the ROAD to ZERO

CDC'S RESPONSE TO THE West African Ebola Epidemic

2014–2015

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Sierra Leone's Deputy Minister of Foreign Affairs and International Cooperation, Dr. Ebun Strasser-King, and Dr. Tom Frieden, CDC Director, meet when she visited CDC in November 2014.

The Long Road

The 2014 Ebola epidemic in West Africa is the first in history. The first case was reported in Guinea in March 2014, and the disease spread in the neighboring countries of Liberia and Sierra Leone. Over the span of a year, the Ebola epidemic has caused more than 10 times as many cases of Ebola than the combined total of all those reported in previous Ebola outbreaks. As the outbreak became more widespread, travel-associated cases appeared in Nigeria, Mali, Senegal, and even countries outside Africa, including the United States. Overall, nine countries have reported cases of Ebola, more than 27,000 people have had suspected, probable, or confirmed Ebola, and more than 11,000 have died. These numbers are likely to be even higher, as many cases have gone undiagnosed and unreported.

Not only has this epidemic been unprecedented, but so has the public health response launched by CDC and its partners. Within a week of the initial report of Ebola, CDC had an expert team on the ground in Guinea. Over the past year, CDC has sent more than 1,000 employees to Guinea, Liberia, and Sierra Leone, many of whom have gone more than once. Thousands more have worked on the response from the agency's headquarters in Atlanta, Georgia, other areas in the United States, and other countries around world. CDC hasn't done this work alone—in every aspect of the response, CDC has collaborated with partners, such as the ministries of health in West Africa, the World Health Organization, CDC Foundation, other parts of the U.S. government, U.S. Agency for International Development (USAID), Doctors Without Borders (MSF), and other non-profit organizations.

The Ebola epidemic has been one of the most challenging global public health emergencies in recent times. The size and scope of this epidemic illustrate the need for stronger, sustainable disease detection and prevention capacity worldwide. On May 9, 2015, more than a year after the outbreak began, the World Health Organization declared the end of the Ebola outbreak in Liberia, but at the end of June, a new case was reported. Cases continue to be reported in Guinea and Sierra Leone. The situation in Liberia shows how important it is to maintain surveillance and response capacity even after an outbreak is over. CDC continues to work in West Africa with the goal of stopping new cases in the affected countries and keeping them from spreading.

July 9, 2015, marks the one-year anniversary of CDC's activation and response to the Ebola epidemic. Many important partners have responded to the Ebola epidemic, and CDC has worked closely with many of these organizations. Rather than reflecting the overall world response, this report documents CDC's work during the outbreak, through the stories of our responders.

"It's like fighting a forest fire. Leave behind one burning ember and the epidemic could re-ignite. That ember could be one case undetected, one contact not traced or healthcare worker not effectively protected, or one burial ceremony conducted unsafely."

Dr. Tom Frieden, CDC Director, August 20, 2014

Rebecca Merrill prepares to deploy to West Africa to support the Ebola response.

RITE (Rapid Isolation and Treatment of Ebola) team members take a canoe on the last leg of their day-long journey to a remote village with suspected Ebola cases.

Tracing Contacts

Contact tracing is a key part of this outbreak. Because the natural reservoir host of Ebola has not yet been identified, we don't know for sure how the virus spreads to humans at the start of an outbreak. However, scientists believe that the first patient becomes infected through some kind of contact with an infected animal, such as a fruit bat or primate (apes and monkeys). Person-to-person transmission follows and can lead to large numbers of cases.

Experience has taught us that rapid case finding, paired with proper infection control, is critical to stop the spread of Ebola. CDC and partners are using contact tracing to identify new Ebola cases quickly, which increases patients' chances of survival, and to isolate patients as soon as they show symptoms, which prevents spread to others. Even one missed contact can mean Ebola will continue to spread because sick people need care from others. Contact tracing works—it's been used in each of the previous 20 Ebola outbreaks over the past 40 years to successfully control Ebola. During this outbreak, success stories from Mali, Nigeria, and Senegal have shown how effective contact tracing can be in containing outbreaks.

"You'll see that over the past 20 years, if infected people are removed from the community within the first two or three days of the disease, you can stop the chain of transmission."

Pierre Rollin, Deputy Branch Chief, Viral Special Pathogens Branch, CDC

David Blackley, CDC responder, prepares to board a U.S. Army helicopter to travel to a remote village in Liberia as part of a RITE (Rapid Isolation and Treatment of Ebola) team.

Contact tracing is the laborious job of finding all those who came into contact with an Ebola patient and checking them for symptoms every day for 21 days. It is slow, painstaking work, but Kari Yacisin, a CDC responder who was deployed to Guinea, knows that effective contact tracing can make a difference. If any of these contacts turn out to be infected, their contacts have to be traced as well—and so on, until the outbreak is contained. The number of contacts can be daunting, especially if the patient isn't recognized quickly and separated from other people.

"We must continue educating the community, maintaining relationships and building trust within the community to get control of this outbreak," said Kari.

Kari Yacisin heads to a remote village in Guinea to complete a day of contact tracing with her team.

Ambulance chasing is a discouraged practice in the United States—but in Liberia it's exactly what Neil Vora, a CDC responder, had to do as part of his efforts to stop the spread of Ebola at its source.

"We would follow ambulances that were called to pick up patients with suspected Ebola cases. We would keep our distance and observe how they collected patients and would make corrections to any lapse in infection control. As soon as the ambulance left we would start the contact tracing investigation," said Neil. Neil recently returned from a month working in Liberia, during which time he was based in Bomi County, a rural area about two hours away from Liberia's capital.

Rapidly identifying contacts of patients with Ebola is a key component to stopping the spread of the virus. Each patient with Ebola can have 10 or more contacts, all of whom need to be monitored for 21 days. "If you skip just one day, it might be the day the contact comes down with Ebola and a whole new chain of Ebola transmission can start all over again," Neil said.

More than 100 Ebola cases were identified in Bomi County, and while Neil was there, he helped local health officials monitor the hundreds of contacts from all of these Ebola cases.

Neil Vora prepares for the two-and-half hour drive to Bomi County in Liberia.

Several factors contributed to the Ebola epidemic in West Africa, and it has taken a large number of partners and strategies to help get it under control.

Among these factors are health systems that were not prepared for an influx of Ebola cases and that had limited knowledge of the virus and its symptoms. Outbreaks in crowded urban centers also constantly seeded new outbreaks in remote areas. Satish Pillai, a CDC medical officer, was sent to Liberia to help solve some of these problems as part of a RITE (Rapid Isolation and Treatment of Ebola) team.

RITE teams are mobilized to respond to remote villages and towns following reports of Ebola cases by local and county health officials. Their goal: stop the chain of Ebola transmission.

"Cases of Ebola in Liberia were showing up in remote areas. In many instances, someone who contracted Ebola in the capital city of Monrovia brought it back to their community," said Satish. "This led to sustained transmission of the virus that was hard to stop because it was so difficult to reach these communities." RITE teams not only work on active case finding and contact tracing but also identify the basic sanitation and food needs in communities.

"One of the communities we visited was banned from the closest market because of Ebola fears. We called in the World Food Program to help. Another community had broken water pumps and could not access safe water. We found partners that could fix the pump," Satish said.

CDC RITE (Rapid Isolation and Treatment of Ebola) team members would camp in rural communities for several days during their outbreak investigation. This picture shows their office in the field.

Dan Martin, a CDC responder deployed for a month to Sierra Leone, said that the shadow of Ebola was constantly present during his time there. His job involved frequent contact with local health workers as he helped them improve their ability to detect, investigate, and follow up on cases.

“We’re learning in this outbreak that Ebola is not always a death sentence. We’re learning how to care for patients so more people can live through it,” he said. “Getting to people early before they are so sick that they can’t be treated will not only improve survival rates but also prevent the virus from spreading.”

Dan formed friendships from a distance while there. “It’s this very strange juxtaposition where on one hand you are always conscious of not touching people, of not getting too close in a crowd, of constantly sanitizing your hands—and on the other hand you’re living very happy, collegial lives,” he said.

By the time he left, his team of local health workers was prepared to contain clusters of Ebola cases—a job that relies on community cooperation.

“I recently heard from the CDC staffer who replaced me that the team discovered 30 unreported Ebola cases in a single village,” Dan said. “The health official in the village thought Ebola was witchcraft and intentionally kept their outbreak a secret.”

Dan Martin (center) crosses a river in Sierra Leone on a human-powered ferry with colleagues Mohamed Okala Sankoh and James Fornah. One Land Cruiser, one motorcycle, and about a dozen people were pulled across this river.

