

## From Contamination to Containment

A perfect storm led to the worst Ebola epidemic to date.

By Cordelia E. M. Coltart, Anne M. Johnson, and David L. Heymann

On March 10, 2014, the Ministry of Health in the West African nation of Guinea was alerted to a disease outbreak in two southeastern regions. Those affected had fever, severe diarrhea, and vomiting. And the majority of them had died. Two days later, *Médecins sans Frontières*, which had been working in Guinea since 2010, conducted a rapid epidemiological investigation and sent blood samples to laboratories in Europe with the highest biosafety rating. These laboratories confirmed that the cause was the Ebola virus, and the World Health Organization (WHO) announced the outbreak on March 23.

The origin of the outbreak was traced to Meliandou, a village in the Guéckédou region, near the border with Sierra Leone and Liberia. The initial case appears to have been a two-year-old child who became ill in December 2013 and died a few days later. One potential theory is that he had been infected with the Ebola virus by eating fruit contaminated with infected bat saliva or excreta. Bats are the most likely animal reservoir for the Ebola virus, and they are healthy carriers—that is, they do not become ill themselves.

Other family members and villagers rapidly became ill and died, including a village midwife who cared for the young boy. Before her death, the midwife was hospitalized in the nearest town and is thought to have infected another healthcare worker, who in turn was hospitalized in a larger town, perhaps initiating the cascade of infection from a rural to an urban outbreak.

The first two cases of Ebola in Liberia were confirmed on March 30, 2014, a week after the outbreak was reported by the WHO. They were close to the border with Guinea, and genetic sequencing confirmed the virus came from there. Nearly two months later (May 25) the first case was confirmed in a young woman in Kenema, the third largest city in Sierra Leone. The incidence of Ebola infection in Sierra Leone then climbed steeply. Further investigation suggested that Ebola had actually been introduced into Sierra Leone more than five months earlier when a woman traveled there from Meliandou village in Guinea and spread the infection to others, causing an undetected “silent phase” that contributed to the steep rise in cases.

The outbreak in West Africa continued, with thousands of cases reported over twenty-eight months. There were spillover cases in Nigeria,

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Mali, Senegal, the United States, and Spain; and infected health workers and other people contributing to the outbreak response returned to the United Kingdom, Spain, Italy Germany, France, Switzerland, the Netherlands, Norway, and the United States for hospitalization and treatment.

Although the outbreak appeared to be over earlier, reinfection from a small number of survivors who still carried the Ebola virus led to new case reports and, therefore, delayed the formal end of the outbreak until September 7, 2016—with a total of 28,646 cases and 11,323 deaths reported.

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Apart from the slow initial response, the legacy of civil war and corrupt dictatorships, poorly functioning health and governmental systems that commanded little public trust, and densely populated urban areas with highly mobile populations are all thought to have contributed to the spread and magnitude of the West African outbreak. Previous Ebola outbreaks had been limited to isolated rural areas, where containment efforts were initially more robust and more effective.

Also contributing to the spread of Ebola was the cross-border movements of the Kissi<sup>1</sup> ethnic group, whose closely tied members inhabit adjacent areas of Guinea, Liberia, and Sierra Leone. Population mobility in the region is substantially higher than elsewhere in the world, facilitated by a developed road network that leads to major urban areas. In search of work and food, the Kissi travel from rural areas to cities, where there are transport links that facilitate the international spread of disease.

A cluster of factors rapidly amplified the outbreak: there was insufficient public health infrastructure to rapidly detect, report, and respond to the outbreak; there were inadequate financial resources in the affected countries; and initially there was ineffective community engagement. On top of that, there was poor coordination as international workers arrived to support government activities, resulting in duplication of effort and gaps in support. Finally, telecommunications and transportation networks were often weak or non-existent, hindering public information campaigns and delaying transport of patients to health facilities and diagnostic samples to laboratories.

