

# ENA Topic Brief

## Key Information

- Ebola is a rare disease caused by infection with a virus of the family *Filoviridae*, genus *Ebolavirus*.
- The current Ebola outbreak in West Africa is caused by the *Zaire ebolavirus* strain.
- The fatality rate for EVD averages around 55–71%, but has varied from 25% to 90% in past outbreaks.
- EVD is transmitted by direct contact with bodily fluids.
- Signs and symptoms of Ebola include fever, severe headache, fatigue, muscle pain, weakness, diarrhea, vomiting, abdominal (stomach) pain, and unexplained hemorrhage (bleeding or bruising).
- Currently affected countries include Guinea, Liberia, and Sierra Leone.
- The incubation period for EVD is 2–21 days.
- Currently, there are no FDA-approved vaccines available for EVD.<sup>14,21</sup>

## Ebola Virus Disease (EVD)

### Purpose

The 2014 Ebola outbreak originating in West Africa has received international attention, not only because of the severity of its symptoms and high fatality rate, but also because of public fears and questions regarding infectious disease containment and control. Since current medical treatment of Ebola virus disease (EVD) is chiefly limited to supportive therapies, timely identification and immediate application of correct infection control measures are vital. Early recognition of suspected cases with immediate barrier precautions for nursing has proven to break the epidemiological chain of transmission, resulting in better control, response, and prevention.<sup>1</sup> Emergency nurses are in a unique position to care for suspected or confirmed patients and to function as public health educators, emergency responders, and advocates for change. The purpose of this topic brief is to examine EVD, discuss transmission, review prevention measures, and consider future preparation strategies.

### Historical Overview

The Filovirus, named after its filament-like appearance, is a genetically unique zoonotic virus that affects humans and nonhuman primates, causing hemorrhagic fevers. The first known emergence of Filovirus in humans occurred with cases in Marburg, Germany, in 1967.<sup>1</sup> The virus was associated with the importation of infected green monkeys from Uganda intended for use in the manufacture of the polio virus vaccine. A total of 31 cases and 7 fatalities were associated with this outbreak.<sup>1</sup> This Filovirus, later called Marburg hemorrhagic fever (MHF), reemerged in 1975 in Zimbabwe, with a few sporadic cases occurring thereafter. Decades later, two large epidemics of MHF occurred in Zaire (now the Democratic Republic of the Congo [DRC]) in 1999, and in Angola in 2005.<sup>2</sup> Currently, there are only two known members of the Filovirus family, Marburg virus and Ebola virus.<sup>2</sup>

In 1976, two distinct disease outbreaks occurred nearly simultaneously in Zaire and southern Sudan near the Ebola River located in the DRC. The causes were identified as viruses similar to the Marburg virus that were later recognized as Ebola viruses.<sup>1</sup> These outbreaks were much larger than the previous MHF incidents and caused greater mortality (90% of Zairian cases and 50% of Sudanese cases).<sup>2</sup> Currently, there are five identified Ebola virus species: *Zaire*, *Sudan*, *Tai Forest* (formerly *Côte d'Ivoire*), *Bundibugyo*, and *Reston ebolavirus*. The Ebola Reston virus was first detected in 1989, when the virus came to the U.S. in circumstances similar to those when the Marburg virus appeared in 1967.<sup>1</sup> Monkeys were brought from the Philippines to Reston, Virginia, for biomedical research. The *Reston ebolavirus* is the only strain that does not cause severe disease in humans.<sup>3</sup>

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Since the introduction of EVD, there have been twenty outbreaks.<sup>3</sup> The ongoing West African EVD outbreak is the largest, most complex in history, and is of the Zaire Ebola virus that emerged in Guinea.<sup>4</sup> In March 2014, in neighboring Liberia, EVD was detected that subsequently spread into Sierra Leone in April, Nigeria in July, and Senegal in September. On September 30, 2014, the U.S. index case of EVD was diagnosed in an individual who had traveled from Liberia to Dallas, Texas, and who later expired on October 8, 2014.<sup>4</sup> Shortly after providing care to the index case, two U.S. nurses tested positive for EVD and were treated and released. A caregiver in Spain and a U.S. emergency physician are among those who have contracted the disease and have since been declared EVD free.<sup>20</sup> Previously affected countries include Italy, Nigeria, Senegal, Spain, Mali, United Kingdom, and the U.S.<sup>17</sup> An EVD outbreak is considered to have ended when 42 days (twice the 21-day incubation period of the Ebola virus) have elapsed since any patient in isolation tests positive for EVD.<sup>17</sup>