Kim Lindblade, a CDC epidemiologist, deployed to Liberia to investigate possible Ebola outbreaks in hard-to-reach places. If she saw cases of Ebola, her team would quickly start active case finding and contact tracing to limit spread of the disease.

“Earlier in the epidemic, most Ebola cases were in the densely populated city of Monrovia, but we found as it continued patients would leave and go back to their rural homes, causing outbreaks that were far from Ebola treatment units (ETUs),” Kim said.

CDC worked with ministry of health colleagues to isolate patients with cases of Ebola and arrange their safe transport to the nearest ETU and then track down their contacts.

“Over time, we started hearing about rural outbreaks faster. At the beginning, it could take weeks to hear about the first case, but by the time I left in late December, we were hearing about them within the first few days of illness. This led to outbreaks being resolved quicker, in less than half the time,” she said.

Kim recalls a report of two very sick people who had driven from Monrovia in a car with a patient suspected to have Ebola. When they arrived at the patient’s home, Kim and her team found more than 20 people living in the house.

“It was late in the evening and we had to scramble to buy chlorine and buckets to help them disinfect the home. We worked with the county health team to move the people to a quarantine facility the next day, and 21 days later every one of them left without becoming sick with Ebola,” she said.

Kim Lindblade and her team were dropped off in a football field near Geleyansiesu, Liberia, by a U.S. military helicopter. The remote village had many Ebola-related deaths.

An "Ebola is Real" campaign poster in a Liberian village.

CDC artist's rendering of the Ebola virus. There are five identified Ebola virus species, four of which are known to cause disease in humans.

Ebola by the Numbers

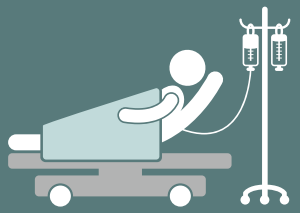
27,000+
Total number of cases

11,000+
Total number of deaths

24,665
Health workers trained by CDC in West Africa

2,471
CDC deployments to West Africa

4
Patients diagnosed with Ebola in the U.S



11
U.S. Patients with Ebola treated in the U.S

650
U.S. healthcare workers trained in Anniston

150,000
U.S. healthcare workers trained by webinars and calls

59,665,191
Number of views for CDC's Ebola website

Lindsey Horton, CDC responder, demonstrates how to clean up infected body fluids at an Ebola treatment unit in Guinea.

Strengthening Health Care and Preventing Infections

Effective infection control can protect communities and the healthcare workers who serve them. Before the Ebola outbreak, infection control in health facilities in Guinea, Liberia, and Sierra Leone was often minimal at best. Fragile healthcare systems added to the rapid spread of the virus and made it difficult to contain the epidemic. In addition, community behaviors needed to change to keep people from getting Ebola when caring for people who were sick or participating in traditional burials. Responders on the ground in West Africa have been working closely with partners and the ministries of health to provide training and health education to reduce the spread of disease. In addition to training, CDC and partners hosted innovative microplanning sessions in Liberia, which focused on early detection and safe isolation of patients, safe burials, and infection control in healthcare settings.

When the first case of Ebola was diagnosed in the United States, CDC worked to tighten infection control procedures. We used the knowledge gained from managing this case to improve preparation of healthcare workers and hospitals around the country.

"We simulated triage of people with unknown Ebola status, putting on and taking off authentic ETU protective equipment, drawing blood from a patient with confirmed Ebola, transporting a body to the morgue, and cleaning up contaminated body fluids"

Kim Newsome, instructor at training course, Anniston, Alabama

The inside of a mock Ebola treatment unit at CDC's training course for healthcare workers in Anniston, Alabama.

The mock Ebola treatment unit (ETU) was a sparse, low-technology space that contrasted sharply with the high technology protective equipment ETU workers must wear every day. Bright yellow suits, orange plastic dividers, hospital cots, and antiseptic sprayers filled the unit, copying every detail of the West African ETUs where volunteer clinicians work. From the hand washing station at the entrance to the station where personal protective equipment is removed, the simulated unit made Kim Newsome feel as if she had been transported to another place.

Kim left a desk job at CDC where data and research drives her day, and the effects of her work are several steps removed. In Anniston, the purpose of her work had a face—the ETU volunteer who would soon be traveling to West Africa. As an instructor, Kim's goal was to provide mock experiences that a real ETU worker might face every day.

During exercises, most trainers met the students in the same way a patient in the ETU would see them—dressed in full protective gear. Staring into the goggled and sometimes anxious eyes of soon-to-be ETU clinicians brought the purpose of their work into sharp focus. The trainers were driven by a common goal of providing lifesaving information for people traveling to West Africa to care for patients there.

A group of students evaluates how to move a "patient" into the mock ETU at CDC's training course in Anniston, Alabama.

Kwan Kew Lai, a graduate of CDC's training course in Anniston, Alabama, served as a doctor with the International Medical Corps in an ETU in Liberia. She knew the work was going to be dangerous, but she also knew her skills were desperately needed.

Each day, Kwan Kew had to use her training, meticulously donning and doffing her PPE, a process that took 15 to 20 minutes each time. Even with temperatures reaching 89°F during training in Alabama, those conditions were nothing like the humid weather the trainees would face in West Africa.

The physical demands, weather, and hot gear worn in the ETU were not the only challenges Kwan Kew faced. It was hard for her to care for patients and encourage them to be hopeful while being encumbered by PPE.

"What makes it even more poignant is that when the patients need close human contact the most, in times of extreme suffering, pain, and fear, there is none to offer except with a barrier of protective covering," she said. "In the beginning, it hit home to me that there was a real possibility of a true exposure; however, as time went on, inspired by the persistence, dedication, and selfless caring of my colleagues, that fear was pushed to the back of my mind and the goal of getting the patients better overwhelmingly became my main concern."

A staff member rests outside an Ebola treatment center.

Channeling the mentality of a scuba diver helped Karen Wong work safely and effectively inside an ETU. Karen was part of the first team deployed to work at the Monrovia Medical Unit in Liberia. “Once you put your personal protective equipment on, your countdown starts in terms of how long you’re able to stay in there comfortably,” she explained. Like a diver underwater, she needed to go into the ETU with a dive plan. “It’s important to figure out what everyone needed to do before entering the ETU,” she added.

Karen did not dive head first into the ETU. “Part of what let me keep going with doing this kind of scary, high risk work was knowing that I had been trained really well in keeping myself safe.” She was one of the 650 healthcare workers who participated in the 3-day training course in Anniston, Alabama, that taught medical professionals about personal protective equipment, how to use it, and how to stay safe as they administered care to patients with Ebola.

“One thing they really focused on during training was our personal safety. If you compromise your safety while treating your first patient, you won’t be able to help the next one,” said Karen.

Karen Wong ready to admit a patient at the Monrovia Medical Unit in Monrovia, Liberia.

When thinking about infection control in Guinea, it's helpful to picture the average health facility in that country. It's usually one to two rooms, it doesn't have electricity or running water, and it's crowded with sick patients.

Heidi Soeters and Lindsey Horton, both CDC responders, implemented an infection control training course for Guinean healthcare workers.

"Our infection control program trains frontline healthcare workers, everyone from doctors and nurses to janitors and ambulance drivers. The training included hands-on exercises in hand washing, triage of patients, putting on protective equipment, and cleaning up contaminated fluids," Lindsey said.

Heidi and Lindsey served as technical advisors for the training sponsor, Catholic Relief Services. Students were recruited from nearby health facilities, but on the first day of training, people came from as far as 25 miles away.

"On the first day of the course, we had 80 students enrolled, but more than 100 more showed up eager to be trained and begging to have a spot in the course. Fortunately, we were able to add more sessions to cover all healthcare workers in three priority regions of Guinea," Lindsey said. "These efforts have the added benefit of being important not just in the context of an Ebola epidemic, but also because they are creating lasting improvements in infection control that should be there for years to come."

Close to 250 people showed up for the first day of Heidi Soeters' and Lindsey Horton's training.

One thing that comes with an outbreak is a need to bury bodies. With Ebola, this cannot be done casually because corpses are the most infectious thing out there. “If you come into contact with the dead body of an Ebola victim, you are very likely to get Ebola yourself. Therefore, people need to be specifically trained on how to bury bodies of people who died from Ebola,” said Leisha Nolen, CDC responder. They are trained how to put on protective suites, masks, goggles, and gloves; how to collect bodies; how to wrap the corpses; and how to bury them. Keep in mind, the people on burial teams usually work on farms or building houses—burying bodies is not their usual job, so all of this is as terrible to them as it would be to you. And it turns out that the obvious part of their job, putting on the equipment and burying the bodies, is not the most difficult part of their job. Instead, it is the part no one expected that is the hardest: the part where the teams have to convince families that taking their loved one to be buried is the right thing to do. In Sierra Leone, washing and burying the dead is an important part of honoring their family.

