

Ebola Virus Disease Outbreak — Nigeria, July–September 2014

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On July 20, 2014, an acutely ill traveler from Liberia arrived at the international airport in Lagos, Nigeria, and was confirmed to have Ebola virus disease (Ebola) after being admitted to a private hospital. This index patient potentially exposed 72 persons at the airport and the hospital. The Federal Ministry of Health, with guidance from the Nigeria Centre for Disease Control (NCDC), declared an Ebola emergency. Lagos, (pop. 21 million) is a regional hub for economic, industrial, and travel activities (1) and a setting where communicable diseases can be easily spread and transmission sustained. Therefore, implementing a rapid response using all available public health assets was the highest priority. On July 23, the Federal Ministry of Health, with the Lagos State government and international partners, activated an Ebola Incident Management Center as a precursor to the current Emergency Operations Center (EOC) to rapidly respond to this outbreak. The index patient died on July 25; as of September 24, there were 19 laboratory-confirmed Ebola cases and one probable case in two states, with 894 contacts identified and followed during the response. Eleven patients with laboratory-confirmed Ebola had been discharged, an additional patient was diagnosed at convalescent stage, and eight patients had died (seven with confirmed Ebola; one probable). The isolation wards were empty, and 891 (all but three) contacts had exited follow-up, with the remainder due to exit on October 2. No new cases had occurred since August 31, suggesting that the Ebola outbreak in Nigeria might be contained. The EOC, established quickly and using an Incident Management System (IMS) to coordinate the response and consolidate decision making, is largely credited with helping contain the Nigeria outbreak early. National public health emergency preparedness agencies in the region, including those involved in Ebola responses, should consider including the development of an EOC to improve the ability to rapidly respond to urgent public health threats.

The Ebola Outbreak

The first known case of Ebola in Nigeria was in a traveler exposed in Liberia. On July 17, 2014, while under observation in a Monrovia, Liberia, hospital for possible Ebola, the patient developed a fever and, while symptomatic, left the hospital against medical advice. Despite advice against travel, on July 20 he flew by commercial airline from Monrovia via Accra, Ghana, to Lomé, Togo, then changed aircraft, and flew to Lagos. On arrival the afternoon of July 20, he was acutely ill and immediately transported to a private hospital where he was noted to have fever, vomiting, and diarrhea. During hospital admission, the patient was queried about Ebola and said he had no known exposure; he was initially treated for presumed malaria. Based on the patient's failure to respond to malaria treatment and his travel from an Ebola-affected country in the region (2), treating physicians suspected Ebola. The patient was isolated and tested for Ebola virus infection while local public health authorities were alerted about a suspected case of Ebola. A blood specimen sent to Lagos University Teaching Hospital was confirmed positive for acute Ebola virus infection. The patient died on July 25.

Port Health Services conducted early contact tracing at the airport and worked with airlines and partners to ensure notification of the outbreak through International Health Regulations (IHR 2005) mechanisms (3). The EOC case-management team took over management of each laboratory-confirmed or suspected case, triaged potential patients, and decontaminated areas inhabited by them. Patients with suspected infection were isolated in the suspected case ward at the Ebola treatment facilities, initially in Lagos and subsequently in Port Harcourt. A contact tracing team staffed and supervised by skilled, dedicated epidemiologists was established to investigate all primary contacts and alert the



case management team of symptomatic contacts for assessment and possible reclassification.* A suspected case[†] was reclassified as a confirmed case if reverse transcription–polymerase chain reaction (RT-PCR) detected Ebola virus in a blood specimen, and was ruled out if RT-PCR testing of two blood specimens collected at least 48 hours apart was negative. Additionally, testing for anti-Ebola virus immunoglobulin G, indicating an immune response to Ebola virus, was added to the testing protocol for PCR-negative suspected cases in persons with some symptoms who were epidemiologically linked to subsequent confirmed cases. When a contact became ill with a suspected case, the contact tracing team gathered data on persons exposed to that contact from the date of symptom onset in the event the suspected case should become laboratory confirmed. Having the capacity to conduct Ebola laboratory diagnosis in-country at the Lagos University Teaching Hospital facilitated rapid identification of confirmed cases and quick discharge of persons with suspected Ebola who tested Ebola negative.

