19 HAS TURNED OUT to be an ideal proving ground for this type of coalition. The virus is constantly evolving, and by comparing genetic sequences from COVID-19 patients in one region to previous samples, scientists at partner labs can spot any noteworthy differences and monitor them more closely. Any changes—especially if they appear in multiple parts of the world simultaneously—could represent mutations that make it easier for the virus to spread or cause more serious disease.

If any lab in the coalition detects a concerning pattern, it immediately shares it with the group. If others are seeing the same trend, Abbott and the partners work to ensure the current tests can still detect the new strain. Should the tests fail, then Abbott scientists would get to work revising them. "We are able to build tools like tests and assays that can be distributed to our partners and potentially manufacture them at scale if needed," says Cloherty. Most important, the coalition also shares any concerning discoveries with global public-health officials, foundations, and government leaders—including the World Health Organization (WHO), the U.S. Centers for Disease Control and Prevention (CDC), and the Bill and Melinda Gates Foundation—as well as on global public databases. Knowing what might be coming can help health authorities deploy limited COVID-19 resources to where they are needed most.

The coalition serves Abbott's business purposes, given that the company has a long history of providing diagnostic tests for pathogens—including its popular BinaxNOW COVID-19 rapid at-home tests. Being the first to hear of any changes in SARS-CoV-2 would give Abbott's scientists a running start at modifying diagnostics. Finding more variants and more viruses means more tests—which makes sense for its bottom line.

But the public-health partners benefit too. Abbott wholly funds the coalition, providing scientists with state-of-the-art equipment, training, and lab supplies to collect samples and conduct genetic sequencing. Abbott also shares its scientific and manufacturing expertise, since it has been following viruses globally for about 30 years, from the start of the HIV/AIDS epidemic. That ongoing surveillance program is the predecessor to APDC; it monitors known pathogens—instead of new or emerging ones, as APDC does—for mutations that might affect diagnostic tests and treatments. The new coalition also links otherwise isolated public-health labs into a tight-knit community that can quickly disseminate information about new pathogens or genetic aberrations they discover.

"Although it is a private company, and diagnostic kits are to be sold, what I see is an effort to bring down scientific borders and increase communication across the globe," says Esper Kallas, professor of infectious and parasitic diseases at the University of São Paulo, a coalition partner.

Being led by a private company sets APDC apart, but it isn't the only collaborative group of virus hunters. The Rockefeller Foundation's Pandemic Prevention Institute, for example, which recently partnered with the Pasteur Institute, is a philanthropy-led group of 33 members that act as sentinels for emerging infectious diseases that could become public-health threats.

Partnerships among entities like public-health groups, foundations, and private companies are increasingly essential for mounting a quick and efficient response against fast-moving viruses. Perhaps the best example of the power of such alliances was the U.S.'s ability to develop, test, manufacture, and distribute millions of COVID-19 vaccines in less than a year. The feat never would have been possible if the U.S. government had not funded pharmaceutical companies' costs in developing and manufacturing these vaccines; doing so helped the U.S. and the rest of the world benefit from the revolutionary mRNA shots that had never before been used against a virus.

Experts believe that the only way to prepare for the next pandemic is not just to create more coalitions like these, but also to sustain them between public-health emergencies. "Public-private partnerships are essential for [disease]

surveillance, testing, treatments, you name it," says Dr. Eric Topol, director and founder of the Scripps Research Translational Institute. "We do better if those groups are working together."

SO FAR, APDC MEMBERS have contributed to identifying three major SARS-CoV-2 variants. In June and July 2020, as the coalition was being formed, hospitals in South Africa noticed a rapid uptick in COVID-19 patients. "We found the exact same variant in samples from clinics that were hundreds of kilometers away, so we knew it was widespread and that we potentially had a new variant," says Tulio de Oliveira, who leads the Center for Epidemic Response and Innovation (CERI) at Stellenbosch University in South Africa, an APDC partner. Data from the South African hospitals suggested that younger people were most affected, and that they were getting sicker than people who had been infected with the earlier version of the virus. De Oliveira alerted global health authorities to the new variant, which allowed them to prepare for a potential wave of hospitalizations. Back in Chicago at Abbott's headquarters, scientists quickly determined that the company's existing PCR and recently authorized at-home rapid tests for SARS-CoV-2 could still detect the new variant, which the WHO later dubbed Beta.

Several months later, Brazilian researchers issued a similar alarm. Researchers at the University of São Paulo led by Ester Sabino had worked with Oxford scientists during Brazil's 2015 Zika outbreak to develop a mobile, compact machine to process virus samples; using it to scan COVID-19 samples in spring 2020, they noticed unusual sequences coming from northern Brazil in the Amazon Basin. The changes to the viral genome turned out to signal a new variant, Gamma, that would go on to cause significant disease and death in the area. But as tragic as Gamma's local effects were, early detection likely prevented it from causing even more disease and death elsewhere in the country and world, says Kallas. "What would have happened if Gamma would not have been discovered until it reached a big city such as São Paulo, of 20 million people?" he says. "We would have been caught completely off guard." Luckily, coalition scientists confirmed that existing rapid tests worked to detect Gamma, just as they had for Beta.