## *Transmission*

EVD is a severe and potentially fatal illness resulting in coagulopathy and septic shock, with a mortality rate of approximately 55%-71%.<sup>5,6</sup> It is suspected that the natural reservoirs of Ebola viruses are fruit bats, which spread the virus during migration.<sup>1,7-9</sup> The infected fruit bats pass on the infection by direct or indirect contact with monkeys and other nonhuman primates, causing them to serve as hosts. It is believed that humans become infected either by direct contact with infected bats or through the handling of live or dead infected animals.<sup>10</sup> In regions of Africa, increasing human-to-animal contact such as through the consumption/handling of bushmeat, introduces the zoonotic disease into human populations.<sup>11</sup> Secondary transmission then occurs with direct human-to-human contact of bodily fluids (blood, saliva, mucus, vomit, urine, feces, breast milk, semen) or exposure to contaminated objects such as needles or syringes. Individuals remain infectious for as long as their bodies contain the virus. Men who have recovered from EVD can still transmit the virus through semen for up to 3 months after clinical recovery.<sup>10</sup> Because transmission of EVD occurs by direct contact, some cultural and societal practices such as burial ceremonies and handling of diseased bodies have resulted in virus spread. Other modes of transmission occur when families or care givers choose to care for infected patients at home without practicing the necessary precautions. Healthcare workers have been infected while treating patients with suspected or confirmed EVD through direct, close contact when proper infection control measures were not strictly implemented. It is essential to break the chain of infection by immediate identification, isolation, and implementation of the appropriate preventative measures.

## *Clinical Manifestations*

Signs and symptoms of EVD include fever (greater than 100.4° Fahrenheit), severe headache, fatigue, muscle pain, weakness, diarrhea, vomiting, abdominal pain, and unexplained hemorrhage or bruising.<sup>10</sup> Any of these symptoms may appear from 2–21 days after exposure to EVD, but symptoms occur within 8–10 days on average. Some infections present similarly to influenza, pneumonia, or malaria and may be difficult to distinguish, especially during early phases, which is why it is critical to assess travel history. EVD is an acute and severe viral illness often characterized by a sudden onset of fever and nonspecific flulike symptoms, followed by a 2–5 day period of deterioration, with muscle pain, intense malaise, severe abdominal pain, copious diarrhea, nausea, and vomiting. Further complications include renal failure, encephalopathy, multisystem organ failure, hypovolemia, and disseminated intravascular coagulation (DIC). It is important to note that hemorrhagic manifestations typically manifest during the time of peak illness, but vary in intensity and may not always develop.<sup>12</sup> Hemorrhagic complications are likely a result of hepatic injury, consumptive coagulopathy, and primary marrow injury to megakaryocytes.<sup>5</sup> The disease severity can be attributed to three principal factors: rapid viral replication, virus-

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induced host immune suppression, and vascular dysfunction.<sup>12</sup> Increased risk of transmission from late-stage patients reflects the increased virus excretion as the disease progresses; acutely ill patients are therefore intensely viremic. Not all individuals develop a severe course of symptoms, but those that do often expire within 8–9 days of disease onset, and those that survive past two weeks typically tend to endure the disease.<sup>5</sup> It is not yet understood why some individuals develop severe disease, but researchers suspect it is related to virus-host interaction.<sup>5</sup> Suspected patients can be definitively diagnosed only through specific laboratory testing, including enzyme-linked immunosorbent assay (ELISA), antigen testing, reverse-transcription polymerase chain reaction assay (RT-PCR), and virus isolation.<sup>13</sup> Testing samples poses an extreme biohazard risk and strict infection control precautions are required to be implemented. Appropriate designated laboratories with infectious disease knowledge and competency in handling specimens should be utilized for this testing.