“Burial teams told me over and over how they had to sit and talk to families for hours before the family would let them take the corpse away for safe burial,” Leisha explained. “And they would sit and talk for hours just to make a family understand why it was helping the whole community to allow their loved one to be buried without the usual ritual.”

A burial team buries an Ebola victim in Sierra Leone.

During the response, John Brooks, lead for CDC's Ebola Response Medical Care Task Force, was responsible for teaching U.S. doctors, nurses, and the general public about how Ebola spreads and how to prevent infection. He and his team led dozens of calls with hospitals on the science behind Ebola and taught them how to evaluate patients reporting symptoms of the virus.

"It was a hectic time. The public had been seized with fear of Ebola, and we were doing our best to manage that fear with science-based information," said John.

"I learned a powerful lesson during my Ebola work, and that is the power of fear. Fear is a natural emotion; it's supposed to protect us from injury or infection. When you see that lion, you run! But too much fear can be a bad thing. It was our responsibility to understand the science behind Ebola and use that to encourage positive action, not panic," he said.

"To understand an epidemic, you often need the 35,000-foot view, looking for trends and patterns," John said. "But you also need to find out what's going on at ground level, what's happening to the people at risk of, and being affected by, the condition you're trying to prevent."

John Brooks was the lead of CDC's Ebola Medical Care Task Force in September–October 2014 and March 2015.

One of the ways CDC helped to prepare U.S. hospitals for a possible patient with Ebola was by sending teams of CDC experts in infection prevention and control, occupational health, and diagnostic laboratory practices—called Rapid Ebola Preparedness (REP) teams—to 81 facilities in 21 states and Washington, DC, to assess their readiness for caring for patients with Ebola. Ron Hall, an Ebola responder based in CDC's National Institute for Occupational Safety and Health, was part of one of these REP teams. He visited U.S. hospitals to evaluate their readiness to safely care for a patient with Ebola. "You're working in hospitals versus a disaster site, but from an occupational safety and health point of view, we're still looking out for the workers, which are healthcare workers," he said.

REP teams were composed of 4 to 10 CDC experts in infection control, occupational health, and laboratory issues, as well as external local experts. According to Ron, "this holistic approach was very important in helping these hospitals achieve what they need to achieve: taking care of patients with Ebola safely and efficiently without getting anyone else sick."

The United States has expanded its network of hospitals prepared and certified to treat Ebola patients, increasing capacity from just three facilities to 55 facilities in 17 states and Washington, DC.

Healthcare workers practice providing care for a patient with Ebola in a mock scenario.

When the first case of Ebola was diagnosed in the United States, and two nurses became infected with the disease, a group at CDC worked quickly to create training on personal protective equipment for healthcare workers in the United States.

CDC worked with a diverse group of partners to provide Ebola infection control training to U.S. healthcare workers through a multifaceted approach. CDC and partners worked together to provide U.S. healthcare workers with the information they needed through web-based tools, daily calls, mobile-friendly training applications, live training events, and in-depth clinical trainings by experts at Emory University Hospital and Nebraska Medical Center. With strategic partners, CDC was able to reach more than 150,000 healthcare workers.

CDC also partnered with Partnership for Quality Care and healthcare unions to conduct live training events in New York City, Los Angeles, and Philadelphia, reaching more than 6,500 people in-person, and more than 20,000 via live webcast. Additionally, CDC, Emory University Hospital, and Nebraska Medical Center trained more than 460 healthcare workers from 87 healthcare systems, including 37 new Ebola treatment centers, on all aspects of infection control and care for patients with Ebola.

Brian Christiansen, CDC Infection Control Team (left), at an Ebola educational session or healthcare workers at the Jacob Javits Center in New York in October 2014.

CDC microbiologist James Graziano and virologist Johanna Salazar test blood samples for Ebola at CDC's lab in Bo, Sierra Leone.

Mobilizing Laboratories

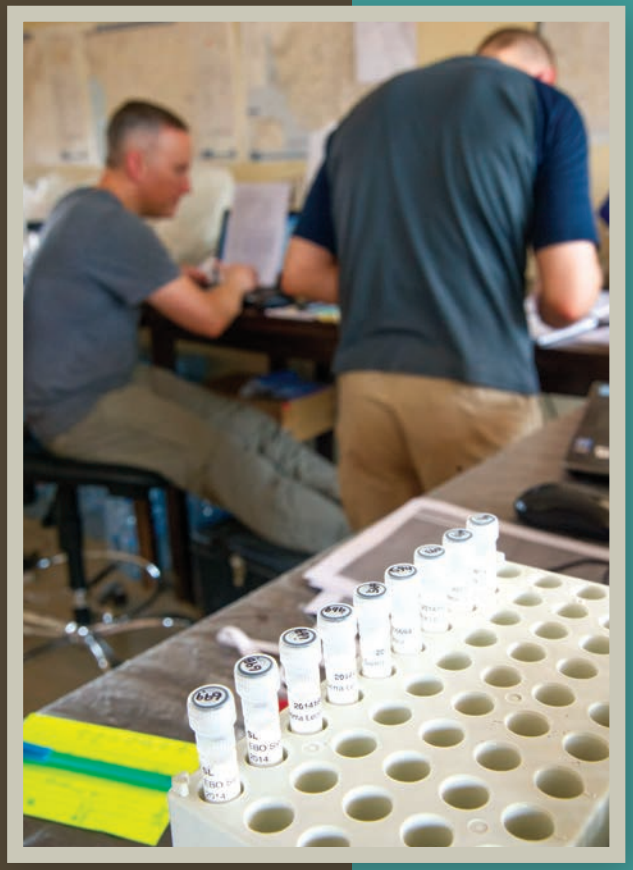
Laboratories, and the Ebola testing they perform, play a crucial role in responding to Ebola both in West Africa and in the United States. The results of each Ebola test can be life-changing for patients. A negative test result might mean release from a hospital or Ebola treatment unit (ETU) after a long illness for a survivor, or peace of mind for a person who might be worried they have Ebola. A positive test result could mean life-saving admittance to an ETU and information for loved ones and contact tracers to better understand and reduce risks of new potential Ebola cases. An effective lab infrastructure, therefore, is essential for countries to rapidly detect and contain Ebola cases.

When lab responders arrived in Liberia and Sierra Leone, they identified a need for labs and quickly set up mobile labs in both countries. CDC runs a lab in Bo, Sierra Leone, jointly ran another lab in Liberia with the National Institutes of Health, and supports labs in Liberia with the U.S. Department of Defense. CDC's Bo lab processed more than 2,000 samples in a 3-week period and has now processed more than 20,000 samples. In addition, CDC supports labs in Guinea, Liberia, and Sierra Leone by providing training, testing equipment, and supplies, as well as overseeing the transition of labs to ministries of health.

In the United States, CDC has increased the number of labs that are able to test for Ebola. Prior to this outbreak, Ebola could only be confirmed at the CDC lab in Atlanta, Georgia, or the lab at the U.S. Army Medical Research Institute of Infectious Diseases. Now, 56 Laboratory Response Network labs across the country are able to test for Ebola, more than quadrupling capacity and vastly decreasing the turnaround time for test results.

"During our first days there, I went out to get samples from a person on a motorbike. He was very anxious because his whole district was worried about the result, which ended up positive, and we learned the next day that the patient had died. It brought home to me that what we were doing has life or death impacts."

Brandy Russell, Ebola responder, Sierra Leone



Staff process data from specimen results at the CDC lab in Bo, Sierra Leone.

CDC tries to set up labs close to treatment centers. “Usually Ebola treatment units are run by Doctors Without Borders (MSF),” said Ute Stroeher, a CDC laboratorian.

CDC epidemiologists who lead contact tracing teams often find people who have been exposed to patients with Ebola. If those people develop Ebola symptoms during their 21-day monitoring period, such as a fever, they are brought back to the treatment centers where healthcare workers wearing personal protective equipment carefully take a blood sample and send it to the lab. Early and accurate testing is critical. If the sample tests negative, the patient is referred to a non-Ebola clinic for diagnosis and treatment and for follow-up testing if indicated. If the sample tests positive, the patient is isolated in a treatment center.

That isn’t the end of the lab’s contribution to helping patients with Ebola, though. Patients who survive Ebola must eventually leave the treatment center. That happens only when their bodies have cleared the virus and the lab test comes back negative.

“We had a very little girl, about a year and a half old, who got Ebola from her mother. We don’t have many kids that small survive—and this child was so ill everyone thought she wouldn’t make it,” said Ute. “But she pulled through. And finally, I had a negative test for her and she could leave the treatment center. That made my day.”

