# Epidemiology of ebola virus : transmission, symptoms, treatment, prevention and control

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**ABSTRACT**

Ebola virus also known as Ebola hemorrhagic fever or Ebola ,is caused by Ebola virus (EBOV).Ebola virus is a linear non segmented, single negative stranded RNA virus .Up to 90% of those who contract the Ebola virus (EBOV) die from the severe hemorrhagic fever it causes. Interest in this virus has increased as outbreaks have become more frequent and since EBOV was added to the category A list of potential biothreat agents. The understanding of the pathogenic mechanisms behind Ebola haemorrhagic fever (EHF) has significantly increased as a result of many investigations conducted in animal models. Vascular dysfunction and immune response impairment are two important elements in the pathogenesis of EBOV. Here, we make an effort to condense the state of our understanding of EBOV pathogenesis, focusing on these two aspects as well as recent developments in the creation of vaccines and potential therapies.

Keywords : Ebola,biotreat,EBOV,epidemiology

## INTRODUCTION

Ebola virus also known as Ebola hemorrhagic fever or Ebola ,is caused by Ebola virus (EBOV).Ebola virus is a linear non segmented, single negative stranded RNA virus . it is belongs to the filoviridae virus family [1].It is a rare but sever disease. It is transmitted to people from wild animals and transmitted to human to human[WHO].It is transmitted primarily through body fluids or contact with contaminated environment or contact with the patient that had EVD[2].when the viral load is high and patient has uncontrolled diarrhea, vomiting , and bleeding,transmission is most likely to occur with advanced disease[2].It has six species has been identified named after the region of discovery :Zaire ebolavirus, Bundibugyo ebolavirus ,Sudan ebola,Reston ebolavirus ,Tai forest ebolavirus and bombali ebolavirus[1].first it is discovered in near ebola river in the democratic Republic of Congo in 1976.2013-2016 outbreak in west Africa was the largest Ebola outbreak since the first outbreak in 1976[2].on 8 August world health organization declared that Ebola disease outbreak in west Africa a public health emergency of international concern (PHEIC).In 2014 September 18 there is a total of 5335 cases with 2622 death reported have been noticed in Guinea ,Liberia and Sierra Leone [4]. Genetic sequencing that has shows that the virus isolated from infected patients in 2014 outbreak is 97% is similar that of the previous outbreaks[BMJ].In of 4 February 2015,a total of 22,495 cases confirmed and 8981 deaths has been reported in nine countries Guinea ,Liberia, Mali, Nigeria, Senegal, Sierra Leone,Spain, The united kingdom and united states [2].On 1st August 2018,the ministry of health of the Democratic republic of the Congo declared that a new outbreak is found in North Kivu province .As of march 12 in 2019 there have been a total of 867 confirmed cases and 587 deaths [1].Ebola is a threatening diseases it cause a major risk for the Health workers [2].Almost 50% of Ebola virus disease end in death on average in previous epidemics mortality rates ranged from 25% to 90% [WHO]. Recently in 2022 there is an outbreak of SUDAN EBOLAVIRUS disease in Uganda started on September 20 ,2022 and was declared over January 11,2023.This review aims to provide an overview of Ebola virus Disease Epidemiology ,symptoms ,transmission and treatment

**EPIDEMIOLOGY**

Ebola virus disease outbreak on 1976 in the tropical region of sub – Saharan Africa .the largest outbreak in 2014 in west Africa [5].The outbreak effected many places like Guinea , sierra Leone, Liberia ,Mali and Nigeria [5].A total of 34 EVD outbreaks is confirmed and total of 34,356 cases are reported and 14,823 deaths have been confirmed since 1976[bmj].

**1.1 Sudan outbreak**

The first EVD is identified in Nzara, South sudan between June and November in 1976 . it is caused by Sudan virus (SUDV)[5]. 284 people were infected and killed 151[6].sudan virus was first identified in Sudan occurred on 27 June in a shopkeeper in a cotton factory in Nzara, He was hospitalized on 30 June and Died on 6 July [5].The mortality rate amongst the 284 notified cases was 58%[7].the Bundibugyo species is responsible for the compact outbreak in Uganda .lvory coast virus has caused one nonfatal case .the virus that found in the pig called Reston virus has identified as viral RNA in African bats , are not known to cause illness in human[9].

