# Ebola virus: Virological and epidemiological perspectives of the Ebola viral disease

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**Abstract - Ebola infection is transmitted to individuals because of direct contact with body liquids containing infection particles of a contaminated patient. The incubation time frame more often lasts up to 5 to 7 days and roughly 95% of the patients show up signs within time frame of 21 days after introduction. Common highlights incorporate fever, significant weakness, loose bowels, stomach torment, cramping and sickness for 3-5 days and possibly continuing for up to seven days.Understanding variables for the re-rise of Ebola viral ailment (EVD), its pathogenesis and in addition understanding the science of Ebola infection in its common reservoir is a standout amongst the most troublesome logical issues confronting researchers today. In spite of the known seriousness of Ebola episodes, no compelling antibody or remedial medication is produced so far on account of the RNA coded nature of this virus, yet numerous competitor immunizations are going on trial basis. Deadly and irresistible nature of this infection requires the powerful indicative techniques.This review aims at highlighting epidemiology, biology, risk factors and in addition the pathogenesis of the disease in the expectation of demystifying the ailment. The present paper discusses the historical backdrop of Ebola infection alongside its source, topographical dispersion, structure, hosts, pathogenicity and control strategies. Since there is a no particular treatment available other than supportive management and palliative care, containment of this conceivably lethal infection is fundamental.**

**Key Words: Ebola infection, EVD, Epidemiology, Pathogenicity, The genome of Ebola virus.**

## I. INTRODUCTION

Out of colossal infectious organisms pervasively exhibit in the environment, around 1500 species are known to be pathogenic to humans and different primates. These incorporate close around 217 viruses. Ebola being one of the zoonotic pathogen has a place within the family *filoviridae* [1, 2]. It is the causative operator of newfound and very infectious illness alluded to as Ebola hemorrhagic fever or Ebola virus disease. The common reservoir of the virus has not yet precisely been recognized. Bats are however, suspected to be the normal suppliers of the Ebola infection as the bat samples gathered from various areas of focal Africa, were found to contain Ebola viral successions [3, 4]. Sudden episodes of these viral maladies have prompt incredible loss of important lives over the most recent couple of decades. The unpredictability related with the recognizable proof of the potential reservoir and the higher virulence ability requiring level IV biosafety cupboards for the evaluation of the virus make it harder to construe the related ailment and build up the effective medicines and preventive measures. Ebola infection is extremely serious, intense and dangerous. Introductory instances of the illness developed in 1976, in the areas of Sudan and Democratic republic Congo of north and focal Africa separately [5]. The virus quickly spreads from the infected individual to the sound individual through direct body contacts or by means of body liquids. The symptoms of the infection show up within 21 days of the exposure to the infection particle. Characteristic highlights incorporate fever, stomach agony and cramps, weakness, retching, looseness of the bowels and nausea, which draw out for possibly more than seven days. Lab testing may uncover expanded levels of aminotransferases and different conditions like lymphocytopenia and thrombocytopenia [28, 6]. Understanding variables for the re-rise of Ebola viral sickness (EVD), its pathogenesis and additionally understanding the science of Ebola infection in its common store is a standout amongst the most troublesome logical issues confronting researchers today. Learning gaps exist for this illness that is yet to be completely comprehended.

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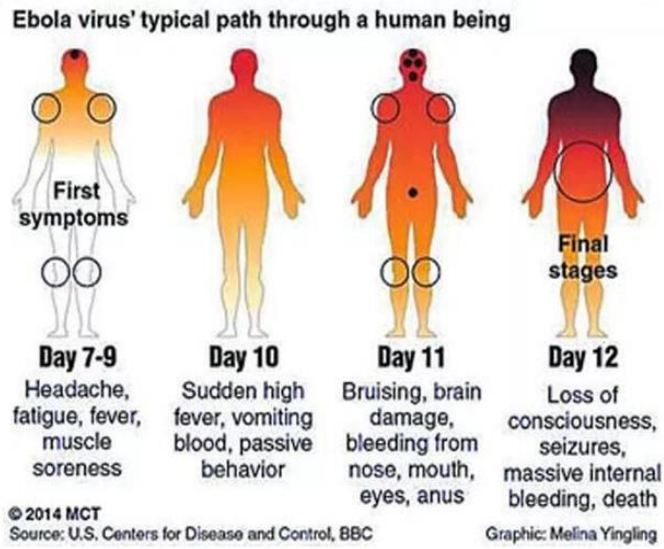


**Fig.1.** Symptoms from the onset of the disease to later stages; progression of disease and involvement of different body parts and systems during the disease progression.

