



Ebola Virus: Pathophysiology, Clinical Presentation, Diagnosis, Treatment, Prevention and Impact in Nigeria

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Abstract

Ebola Virus Disease (EVD) is a highly lethal infectious disease caused by the Ebola virus, with mortality rates ranging from 25% to 90%. First identified in 1976, EVD has emerged as a major public health threat, particularly in sub-Saharan Africa. The disease is transmitted through contact with infected animals and humans, with outbreaks often exacerbated by limited healthcare infrastructure. Nigeria experienced a notable outbreak in 2014, which highlighted the challenges of diagnosis, treatment, and prevention in resource-limited settings. This review explores the pathophysiology, clinical presentation, diagnosis, treatment, and prevention of EVD, emphasizing Nigeria's experience and response. It underscores the importance of surveillance, public awareness, supportive care, vaccination, and international collaboration in mitigating the impact of future outbreaks.

Keywords: Ebola Virus Disease (EVD), Pathophysiology, Public Health, Outbreak Response, Vaccination, Nigeria

OVERVIEW

Ebola virus disease (EVD) is a highly lethal infectious disease caused by the Ebola virus, which primarily affects humans and non-human primates. First identified in 1976, the disease has since become a significant public health concern, particularly in sub-Saharan Africa. EVD is characterized by a spectrum of severe clinical manifestations, including fever, vomiting, and hemorrhagic symptoms, with case fatality rates ranging from 25% to 90%, depending on the outbreak context. The 2014-2016 West African outbreak highlighted the devastating impact of EVD, resulting in over 11,000 deaths and drawing global attention to its epidemiology and transmission dynamics.

The disease is predominantly transmitted through close contact with infected animals and humans, with human-to-human transmission posing a considerable risk, especially in healthcare settings lacking appropriate infection control measures. Nigeria's first major outbreak in 2014 resulted in 20 confirmed cases and 8 deaths, underscoring the need for effective surveillance, preparedness, and response strategies to mitigate future outbreaks.

The pathophysiology of EVD involves extensive immune system dysregulation and multi-organ failure, primarily due to the virus's ability to replicate rapidly within host cells. Although there is no specific antiviral treatment for EVD, supportive care, including fluid and electrolyte management, remains critical in the treatment of affected individuals. Vaccination efforts, particularly the deployment of the rVSV-ZEBOV vaccine, represent a significant advancement in prevention strategies.

This article explores the complex landscape of EVD in Nigeria, detailing its etiology, epidemiology, clinical presentation, diagnosis, treatment, and prevention measures. It will also examine the unique complications faced by Nigeria during the 2014 outbreak and the ongoing challenges in managing EVD, ultimately reflecting on the lessons learned to enhance preparedness for future public health emergencies.

INTRODUCTION

Ebola virus disease (EVD) is a severe illness in humans and non-human primates caused by the Ebola virus. The disease was first identified in 1976 near the Ebola River in the Democratic Republic of Congo (WHO, 2023). Symptoms include fever, muscle pain,

headache, and sore throat, followed by vomiting, diarrhea, and, in severe cases, internal and external bleeding (CDC, 2023).

EVD has a high mortality rate, with case fatality rates varying between 25% and 90% depending on the outbreak (Feldmann & Geisbert, 2011). The virus gained significant attention during the 2014-2016 West African outbreak, which caused over 11,000 deaths (Kuhn & Jahrling, 2015).

EPIDEMIOLOGY

EVD primarily affects sub-Saharan Africa, with significant outbreaks recorded in the Democratic Republic of Congo, Sudan, Uganda, and West Africa. The 2014-2016 outbreak in Guinea, Sierra Leone, and Liberia was the most extensive and deadly (WHO, 2023). EVD continues to pose a risk due to its presence in animal reservoirs, particularly fruit bats. Human-to-human transmission in healthcare settings also remains a significant concern during outbreaks (CDC, 2023).

Nigeria experienced its first major outbreak in 2014, which resulted in 20 confirmed cases and 8 deaths (NCDC, 2022). Since then, sporadic cases have been reported, highlighting the need for ongoing surveillance and preparedness (Okonkwo et al., 2023). The case fatality rate for EVD can reach up to 90% in some outbreaks, emphasizing the disease's lethality (CDC, 2023).

AETIOLOGY

EVD is caused by the Ebola virus, part of the Filoviridae family. There are five known species of the virus, including Zaire ebola virus, which is the most lethal and responsible for most outbreaks (Feldmann & Geisbert, 2011). The Ebola virus is an enveloped, single-stranded RNA virus that replicates within host cells, causing severe tissue damage and hemorrhagic fever (Kuhn & Jahrling, 2015).