CDC staff spray a bleach solution on paperwork received from a rural health post at CDC’s lab in Bo, Sierra Leone.

In August 2014, CDC microbiologist Barry Fields was deployed to Liberia to help set up a new mobile lab in Monrovia in collaboration with the National Institutes of Health (NIH). Setting up a molecular diagnostics lab in the field without utilities or infrastructure is quite a challenge.

When Barry's team arrived in Monrovia, they realized very quickly that the outbreak had reached settlements in the city. A lab was critically needed in Monrovia to deal with these cases. The CDC-NIH team worked quickly to establish a mobile lab in close proximity to the ETU set up on the grounds of the Eternal Love Winning Africa (ELWA) Hospital.

Although Barry has worked in many outbreak investigations, the situation in Liberia was particularly challenging for him. One of his greatest concerns was how close the lab was to the ETU and the many patients walking back and forth. This foot traffic posed contamination risks for him and his team. According to Barry, having a team in which all members had international experience and knew how to work in an emergency situation with limited resources made a huge difference. Because of their collective experience, they were able to quickly adjust and set up more than 700 pounds of lab equipment that had been shipped to Liberia by CDC-Kenya.

Because of the heavy rains at that time in Monrovia, the mobile labs were eventually moved to a house formerly occupied by Samaritan's Purse on the ELWA grounds. According to Barry, this facility is ideal, especially when compared to the tent they were in before.

The initial mobile lab set up by CDC and the National Institutes of Health in Monrovia, Liberia.

In West Africa, lab samples can arrive by many different methods—motorbike, couriers, helicopters—and too often the lack of transportation makes it difficult to get the samples to the lab quickly.

John Saindon, a CDC laboratorian deployed to Liberia, worked with U.S. government partners to improve the alignment of U.S. government labs with the country's ETUs. They reduced the amount of time it took to get test results from 5 to 7 days to less than 24 hours, simply by reducing the amount of time it took for samples to reach the labs.

Sometimes it wasn't just about how quickly the samples reached the lab, but the state they were in when they got there. "The samples arrived in all different types of containers and weren't always labeled well," said Brian Bird, a CDC laboratorian deployed to Sierra Leone. "We had samples in coffee pots and glass jars. It was quite a challenge."

Despite the challenges of working in and supporting the field labs in West Africa, both Brian and John found the experience to be rewarding.

"When we were in Kenema, one of the highlights of my public health career was when we discharged 12 to 14 children all at one time," said Brian. "They were so full of life. It was like looking at the future of Sierra Leone after it had come through such a horrible tragedy, but there it was looking you right in the face."

John Saindon with members of the U.S. Army identifying Ebola lab sites in Greenville, Liberia.

Lab Team 5 in Bo, Sierra Leone—the first and only all-woman team to run an Ebola testing lab in the heart of the epidemic—set records for the most Ebola samples processed in one day (162), the most samples tested in 21 days (2,012), and the most samples tested in 28 days (about 2,700).

Like the previous four teams deployed to test blood samples for Ebola, Lab Team 5 was a group of highly trained lab technicians with extensive experience handling deadly pathogens in high security BSL-4 labs. They were prepared to work with Ebola under challenging circumstances during the most dangerous step in the testing process—removing potentially infected blood from a vial and inactivating it so that it could be safely tested in later steps.

Samples came to the CDC lab from eight different districts. To overcome frustrating delays in delivery from remote forested regions, the team completed plans to have samples carried to Bo by U.N. helicopter. A constant stream of samples arrived by UN helicopter, ambulance, taxi, motorcycle, and also by hand from the Doctors Without Borders Ebola (MSF) treatment unit adjacent to the lab.

While the team worked in harsh conditions, often with unreliable electricity, the best times were evenings when they would hear the community drumming from outside the nearby ETU.

“One of the doctors told us that was what families did when they celebrated the release of an Ebola survivor. We were doing their testing, and whether they could be released depended on us,” said Angela Sanchez.

Team 5 member Aridth Gibbons in the Bo lab, Sierra Leone.

CDC responder Karlyn Beer (left) and local officials look across a river that acts as a border between Liberia and Côte d'Ivoire. The power lines show how electricity is generated in Côte d'Ivoire and carried across to Liberia.

Protecting Borders

A disease threat anywhere is a disease threat everywhere, and the Ebola epidemic has shown how easily infectious diseases can cross borders—land, rivers, and even oceans. From the start of the epidemic, porous country borders among the three West African countries and a highly mobile population aided the rapid spread of Ebola from its origin in Guinea. In West Africa, border control measures are mostly nonexistent—getting to another country is often as simple as taking a boat across a river. This makes it easy for a disease like Ebola to spread across countries and it complicates contact tracing.

In West Africa, CDC works with airlines, airports, ministries of health, and other partners to provide technical assistance for conducting exit screening and travel restriction in countries with Ebola. Exit screening helps to identify travelers who may have symptoms of Ebola, or who have been exposed to Ebola, to prevent them from leaving a country until it is confirmed they are not sick.

Once travelers land in the United States, more measures are in place to protect the public. CDC works closely with partners at major U.S. ports of entry to recognize signs of infectious disease in travelers. Since October 2014, CDC has been working with CBP to identify travelers who could have been exposed while in West Africa and conduct enhanced entry screening at five U.S. airports. CDC has similarly been working with the states, providing information and guidance, so that they can monitor these travelers once they arrive at their destinations. Screening and monitoring not only protects the health of these travelers but also reduces the chances of them spreading Ebola to others.

To protect borders, CDC advises travelers about health threats, writes messages for airport message boards and signs, develops guidance for airlines and other partners, and trains customs agents and airport Emergency Medical Services personnel to identify symptoms of Ebola in travelers coming to the United States from countries with outbreaks. We also develop materials and training to screen travelers leaving countries with Ebola.

Health screening at the Conakry Maritime Port in Guinea.

Small boats regularly cross the river that divides the countries of Guinea and Sierra Leone, taking people back and forth across the border.

Along this river bank, CDC responder Rupa Narra taught infection control to Guinean medical workers who were screening boat passengers for symptoms of Ebola.

“They had two physicians, a nurse, and a couple other people working in a tiny health post made out of a tarp. The staff was really welcoming and happy to have the training.”

Before becoming an officer in CDC’s Epidemic Intelligence Service, Rupa worked for Doctors Without Borders (MSF). During her deployment, she struggled with not having a role in direct patient care, especially when Ebola patient admissions tripled at the MSF facility adjacent to her office during her 30-day trip.

“Seeing how stretched thin they were with human resources was the most devastating, helpless, heartbreaking feeling possible,” she said. But she found a way to help by educating MSF nurses about infection control. “It really opened up some new roles for us in the field and showed us some other needs that were different from surveillance and data entry.”

Rupa also spent time in Conakry, the capital of Guinea, working with their Ebola data system and on contact tracing activities. “Ebola was the talk of the town,” she said. “You couldn’t go through 10 minutes of your day without hearing local people speaking about Ebola and what is going on. Everyone’s lives have changed.”

Rupa Narra (second from right), provides an infection control lesson to healthcare workers staffing a health inspection station at the border of Guinea.

When Blanche Collins arrived as the newest addition to CDC's Border Health Team in Sierra Leone, she quickly dove in to help ensure that exit screening was being performed properly at Lungi International Airport. Since August 2014, CDC staff have partnered with airports, airlines, and others to help with exit screening and border health issues in countries with Ebola outbreaks. The screening—which includes temperature checks and looking closely for signs of illness—is designed to reduce spread of Ebola by preventing people who have symptoms or exposures from traveling.

Blanche helped the Lungi airport team check and evaluate travelers leaving Sierra Leone. During a typical day at the airport, she would check health declaration forms or ensure the quality of standard operations, such as checking temperatures or providing chlorinated water for hand washing. Then at night, she would watch exit screening of passengers before their flight departed.

She also had a chance to see the country, traveling to border crossings between Sierra Leone and Guinea to train CDC partners. She taught them how to use noncontact thermometers for screening arriving travelers and how to put on and take off personal protective equipment. Her duties took her to seaports as well, leading training sessions.

Blanche said that her month in Sierra Leone was one of the best experiences of her career. "The moment we became involved in this response, I knew I wanted to go to West Africa to contribute." And after she came home, she knew she wanted to go back.

Health officials at the airport in Lungi, Sierra Leone.

Karen Wong, a CDC medical officer, deployed to Liberia in 2014 to work in the Monrovia Medical Unit for two months.

"Since I treated patients with Ebola, I was required to do direct active monitoring for 21 days when I returned to the U.S.," said Karen. "When I returned, staff at the airport took my temperature, asked questions about my exposure to Ebola and symptoms, and provided me with a CARE (Check and Report Ebola) Kit."

