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Ebola: The Killer Virus

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ABSTRACT

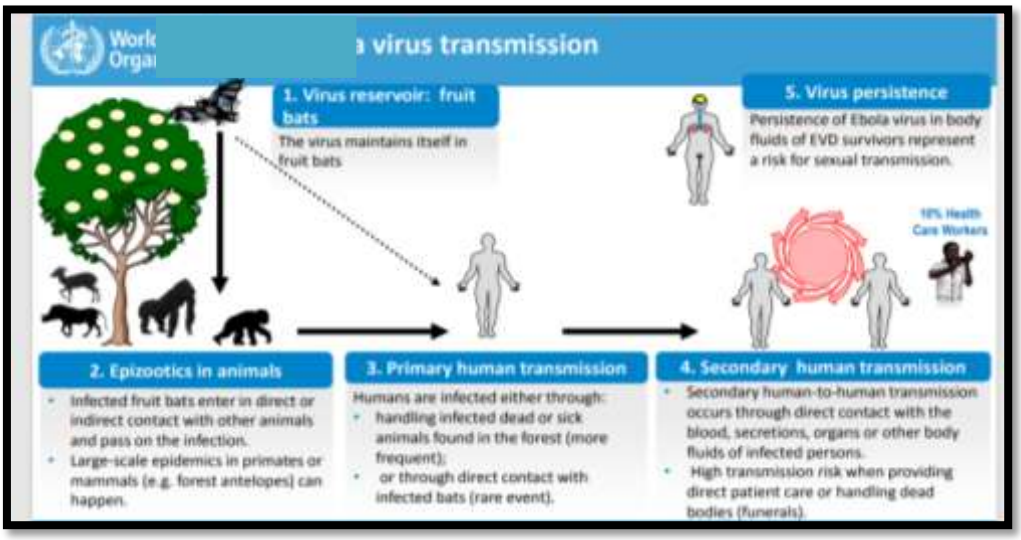
Ebola virus disease (EVD) is a deadly disease with occasional outbreaks that occur primarily on the African continent. EVD most commonly affects people and nonhuman primates (such as monkeys, gorillas, and chimpanzees). Five species of Ebola virus have been identified. Among them, Bundibugyo ebolavirus, Zaïre ebolavirus, and Sudan ebolavirus have been associated with large outbreaks in Africa.These viruses cause a disease characterized by systemic viral replication, immune suppression, abnormal inflammatory responses, major fluid and electrolyte losses, and high mortality. The largest outbreak to date was the epidemic in West Africa, which occurred from December 2013 to January 2016, with 28,646 cases and 11,323 deaths.

Keywords: Ebola virus disease; Epidemiology;Clinical Manifestations; Outbreak; Virology;Treatment;Prophylaxis.

I. INTRODUCTION

Ebola, also known as Ebola virus disease (EVD) or Ebola hemorrhagic fever (EHF), is a viral hemorrhagic fever of humans and other primates caused by ebolaviruses.[1,2]Filoviruses (family Filoviridae) are enveloped, negative-sense single-stranded RNA viruses that can reach lengths of 800–1400 nm.[6] The virus family Filoviridae includes three genera: Cuevavirus, Marburgvirus, and Ebolavirus.[7] Ebolavirus can be subdivided into the:[8]

- Zaire
- Sudan
- Tai Forest
- Bundibugyo
- Reston Ebolavirus species



Source: World Health Organization

The virus is transmitted to people from wild animals and then spreads in the human population through human-to-human transmission.[5] These public health pathogens are primarily