**1.2 Zaire outbreak**

On 26 August 1976 , a second outbreak of Ebola virus has occurred in Yambuku , it is a small rural village in Mongala district in northern Zaire[7].this is caused by EBOV. which is the member of genus Ebola virus [2].Mabalo Lokela ,was the first infected person and he showing the symptoms on 26 August 1976.lokale went to a trip a trip to Northern Zaire near the central of africal republic border and visited Ebola river between 12 and 22 August [7].He was originally belived to have malaria and given a anti malaria drug called quinine[6 ].his condition become worse and admitted to Yambuku mission hospital on 5 September. He died on 8 September after 14 days he displaying symptoms [6].after this there were nearly 29,000 total cases of which more than laboratory confirmed .and the fatality rate was approximately 40 percent [8].the Zaire virus is responsible for additional epidemics, including outbreak in the Equateur province recognized in first june 2020 and declared over on November 18 2020 [8].the outbreak that caused by Zaire ebolavirus was acknowledge in the Equateur territory of the DRC in april 2022, it is representing the third outbreak in this territory and the sixth in the county since 2018[9]In 1995 second major outbreak occurred in Zaire .it affected 315 and death 254.in 2000 Uganda had outbreak of sudan virus affected 425 and killing 224. In 2003 there was an outbreak in republic of the congo .reported 143 and confirmed 128 .it is the outbreak that cause the highest death rate which of 90 % of Ebola virus . a Russian scientist diedin 2004 from EVD after sticking herself with an infected needle [10].Ebola cases were verified in a four village zone of democratic republic of congo in September[7].in central Africa EVD was first identify when two outbreak occurred almost at the same time in Zaire and Sudan[9].the outbreak in 2007 eventually affected 264 people and reported 187 deaths [8].30 November 2007 the Bundibugyo District in western Uganda were reported to have an Ebola virus outbreak by the Uganda ministry of health [10].they found a new species of ebola virus.in 2012 they confirmed two outbreak in Uganda. In first outbreak 7 people were effected and reported 4 deaths and 24 people were affected and 17 death were reported in the seconde outbreak[7].

**1.3 West Africa outbreak**

In west Africa EVD due to the Zaire virus has been reported in Guinea in 2013 and was confirmed by the World health organization in March 2014. It was thought that this is first occurred in 2 years old child that show symptoms live fever , vomiting and black stools without showing any other signs of bleeding [9].the disease rapidly spread to the other places such as Nigeria , Senegal, Mali , Liberia , and Sierra Leone .29,000 Ebola virus reported and more than 11,000 deaths has been confirmed due to Ebola virus . in this health workers also involved . 881 health works were infected and approximately 60 percent died, the end of the epidemic was officially recognized in early 2016[8].

**TRANSMISSION**

Ebola virus transmitted to the human population through contact with blood, secretions , organs or other bodily fluids of infected animals such as fruit bats, chimpanzees, gorillas, monkeys, forest antelope or porcupines found ill or dead or in the rainforest and also it will transmit to human to human via direct contact through broken skin or mucous membranes and mucus ,vomit, feces,sweat,tears,breast milk,urine and semen [WHO].development of disease played