**(Source:** *http://www.md-health.com/Early-Symptoms-of-Ebola-Virus-Disease.html)*

## II. THE STUDY OF DISEASE TRANSMISSION-EPIDEMIOLOGY

To start with, instance of the Ebola viral disease was accounted for in 1976 in Zaire and Sudan locales of Africa. The virus got its name after the 'Ebola River' where it was found. Amid the Zaire flare-up on 26 August 1976, Dr. Ngoy Mushola noted and set forth the principal clinical portrayal of the Ebola viral disease in Yambuku, his depiction expressed, "The condition is described with high body temperature (102˚F), diarrhea alongside blood, stomach torment, hematemesis, prostration and heavy enunciations, and loss of life within couple of days [7,8,9].

In 1995, Hundreds of instances of the ailment were accounted for in kikwit, Democratic republic Congo that were caused by the Zaire types of the EBV, out of 300 cases 231 demises were reported. In 1996, the infection hit double the district of Gabon; the principal flare-up that happened in February brought about 37 instances of the EVD, out of which 21 deaths were accounted for. Amid the second episode (July to December), 52 cases were accounted for out of which 40 died [10]. In 2000, more than 400 individuals were contaminated with the Sudan virus in Gulu, Uganda. This Ebola virus episode is considered as one of the biggest epidemics. In 2007-2008, amid a viral fever flare-up in Bundibugyo region of Uganda, another strain of the Ebola infection was found, which was named as Bundibugyo Ebola virus. It was related with less death rates when contrasted with the Sudan Ebola infection flare-ups in Sudan and Gulu areas [11, 12].

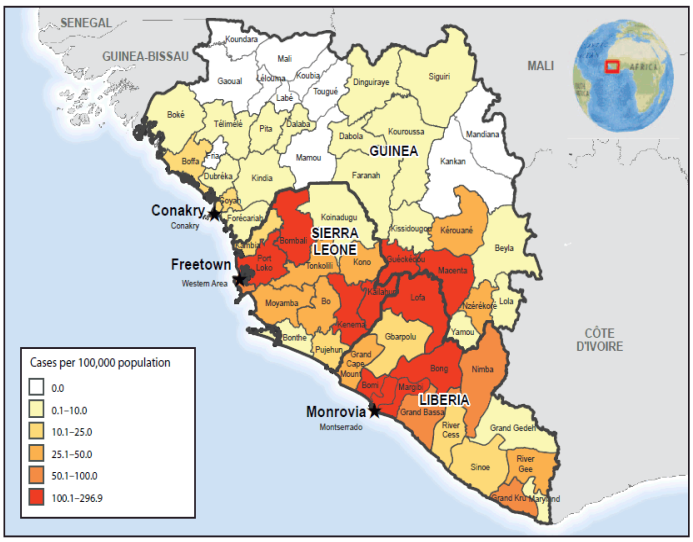


**Fig.2.** Number of cases (cumulative incidence number) reported in South Africa during September –October 2014 outbreak. [The picture depicts the regions of west Africa , with highest incidence rates in the regions of **Guinea** (Guéckédou and Macenta), **Sierra Leone** (Bombali, Kailahun, Kenema, and Port Loko) and **Liberia** (Bomi, Bong, Lofa, Margibi, and Montserrado)]

**(Source:** https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6343a3.htm)

The 2014-2015 Ebola flare-ups in West Africa is viewed as the greatest and most across the board Ebola epidemic until now. Zaire types of the Ebola virus was in charge of this outbreak and sustained transmission was watched this time, prompted higher mortality and fidelity extents. Out of the 4507 speculated cases from five nations including Nigeria, Senegal, Sierra, Liberia and Guinea, 2296 deaths were accounted for (December 2013 to September 2014) [13].Total of 28,599 cases were accounted for by WHO by tenth November 2015, out of these 11,289 died. The flare-up was followed back to a 2 year old child who passed away in December 2013 [14, 15]. As indicated by the information provided by the WHO, close around 24 episodes of the EVD have happened since the first main outbreak in 1976 to late West Africa Epidemic flare-up in 2013-15.

### Genome and Structure

The genome of Ebola virus (EBOV) particles consists of a single stranded (negative) RNA. It is approximately 19 kb in size, 18,959 to 18,961 nucleotides in length and helically twisted with seven linearlyorchestrated genes encoding seven proteins (structural). Four among these proteins nucleoprotein (NP), VP30, VP35 and L, are required for the interpretation and replication of the viral genomic RNA by forming a helical nucleocapsid [33, 34]. Rest three genes encoded proteins are glycoprotein (GP), VP24 and VP40; these are related with viral membrane to frame the filamentous virions [35, 36]. Articulation of the virion associated proteins VP24 and VP35 prompted assembly of

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nucleocapsids by transmission of electron microscopy and demonstrated that it is engaged with the assembly of EBOV nucleocapsids [37]. VP24 protein is additionally indulged in the regulatory procedure of viral genome replication and translation [38]. As Ebola infection is RNA coded, subsequently it was found to transform exceptionally quickly inside the host and repository populace. The watched mutational rate of Ebola infection is 2.0 x 10-3 substitutions per site every year that is as quick as occasional flu. That is the reason it is exceptionally hard to create immunization against Ebola infection. The structure of Ebola is barrel shaped/ tubular and enveloped contains a nucleocapsid and matrix framework segments. The width of barrels/ cylinders is around 80 nm and the length might be 14000 nm, with a spike like virally encoded glycoprotein (GP) of 7 - 10 nm long projections [39]. The general morphology of virions fluctuates significantly extending from straightforward cylinders to branches, loops and invert directions. In any case, the trademark threadlike structure is a more general state of filoviruses.

