



**Congressional  
Research Service**

Informing the legislative debate since 1914

---

# **Ebola: Basics About the Disease**

**Sarah A. Lister**

Specialist in Public Health and Epidemiology

October 3, 2014

**Congressional Research Service**

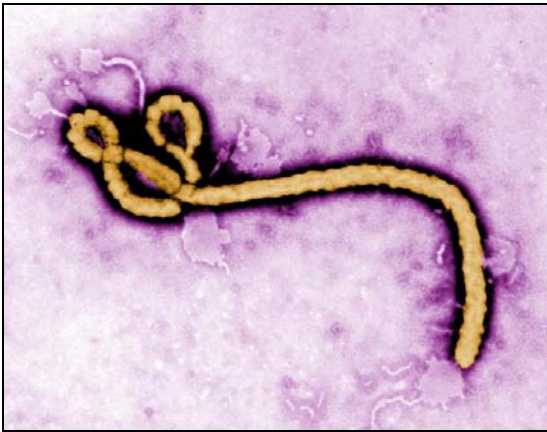
7-5700

[www.crs.gov](http://www.crs.gov)

R43750

In March 2014, global health officials recognized an outbreak of Ebola virus disease (EVD) in Guinea, West Africa. In retrospect, officials determined that the outbreak began in December 2013, and spread to the adjacent countries of Liberia and Sierra Leone. In September 2014, the U.S. Centers for Disease Control and Prevention (CDC) confirmed the first EVD case diagnosed in the United States,<sup>1</sup> heightening concerns among some who fear the disease could spread in American communities.<sup>2</sup> This report discusses EVD in general, including symptoms, modes of transmission, incubation period, and treatments; presents projections of the future course of the outbreak; and lists additional CRS products, including products focused on the situation in West Africa. Unless otherwise cited, information in this report is drawn from Ebola information pages of CDC<sup>3</sup> and the World Health Organization (WHO).<sup>4</sup>

**Figure 1. Ebola Virus Particle**



**Source:** Colorized transmission electron micrograph from CDC, Public Health Image Library, image #10815, <http://phil.cdc.gov>.

## The Ebola Virus and EVD

The Ebola virus is named after the Ebola River, near where the virus was discovered in 1976 in Zaire, now known as the Democratic Republic of the Congo (DRC). It is in the filovirus family, so called because of its filamentous shape. EVD is also known as Ebola hemorrhagic fever. The disease sometimes causes hemorrhage (i.e., bleeding) from body openings, but this symptom is not consistent. Five strains of Ebola virus have been identified. The Zaire strain is responsible for the current outbreak in West Africa. A slightly different Zaire strain is responsible for a smaller unrelated outbreak now in the DRC.

## Transmission

Ebola virus is thought to live in nonhuman animals in parts of Africa. Fruit bats are thought to be the most likely or most common animal reservoir for the virus. Humans may be exposed through contact with infected animals.

During an outbreak, EVD spreads through human-to-human transmission. Transmission requires direct contact with body fluids from an infected person or contaminated objects such as medical equipment. It cannot be spread through the air. Hence, EVD is not as easily transmitted as influenza or common cold viruses, which can be spread through the air. However, healthcare workers, family members, and others who care for EVD patients have a high risk of infection because they are in regular contact with infected body fluids.

<sup>1</sup> Centers for Disease Control and Prevention (CDC), “CDC and Texas Health Department Confirm First Ebola Case Diagnosed in the U.S.,” press release, September 30, 2014.

<sup>2</sup> CRS Report IN10126, *Safe at Home? Letting Ebola-Stricken Americans Return*, by Sarah A. Lister.

<sup>3</sup> Centers for Disease Control and Prevention (CDC), “Ebola virus disease,” <http://www.cdc.gov/vhf/ebola/index.html>.

<sup>4</sup> World Health Organization (WHO), “Ebola virus disease,” <http://www.who.int/csr/disease/ebola/en/>.

In humans EVD has an incubation period—the time between exposure and onset of symptoms—from 2 to 21 days, with an average of 8 to 10 days. Individuals are not contagious, meaning they cannot transmit EVD to others, until symptoms are present. Those surviving infection may still have Ebola virus in their bodies and remain contagious for several months after infection, even when symptoms are no longer present. They can be tested for the presence of virus in order to maintain their quarantine until they are no longer contagious.

## Symptoms and Diagnosis

The early symptoms of EVD are shared by many more common illnesses, complicating diagnosis.<sup>5</sup> Symptoms may include a high fever (greater than 38.6°C, or 101.5°F), severe headache, muscle pain, weakness, diarrhea, vomiting, abdominal (stomach) pain, and unexplained hemorrhage (bleeding or bruising).