between virus,host and environment . for the four human pathogenic Ebolaviruses different case fatality rates have been reported.WHO states that the people who are very sick are able to spread the virus through saliva,and there is no evidence that the entire virus can be disseminated through perspiration [10].the virus is typically transferred through vomit,feces , and blood. The virus can enter the body through the nose, mouth, eyes, as well as open sores ,cuts, and abrasions .the virus can also be spread by contact with infected surfaces or items , particularly needles and syringes[10] .the virus is able to sustain in an object and can survive for a few days within the body [11].the virus is transmitted to wide range and they noted that the increase in virus outbreak since 1994 is frequently associated with drastic chanes that caused in the ecosystem in the tropical African region[13].the disruption of these ecosystem is caused by the extensive deforestation and human activity in the depth of the forests may have promoted directly or indirectly contact between humans and the nature reservoir of the virus[12].Ebola virus are the virus biosafety level 4 pathogens and required special measure and barrier protection especially for the health workers the virus will survive in the liquid or dried surface for so many days[14].the virus can be destroyed by gamma radiation ,heating for 60 minutes or boiling for 5 minutes and this virus is sensitive to sodium hypochlorite and other disinfectants[13].freezing will not inactivate the virus [4].the period between infection and first symptoms that is called incubation period is usually 4 to 10 days but can be as two days and as long as 22 days [5].CFR for ZEBOV infections is roughly calculate between 44% and 90%[7].Airborne transmission has not been dictated [1].the level of risk is low when the contact is casual with like sharing a seat area or public transportation . when the risk is high when direct contact with any material that have the bodily fluids from a probable or confirmed case[13]. Due to its nature this virus is classified as a biologic class 4 pathogens .in this virus tree types is toxic for human body [7].Ebola Zaire ,Ebola Sudan and Ebola Tai[10].the infection affected by necrosis of the liver ,kidney , spleen ,lymph nodes, testes and ovaries due to viral replication within the parenchymal cell .more effects are microvascular damage , changes in vascular permeability and activation of the clotting cascade[8].it is not been documented EBOV can be transmitted from pigs to primates but not from primates to primates ,through the air during EVD outbreak [7]EBOV has not been found to spread through water or food sources other than bushmeat[15].No spread by mosquito or other insects has been reported [2].low levels of the virus in monkeys lungs and other respiratory organs that are insufficient to induce new infection are thought to be the source of the apparent lack of airborne transmission among humans [8].the pigs with the virus have extremely high Ebola virus concentration in their lungs rather than their circulation [16]. several research widely studying about the airborne transmission and they found out that the transmission from pigs to primates could occur without direct contact . therefore, when pigs sneeze or cough, the virus can spread through droplets in the air or on the ground [14].it not fully clear hoe Ebola initially spreads from animals to humans and the spread in involve direct contact with an infected wild animal or fruit bat [4].following EBOV infection a cluster of asymptomatic infection has been noted of these 24 contacts ,11 has asymptomatic infection and between day 7 the day of sample and day 16 had IgM and IgG responses in addition to a moderate viremia [8]. 43 the other 13 individual showed significant levels of pro –inflammatory cytokines together with high plasma viraemia [16].these findings imply a relationship between peak viraemia and pro – inflammatory cytokine comcentration that affect illness severity [15

**SYMPTOMS AND DIAGNOSIS**

Symptoms in EVD patients normally occur after an incubation period of 4 – 10 days with a range of 2 – 21 days[17] . after that there is a sudden onset of fever , myalgia , chills and vomiting and diarrhoea. The disease can rapidly involve into a severe state with a rapid clinical decline[7] .Potential hemorrhagic consequences and multiple organ failure characterize this disease phase [17].patients with this virus may can develop gastrointestinal symptoms like nausea,stomach pain,vomiting , and diarrhea[7] .neurological symptoms like headache , profound weakness , and coma, respiratory symptoms like coughing , dyspnea , and rhinorrhea as well as generalized symptoms from cardiovascular system failure like shock and swelling [4].between days 5 and 7 after the start of this virus the most frequently cited reported symptoms are fever together with anorexia , asthenia,and a maculopapular rash[2].in the current outbreak the majority constitute gastrointestinal symptoms [5].clinical symptoms and chemical laboratory tests confirmed that multi –organ involvement [7].leucopenia and lymphopenia , are the most common haematological with a specific decreased neutophill count and increase in liver enzymes [4].prothrombin time and activated partial thromboplastin time prolong as the disease progresses in EVD patients , causing thrombocytopenia [8]. The rise in fibrin products that break down and the lengthening of clotting durations point to a consumptive coagulopathy brought on by disseminated intravascular coagulation which worsens multi – organ failure[2].most fatal Ebola virus disease cases pass away between days 6 and 16 following the onset of symptoms [6].the patients that infected with this virus due to shock haemorrhage and multi – organ failure [5]. If the patients recover the clinical improvement arises occur with the development of the antibody response [7].in some cases the antibody response sometimes remains absent [8].people that recoverd from the virus could develop long – term symptoms and disorder such as recurrent hepatitis