## *Treatment*

Currently, there are no FDA-approved vaccines available for the treatment of EVD, but experimental vaccines and treatments are under development and have yet to be fully tested for effectiveness and safety.<sup>14,21</sup> As of April, 2015, there are experimental EVD vaccines and treatments under development but these investigations are in the earliest stages of development.<sup>14,22</sup> Treatment for EVD includes an aggressive therapeutic approach, focusing on symptomatic treatment together with intensive care. Therapeutic approaches include palliative care (rehydration and electrolyte supplementation) and support of liver and kidney function.<sup>13</sup> Symptomatic treatments include pain relief, anti-emetics, antipyretics, antibiotics, anxiolytics, and oxygen.<sup>13</sup> In severe cases involving hemorrhage, transfusion of blood, platelet concentrates, fresh frozen plasma (FFP), and vasopressors are potential options to assist in hypovolemia and coagulopathy.<sup>13</sup> Any treatments that would provoke bleeding, such as the use of salicylates or other non-steroidal anti-inflammatory drugs (NSAIDs) and intramuscular injections, should be avoided.<sup>15</sup> Respiratory treatments or any aerosol-generating procedures (AGPs) should be avoided, but if they are required, a combination of infection control measures should be implemented to protect the healthcare worker and avoid further exposures.<sup>15</sup>

Basic interventions implemented early can significantly increase the chances of survival for EVD patients. Recovery depends on numerous variables, such as an individual's immune response, timeliness of interventions, comorbidities, and supportive care provided. Since EVD is a virus, patients who recover develop antibodies that last for 10 years and possibly longer.<sup>14</sup> At this time, it remains unknown if those who recover from EVD can become infected with different species of Ebola or are totally immune to this type of viral infection. Long-term complications continue to be investigated, with joint and muscle pain as well as residual vision problems being reported.<sup>14</sup>

Emergency departments and other acute healthcare facilities have important roles in identifying, isolating, and evaluating persons under investigation (PUI) for EVD and in informing public health authorities. The level of treatment required to safely care for EVD patients requires specific competencies and resources,<sup>23</sup> and the preparations necessary to meet these requirements will vary by facility. Because of this, acute healthcare facilities can serve one of three roles: As a frontline healthcare facility, as an Ebola assessment hospital, or as an Ebola treatment center.<sup>23</sup> The U.S. Department of Health and Human Services, Centers for Disease Control and Prevention (CDC) has developed such a tiered system to assist in directing EVD patients to the treatment facilities that can best provide the appropriate subject matter expertise and comprehensive treatment.<sup>23</sup> Since each acute healthcare facility has specific roles, healthcare providers can make treatment decisions based both on individual facility's policies and procedures as well as the CDC's recommendations (*Interim Guidance for U.S. Hospital Preparedness for Patients Under Investigation (PUIs) or with Confirmed Ebola Virus Disease (EVD): A Framework for a Tiered Approach*).

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## *Prevention and Containment*

Prevention begins with education. Becoming familiar with the historical background of EVD, understanding modes of transmission, using evidenced-based screening tools, recognizing clinical signs and symptoms, staying abreast of current treatments, and participating in hands-on training for proper donning and doffing of personal protective equipment (PPE) are essential for prevention. Reducing the risk of human-to-human transmission of EVD involves basic infection control measures of hand hygiene, strict compliance with appropriate PPE use, safe handling and disinfection of contaminated objects, safe injection practices, and appropriate handling of expired EVD patients.<sup>16</sup> For individuals who have had direct contact with suspected or known EVD patients or who have worked in or traveled to affected countries, it is important to monitor health status for 21 days after exposure, seek medical care immediately if signs or symptoms of EVD develop, and notify health officials.<sup>16</sup> While these are a few preventative measures, there are several precautions within health facilities that should be considered to prevent further exposures to EVD. These include patient placement, availability and competency of PPE, designated patient equipment, environmental infection control measures, appropriate monitoring and management of potentially exposed personnel, and monitoring, management, and education of visitors. As a result, it is imperative that facilities engage in collaborative efforts, including the engagement of various disciplinary teams in developing, improving, and sustaining protocols and policies for EVD and other infectious diseases. While preventative measures have been implemented in affected countries, several factors, such as political instability, lack of capacity, cultural beliefs, lack of resources (clean water, medical supplies, and PPE), availability/ease of travel, and fear, have made containment arduous.<sup>16-18</sup>

## *Future*

The 2014 EVD outbreak has generated immense international attention, illuminating the need for stronger emergency preparedness plans in both the private and public arenas. It is evident that preparation needs a multidisciplinary focus in order to establish evidenced-based policies, protocols, and procedures. The future of EVD preparedness also needs to include legislation that protects healthcare providers and improves patient care. Emergency nurses are in a unique position to advocate for change and support legislation such as H.R. 4080/S. 2405 (The Trauma Systems and Regionalization of Emergency Care Reauthorization Act) that will address deficiencies in emergency healthcare. The programs would create, implement, and evaluate innovative models of emergency care systems, and give grants to states for developing effective and integrated trauma systems.<sup>19</sup> The establishment of a coordinated and regionalized approach to emergency care will direct patients immediately to the appropriate facility that is best suited to provide optimal care.<sup>19</sup> This regionalization could result in the designation of infectious disease facilities that would be better prepared to handle unique diseases like EVD. This approach would ensure that designated hospitals have the required procedures and protocols in place to appropriately protect frontline healthcare professionals and the general public.

