



Safeguarding

A VERY SMALL WORLD





Clockwise from top left: Women and children wait for health services at the ICAP-supported Ujiji Health Center in Tanzania; a prototype sketch for Mercury, a new diagnostic device being developed at the Center for Infection and Immunity; practicing hand hygiene in Ukraine; a Global Alliance for Pandemic Preparedness training in Cape Town, South Africa.

Two teams at Columbia Mailman School, ICAP and the Center for Infection and Immunity, are leaders in global health security research and infectious disease prevention. They've been busy.

By Dana Points

For more than four years, medical trains have criss-crossed Ukraine, moving wounded people from the conflict zone to distant hospitals. Deadly antimicrobial-resistant (AMR) bacteria often stow away on board. When a train arrives, an ordinary public hospital—not a military hospital—could get 50 patients at once, many carrying these resistant germs. "It's like having a mass casualty event every week," says Andrea Howard, MD, who until recently was clinical and laboratory unit director at ICAP, the global health center headquartered at Columbia Mailman. While at ICAP, Howard, now deputy commissioner of disease control at the New York City Department of Health and Mental Hygiene, oversaw a program in Ukraine to counter the AMR threat at a time when drug-resistant organisms are responsible for more than a million deaths every year.

The war has left hospitals understaffed and overcrowded, with few isolation rooms to protect against disease spread. Supply shortages make it hard to follow infection prevention and control (IPC) protocols. Labs are ill-equipped, and even if they did identify harmful organisms, antibiotics are often nowhere to be found. It is a perfect environment for AMR organisms to spread. "Antimicrobial-resistant strains of bacteria originating in Ukraine have been detected in European countries and as far away as Japan," says Howard. "Some are resistant to all classes of antibiotics, with deadly consequences."

FACING OUR COLLECTIVE VULNERABILITY

Stopping the spread of drug-resistant organisms is one reason why global health security (GHS) has become a worldwide imperative. And ICAP has been a key partner in GHS efforts—working in Ukraine to advance the country's ability to diagnose, prevent, and manage AMR organisms being just one example. GHS involves a constellation of activities that, together, minimize the risk and impact of acute public health events that cross geographical regions and international boundaries. The World Health Organization launched its GHS initiative in the wake of the Sept. 11, 2001, terrorist attacks, uniting countries and experts to fight the potential threat of bioterrorism. The work quickly expanded to encompass pandemic influenza and other diseases.

Today, both ICAP and the Center for Infection and Immunity (CII) at Columbia Mailman are leading aspects of GHS work worldwide. At CII, the effort often revolves around the use of capture sequencing technology that can identify viruses, bacteria, fungi, and parasites with a single rapid, inexpensive, sensitive test. The system was invented by a team led by W. Ian Lipkin, MD, CII director and John Snow Professor of Epidemiology. "Capture sequencing takes small fragments that we synthesize that represent portions of bacteria, fungi, parasites, and viruses. These mix with materials that have magnetic beads that bind to the sequences

Photographs: (hand) jxfzsy/iStock; (globe) vinap/iStock; Circle images: (clockwise from top left) Nathan Golon for ICAP, Courtesy CII, Courtesy ICAP, Courtesy CII.



Team members don protective equipment during an ICAP training on responding to infectious disease outbreaks in Sierra Leone.

and let you pull out and enrich what is of interest. People talk about a needle in a haystack. If you have to search the whole stack, it is tedious, but with a magnet, you can pull out what's relevant," says Lipkin. His team came up with the idea for the original technology, VirCapSeq, which was focused on viruses, in 2003 during the first SARS (severe acute respiratory syndrome) outbreak. They ultimately patented it in 2014. Since then, investigators of infectious disease in 30 countries in Africa, Asia, Europe, and the Americas have been trained to use the tests.

ICAP's GHS efforts started at the height of the 2014–2016 Ebola outbreak in West Africa. "We had no experience with Ebola, but we were confident that our teams had the skills to do something meaningful," says Susan Michaels-Strasser, PhD, MPH, ICAP's senior director for human resources for health and lead for ICAP programs in Sierra Leone and Zambia. Since its founding in 2003, ICAP has been partnering with ministries of health in countries with fragile, under-resourced health systems to build strength in program services, research, training, data, and laboratory systems.