The CARE Kit contains information about Ebola, tools to check and track temperature and symptoms for 21 days, and information on whom to contact.

Direct active monitoring requires a public health worker to observe Ebola response workers at least once every day to see if they have a fever or other symptoms. This direct active monitoring can be done in-person or via video chat for 21 days. "A colleague of mine, who is a public health worker, was responsible for observing me. Sometimes we met in-person, but other times I took my temperature while I video chatted with her," said Karen. "It was very easy to do and important for keeping everyone safe."

"Although I had gotten a flu shot earlier, taking my temperature every day and seeing a normal reading was reassuring," said Karen. The flu has some symptoms similar to those of Ebola, and if Karen had any flu symptoms, she would have needed a medical evaluation and possibly Ebola testing. She was relieved when she was confirmed Ebola-free at the end of 21 days. "I went out with friends to celebrate completing my monitoring—it was a good day."

A digital thermometer is included in the Ebola CARE Kit for travelers to monitor themselves for fever.

Derek Sakris was working at Chicago's O'Hare International Airport in late 2014 when an officer from Customs and Border Protection (CBP) told him that a traveler who had been screened the previous day was back and needed assistance. The traveler was David Johnson, a native of Liberia and now a U.S. citizen who had just returned to the United States from West Africa. He had been searching for family members who were separated in wartime. His hopes were realized when he located his brothers and sisters in Sierra Leone.

David returned penniless, only to find that his landlord had moved his belongings out of his rented apartment. Friends refused to house him because they feared he might have Ebola. He hadn't eaten for two days. With nowhere else to turn, David spent the night at the airport.

When Derek heard about the stranded traveler's plight, he mobilized resources. He contacted partner agencies to secure life necessities for David. CBP officers bought him food and the Chicago Department of Public Health and American Red Cross provided lodging and meal vouchers for David during his 21-day active monitoring period.

To provide for his long-term needs, CBP enlisted Travelers Aid Chicago. The social service program helps travelers in crisis, offering social and emotional support. A case manager helped David find a job and long-term housing.

"In public health work, it is rare that you get to observe someone getting immediate help like this. You don't always witness the impact of your help, but this was one of those nice occurrences," Derek said.

CBP officer Pila and Chicago Quarantine Station officer Derek Sakris with traveler David Johnson.

How CDC is Protecting our Borders

Exit Screening in West Africa

CDC works with airlines, airports, ministries of health, and other partners in West Africa to provide assistance for conducting exit screening and travel restriction in countries with Ebola transmission. Exit screening efforts in West Africa help identify travelers who may have symptoms consistent with Ebola or who have been exposed to Ebola, to prevent them from leaving a country until it is confirmed that they are not sick with Ebola and are therefore not at risk of spreading Ebola. CDC believes that screening outbound passengers in West Africa is one of the most highly effective measures for preventing the spread of Ebola.

Ebola information in the Conakry, Guinea airport. This video features CDC Ebola expert, Dr. Pierre Rollin.

Entry Screening in the United States

All air travelers entering the United States who have been in Guinea, Liberia, or Sierra Leone are being routed through five U.S. airports (New York's JFK International, Washington-Dulles, Newark, Chicago-O'Hare, and Atlanta) for entry screening.

- Entry screening helps to prevent further spread of Ebola and protect the health of all Americans by identifying travelers who may be sick with Ebola or may have had an exposure to Ebola and by ensuring that these travelers are directed to appropriate care.
- These inbound travelers receive Check and Report Ebola (CARE) Kits that contain further information about Ebola. This kit includes information about Ebola, tools to help travelers check their temperature and symptoms each day for 21 days, and information about who to call if they have symptoms.

Active Monitoring

The purpose of active monitoring is to ensure that a person's health is closely followed by public health authorities so that, if symptoms develop, action can be taken immediately to isolate the person from others and arrange for medical evaluation. People who have been in a country with widespread transmission are actively monitored.

Active monitoring means that the state or local public health authority checks daily with the traveler to see if he or she has symptoms and fever. The traveler reports daily on temperature and symptoms consistent with Ebola (including severe headache, fatigue, muscle pain, weakness, diarrhea, vomiting, abdominal pain, or unexplained bleeding).

Screening by the Numbers*

18,672
Travelers who entered the U.S. from Guinea, Liberia, and Sierra Leone

3,797
Guinea

9,576
Liberia

4,413
Sierra Leone

13,304
CARE kits distributed

12,300
CARE phones distributed

203,453
Travelers screened when leaving a country with widespread transmission

122,931
Guinea

35,685
Liberia

44,834
Sierra Leone

150
Travelers denied boarding in countries with widespread transmission

*10/11/2014 – 5/30/2015

A family under voluntary quarantine in the Kaffu Bullom community of Port Loko, Sierra Leone, looks on as Soriba Suma, a CDC responder, uses pictures to teach them about Ebola and safe practices.

Communicating & Educating

In an emergency response, communication is often the first line of defense. Fighting disease becomes less stressful when communities understand what they can do, when journalists report accurate information quickly, and when officials know how to communicate effectively. During a disease outbreak, communication strategies provide the essential bridge between science and the public—creating audience-tailored products, spreading accurate information through the best channels, fighting rumors and stigma, and ensuring the response respects a community's needs.

During a large-scale epidemic like Ebola, scientists aren't the only experts needed to help stem the spread of disease. CDC also sends teams of experts in communication, education, anthropology, and behavioral science to help communities with low technology access get the information they need to protect themselves—through radio, posters and billboards, and face-to-face visits.

"It was clear to me that Ebola had changed everyday life for Liberians. Hugs and handshakes, common greetings in Liberia, were too risky because of Ebola. Soccer teams wouldn't meet for practice. Fresh fruits and vegetables weren't being brought into Liberia from neighboring countries. The efforts to confine the virus also confined so many aspects of everyday life."

Karlyn Beer, Ebola responder, Liberia

"Ebola is real: Let's stop the sprea[d] of Ebola." This banner was displayed on the vehicle of the zonal head for the Kings Gray community near ELWA hospital in Monrovia, Liberia.

Ebola talk was everywhere. At church, where parishioners heard sermons about communicable diseases, they also heard about Ebola. Talk was on the radio and music television, where performers sang songs about the deadly virus. It was visible outside Ebola treatment units where patients were sometimes turned away because of a lack of beds.

Erik Reaves, a CDC responder deployed to Liberia, says many of his Liberian colleagues had family members or friends who had died or were sick, and at times they would break down and cry. “They’re just trying to do what they can to keep pushing forward and help the response, but it was taking an emotional toll on them,” he said.

Erik and his team worked with local health officers to identify their technical capabilities, and evaluated their ability to respond to and monitor cases. He helped them get ready to transition from written records to tablets and smartphones, a program funded by the CDC Foundation to support timelier reporting of cases.

Educational messages on Ebola are delivered in unique ways in Liberia. Here, a mural shows symptoms of Ebola.

When Monique Tuyisenge-Onyegbula arrived in West Africa, she brought more than the standard trunkful of CDC-issued gear and personal protective equipment.

“What I brought was my technical skills and my understanding of the culture and customs,” said Monique, who was born in Michigan but raised in Rwanda. To add to that unique mix of cultures, she is now married to a Nigerian. She has lived and worked in several African nations. In addition to English, she speaks Kinyarwanda (common to Rwanda and Burundi), Swahili, and French.

Monique is quick to point out there is no single “African culture”—it’s a big continent of many nations and people.

“But we do share things in common, such as the proper way to address elders or our difficulty remembering to avoid touching others during an Ebola outbreak—touching is a big thing in Africa,” she said. “I don’t have to think about these things because I am an African, an insider. I am received not as ‘they are coming to help us,’ but as ‘we are helping ourselves.’”

Monique said that is what is important: working with youth, local people, and community leaders to spread the message. “We from CDC can’t reach all these people, so must rely on the volunteers in the communities to spread the awareness. We train as many as we can, giving anyone and everyone the skill and knowledge to educate others on preventive measures.”

Guinea Red Cross volunteers travel door-to-door sharing information about Ebola.

In the Kroo Bay Slum in Sierra Leone, life expectancy was 35 years—and then Ebola hit. In that neighborhood, Nicole Hawk, a CDC communication expert, saw what she was up against.