As of September 24, 19 laboratory-confirmed Ebola cases and one probable case had been identified (Figure 1). A total of 894 contacts were identified, and approximately 18,500

face-to-face visits were conducted by contact tracers to assess Ebola symptom development. Persons with suspected Ebola were transported to a suspected case isolation ward by the case management team, and persons who subsequently tested Ebola positive were moved to the confirmed case ward at the same facility in either Lagos or Port Harcourt. Eleven patients had been discharged, one additional patient had a confirmed diagnosis in the convalescent stage, and eight had died (seven confirmed; one probable) for an overall case fatality ratio of 40%. The isolation and treatment wards were empty, and 891 (all but three) contacts had successfully exited follow up. The remaining three contacts became ill but tested Ebola negative and were released from the isolation ward in Lagos. As is standard practice, upon release, the patients who had been suspected cases started a new 21-day follow-up as contacts because of the possibility that they were exposed in the ward. In this instance, no one was diagnosed with Ebola while these three contacts were in the ward, thus the likelihood of Ebola exposure was very low, and all three are due to exit follow-up on October 2.

Investigation of the index patient and all exposed contacts required coordination between multiple IMS response teams and across several cities in the course of the response. The three-generation spread of Ebola (all 19 confirmed and probable cases) to date can be traced to the index case through contact networks (Figure 1). Twelve of the 20 patients were exposed in two health facilities in Lagos. Four of the cases have been associated with a suspected case in a patient who traveled while ill via commercial aircraft from Lagos to Port Harcourt, Rivers State, and back (Figure 1). After the patient who traveled was discovered, manifests were collected from both flights, and attempts were made to contact passengers to ensure they had not become ill because >21 days had passed since the travel occurred. No ill or deceased passengers were identified. Overall, no new cases have occurred since August 18 in Lagos and August 31 in Port Harcourt, suggesting that the Ebola outbreak in Nigeria might have been contained (Figure 1).

Public Health Response

The threat to Nigeria posed by the arrival in Lagos of a patient acutely ill with Ebola was potentially enormous. Lagos is Africa's largest city and is also a transit hub for the region with air, land, and sea ports of entry (1). The dense population and overburdened infrastructure create an environment where diseases can be easily transmitted and transmission sustained. Suboptimal infection control practices in health centers lacking necessary equipment and supplies increase the risk for Ebola transmission to health care workers. Contact tracing efforts are burdened by the complex nature of transit, commercial, and public health notification and reporting mechanisms.

* An Ebola contact was defined as a person who had a known exposure to a confirmed, probable, or suspected case. Contacts were actively monitored for 21 days after the date of last exposure. The contacts were further classified by their exposure to the case as Type 1 (contact with body fluids such as blood, vomit, saliva, urine, or feces of a confirmed patient); Type 2 (direct physical contact with the body of a confirmed patient or decedent); Type 3 (contact with linens, clothes, or dishes/eating utensils); and Type 4 (a history of sleeping, eating, or spending time in the same household or room as a patient). Contacts were reclassified as suspected cases if they reported fever (or were observed to have temperature $\geq 99.5^{\circ}\text{F}$ (37.5°C) axillary or $\geq 100.4^{\circ}\text{F}$ (38.0°C) core and met one of the following criteria: 1) had vomiting, diarrhea, or bleeding from stool or mucous membranes; or 2) had two additional symptoms including headache, myalgia, arthralgia, or weakness.

[†] The case definition for a suspected case of Ebola in this outbreak was adapted from the World Health Organization recommended case definition (9). An illness in a patient who met all three of the following was a suspected case: a) Fever: The patient either reported having a fever, or if measured, had a temperature of $\geq 99.5^{\circ}\text{F}$ (37.5°C) axillary or $\geq 100.4^{\circ}$ (38.0°C) core; b) Exposure: The patient visited an affected area in the preceding 3 weeks or had contact with an ill person who visited an Ebola-affected area within 3 weeks of becoming ill; c) Presence of additional symptoms: The patient had any two of the following: bleeding (at mucous membranes or in stool), vomiting, diarrhea, headache, myalgia, arthralgia, or weakness. In addition, an illness was a suspected case if the patient met these two criteria: a) Fever: The patient either reported having a fever, or if measured, had a temperature of $\geq 99.5^{\circ}\text{F}$ (37.5°C) axillary or $\geq 100.4^{\circ}$ (38.0°C) core; b) Higher level exposure: Close contact with a confirmed Ebola case or with a person who died, if the person died from a febrile or unexplained illness and had visited an affected area within 3 weeks of becoming ill, or participation in a funeral within 3 weeks of having a fever in which 1) the funeral was conducted in an affected area, or 2) the deceased person had visited an affected area within 3 weeks of becoming ill (9). Suspected cases were confirmed to be Ebola by laboratory testing using RT-PCR to test blood for the presence of Ebola virus. In situations in which the suspected case was identified during a convalescent period, post-disease immunoglobulin G testing was conducted to assess an immune response to Ebola and/or semen samples were tested using RT-PCR for the presence of Ebola virus. Suspected cases were ruled out as confirmed if two consecutive negative RT-PCR tests spaced ≥ 48 hours apart were negative.