Then came Omicron. A lab technician in South Africa was conducting routine genetic sequencing of random SARS-CoV-2 samples in November 2021 and noticed that the virus was missing one of three protein signatures that all the previous variants had had. The technician tipped off de Oliveira's group, which conducted a more detailed analysis showing that the virus had picked up a shocking 30 or so mutations—most of them in the spike protein, the very region targeted by vaccine- and drugmakers. In the span of six hours, hundreds of samples from more than 100 South African clinics arrived at de Oliveira's labs. Sequencing those samples revealed the same pattern of mutations. Within 36 hours, de Oliveira had notified the Health Minister and President of South Africa, along with the WHO, that a new version of the virus was brewing.

Within days, de Oliveira also looped in coalition partners around the world to give countries a head start in looking for the genetic changes signaling the Omicron variant (which the WHO named shortly after).

The collaboration quickly put lots of different eyes on the same urgent problem. "Each of us brings a different skill set," says Dr. Sunil Solomon, assistant professor of medicine in infectious diseases at Johns Hopkins and director of YRG Care in Chennai, India, one of the coalition partners. "People can go down rabbit holes thinking what they are working on is important, so they forget what the bigger picture is. The coalition is focused on translating what all of us find for clinical relevance to make sure that whatever we are doing is tailored toward improving the public's health."

'Preventing the next pandemic is a team sport.'
—GAVIN CLOHERTY,
ABBOTT PANDEMIC DEFENSE COALITION

A prominent proponent of this type of virus-hunting squad is Bill Gates. In his 2022 book *How to Prevent the Next Pandemic,* he describes the ideal global infectious-disease monitoring system, which he dubs GERM, for Global Epidemic Response and Mobilization. The idea is to maintain a network of scientists whose sole mission is to stay on top of infectious-disease cases and raise alerts if new unexplained infections are bubbling up anywhere in the world. GERM would also be responsible for sending teams of experts to help countries where outbreaks are occurring.

Similar systems already exist, but they aren't robust enough. The WHO tracks emerging public-health threats through its Global Outbreak and Alert Response Network, which provides assistance to countries confronting emergencies. But its responsibilities extend beyond such outbreaks to include crises in food safety, natural and man-made disasters, and the release of chemical toxins. The CDC also surveils emerging pathogens and maintains international teams and mobile groups ready to provide assistance if countries ask for it.

Unfortunately, enthusiasm and funding for maintaining these types of systems ramps up during outbreaks—such as Ebola in the 2010s and now COVID-19—only to die down when the threat retreats. "It's out of sight, out of mind," says Sumit Chanda, professor of immunology and microbiology at Scripps Research, of the existing preparedness strategy. Gates calculates that it would cost about $1 billion to support 3,000 full-time virus hunters in a sustained war against invisible marauders—less than one-thousandth of what nations currently spend on defense. The funding, Gates says, should not come solely from philanthropists or foundations like his, but also from governments, which need to invest in preparing for public-health threats in the same way they shore up defenses against other dangers; and from private companies, which can provide experience and resources in the form of tests and manufacturing capabilities.

The prospectus for these investments is written in the headlines. Coronaviruses alone have caused significant outbreaks several times over recent decades—and that's just one family of viruses. As the world learned with COVID-19, by the time a pandemic hits, it's already too late to start creating relationships and building networks among different countries to share information in real time. And the network's potential is only as extensive as its reach; the more partners linking together, the more likely the world will benefit from discoveries.

COVID-19 also made clear that monitoring for changes in existing pathogens and keeping a lookout for new ones isn't a job for governments and global health groups alone. Industry can play important roles in controlling health outbreaks, but there often aren't financial incentives for businesses to do so. "I don't see enough companies who have made billions of dollars using some of that great profit to do things that are not in their self-interest," says Topol. Instead, the world is left with a patchwork system of public-health sentinels that's riddled with enough holes for pathogens to slip through undetected, giving them enough time to spread before diagnostic tests, vaccines, or treatments can be developed.

GUI CHRIST FOR TIME

Layla Honorato at the Institute of Tropical Medicine of São Paulo analyzes blood samples for any viruses present in them

Even the refinement of COVID-19 vaccines in the U.S. is currently stalled. With more transmissible variants of SARS-CoV-2 circulating, and low uptake of the shots in many parts of the world, new vaccine designs—including nasal shots that might provide stronger and more durable protection against respiratory viruses like SARS-CoV-2—haven't moved beyond the research and early-testing stages because of a lack of funding. Pharmaceutical companies could be enticed to invest in testing and developing innovative solutions like these if the government or philanthropic groups matched the funds industry partners put into development, Topol says, so that no one group would have to subsidize the entire cost. But so far, those investments aren't forthcoming.

Systemic changes—like sustained funding—are needed in order to prepare for the next pandemic. Until we make those types of commitments, the world's ability to see viruses coming will continue to be limited. But some experts, like Kallas, are hopeful that COVID-19 proves to governments how critical collaborations between countries can be, especially when it comes to identifying new potential health threats.

"Some people call the Amazon Brazil a hot zone, a place where diversity in flora and fauna are so [rich] that the chances of a bug jumping from one species into humans is high," he says. A country like Brazil, then, would benefit greatly from having more virus hunters. Gamma, after all, won't be the last virus to emerge from there. "We need a cultural change in mindset," he says, "one that sees the value to society in investing in science to decrease suffering and make us a better society." ◻