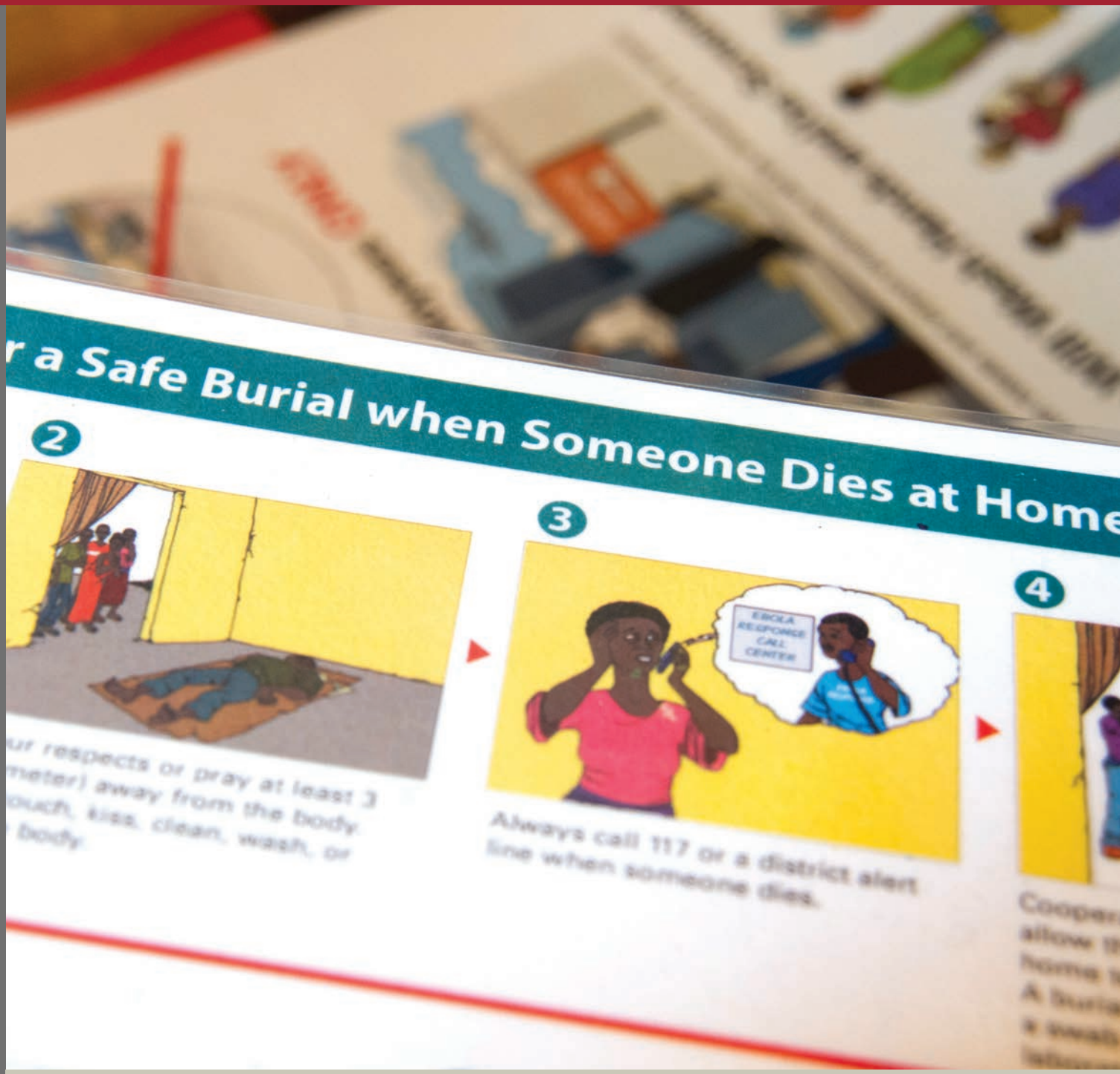
"People are living on top of each other, lacking basic sanitation and medical care. It was really eye-opening. It's vital that we do what we can to stop this outbreak," she said.

For a month, Nicole helped craft and distribute Ebola-prevention messages for the general population in Freetown, Sierra Leone. During her deployment, the team began to shift its messaging from the basic "Ebola is real" to steps people can take to protect themselves and their families from the virus.

The visit to the slum highlighted how hard those messages are to follow.

"Washing your hands isn't easy when you don't have regular access to clean water. Quarantining someone in a separate room isn't easy when an entire family lives in one room, and getting help isn't easy when ambulances can't get in because of a lack of roads," Nicole said. "It really made me realize just how critical it is that we be on the ground trying to stop the virus."

Nicole said her work has never been so important or gratifying. "I felt like the work we were doing was having a direct impact on saving lives."



Materials developed at CDC headquarters in Atlanta, Georgia, are being used in Sierra Leone to educate people in villages.

When Kelsey Mirkovic deployed to Guinea, she quickly saw one of the reasons Ebola had managed to spread so easily through three West African nations. Families often live on both sides of the shallow, narrow river that divides Guinea from Sierra Leone and Liberia. People can easily shout across the muddy stream, and boatmen readily ferry travelers from one nation to the next. If people can cross freely, so can Ebola.

Armed with her "intermediate" French, Kelsey visited area villages. Although the nation's official language was French, sometimes only one person in a village might speak it, so she worked with that person to translate important health messages into the local language. In this manner, she worked to gain the confidence of village leaders and to train community health workers to spread the word about how to avoid getting—and stop spreading—Ebola.

Kelsey's team trained them to follow up with anyone who was exposed to patients with Ebola, checking on them every day for three weeks. Every day, except Sunday, the workers would report their findings to a supervisor.

"One day, the community workers reported that a person with Ebola symptoms had refused to go to into isolation at the treatment center," Kelsey says. "It was a Monday, so the report was two days old. Worried, I met with the village chief, who pressured the person to go to the center."

Out of that one meeting, many lives were saved. The grateful village chief presented Kelsey with a symbolic gift of cocoa pods and a coffee plant. For her, the gift symbolized not how much she gave, but how much she received.

A river dividing Guinea and Liberia shows how easily people can travel from one country to the other.

A common sight in Liberia during the rainy season, two trucks are stuck in mud, causing a traffic jam that forced CDC responder Karlyn Beer to sleep in her car overnight.

Overcoming Challenges

The Ebola epidemic, larger and more widespread than any previous Ebola outbreak, has caused public health responders to face new and challenging obstacles—from hard-to-reach places and impassable roads to personal protective gear, transportation, and laboratory needs. A global health crisis always generates new ideas and bold solutions to problems that surface during an outbreak response. Every day, responders come up with innovative ways to handle the unexpected challenges in this Ebola epidemic. In the past year, CDC responders have found themselves conducting trainings by flashlight, reconstructing bridges to get to remote villages, and finding other workarounds when resources were scarce. CDC and other organizations have also started work on better tools to battle Ebola in the future, through vaccine trials, new uses for technologies, development of rapid diagnostics, and partnerships.

"…Creativity is possibly just as valuable as all the hard facts and materials. When there is no money, people are working beyond exhaustion and options are limited, thinking creatively can be the thing to pull you through."

Leisha Nolen, Ebola responder, Sierra Leone

Contact tracer Dorissa Bestman uses a tablet to follow up on her daily contacts in the New Cru Town section of Monrovia, Liberia. A trial program conducted by CDC partner eHealth Africa in Liberia is using technology to load and store data where pencil and paper is the standard.

Healthcare workers in West Africa report that some personnel are able to wear their PPE for only 40 minutes at a time because of high temperatures and humid conditions. Even in the United States, where management of patients with Ebola is done in air-conditioned environments, uncomfortable PPE is a common complaint and causes a burden for healthcare workers.

In September 2014, President Obama announced a "Grand Challenge" to design improved PPE for use by healthcare workers during treatment of Ebola patients. CDC's National Institute for Occupational Safety and Health (NIOSH) is partnering with other U.S. agencies on the "Fighting Ebola: A Grand Challenge for Development" to help healthcare workers on the front lines provide better care and stop the spread of Ebola. The USAID-led Grand Challenge includes developing, testing, and improving PPE to address issues of protection, heat stress, and comfort for healthcare workers.

NIOSH conducts research that supports the epidemic response and the Grand Challenge and is working closely with federal partners on the Grand Challenge, including (but not limited to) participating in crowdsourcing events to promote innovation, reviewing promising ideas that can be scaled to the field, and setting performance, test, and evaluation requirements.

A NIOSH sweating thermal manikin with the PPE ensemble commonly used by Doctors Without Borders (MSF) for high exposure areas.

Soon after CDC responder José Hagan arrived in Liberia, his team learned of rampant Ebola outbreaks in remote parts of the country. Hours later he found himself trekking miles into the jungle.

José described coming across grave after grave along the path as they approached a village. “When we finally got to the village, it was deserted. People were hiding in the forest or had fled to neighboring villages, taking the virus with them.”

José and his colleagues immediately started contact tracing. “We quickly learned that contact tracing wouldn’t work here. There were dozens of unknown Ebola contacts scattered across the dense forest and there was no cellphone signal to coordinate teams. Villages were connected only by narrow forest trails that were unreachable even by motorbike.”