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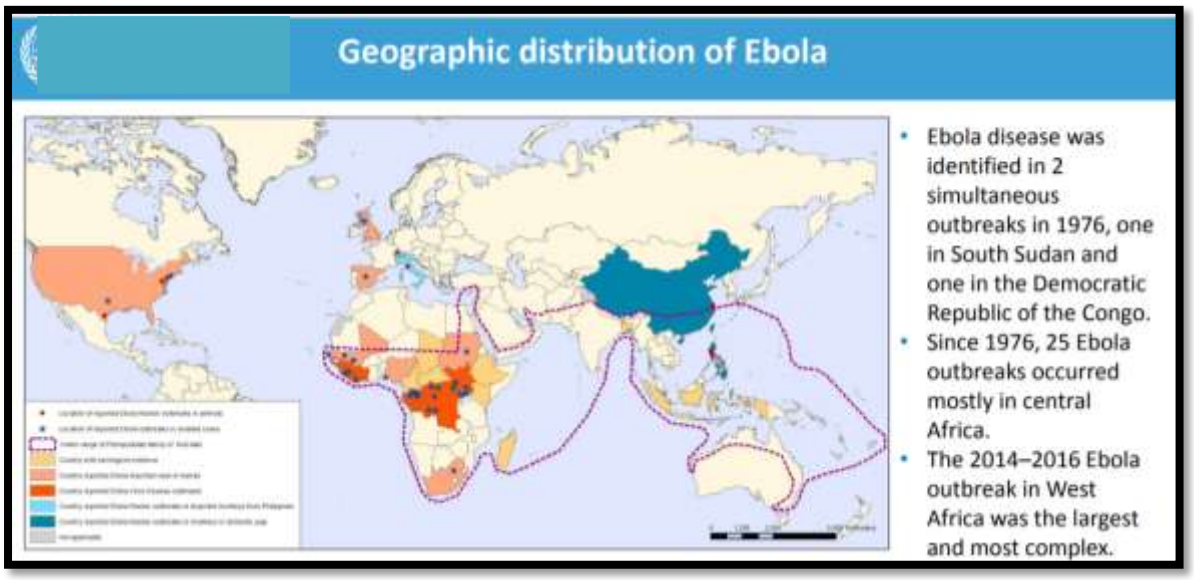
transmitted by human-to-human contact with infected body fluids and corpses and causes severe and acute systemic disease with high mortality.[9] The average Ebola case fatality rate is around 50% Ebola viruses have substantial epidemic potential, as shown by the 2013–16 west African outbreak.[10,11] Its economic impact on the west African region was crippling. This outbreak also showed that, in a context of resource-poor public infrastructure, a rapid transition from primarily affected.[13]

HISTORY

Ebola Virus was discovered in 1976 when two consecutive outbreaks of fatal hemorrhagic fever occurred in different parts of Central Africa.[14] The first outbreak occurred in the Democratic Republic of Congo (formerly Zaire) in a village near the Ebola River, which gave the virus its name.[15] The second outbreak occurred in what is now South Sudan, approximately 500 miles (850 km) away. Initially, public health officials assumed these outbreaks were a single event associated with an infected person who traveled between the two locations. However, scientists later discovered that the two outbreaks were caused by two genetically distinct viruses: Zaire ebolavirus and Sudan ebolavirus.[16] After this discovery, scientists concluded that the virus came from two different sources and spread independently to people in each of the affected areas.



Source: World Health Organization

Since its discovery in 1976, the majority of cases and outbreaks of Ebola Virus Disease have occurred in Africa.[17] The 2014-2016 Ebola outbreak in West Africa began in a rural setting of southeastern Guinea, spread to urban areas and across borders within weeks, and became a global epidemic within months. Other outbreaks in Africa began in the Democratic Republic of the congo in 2017 and 2018.[18]

EPIDEMIOLOGY[5]

Since ebolaviruses were first identified in 1976, over 20 known outbreaks of Ebola disease have been identified in sub-Saharan Africa, mostly in Sudan, Uganda, Democratic Republic of Congo, and Gabon, and mainly due to the Ebola and Sudan viruses.[15,19]Ebola virus disease is considered to be zoonotic, with occasional spillovers to humans, apes, and possibly other animals. Fruit bats belonging to the Pteropodidae family are thought to be the natural hosts of the Ebola virus, although the virus has not been isolated yet from bats in natural conditions.[20]