With Wafaa El-Sadr, MD, MPH '91, MPA, the founder and global director of ICAP, Michaels-Strasser went to Sierra Leone in 2014. The Ebola virus, which causes a devastating hemorrhagic fever that was ultimately fatal in roughly half of patients, crossed borders, popping up in three countries in West Africa. In Sierra Leone, it is estimated that up to 1 in 5 healthcare workers died of Ebola. The countries hit hardest had limited resources and a shortage of healthcare workers.

El-Sadr vividly remembers the silence and fear that permeated the air as she and Michaels-Strasser visited a remote village in Sierra Leone experiencing an Ebola surge. "We shared ways villagers could protect themselves and their families, walking them through how to suspect Ebola and the importance of seeking care rather than refraining from doing so due to stigma or fear of being shunned and isolated," she recalls.

ICAP's approach had been honed while leading the fight against HIV in Africa and was well suited to this GHS emergency. "We know the steps necessary for a resilient response," says Michaels-Strasser. "We work hand in hand with the country's government, working with resources that exist and incrementally improving laboratory and surveillance systems, health worker capacity, and community responses."

In the spring of 2026, Ebola appeared anew in the Democratic Republic of Congo, where armed conflict, mass displacement, food insecurity, and a fragile healthcare system made this latest outbreak a public health emergency of international concern, according to the World Health Organization. ICAP, with funding from the U.S. Centers for Disease Control and Prevention (CDC), was working in the Democratic Republic of Congo prior to the current epidemic, and as recently as June trained more than 200 doctors, nurses, and other staff in Kasaï,



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Wafaa El-Sadr, MD, MPH '91, MPA, ICAP founder and global director

Photographs: Courtesy ICAP

which is outside the area of active Ebola infections, in IPC procedures. ICAP has also worked to prop up the fragile healthcare system there, building latrines and bringing in autoclaves that can be used to sterilize instruments with charcoal. "If you bring something that relies on electricity and there is none, it's of no use," explains Stéphania Koblavi, PharmD, PhD, ICAP's country director for the Democratic Republic of Congo. "We improve the capacity of a health center with materials that are sustainable."

At press time, ICAP was scheduled to begin a new project at the epicenter of the current Ebola outbreak, in Bunia and Beni, two major conflict-affected areas in the eastern Democratic Republic of Congo. The focus will again be on training local staff in IPC and equipping them with a means to clean contaminated water and sterilize equipment using solar power. "We'll hire local staff, build their capacity, and improve the infrastructure," Koblavi says. Again, the work is supported by the CDC. In protecting Africa, ICAP's team is helping to safeguard the world at large. "We are all intricately connected," says El-Sadr. "We can imagine that borders between countries and wide oceans will protect us. But we live in one interconnected world. Our safety and security are dependent on everyone else's health and well-being."

DIAGNOSIS: A FIRST LINE OF DEFENSE

The COVID-19 pandemic that shook the world in 2020 drove home the idea of our global interconnectedness. Early in the pandemic, Lipkin took a leap forward with CII, founding the center's Global Alliance for Pandemic Preparedness (GAPP), which introduces countries worldwide to inexpensive detection methods that help local labs identify and characterize known—and unknown—infectious threats. Today, GAPP offers a two-week remote learning course and a three-week intensive, hands-on course at CII, training investigators from around the world to use the latest laboratory technology and build a sustainable structure for infectious disease discovery and investigation. As at a university, participants must clear the bar of the prerequisite (the remote learning course) before they can take the intensive.

ICAP, too, pairs academic rigor with real-world preparation. "ICAP is unique in that we are at an academic institution, Columbia Mailman, in a big city, New York City. We have one foot in that academic world, and another in the 'real world.' We anchor what we do in scientific evidence, then work diligently to design novel interventions and go to implementation and scale up, always in partnership," says El-Sadr.

A key focus of GHS is ensuring that public health professionals can respond swiftly and accurately to an outbreak. A guiding principle is the 7-1-7 approach: identifying an outbreak within seven days, informing government authorities within one day, and completing essential actions within seven days. Achieving this goal shaped ICAP's work in Sierra Leone, where ICAP partnered with the global health organization Resolve to Save Lives to establish Epidemic Ready Primary Health Care—an approach that strengthens primary healthcare systems to prevent, detect, and respond to outbreaks while maintaining essential health services.