,myelitis,prolonged hair loss. phychosis and uveitis [11].the diagnosis of virus is identified by the viral genome detection through RT-PCR .the virus is generally detectable 48 hours after infection in both lethal and non – lethal cases . this indiucates that EBOV infection cannot be ruled out by a negative test result within the first 48 hours of exposure [13].serology is not used to diagnose virus patients because to the rapid progression of the disease , but it may be useful in epidemiological and surveillance research[17] . IgM antibodies can typically be found starting two days after the onset of the initial symptoms and diminish after 30-168 days [10].the 24 IgG response often begins between days 6 and 18 after the commencement of the illness and lasts for years[11].when compared to those who survive,the antibody profile of the sera from individuals with fatal diseases is noticeably different . this distinction can act as a prognosis indicator for the treatment of this virus [9].ithas been shown that deceased patients show a much lower or even absent antibody reponse compared with survivors[1].there is a special laboratory testing that diagnosis of Ebola virus is detecting by isolating the virus, identifying RNA or proteins or detecting antibodies for the virus in the persons blood [9].isolation of the virus can be done by cell culter , detecting the viral RNA by polymerase chain reaction and detecting proteins by enzyme – linked immunosorbent (ELISA) this are the test thatb take place in early stages of the disease and also for detecting the virus in human remains [9].identifying antibodies against the virus is most dependable in the later stages of the virus and in those

**TREATMENT**

In October 2020, the DA approved the first treatment for Ebola virus . the new medication ,inmazeb,combines three antibodies such as atoltivimab , maftivimab,and odesivimab – ebgn . patients who take inmazeb have a higher chance of survival[6].early supportive care combined with symptoms therapy and rehyradtion increases survival[3].rehydration can br accomplished either orally or intravenously [7].,management of pain .nausea , fever and anxiety are a few examples of these measures [3].it is also possible to employ blood components such packed red blood cells,platelets , or fresh frozen plasma[8].heparin which is used to stp disseminatrd intravascular coagulation , and clotting factor , which reduce bleeding, are other coagulation regulators that have been attempted[10].even though there is no proof that such treatment is effective it is frequently employed before the diagnosis is definitive[11].there are several investigational therapies under investigation [6].no known vaccines or treatment are that effectivr according to the head of the us national institute of allergy and infectious diseases , research on the causrs , symptoms and potential treatment for Ebola virus infection is still in its infancy [7]. Clinical studies are currently being conducted or will soon be conducted on a number of novel therapies that are being explored for use in the context of this outbreak but it will still be some time before enough of these have been created to support broad trials[16].MSF said on November 13 that trials of potential treatment would begin in November in Ebola treatment facilities [6]. The Strategic Advisory Group of Experts on Immunization recommends the Ervebo vaccine as part of a more comprehensive arsenal of Ebola outbreak response options since it has been demonstrated to be effective in defending humans against the species Zaire ebolavirur [7].The vaccine was prequalified by WHO and authorised by the US Food and Drug Administration in December 2020 for use in people 18 years of age and older (apart from pregnant and nursing women) as a means of preventing the Ebola virus sickness brought on by the Zare Ebola viru[7]. More than 350 000 people received the vaccine as part of the "compassionate use" protocol during the Ebola virus disease epidemics in Guinea and the Democratic Republic of the Congo in 2018–2020[WHO]. The vaccination has proven to be both secure and efficient against the Zaire ebolavirus species[16]. Beginning in January 2021, the Ervebo vaccination will be stocked globally[3]. The European Medicines Agency proposed in May 2020 that a 2-component vaccination called Zabdeno-and-Mvabea for people 1 year and older be given marketing clearance[17]. he vaccination is given in 2 doses: Zabdeno is given first, and Mvabea is given as a second dose about 8 weeks later. Therefore, this preventative 2-dose regimen is not appropriate for an outbreak response where prompt protection is required.[7 8].