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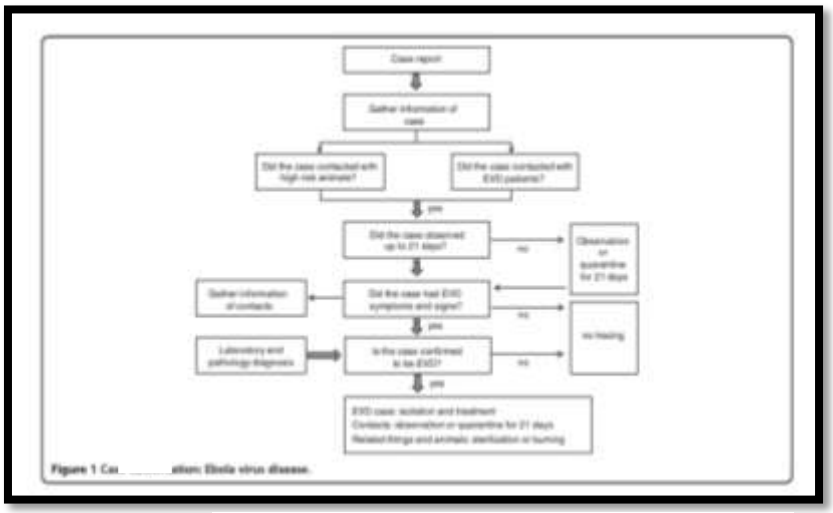
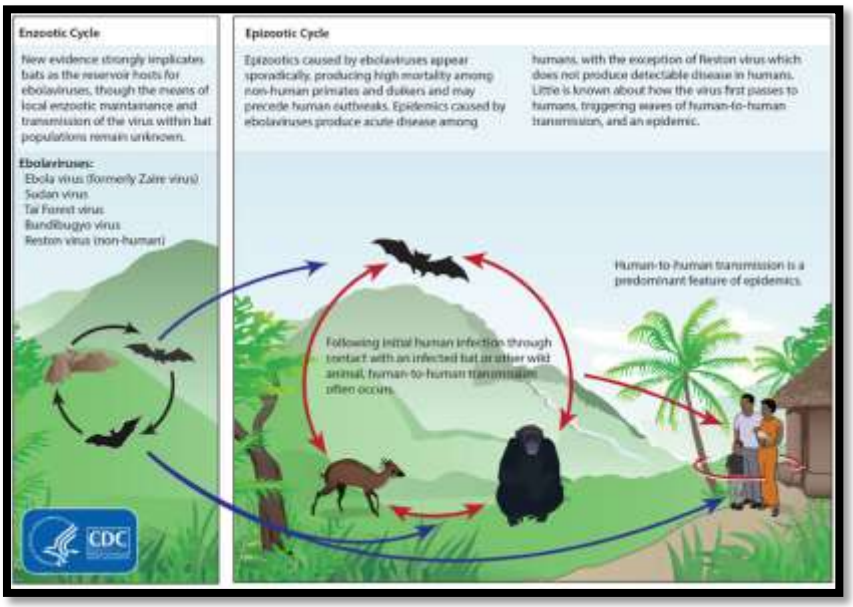


Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4440555/

Beyond the direct morbidity and mortality attributable to Ebola virus disease, the disease has indirect effects on population health because resources are diverted from programmes aimed at controlling other diseases of major importance—such as HIV infections, malaria,tuberculosis and human African trypanosomiasis— from programmes improving maternal and infant health and from primary care.[9,21]



Source: https://www.askscientific.com/ebola-virus-life-cycle-and-pathogenicity-in-humans/here

CLINICAL MANIFESTATIONS

Symptoms may appear anywhere from 2 to 21 days after contact with the virus, with an average of 8 to 10 days.[22] The course of the illness typically progresses from "dry" symptoms initially (such as fever, aches and pains, and fatigue), and then progresses to "wet" symptoms (such as diarrhea and vomiting) as the person becomes sicker.

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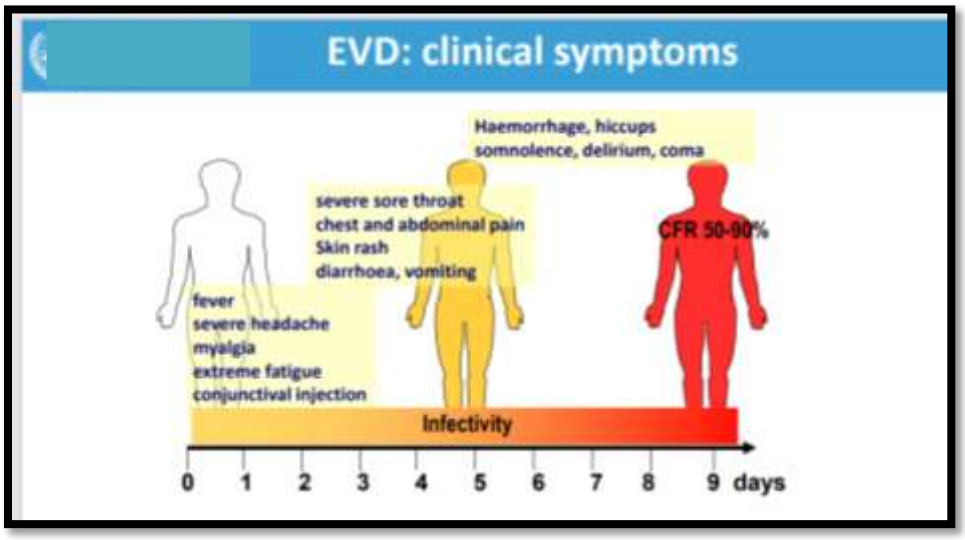
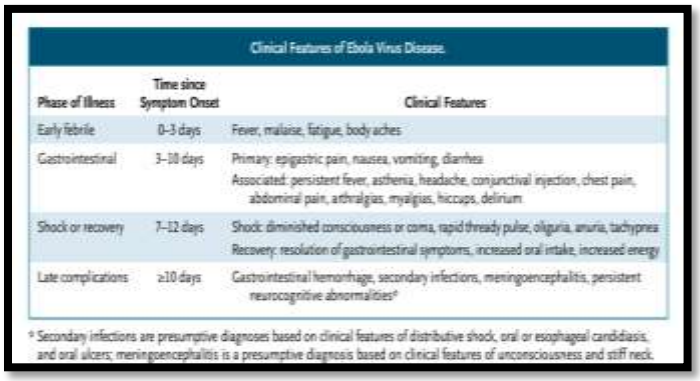