Several laboratory tests are available to test patients for EVD. These tests may yield negative results within the first few days after symptoms appear. As a result, patients who have potentially been exposed to EVD and who show some of the symptoms above should be isolated, even if test results are negative, and retested a few days later.

### Isolation or Quarantine?

**Isolation** is used to separate ill persons who have a contagious disease from others. It is often carried out in a healthcare setting.

**Quarantine** is used to separate and restrict the movement of well persons who may have been exposed to a contagious disease to see if they become ill. It is often carried out at home.

## Death Rates

EVD is known and widely feared for being exceptionally deadly. The case fatality rate (CFR), the percentage of infected individuals who do not survive, generally exceeds 50%, an extraordinarily high rate among infectious diseases. The true CFR is an inherent property of the infectious agent (in this case, the Ebola Zaire virus). However, the measured CFR is affected by the availability of vaccines and specific treatments, as well as general medical care, among other factors. Perhaps the most significant factor is how cases are counted; whether counts are limited, for example, to cases in which EVD is confirmed with a laboratory test, or to hospitalized patients, or to patients for whom an outcome (lived or died) is confirmed. Different approaches to case counting can affect the measured CFR considerably.

WHO analyzed CFRs for the current outbreak in West Africa, limiting its analysis to patients with confirmed outcomes. It found rates of about 70% in each of the severely affected countries—Guinea (70.7%), Liberia (72.3%), and Sierra Leone (69.0%). In all three countries, hospitalized patients in this group had somewhat lower CFRs (ranging from 61% to 67%) than patients who were not hospitalized.<sup>6</sup> Regardless of variations in measured rates, EVD is clearly a deadly disease.

<sup>5</sup> See for example Luran Neergard and Paul J. Weber, “U.S. Hospital Sent Ebola-infected Patient Home,” *Associated Press*, October 2, 2014, discussing initial failure of providers in a Dallas hospital to diagnose EVD in a patient.

<sup>6</sup> WHO Ebola Response Team, “Ebola Virus Disease in West Africa—The First 9 Months of the Epidemic and Forward Projections,” *NEJM*, September 23, 2014, Table 2, p. 11, <http://www.nejm.org>.

## Preventing Transmission

Prevention of human-to-human transmission of Ebola virus requires avoiding contact with body fluids of those who are sick. As a result, EVD is not likely to be easily transmitted in community settings in the United States. However, caregivers, including family members and healthcare workers, face considerable risk of transmission. Barrier protections (called personal protective equipment or PPE), liberal disinfection of premises and facilities housing EVD patients, and careful handling of human remains and contaminated objects are essential.<sup>7</sup> In resource-constrained environments (such as in developing countries), consistent adherence to these practices can be hampered by shortages of personnel and supplies, and other factors. However, according to CDC, “virtually any hospital in the [United States] can do isolation for Ebola.”<sup>8</sup>

## Therapies and Vaccines

No specific therapy or vaccine against EVD is approved by the U.S. Food and Drug Administration (FDA) for use in the United States, or is available elsewhere in the world. However, for more than a decade the U.S. government has funded research and development of specific therapies (such as antiviral drugs) and vaccines against EVD for military force protection and domestic biodefense purposes. Given the current outbreak, pharmaceutical companies, FDA, and other federal agencies have accelerated their work on some promising products.<sup>9</sup> Some products are or may soon be available for investigational use (i.e., in clinical trials) both domestically and abroad.

WHO assumes that EVD-specific therapies and vaccines will not be available in sufficient time or amount to quell the current outbreak. It urges continued aggressive efforts to stop ongoing transmission through contact tracing (i.e., identifying and monitoring all individuals who may have been exposed to an infected patient) and use of protective measures.<sup>10</sup>

Non-EVD-specific treatments include fluids (orally or intravenously) to maintain hydration, and blood transfusions to counter blood loss from hemorrhagic symptoms. Transfusions of blood, serum, or plasma from EVD survivors have been given to some victims in order to provide antibodies from the survivors. The effectiveness of this approach has not been demonstrated.<sup>11</sup>

Testing unproven therapies in the midst of an outbreak raises technical and ethical concerns. A WHO committee has said that the use of investigational products is warranted for the current outbreak.<sup>12</sup> Experts disagree about the particulars of such use, however. For example, some say

---

<sup>7</sup> See for example CDC, “Ebola Virus Disease: Prevention,” <http://www.cdc.gov/vhf/ebola/prevention/index.html>.

<sup>8</sup> Comments of CDC Director Tom Frieden, “CDC Confirms First Ebola Case Diagnosed in the United States,” Press Briefing Transcript, September 30, 2014, <http://www.cdc.gov/media/archives.htm>.