TRANSMISSION

The Ebola virus is transmitted to humans through close contact with infected animals, particularly fruit bats, and other primates (CDC, 2023). Once in the human population, it spreads through direct contact with bodily fluids of infected individuals or contaminated objects, especially in healthcare settings where personal protective equipment is not adequately used (WHO, 2023). Survivors can carry the virus in certain bodily fluids, such as semen, for months, which can lead to sexual transmission (Feldmann & Geisbert, 2011).

EBOLA VIRUS DISEASE (EVD): PATHOPHYSIOLOGY, CLINICAL PRESENTATION, DIAGNOSIS, TREATMENT, AND PREVENTION

Pathophysiology

Ebola Virus Disease (EVD) is caused by viruses from the genus Ebolavirus in the Filoviridae family. The virus enters the host through mucosal surfaces, breaks through the skin, or is administered parenterally (Brown et al., 2017). The virus primarily targets cells of the immune system, particularly macrophages, dendritic cells, and monocytes, leading to rapid viral replication and dissemination throughout the body. Once inside the cells, the virus hijacks the host's machinery to produce more viral particles, which are released to infect surrounding tissues and organs (Letafati, Ardekani, Karami, & Soleimani, 2023).



<https://image.cnbcfm.com/api/v1/image/101903411-ebola-virus.jpg?v=1532564439&w=1480&h=833&ffmt=webp&vtcrop=y>

The immune system responds with a massive release of cytokines, causing a “cytokine storm,” which results in widespread inflammation and tissue damage. This hyperactivation of the immune system leads to vascular leakage, organ damage, and disseminated intravascular coagulation (DIC), which manifests as bleeding and hemorrhagic complications (Moghadam, Omid, & Bayrami, 2015). Key organs such as the liver, kidneys, and adrenal glands are particularly affected, leading to multi-organ failure. Endothelial cells and platelets are also infected, which compromises the integrity of the vascular system and contributes to hemorrhagic symptoms (Tiffany, Vetter, Mattia, Dayer, & et al., 2016).

The high mortality rate associated with EVD is due to the combination of direct viral damage to organs and the host’s dysfunctional immune response. Fatal cases often exhibit severe fluid and electrolyte imbalances, hypovolemic shock, and multi-organ failure.

CLINICAL PRESENTATION

The incubation period for the Ebola virus typically ranges from 2 to 21 days, with most cases presenting symptoms between days 8 and 10 after exposure (Centers for Disease Control and Prevention [CDC], 2023). The clinical course of EVD is often divided into early, advanced, and late stages.

- **Early Stage:** Initial symptoms are non-specific and can resemble those of other endemic infections such as malaria, typhoid, or influenza. These symptoms include fever, severe headache, muscle pain, fatigue, and malaise (Brown et al., 2017). Gastrointestinal symptoms such as nausea, vomiting, diarrhea, and abdominal pain typically develop soon after the onset of fever, often leading to dehydration.
- **Advanced Stage:** As the disease progresses, patients may experience systemic manifestations including confusion, lethargy, and profound fatigue. Hemorrhagic manifestations, such as petechiae, ecchymosis, and bleeding from mucous membranes, can develop in about 30% to 50% of cases (Letafati et al., 2023). In severe cases, bleeding occurs from the gastrointestinal tract, gums, or puncture sites.
- **Late Stage:** In critical cases, multi-organ failure ensues. Acute kidney injury, liver damage (manifesting as jaundice), and respiratory distress are common in fatal cases (Tiffany et al., 2016). Neurological complications such as encephalopathy, seizures, and coma can also occur in the later stages of the disease (Billieux, Smith, & Nath, 2016).

Survivors of EVD frequently experience long-term complications, including post-Ebola syndrome, which is characterized by persistent joint and muscle pain, chronic fatigue, and ocular problems such as uveitis (Tiffany et al., 2016).

DIAGNOSIS

Timely diagnosis of EVD is crucial for effective isolation, treatment, and prevention of transmission. Diagnosis typically involves a combination of clinical evaluation and laboratory testing.