Source: World Health Organization

Symptoms of EVD can be sudden and include:[23]

- Fever
- Fatigue
- Muscle pain
- Headache
- Sore throat



Clinical Features of Ebola Virus Disease

Phase of Illness	Time since Symptom Onset	Clinical Features
Early febrile	0–3 days	Fever, malaise, fatigue, body aches
Gastrointestinal	3–10 days	Primary: epigastric pain, nausea, vomiting, diarrhea Associated: persistent fever, asthenia, headache, conjunctival injection, chest pain, abdominal pain, arthralgias, myalgias, hiccups, delirium
Shock or recovery	7–12 days	Shock: diminished consciousness or coma, rapid thready pulse, oliguria, anuria, tachypnea Recovery: resolution of gastrointestinal symptoms, increased oral intake, increased energy
Late complications	≥10 days	Gastrointestinal hemorrhage, secondary infections, meningoencephalitis, persistent neurocognitive abnormalities*

* Secondary infections are presumptive diagnoses based on clinical features of distributive shock, oral or esophageal candidiasis, and oral ulcers; meningoencephalitis is a presumptive diagnosis based on clinical features of unconsciousness and stiff neck.

Source: https://www.nejm.org/doi/full/10.1056/nejmp1413084

This is followed by:

- Vomiting
- Diarrhoea
- Rash
- Symptoms of impaired kidney and liver function
- In some cases, both internal and external bleeding (for example, oozing from the gums, or blood in the stools).
- Laboratory findings include low white blood cell and platelet counts and elevated liverenzymes.

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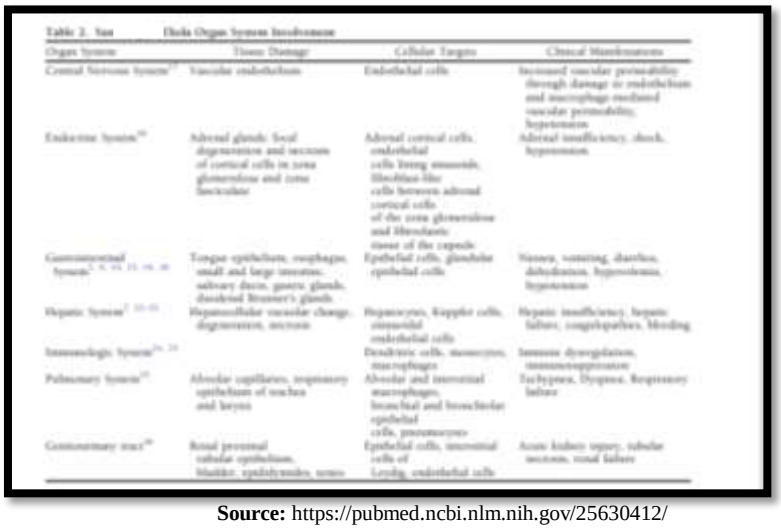

Source: https://pubmed.ncbi.nlm.nih.gov/25630412/

EVD is a rare but severe and often deadly disease. Recovery from EVD depends on good supportive clinical care and the patient's immune response.[25] Studies show that survivors of Ebola virus infection have antibodies (proteins made by the immune system that identify and neutralize invading viruses) that can be detected in the blood up to 10 years after recovery. Survivors are thought to have some protective immunity to the type of Ebola that sickened them.[26]