The recent emergence from civil war in all three countries had left a legacy of distrust of authorities, suspicion of government motives, and episodes of civil disobedience. An initial lack of cultural sensitivity on the part of international responders, who recommended removing the dead from

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<sup>1</sup> (VM): [https://joshuaproject.net/people\\_groups/12722/GV](https://joshuaproject.net/people_groups/12722/GV)

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their homes for mass burial or cremation, also hindered action. That course of action was not without merit: some of the traditional burial practices were known to propagate Ebola virus transmission. For example, close female relatives may travel significant distances to wash the body of a deceased woman; if they become infected during this practice, they can then spread infection when they return home. Likewise, when a woman dies of Ebola her widower may be obliged to travel to her home village and work there in order to complete an outstanding dowry payment, and he could carry infection with him. In one month alone—August 2014—60 percent of new infections in Guinea were linked to funerals; in Sierra Leone in November 2014, 80 percent of infections were linked to funerals.

But forcing removal of the bodies of the deceased from their homes raised suspicions that they were being used for witchcraft or for other purposes. Funerals are in fact steeped in cultural significance, and ignoring this sets up barriers. It was only after several months that communities began to appreciate the need for safe burial, reporting of cases, and tracing of contacts in order to prevent the spread of infection. Once communities became involved, they contributed to the response that eventually brought the outbreak under control.

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There has been much speculation and criticism regarding the timing and delay of both the national and international responses. The WHO was singled out for its delay between announcing the outbreak (March 23, 2014) and declaring it a Public Health Emergency of International Concern (August 8). Lack of good governance and accountability at a national and local level are other key factors cited.

The failure to promptly implement public health measures in March 2014 when the outbreak was first identified was tragic. Intervention strategies that can contain outbreaks and stop their spread have been known and effectively implemented for over twenty-five years. In fact, they have been understood since the first Ebola outbreaks that occurred in 1976 in the Democratic Republic of the Congo (DRC) and what is now South Sudan, and were validated the next year at a second outbreak in the DRC. These include community engagement so that the village chiefs and elders understand the ways to stop transmission, such as reporting cases, isolation, tracing contacts (and observing them for two weeks in case they become ill), as well as safe burial practices.

In fact, Jean-Jacques Muyemebe, an expert from DRC and among the first scientists to investigate the DRC Ebola outbreak in 1976, has perfected his own strategy to engage a community during new outbreaks. His first visit is not to the hospital but to the district commissioner's office,

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where he asks the commissioner to call together all the village chiefs and elders in the area. He then explains to them—in locally acceptable terms—what is causing the outbreak and how it can be stopped. He often gives the analogy that people who are sick are filled with evil spirits trying to get out, and that if they or their dead bodies are touched, the evils spirits will enter those who touch them. After that, he reviews with the chiefs and elders the specific measures that can help stop the spread, making the job of the public health teams much more effective.

Much of what was known about Ebola was confirmed in the West African outbreak of 2013–2016. New understanding was also gained, such as the possibility for some survivors to have virus hidden in their bodies and to be able to transmit it during sexual intercourse. We also now know that after a patient recovers, the virus may remain within the eyes, causing long-term visual problems. When available, therapy remains largely supportive, relying on replacing fluids and electrolytes and administering antibiotics and anti-diarrheal agents. Some progress was made with experimental therapies, including transfusions of blood products from survivors recovering from the disease. But the main control measures remain the same as they were before.

Although it was delayed, the response to the 2013–2016 outbreak eventually demonstrated unprecedented levels of international cooperation. No doubt this was in part because, for the first time, Ebola was regarded as a global public health emergency and a threat to all countries. The world owes a debt to the individuals, national governments, and organizations that took action to bring relief to those suffering in West Africa, and especially to the healthcare workers and members of the affected communities who took great personal risk to limit the impact of this global health disaster. The important lesson is that nations need the ability to rapidly detect and respond to disease outbreaks that have the potential to spread both locally and internationally, with a safety net of international support in place that can be called upon if needed.

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