- **Clinical Evaluation:** A high index of suspicion is necessary for patients presenting with symptoms consistent with EVD, especially if they have epidemiological risk factors such as recent travel to an outbreak area or contact with confirmed cases (Oluabunwo, Ameh, Oduyebo, Ahumibe, & et al., 2016).
 - **Laboratory Testing:**
 - **Reverse Transcriptase Polymerase Chain Reaction (RT-PCR):** This test is the gold standard for confirming Ebola virus infection, as it detects viral RNA in the blood during the acute phase of the disease. RT-PCR can typically detect the virus within days of symptom onset, allowing for early diagnosis (CDC, 2023).
 - **Antigen Detection ELISA:** This test can detect viral proteins (antigens) in patient samples and is used as a rapid diagnostic test in field settings. It is less specific than RT-PCR but useful for rapid screening.
 - **Serological Testing:** Serological tests are used to detect antibodies (IgM, IgG) against the Ebola virus. These tests are typically used to confirm past infections or in late-stage disease when the viral load decreases (Brown et al., 2017).
 - **Other diagnostic tests include:** liver and kidney function tests, coagulation profiles to assess bleeding risk, and imaging studies to evaluate organ damage. Early diagnosis is key to preventing transmission and initiating life-saving interventions.
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TREATMENT

There is no specific antiviral treatment for Ebola virus infection approved for widespread use, but supportive care is the cornerstone of EVD management. Treatment aims to stabilize the patient and manage complications through the following interventions:

- **Fluid and Electrolyte Management:** Patients often experience significant fluid loss due to vomiting and diarrhea, leading to dehydration and electrolyte imbalances. Aggressive rehydration with intravenous fluids and electrolyte replacement is critical to maintaining hemodynamic stability (Letafati et al., 2023).
- **Oxygenation and Hemodynamic Support:** Patients with respiratory distress may require supplemental oxygen or mechanical ventilation. Blood pressure support with vasopressors may be needed in cases of septic or hypovolemic shock (Oleribe, Oladipo, Nwachukwu, & Abimbola, 2014).
- **Investigational Treatments:** Several experimental therapies have been developed and tested, particularly during the 2014-2016 West African outbreak. Two monoclonal antibody treatments, Inmazed and Ebanga, have been approved for use in the treatment of EVD. These therapies have been shown to reduce mortality in patients when administered early in the course of the disease (WHO, 2021). Other investigational treatments include antiviral agents such as Remdesivir, which has demonstrated some efficacy in inhibiting viral replication (Brown et al., 2017).
- **Post-Ebola Syndrome Management:** For survivors, long-term follow-up is necessary to address lingering complications such as joint pain, chronic fatigue, and mental health issues (Tiffany et al., 2016). There is no specific antiviral treatment for EVD; supportive care remains the cornerstone of management. This includes intravenous fluids and electrolyte replacement. Recently developed monoclonal antibodies and vaccines have shown promise in clinical trials (Annual Review of Virology, 2019). The Ervebo vaccine has been approved for use against the Zaire strain of the virus (WHO, 2023).

PREVENTION

Prevention strategies are critical for controlling the spread of the Ebola virus, especially in outbreak-prone regions. Prevention measures focus on minimizing human exposure to the virus and controlling transmission through effective public health interventions:

- **Vaccination:** The recombinant vesicular stomatitis virus-Zaire Ebola virus (rVSV-ZEBOV) vaccine has been a major breakthrough in preventing EVD. It has been deployed in mass vaccination campaigns targeting high-risk populations, including frontline healthcare workers and individuals in outbreak zones. The vaccine provides significant protection against the Zaire strain of the Ebola virus (Brown et al., 2017).
- **Infection Control Practices:** Strict infection control measures are necessary to prevent nosocomial transmission. Healthcare workers must use personal protective equipment (PPE), including gloves, masks, gowns, and face shields, when caring for patients with suspected or confirmed EVD (Oluabunwo et al., 2016). Proper hand hygiene, sterilization of equipment, and safe disposal of medical waste are essential components of infection prevention.
- **Contact Tracing and Quarantine:** Early detection of EVD cases and contact tracing are vital to limiting the spread of the virus. Suspected cases should be isolated, and individuals who have had close contact with confirmed cases should be quarantined and monitored for symptoms for 21 days (CDC, 2023).
- **Safe Burial Practices:** The Ebola virus can persist in the bodies of deceased individuals, making burial practices a significant risk factor for transmission. Safe burial protocols include wearing PPE and handling the body in a way that minimizes exposure to bodily fluids (WHO, 2021).
- **Public Awareness and Education:** Community engagement and education are essential for preventing future outbreaks. Public health campaigns should focus on educating populations in high-risk areas about Ebola transmission, symptoms, and the importance of seeking medical care early (Ayenigbara, 2014).

COMPLICATIONS OF EBOLA VIRUS IN NIGERIA

Ebola Virus Disease is characterized by a range of clinical symptoms that may lead to severe complications. In Nigeria, as in other affected countries, complications varied depending on the severity of the infection.