José and his team set up a system based on a traditional method of communication used in these villages for hundreds of years.

“We worked with the village chiefs in the surrounding area to identify trusted members of their community who would be responsible for asking every villager how they were feeling each day. They would have a runner, usually a child, sprint the information back to the central village, which then connected every day with the district health team to pass on the information.”

As Ebola cases were found, José helped set up an isolation area and brought in Doctors Without Borders (MSF) to treat patients.

José Hagan (second from left) and his World Health Organization and County Health Department colleagues stand on a bridge they had to reconstruct to communicate with nearby villages.

Teams responding to the Ebola outbreak in West Africa often face the challenge of finding people and communities living in remote areas. Maps of these regions often do not exist, aren't correct, or are outdated. Basic information—location of houses, buildings, villages, and roads—is not easily accessible, making contact tracing extremely difficult.

To help the response effort, volunteers from around the world are using an open-source online mapping platform, called OpenStreetMap (OSM), to create detailed maps of Guinea, Sierra Leone, Liberia, and parts of Mali.

OSM's goal is to make a free map of the world available to everyone. The Humanitarian OpenStreetMap Team (HOT) is a U.S.-based, non-profit organization that uses OSM data and tools to prepare and respond to humanitarian disasters. Because OSM data can be downloaded for free, volunteer mappers generate data that are useful to CDC and other agencies involved in the Ebola response. CDC is supporting and promoting volunteer mapping in affected West African areas where CDC teams work.

In the eight months since HOT began mapping countries with Ebola outbreaks, more than 2,500 volunteers mapped more than 750,000 buildings and hundreds of kilometers of roads, resulting in detailed maps of affected West African communities. Not only do these maps help first responders and other organizations around the world, they also contribute to the national information infrastructure essential to the recovery and rebuilding of affected regions.

CDC responders Yoshinori Nakazawa and Jessica Hancock Allen used OpenStreetMap data on a tablet computer to help navigate to this small village between Kambia town and Kabaia in Kambia District, Sierra Leone.

CDC is conducting the Sierra Leone Trial to Introduce a Vaccine against Ebola (STRIVE), in collaboration with the Sierra Leone College of Medicine and Allied Health Sciences and the country's Ministry of Health and Sanitation.

The vaccine trial, which launched in April 2015, is testing an Ebola vaccine among more than 8,000 health and other frontline workers in five districts of Sierra Leone that have been heavily affected by the outbreak.

The vaccine used in the trial, called rVSV-ZEBOV, cannot cause Ebola but can potentially stimulate an immune response to protect against the disease. The vaccine was developed by the Public Health Agency of Canada's National Microbiology Laboratory and licensed to NewLink Genetics. The vaccine has been studied in hundreds of people in Africa, Canada, Europe, and the United States. Early studies have shown that the rVSV-ZEBOV candidate vaccine produces an immune response.

While it's not clear yet whether the vaccine will be the Ebola prevention tool public health officials (and the world) are so eager for, the results of the trial may still help to save lives in the current and future Ebola outbreaks. The study will also strengthen research in Sierra Leone's institutions by providing training and research experience to hundreds of Sierra Leonean staff. Much of this work will live on for the future, such as renovating structures and building new ones to enroll and vaccinate participants, handle data management, and store the vaccine.

Nurses at a vaccination site in Freetown, Sierra Leone, sign for chain of custody for the Ebola vaccine.

Ebola survivor, Ruth, celebrates as she is released from the Ebola treatment unit.

Moving Forward

The West African Ebola epidemic is a vivid reminder that even in the 21st Century, disease can still threaten not only people's health, but also the very foundations of national and international economies.

The Ebola response has been the largest international outbreak response in CDC's history. Thousands of highly trained public health professionals, in Africa and the United States, have helped stop the epidemic in Liberia and are working to stop it in Guinea and Sierra Leone. CDC continues alongside many national and international partners in West Africa work toward the goal of zero new cases in the affected countries and to strengthen vigilance throughout the region.

When that day comes, West Africa will have many systems and resources that it did not have before—emergency operations centers, laboratories, stronger surveillance systems, vaccine trials, and CDC country offices. But just as people and their expert knowledge and skills made the difference in curbing the epidemic, people hold the key to securing national and global health in the future.

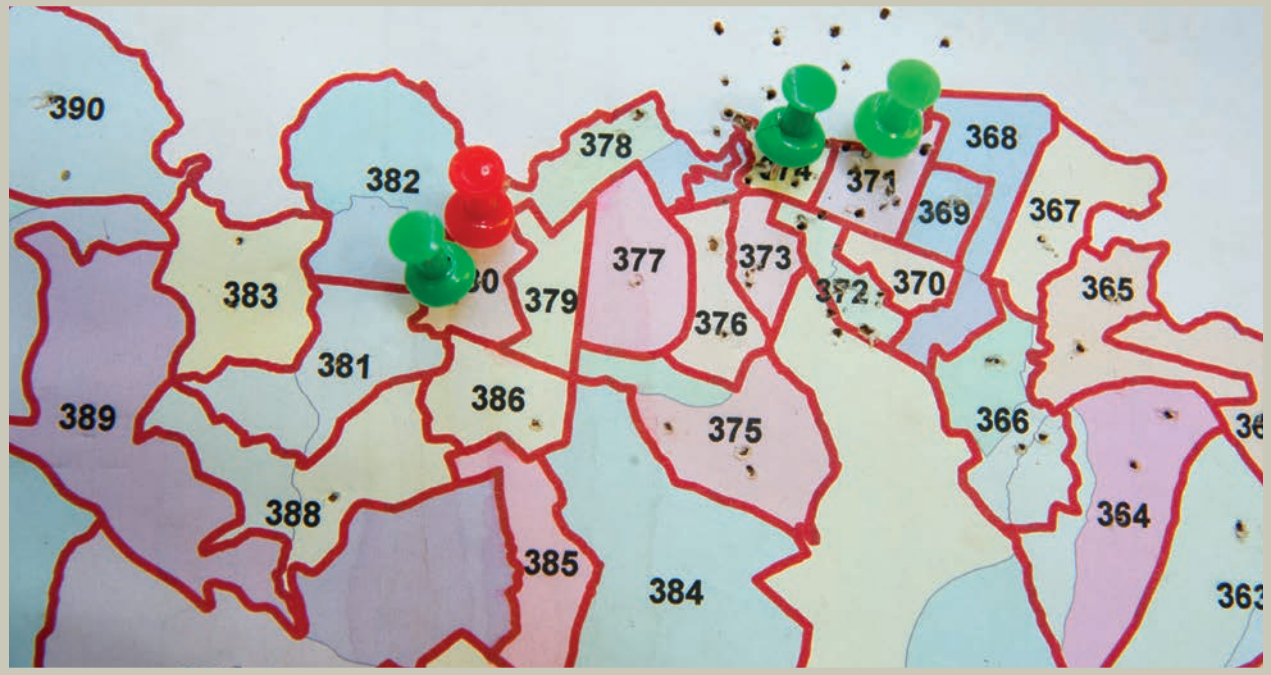
Having enough trained healthcare and public health professionals in the countries where infectious disease risks are greatest is the world's strongest defense to prevent, detect, and respond to threats as soon as they occur.

Getting to zero for the first time in Liberia demanded a massive, worldwide response. Yet, the situation in Liberia also shows how difficult it is to stay at zero cases. There is a need for continued vigilance and the same kind of ongoing intensity and commitment to protect not only the residents of countries where outbreaks will occur, but also their neighbors around the world.

"We've made great progress, but we can't let down our guard. There will continue to be cases and clusters of Ebola, but an epidemic of the kind we've had for the past year never has to happen again."

Dr. Tom Frieden, CDC Director, June 30, 2015

Dr. Tom Frieden speaks to a patient from the family visitor area at the Bong Ebola treatment unit in Liberia.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KNOW THE FACTS!
PREVENT
YOURSELF FROM
EBOLA VIRUS
IT QUICKLY KILLS
ALWAYS WASH YOUR HANDS
Symptoms
Fever
Intense Weakness
Muscle pain
Headache
Sore throat
Vomiting
Diarrhea
Rash
Impaired kidney & liver function
Internal & external bleeding
Preventions
Avoid phytical contact with Ebola patients
Wash your hands regularly
Cook all anima food by-products thoroughly
Avoid contact with fruit bats, MONKeys & other primates
Handle animals with gloves & protective clothing
Use gloves when taking care of infected patients
Avoid contact & do not touch those who have DIED from EBOLA
Take The Lead In Your Institution
As I Take The Lead In My Institution,
Let's Fight EBOLA: A Message From: Madam
Ellen Johnson Sirleaf~ President Of
The Republic Of Liberia...
A CALL FOR SUPPORT TO: YAVIL Ebola Campaign

URBAN
70 MORCEAUX DE SAVON
DIAMA
SAVON

PHOTO CAPTIONS

Top row, left-to-right

Training in Guinea can be challenging because of the mix of languages used across the country. This class of midwives and cleaners from Macenta were trained in the Malinke language since they do not speak French, the official language of Guinea.