In addition to advocacy, future EVD preparation must include broadening the scope of knowledge to include emerging and existing infectious diseases, bioterrorism, and emergency preparedness. Facility leadership should take an active role in providing resources, implementing effective prevention measures, and mandating infection control training and competency checks. Lessons learned from the current outbreak suggest there is need for further education and training on EVD as well as other emerging infectious diseases and emergency preparedness.

As more is being learned about EVD, further ethical and practical considerations have emerged, such as the social stigma attached to volunteers returning from West Africa, healthcare providers opting out of care, family presence at the bedside, participation of trainees in EVD care, treatment goals, and the obligation of emergency departments and

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hospitals to support other centers in the domestic or foreign response to EVD.<sup>24</sup> These are emerging considerations, but other concerns regarding effective outbreak control persist. Effective outbreak control necessitates the implementation of case management, surveillance and contact tracing, proper laboratory services, and safe cultural practices. In particular, public interactions to reduce fears through education on risk factors and protective measures, and generally increasing the level of preparedness are key strategies to reduce disease transmission.

## *Conclusion*

While the ongoing EVD outbreak in West Africa is devastating, the residual effects have raised numerous concerns regarding emergency preparedness. Disease management recommendations for EVD may change as the outbreak continues to develop and treatments advance. The fundamental approaches, “Identify, Isolate, and Inform,” recommended by the Centers for Disease Control and Prevention (CDC), will assist in the early recognition, treatment, and containment of EVD. The high case-fatality rates and the potential for human-to-human transmission highlight the importance of proper infection control precautions. However, while appropriate PPE use is an important aspect, it is not the only preventative measure. Emergency nursing is a science-driven practice, and fear of the unknown should not impede the ability to provide safe practice, safe care.

## *Tools*

- [\*ENA Ebola News and Resources\*](#)
- [\*Centers for Disease Control and Prevention\*](#)
- [\*World Health Organization\*](#)
- [\*Identify, Isolate, Inform: Emergency Department Evaluation and Management for Patients Who Present with Possible Ebola Virus Disease\*](#)
- [\*Guidance on Personal Protective Equipment To Be Used by Healthcare Workers During Management of Patients with Ebola Virus Disease in U.S. Hospitals, Including Procedures for Putting On \(Donning\) and Removing \(Doffing\)\*](#)
- [\*Interim Guidance for U.S. Hospital Preparedness for Patients Under Investigation \(PUIs\) or with Confirmed Ebola Virus Disease \(EVD\): A Framework for a Tiered Approach.\*](#)

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## Definitions of Terms

<b><i>Ebola virus disease (EVD):</i></b>	Previously known as Ebola hemorrhagic fever, it is a rare and frequently fatal disease caused by infection with one of the Ebola virus strains. EVD can cause disease in humans and nonhuman primates (monkeys, gorillas, and chimpanzees). EVD is caused by an infection with a virus of the family Filoviridae, genus Ebolavirus. There are five identified Ebola virus species, four of which are known to cause disease in humans.
<b><i>ELISA</i></b>	Enzyme-linked immunosorbent assay; a sensitive immunological assay technique using an enzyme linked to antibody or antigens as tools to detect specific proteins, particularly antigens or antibodies.
<b><i>Filovirus:</i></b>	Filamentous, enveloped particle, negative-sensed, single-stranded RNA genome, belonging to the Filoviridae virus family, which can cause severe hemorrhagic fever in humans and nonhuman primates. Currently, only two members of this virus family have been identified: Marburgvirus and Ebolavirus.
<b><i>Index Case</i></b>	The primary case or initial patient in the population of an epidemiological investigation.
<b><i>Regionalization</i></b>	Dividing or separating into areas or regions and designating/recognizing specialty centers for a more organized response to handling specific patient and population needs.
<b><i>RT-PCR assay</i></b>	Reverse-transcription polymerase chain reaction: a highly sensitive laboratory technique based on the polymerase chain reaction (PCR) that is used to detect and quantify messenger RNA (mRNA).
<b><i>Zoonotic disease:</i></b>	Disease caused by viruses, bacteria, parasites and fungi that can be passed between animals and humans.

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