<sup>9</sup> FDA, “2014 Ebola Outbreak in West Africa,” <http://www.fda.gov/EmergencyPreparedness/Counterterrorism/MedicalCountermeasures/ucm410308.htm>; and CRS, *Availability of Treatments for the Ebola Virus Outbreak in West Africa*, memorandum for general distribution, September 12, 2014, by Frank Gottron, 7-5854, Sarah A. Lister, 7-7320, and Susan Thaul, 7-0562. Contact authors for a copy.

<sup>10</sup> WHO, *Ebola Response Roadmap*, August 28, 2014, Geneva, Switzerland, <http://www.who.int/csr/disease/ebola/ebola-response-roadmap/en/>.

<sup>11</sup> WHO, “Experimental Therapies: Growing Interest in the Use of Whole Blood or Plasma from Recovered Ebola Patients (Convalescent Therapies),” September 26, 2014, <http://who.int/mediacentre/news/ebola/26-september-2014/en/>.

<sup>12</sup> WHO, “Ethical Considerations for Use of Unregistered Interventions for Ebola Virus Disease: Report of an Advisory (continued...)”

that in order to understand whether an investigational product is effective, it must be studied by comparing outcomes of groups of people who receive the product, and groups who receive a non-therapeutic drug or vaccine (i.e., a placebo) instead. Others feel that placebo comparisons are not necessary, arguing that if a given investigational product were effective, it would be evident in how it lowered the normally high case fatality rate of EVD, and more people would be able to benefit from it.<sup>13</sup> This issue often arises when clinical trials are carried out in developing countries; the path(s) chosen in deploying investigational products for EVD in West Africa will be examined in order to inform the response to outbreaks of EVD and other diseases in the future.

## **Outbreak Models and Projections**

Guinea, Liberia, and Sierra Leone, countries without prior experience with EVD, have been severely affected by the current outbreak. In late summer case counts in the three countries rose precipitously. On September 22, WHO warned that “[u]nless Ebola control measures in west Africa are enhanced quickly, ... numbers will continue to climb exponentially, and more than [20,000] people will have been infected by early November...”<sup>14</sup>

The same week, CDC authors published outbreak projections for Liberia and Sierra Leone. The model found that without further interventions to slow the outbreak (a worst case scenario), the case count in the two countries could reach 1.4 million by January 20, 2015. Conversely, if 70% of EVD patients were effectively isolated going forward, the outbreak in both countries would be almost controlled by that same date.<sup>15</sup>

In light of concerns raised by the introduction of EVD into the United States, the CDC Director has said that these concerns can best be alleviated by controlling the outbreak in West Africa.<sup>16</sup>

## **Additional CRS Products**

- CRS Report R43736, *Ebola Virus Disease (Ebola or EVD): Experts List*
- CRS Report R43697, *The 2014 Ebola Outbreak: International and U.S. Responses*, by Tiaji Salaam-Blyther
- CRS Report IN10152, *Increased Department of Defense Role in U.S. Ebola Response*, by Don J. Jansen
- CRS Report IN10126, *Safe at Home? Letting Ebola-Stricken Americans Return*, by Sarah A. Lister

---

(...continued)

Panel to WHO,” August 17, 2014, <http://www.who.int/csr/resources/publications/ebola/ethical-considerations/en/>.

<sup>13</sup> See for example Kai Kupferschmidt, “Ebola Vaccine Tests Needlessly Delayed, Researchers Claim,” *Science* magazine, September 29, 2014, <http://news.sciencemag.org/category/africa>.

<sup>14</sup> WHO, “Study Warns Swift Action Needed to Curb Exponential Climb in Ebola Outbreak,” press release, September 22, 2014, referring to the NEJM article at footnote 6, <http://who.int/mediacentre/news/releases/2014/ebola-study/en/>.

<sup>15</sup> Martin I. Meltzer et al., “Estimating the Future Number of Cases in the Ebola Epidemic—Liberia and Sierra Leone, 2014–2015,” *MMWR*, vol. 63, Supplement, no. 3 (September 26, 2014), pp. 1-14, <http://www.cdc.gov/mmwr/>.

<sup>16</sup> See for example comments of CDC Director Tom Frieden, “CDC Confirms First Ebola Case Diagnosed in the United States,” Press Briefing Transcript, September 30, 2014, <http://www.cdc.gov/media/archives.htm>.

- CRS Report R40570, *Immigration Policies and Issues on Health-Related Grounds for Exclusion*, by Ruth Ellen Wasem

## **Author Contact Information**

Sarah A. Lister  
Specialist in Public Health and Epidemiology  
slister@crs.loc.gov, 7-7320