7-1-7

The 7-1-7 approach:

- → Identify an outbreak within seven days.
- → Inform authorities within one day.
- → Complete essential actions in seven days.

"Epidemics don't present themselves at a national emergency operations center in the capital city," says Michaels-Strasser. "They show themselves first at a rural clinic, most likely to a nurse who has never seen that condition before. This is where we must put our efforts and resources." This means strengthening primary care workers' knowledge and ability to be vigilant about uncommon presentations—from handwashing to the proper use of personal protective equipment. To build these skills, ICAP used trained actors to make unannounced visits to rural clinics, describing symptoms consistent with Ebola, for example, as experts observed how the nurses performed. Did they ask the right questions? Did they rapidly don protective equipment? Did they move the "patient" to an isolation room?

The project grew from 80 clinics in phase one to 200 sites at completion. "The health workers are so proud. The program showed them what to do and how to protect themselves and others," says Michaels-Strasser, who also leads a fellowship for pandemic preparedness with NewYork-Presbyterian Hospital.

SAFEGUARDING THE FOOD SUPPLY

GHS work extends beyond borders and to other species as well. At CII, researchers have worked on projects to ensure the safety of food. "Food security is a key aspect of GHS," says Lipkin. In 2007, Lipkin and fellow researchers published evidence that honeybees' immunosuppression was a contributing factor in colony collapse disorder. (One-third of our food supply comes from



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> **W. Ian Lipkin, MD, CII Director and John Snow Professor of Epidemiology**

insect-pollinated plants, with honeybees providing 80 percent of pollination.) Over the years, Lipkin has also investigated a virus killing salmon and another infecting tilapia, two of the most consumed fish in the U.S.

They have also investigated zoonotic viruses—those that spread between animals and humans, often via food production or consumption. "In Saudi Arabia, we found out camels were the source of a Middle East respiratory syndrome coronavirus that had infected humans. People were exposed when the meat wasn't properly washed. We are very interested in how people get infected, how domestic animals get infected, and how we can contain spread," says Lipkin, who is also a professor of Neurology and of Pathology and Cell Biology at Columbia University Irving Medical Center.

Earlier this year, Nischay Mishra, PhD, associate professor of Epidemiology in CII, identified an emerging bat-borne orthoreovirus in people in Bangladesh who had recently consumed raw date-palm sap—a sweet liquid also enjoyed by bats. Bats are the natural reservoir of numerous known and novel zoonotic viruses, including rabies, Nipah, Hendra, Marburg, and SARS-CoV-1. The patients in Bangladesh had experienced severe fever, vomiting, headache, fatigue, and neurological symptoms. Date-palm sap is a known vector for human Nipah infections in Bangladesh, but these new findings showed that the risk of disease associated with raw date-palm sap consumption extends beyond Nipah virus. "We can say with confidence that these viruses are evolving in bats, and some of them are contagious to humans," says Mishra. His research was supported by the U.S. Department of Agriculture. "The USDA would always like to know what viruses can cross the border," Mishra adds. "America's economy and health are very much dependent on animals, so they always want to understand what viruses can spill over from bats, camels, and more."

DEFENDING INVISIBLE BORDERS

Agriculture agencies are often joined in GHS efforts by a seemingly unlikely partner: defense departments. In Kenya, GAPP has worked with the Walter Reed Army Institute of Research–Africa, teaching researchers how to use CII-developed diagnostic techniques. "Kenya has always known it has a Zika problem but was never able to detect it. We taught them how to use this tool; they interrogated mosquito samples and people bitten and were able to detect, for the first time ever, genetic evidence of Zika being transmitted within the country," says J. Kenneth Wickiser, PhD, Phyllis Mailman Associate Professor of Epidemiology in CII and the administrative director for GAPP. "We're working closely with the U.S. Navy in Ghana on the exact same training. The Navy wants to protect Americans who are deployed there."

Mercury, a small, fully automated diagnostic system currently in the works could give a diagnosis in as little as

6 hours

Even as GAPP works with the Army or Navy with an eye toward protecting the U.S. military, it is also collaborating with local clinicians and scientists. "Both the Army and Navy have significant healthcare assets across Africa," says Wickiser, a former faculty member at West Point and Army helicopter pilot. "But at the end of the day, we are trainers of diagnostics. If someone's motivation is protecting the homeland, protect the U.S. But if someone also wants to say, 'We are working hard to provide locals ways to protect their brethren' and be of a more classical public health mind, that is great too."