**Transmission:**

Fruit bats are purportedly believed to be the normal hosts of the EBOV. The infection might be brought into human populace through the nearby contact with the tainted creatures like chimpanzees, monkeys, pronghorns, fruit bats that might be either dead or as yet experiencing the sickness [5]. The nearness of a lot of Ebola viral particles in the sweat organs of humans recommend the conceivable transmission of the infection by means of direct body contact or on the contact with the body liquids of the contaminated individual. The viral particles might be available in the body linings and liquids, for example, bodily fluid, salivation, excrement, tears, sweat, urine, semen and breast milk [16]. The greater part of the transmissions happen through blood, excrement and vomit though no entire virus transmission has been accounted for through sweat [17].

The entry routes for the EBV encompass mouth, nose, wounds, cuts and eyes [16]. Higher constancy of the Ebola infection is seen in the semen and the breast milk of the infected individual who have been as of now recovered. The viral particles stay dynamic in the semen of the recovered individual for up to two months or increasingly and might be exchanged to the sound individual amid the sexual practices. The infection may likewise be available in the breast milk of the survivor after she has recuperated and might be transmitted to the newborn child amid nourishing procedure. Under different conditions, the individual who has once recovered from the malady is non-infectious [29].

Dead bodies of the tainted people are significant wellspring of disease as they contain feasible viral particles in plenitude even after the demise of the individual. Individuals indulged in the custom services of the dead are more inclined to the disease amid the customary practices like washing the body, touching, kissing and so on [18].

Airborne transmission of the infection has not been accounted for between people [3].The proposed explanation behind this absence of transmission by means of air is the low number of infection particles introduced in the lungs and respiratory track of the primates, which are not adequate to cause a disease in the sound individual [19]. Airborne transmission from pigs to primates has been accounted for lab conditions because of presence of similarly higher centralization of the Ebola virus in the lungs of pigs than in their circulation system [20]. Pigs experiencing the Ebola viral illness can spread these infection particles straightforwardly into nature through the droplets that turn out when they sniffle, cough or eat something [21].

As opposed to other infections, Ebola demonstrates most elevated transmissibility levels amid the clinical course of contamination [26]. The infection can spread to wherever on the planet in less time by means of current transportation. Late investigations recommend a critical part of environmental factors and conditions in the transmission of the ailment [22].

Centre of Disease Control (USA) has announced the EBOV and MARV as category A bioterrorism specialists as these are exceptionally infectious and can be utilized as strong natural weapons [23].

**Counteractive action and Treatment:**

Adopting preventive measures is the main productive approach to limit the spread of the ailment to a bigger populace, as there is no particular treatment accessible for the Ebola hemorrhagic fever till date. Immunizations that may demonstrate valuable in treatment of the related illness are under clinical trials to guarantee human safety [24]. To enhance the condition and odds of survival of the patient intercession of electrolytes to keep up the balance of the body salts, managing the circulatory pressure levels and keeping up a regime of antiviral and anti-toxin medications to battle the extra infections may prove empowering [25].

A formulation containing equine IgG, acquired from horse subsequent to immunizing it with EBOV was made economically accessible by WHO for use after 1995 breakout. Comparable counter acting agent (antibody) preparations were later on prepared, yet these did not demonstrate effective for some of the animal varieties like monkeys yet gave better outcomes when tried on *Hamadryas bamboo* [26]. The best method to limit the death toll is embracing the control methodologies. These incorporate honing safe entombment and crimination of the tainted bodies. Direct contact with the patient ought to be abstained from, wearing gloves and covers while managing the patients can prove useful in control. Standard purification of the rooms, utensils and the various living territories can prove valuable. Different immune treatments,

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drug mixes and serological items are being assessed and are presently under scrutiny to discover particular treatment for the disease. Utilization of biosafety level - 4 labs amid research and experimentation on creature models, creating mindfulness in the general people and groups about the dangers and the symptoms can limit the seriousness and severity in many cases [27].