A map at the District Emergency Response Center in Freetown, Sierra Leone, show the locations of recent Ebola cases. The response center houses the 117 call center for such cases.

Infection control supervisor Simone Loua (left) reinforces proper hand washing techniques during a field supervision visit to a small clinic in N'Zérékoré, Guinea.

Bottom row, left-to-right

Health promotion is a key part of preventing infection in healthcare settings and in the community. A poster in Liberia shows facts about Ebola and how to prevent it.

CDC responder Alex Alvarez monitors the transportation of soap as part of a program to reduce resistance in Guinea. Within two weeks of the program's start, reports showed resistance was tangibly reduced.

CDC responder Soriba Suma uses materials developed by CDC to educate quarantined families about Ebola in the community of Kaffu Bullom, Sierra Leone.

Blood sample tubes at the CDC lab in Bo, Sierra Leone.

CDC's Response to Ebola: March 2014 – July 2015

Early reports of Ebola virus disease from Guinea, CDC field team deployed

Spread to Liberia and Sierra Leone

CDC Emergency Operations Center activated, CDC deployments surge

Spread to Nigeria and Senegal, CDC teams help stop the outbreak

CDC issues Level 3 Travel Warnings for West Africa

CDC laboratory established in Sierra Leone

CDC expands Ebola testing among US labs

Dr. Frieden travels to Guinea, Liberia, and Sierra Leone

Traveler with Ebola comes to US (Dallas), 2 nurses infected

Microplanning workshops with county leaders held in Liberia

CDC organizes healthcare worker safety course in Anniston, Alabama for West Africa volunteers

CDC implements enhanced screening at airports, new tracking program for people coming from countries with Ebola outbreaks

Rapid Isolation and Treatment of Ebola (RITE) teams help rapidly control new outbreaks in Liberia

CDC works with states to improve hospital readiness

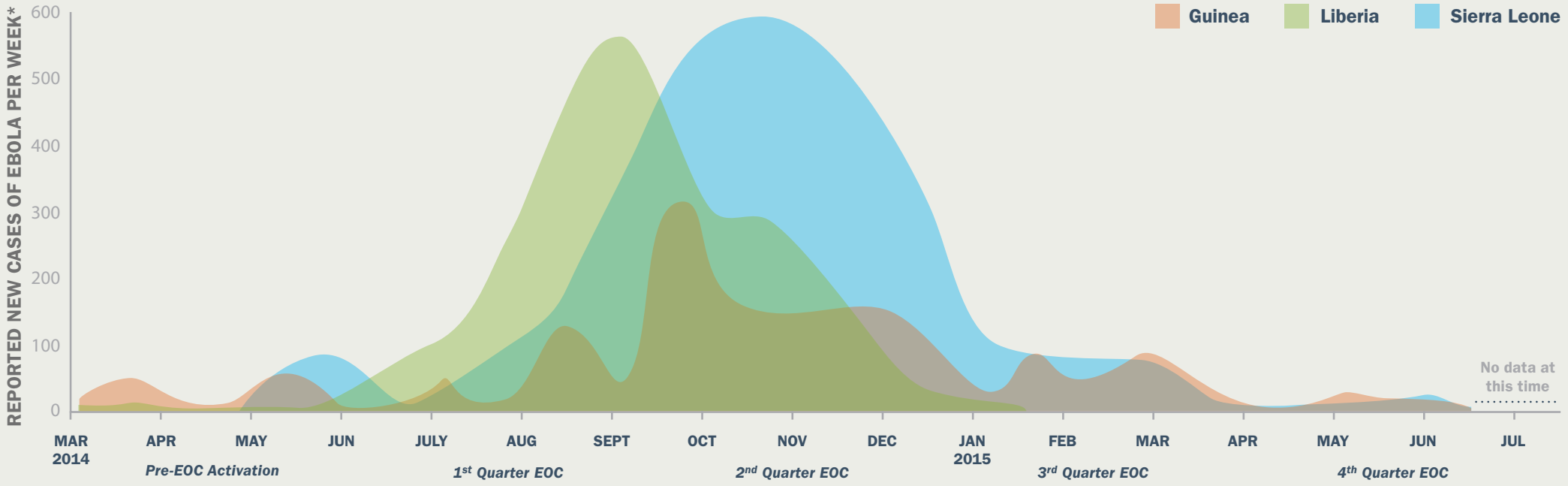
Spread to Mali, CDC teams help stop the outbreak

CDC deploys 1000th staff member

CDC recommends reduced screening for passengers from Liberia

Liberia outbreak declared over

New cases reported in Liberia



* *Approximate numbers*

COVER PHOTO CAPTIONS

Front cover (clockwise)

Yoshinori Nakazawa uses his tablet's GPS receiver to navigate and record geographic information for parts of Kambia District, Sierra Leone. The data are sent to CDC headquarters and shared with other partners.

Volunteers in Nigeria wear their Stop Ebola T-shirts.

Freetown residents voluntarily quarantined for possible exposure to Ebola patients pose outside of their housing block at the Voluntary Quarantine Facility in the Hastings community outside of Freetown, Sierra Leone.

Back cover (clockwise)

Ebola survivor Mohamed Bangura poses with the certificate presented by the government health services of Sierra Leone after he survived the Ebola virus in August 2014.

EIS officer KP Djawe completes daily tally sheets from his contact tracing visit in Kamian, Guinea, with some curious onlookers.

A local boy looks on as a CDC team responds to a call about a man showing symptoms of Ebola in the community of Bolima, in the town of Waterloo just outside of Freetown.

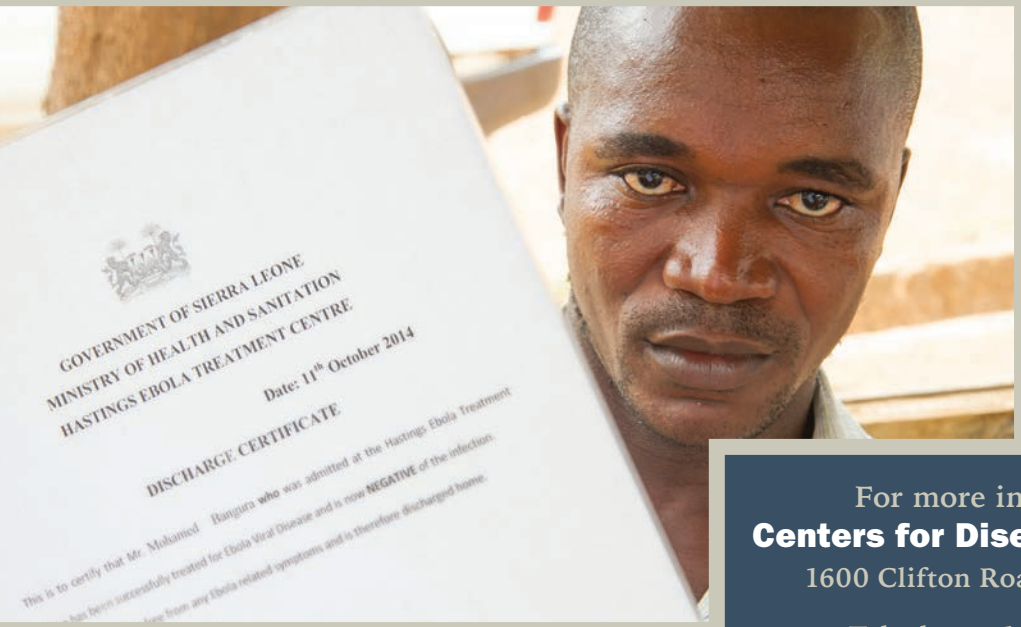
Log bridge in Sinoe County, Liberia.

Acknowledgements

Thank you to everyone who told us their stories so that we could share these examples of innovative public health work with the world. This book represents a small fraction of the stories from our thousands of Ebola responders and shows how our dedicated and determined Ebola responders have been navigating the road to zero.

A special thanks to those who worked on this project: Mark Conner, Jennifer McQuiston, Laura Smith, Erin Sykes, Curt Wommack, and Cathy Young

Photos on the front and back cover and pages 9, 22, 23, 24, 31, 36, 40, 43, 47, 51 ©David Snyder/ CDC Foundation.



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