**PREVENTION AND CONTOL**

As shown by a worker from the Centers for Disease Control (CDC) with an Ebola patient, protective clothing was not always a usual practise for healthcare personnel, as opposed to today. People providing Ebola care should dress in protective gear, such as masks, gloves, gowns, and goggles.[7]. he CDC advises that no skin should be exposed while using protective gear. These precautions are also advised for anybody who could handle objects that have been in contact with bodily fluids of an infected individual[8]. The CDC started advising medical staff to receive training in 2014 on how to properly don and take off personal protective equipment (PPE); additionally, a designated individual who has received the necessary biosafety training should be monitoring each step of these procedures to ensure they are done correctly[5]. he sick person needs to be kept away from other people behind barriers[9]. It is necessary to disinfect any equipment, medical waste, patient waste, and surfaces that may have come into touch with bodily

fluids[11]. During the 2014 outbreak, kits including protective gear, chlorine powder, and other cleaning items were created to assist families in treating the disease at home[17]. eat (heating for 30 to 60 minutes at 60 °C or boiling for 5 minutes) can destroy Ebola viruses. Some solvents, including alcohol-based products, detergents, sodium hypochlorite (bleach) or calcium hypochlorite (bleaching powder), and other acceptable disinfectants may be used at the right quantities to clean surfaces[10]. The hygiene and sanitation team is in duty of properly cleaning and burying all dead remains, including those with and without Ebola. Usually, these tasks are carried out by local Red Cross volunteers.[WHO]. Active and passive case discovery, contact tracing, and rumour-verification of potential cases or fatalities in the neighbourhood are all tasks performed by the epidemiological surveillance team[11]. In order to effectively contain an Ebola outbreak, social mobilisation and health education are essential. This is because community members frequently refuse to readily share information about patients, fatalities, and contacts[1]. Many socio-cultural features of Ebola haemorrhagic fever outbreaks need to be thoroughly explored since communities may reject the anti-epidemic control measures enforced by the international scientific and technical committee.[5]. The viral nature of the illness may be obscured by the stories and urban tales surrounding the epidemics[10]. The 2003 Ebola outbreak in the Republic of the Congo, for instance, required that anti-epidemic control methods be adjusted to local cultural norms about funeral customs (Hewlett et al. 2005). For public awareness, education, and information, this team should comprise medical anthropologists, local Red Cross volunteers, and opinion leaders like teachers, religious organizations, etc.[1] The secretariat, transportation, and communication coordination, as well as any other administrative, logistical, and technical support needed by the other teams, fall within the purview of the logistic support team[5]. Clinical samples for diagnostic confirmation are collected, stored, and shipped by the laboratory and research team[4]. This group is also in charge of doing ecological research to identify an outbreak's starting point[10] Prior epidemics did not prioritise providing psychosocial care for the affected family or families, but the stigmatisation of survivors and their families by the community has made this problem increasingly crucial[10].

## CONCLUSION

The deadly Ebola haemorrhagic fever outbreaks, which were once uncommon and had high case fatality rates (up to 90%), are occurring more often in Africa, primarily as a result of increased interaction with infected wildlife. Previous outbreaks took a while to be discovered, in part because of the remoteness of the epidemic's focal point, the lack of laboratory resources, and the lack of medical professionals' knowledge of the disease, which caused them to mix Ebola disease with typhoid fever or malaria. n Africa, Ebola haemorrhagic fever epidemics are a serious public health concern, necessitating the rapid development of an effective vaccine. Doctors, nurses, and field epidemiologists working in endemic nations would particularly benefit from such a vaccination. The second target audience would include researchers studying the Ebola virus, vets, and others trying to conserve wildlife in endemic regions. Many things have been learned about Ebola's virology, physiopathology, clinical manifestations, and epidemiology since the disease was first discovered in 1976, but the virus reservoir in nature is still a mystery. It is necessary to strengthen and include the reservoirs of other Ebola species in the research now being done on bats as potential ZEBOV reservoirs.

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