**Fig.3.**Preventive measures to minimize the spread of disease. (Avoiding direct contact with the infected person or infected animals and dead bodies and maintaining proper hygiene can mitigate the spread of this contagious disease)

**(Source:** https://eboladelara.weebly.com/treatment-andor-prevention.html)

**Elective medication**

The Food and Drug Administration (FDA) instructs individuals to be cautious regarding promotions making of unconfirmed or fake cases of advantages picked up from different anti- Ebola products [30]. The FDA has effectively conveyed no less than one letter of caution to a merchant of colloidal silver who made unsubstantiated claims of Ebola related advantages, apparently got from the utilization of their products [31].

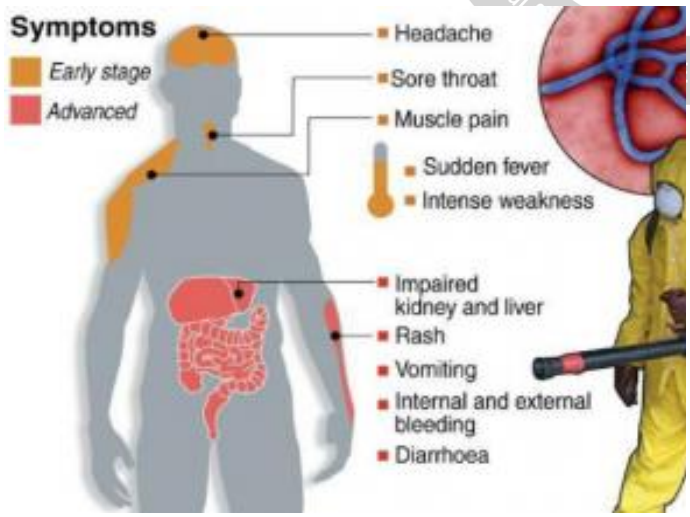


**Fig.4.** Symptoms of the Ebola viral disease - initial stage symptoms and the involvement of vital organs like kidney and liver during the advanced stage of infection.

**(Source:** https://academichelp.net/samples/academics/essays/expository/ebola.html)

## III. PROBABLE REASONS THAT MAKE THE EBOLA VIRUS ONE OF THE DEADLIEST EXPOSURE FOR HUMANS

Different irresistible maladies including tuberculosis, AIDS and dengue result in death of a huge number of individuals everywhere throughout the world yet what contrasts Ebola from others, is that it is profoundly baffling. Herein are some intriguing actualities about the Ebola infection that make it so savage [32].

- It can lead to loss of life within seven days
- Specific treatment or vaccination is not available.
- Assaults all aspects of the human body
- Disturbs the immune system
- Its origin is not known
- The infection interferes and manipulates the immune system
- We don't have the foggiest idea about all the diverse ways it can spread
- Increases in number and multiplies quickly
- Destabilizes the vascular framework
- Discharges several infectious particles at any given moment

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## IV. CONCLUSION

EVD is a considerable and disturbing reminder that a flare-up anywhere can be a hazard all around. The Global Health Security Agenda looks to implement general wellbeing frameworks and health systems in most influenced nations with a specific end goal to dispose of the spreads before they move toward becoming crises. Despite the fact that awesome changes have been accomplished over the previous decade, better observation, continuous sharing of information and making quick move based on the accessible data stay fundamental. Since Ebola infection is fundamentally transmitted through contact with the body liquids of symptomatic patients, the contamination spread can be halted by an early conclusion, contact precaution, quiet detachment and care, contamination control and safe internment. In spite of the known seriousness of Ebola flare-ups, no compelling immunization or restorative medication is created so far on the grounds because of the RNA coded nature of this infection, yet numerous applicant immunizations are going on trial premise. Recently , The U.S. Food and Drug Administration (FDA) affirmed the Ebola immunization rVSV-ZEBOV (called Ervebo®) on December 19, 2019. This is the first FDA-endorsed vaccine for Ebola. This vaccination is given as a solitary portion antibody and has been discovered to be defensive against Zaire ebolavirus, which is responsible for most lethal Ebola episodes till date. The Advisory committee on immunization practices (ACIP) suggested pre-exposure prophylaxis immunization with rVSV-ZEBOV for grown-ups ≥ 18 years old in the U.S. populace who are at possible occupational risk of contracting Zaire ebolavirus. A two-dose immunization routine of an alternate vaccine that was likewise intended to ensure protection against the Zaire ebolavirus was utilized under a research procedure in 2019 during an Ebola flare-up in the Republic of the Congo. This two dose immunization utilizes two diverse vaccine portions (Ad26.ZEBOV and MVA-BN-Filo) and the routine requires a first initial dose and a "booster" dose 56 days after that. This vaccination has not yet been affirmed by the FDA for regular use. Deadly and irresistible nature of this infection requires the viable analytic strategies. Researchers working in this field ought to be agreeable and committed to battle this cataclysmic event successfully.

## CONFLICT OF INTEREST

The creators pronounce no conflict of interest. The writers alone are in charge of the substance and composing of this article.

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