Naturally occurring pathogens aren't the only concern. In Taiwan, at the behest of the U.S. government, GAPP is teaching the Taiwanese military how to interrogate wastewater from military hospitals so they can better

Photographs: (left) Len Small/*Columbia Magazine*; (right) courtesy ICAP

understand what is circulating in the population—with an eye toward potentially identifying an engineered pathogen. "The only way you can know if it's something that has been engineered is by getting the full genomic sequence, which tests pioneered at CII make possible," says Wickiser.

SHRINKING DOWN, SCALING UP

Innovation is the foundation of ICAP's work, but its goal is to bring successful new programs and practices to life widely around the world. El-Sadr notes that the last stage in ICAP's approach is scaling up interventions that work. Capacity (at scale) is the premise of the Field Epidemiology Training Program that ICAP has led in Eastern Europe and the South Caucasus since 2022. The goal is simple—to enhance local capacity to evaluate and strengthen public health surveillance systems, investigate outbreaks, and conduct field studies. In five workshops, participants from Ukraine, Georgia, Moldova, Armenia, and Azerbaijan learn to conduct disease surveillance, analyze data, detect and investigate outbreaks, and communicate with scientific and non-scientific audiences. Between these workshops, participants go back to their jobs and work on field projects to reinforce classroom learning. Field projects have focused on leptospirosis in Ukraine, anthrax in Georgia, brucellosis in Armenia, and salmonella in Moldova—offering real-world experience to put theory into action. Thus far, the Field Epidemiology Training Program has graduated 68 individuals from the region across four cohorts.

CII, too, has scale in mind, though in this case scaling up involves reducing the size and cost of the equipment used in diagnoses. With support from the Skoll Foundation and the Moore Charitable Foundation, Lipkin and his team are working on a prototype for Mercury, a small, fully automated system for diagnosing infectious diseases. "Mercury will make it possible for healthcare workers anywhere to take any sample and rapidly get answers on why someone is ill and how they should be treated. It will identify causes of outbreaks, and mitigate morbidity, mortality, and healthcare costs. The first prototype has already been built," says Lipkin.

Reflecting on the spring 2026 outbreak of a mysterious infection among passengers and crew members aboard a Dutch cruise ship, he adds, "The machine I'm talking about could give an answer within six hours. You would be able to determine if individuals who felt ill had the same thing." In the case of the Dutch ship, two patients died and more fell ill in the weeks between the first patient's symptoms and when the infection was confirmed to be Andes virus, a rare form of hantavirus.

The same technology could also have enabled rapid identification of the Bundibugyo strain of Ebola virus



↑ A clinician prepares for a needle stick during a recent ICAP training around Ebola in the Democratic Republic of Congo.

in the 2026 outbreak in the Democratic Republic of Congo. (It took weeks in the spring of 2026 to determine that Bundibugyo was the strain involved in the current outbreak.) "Our dream is to build and deploy hundreds of Mercury labs worldwide so that patients everywhere can benefit and we are never caught flatfooted again by the emergence of another threat to public health like Bundibugyo or Andes virus," says Lipkin.

In Ukraine, ICAP has helped to build infrastructure and knowledge to manage AMR organisms. "We started having calls with multidisciplinary teams in three hospitals, which expanded to four, and soon five," Howard recalls. In the beginning, the approach was didactic. "But over time, we started incorporating case discussions and, soon enough, doctors, laboratorians, nurses, and the IPC specialist were all sharing perspectives. It was wonderful to see them work as a team," despite often having spent the previous night in a bomb shelter. These efforts yielded admirable results. In one study of adherence to hand-hygiene protocols, compliance increased from 44 percent to 80 percent over nine months at one hospital, and from 63 percent to 88 percent at another.

From day one, ICAP has believed in investing in people and systems. "That is what is durable," says El-Sadr. "The investments we and others have made have created a world in which people can work effectively together within and across borders. Whether in Ukraine, facing war and destruction, or in remote rural areas of Africa, the resilience and determination of health workers is truly astonishing and inspiring." ●

Dana Points, BC '88, is the editor of this magazine.