- **Neurological Complications:** Survivors of EVD in Nigeria reported significant neurological issues such as meningitis, encephalitis, and other brain-related illnesses. Studies indicate that the virus can infect and damage the central nervous system, leading to long-term neurological sequelae such as chronic headaches, seizures, and cognitive dysfunction (Billieux et al., 2016).
 - **Ocular Complications:** Another common complication among Ebola survivors in Nigeria was ocular problems, including uveitis (inflammation of the eye), which, if untreated, can lead to blindness. Studies from Sierra Leone, another West African nation, have indicated that persistent viral particles in the eye can result in vision impairment (Tiffany et al., 2016).
 - **Mental Health and Psychological Effects:** The Ebola outbreak also brought with it significant mental health challenges. The fear of infection, coupled with witnessing death on a large scale, caused post-traumatic stress disorder (PTSD), depression, and anxiety among survivors, families, and healthcare workers (Ayenigbara, 2014). The stigma attached to the disease further exacerbated these psychological issues, leaving survivors ostracized in many communities.
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- **Physical Debilitation and Long-Term Health Effects:** Survivors in Nigeria, much like in other regions, experienced long-term physical debilitation. Chronic joint and muscle pain, fatigue, and weakness were common among patients who recovered from EVD, sometimes lasting months or even years. These complications severely impacted their ability to return to normal life and earn a livelihood (Moghadam et al., 2015).

PUBLIC HEALTH RESPONSE

The Nigerian government has implemented various strategies to combat EVD outbreaks. These include community education, contact tracing, and vaccination campaigns targeting high-risk populations (NCDC, 2022). The establishment of Ebola Treatment Units has been crucial in managing confirmed cases while preventing further transmission.

CURRENT CHALLENGES IN MANAGING EBOLA IN NIGERIA

Despite Nigeria's successful containment of the 2014 outbreak, several challenges continue to hinder effective management and preparedness for potential future outbreaks.

- **Healthcare Infrastructure:** One of the major challenges Nigeria faced during the outbreak, and which remains relevant today, is the lack of an adequate healthcare infrastructure. While Nigeria managed to contain the outbreak in 2014, this success was largely due to the rapid international response and support (Oluabunwo et al., 2016). The country's healthcare system remains underfunded and understaffed, which leaves it vulnerable to future outbreaks.
- **Public Awareness and Education:** Despite the success of public awareness campaigns during the 2014 outbreak, there remains a challenge in ensuring sustained education and awareness about EVD. Misinformation, cultural beliefs, and distrust in the healthcare system continue to pose barriers to the successful management of infectious diseases like Ebola (Ayenigbara, 2014). Ensuring that the public understands the risks and prevention measures is vital to containing future outbreaks.
- **Post-Ebola Syndrome and Survivor Care:** Nigeria continues to face challenges in caring for survivors who experience what is now called post-Ebola syndrome (PES). This syndrome refers to the array of lingering physical and psychological symptoms that persist after the virus has cleared from the body. The country lacks a robust system for follow-up care of Ebola survivors, and many patients have limited access to the medical and psychological support they need to recover fully (Vetter et al., 2016).
- **Epidemiological Surveillance and Preparedness:** Nigeria's epidemiological surveillance system has improved since 2014 but remains underdeveloped in rural areas. Effective surveillance is critical for early detection and response to future outbreaks. Ensuring timely data collection, information sharing, and rapid response mechanisms is a continuous challenge for Nigerian health authorities. Any delays in identifying and isolating Ebola cases could lead to widespread transmission, especially in urban slums where living conditions make containment more difficult (Oluabunwo et al., 2016).
- **International Collaboration:** Nigeria's response to the Ebola outbreak in 2014 was bolstered by strong international cooperation. However, sustaining such partnerships and securing long-term financial and technical support for preparedness initiatives remain challenging (Moghadam et al., 2015). Future outbreaks may not always benefit from the same level of international intervention, making it crucial for Nigeria to invest in self-reliance.

CONCLUSION

The Ebola outbreak in Nigeria serves as a significant case study of how quick and decisive action can contain a potentially catastrophic public health crisis. Nigeria's success in 2014 was the result of a coordinated response that combined public health expertise, swift isolation measures, and international support. However, challenges remain in ensuring the country is better prepared for future outbreaks. The need for improved healthcare infrastructure, better public health education, and continued support for survivors is critical in mitigating the long-term impact of the virus. Also, continued investment in surveillance, research for effective treatments and vaccines, and community engagement are essential for controlling future outbreaks.

As the threat of emerging infectious diseases remains ever-present, Nigeria must build on the lessons learned from the Ebola crisis. The country's healthcare system needs stronger investment in disease surveillance, training, and healthcare resources to ensure it can respond effectively to future public health emergencies. Finally, care for survivors should become a national priority, as post-Ebola complications continue to affect the lives of those who survived the disease but are left battling its long-term effects.

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