Source :https://microbiologyinfo.com/signs-and-symptoms-of-ebola-virus-disease/

TRANSMISSION[3,12]

Scientists think people are initially infected with Ebola virus through contact with an infected animal, such as a fruit bat or nonhuman primate. This is called a spillover event. After that, the virus spreads from person to person, potentially affecting a large number of people.[3,27]

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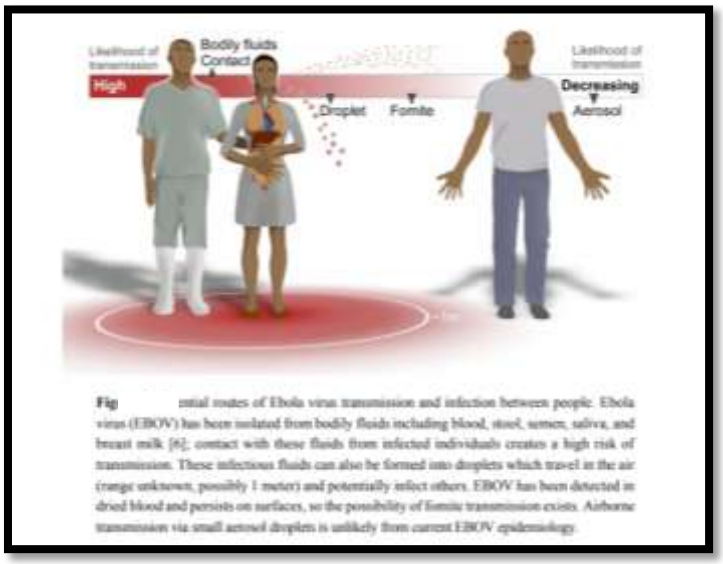

Fig ential routes of Ebola virus transmission and infection between people. Ebola virus (EBOV) has been isolated from bodily fluids including blood, stool, semen, saliva, and breast milk [6]; contact with these fluids from infected individuals creates a high risk of transmission. These infectious fluids can also be formed into droplets which travel in the air (range unknown, possibly 1 meter) and potentially infect others. EBOV has been detected in dried blood and persists on surfaces, so the possibility of fomite transmission exists. Airborne transmission via small aerosol droplets is unlikely from current EBOV epidemiology.

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4353901/

The virus spreads through direct contact (such as through broken skin or mucous membranes in the eyes, nose, or mouth) with:[28]

- Blood or body fluids (urine, saliva, sweat, feces, vomit, breast milk, amniotic fluid, and semen) of a person who is sick with or has died from Ebola virus disease (EVD).
- Objects (such as clothes, bedding, needles, and medical equipment) contaminated with body fluids from a person who is sick with or has died from EVD.

Table 1. ge about different routes of Ebola virus transmission.

Mode of transmission	Consensus likelihood of occurring	Known	Unknown
Airborne/Aerosol (small droplet/droplet nuclei)	Unlikely from epidemiology of disease	EBOV can be aerosolized mechanically and cause lethal disease in non-human primates at low concentrations [2,3]	Ability of the virus to become airborne through respiratory tract in humans and animals
		Outbreaks contained without airborne precautions in the afflicted population [4]	Airborne stability of EBOV in tropical climates
		EBOV detected after 90 min in experimental small aerosols [5]	Whether AGPs produce EBOV aerosols that cause transmission
Fomite	Less likely from environmental sampling	Virus found in dried blood [6]	EBOV stability in tropical climates and on surfaces
		Persists on glass and in the dark for 5.9 days [7]	
Droplet (large droplet)	Likely from epidemiology and experiments	EBOV found in stool, semen, saliva, breast milk [6]	Whether infectious fluids are formed into droplets by humans
		Accidental infections in non-human primates, possibly from power washing [8,9]	Range of droplets containing EBOV
		EBOV infections without direct contact [10]	
Bodily fluids contact	Very likely from epidemiology and experimental data	Sharing needles and handling the deceased or sick are high risk factors [11]	How much virus is shed in different fluids
		EBOV found in a variety of bodily fluids [6]	

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4353901/

- Infected fruit bats or nonhuman primates (such as apes and monkeys).
- Semen from a man who recovered from EVD (through oral, vaginal, or anal sex). The virus can remain in certain body fluids (including semen) of a patient who has recovered from EVD, even if they no longer have symptoms of severe illness. There is no evidence that Ebola can be spread through sex or other contact with vaginal fluids from a woman who has had Ebola.

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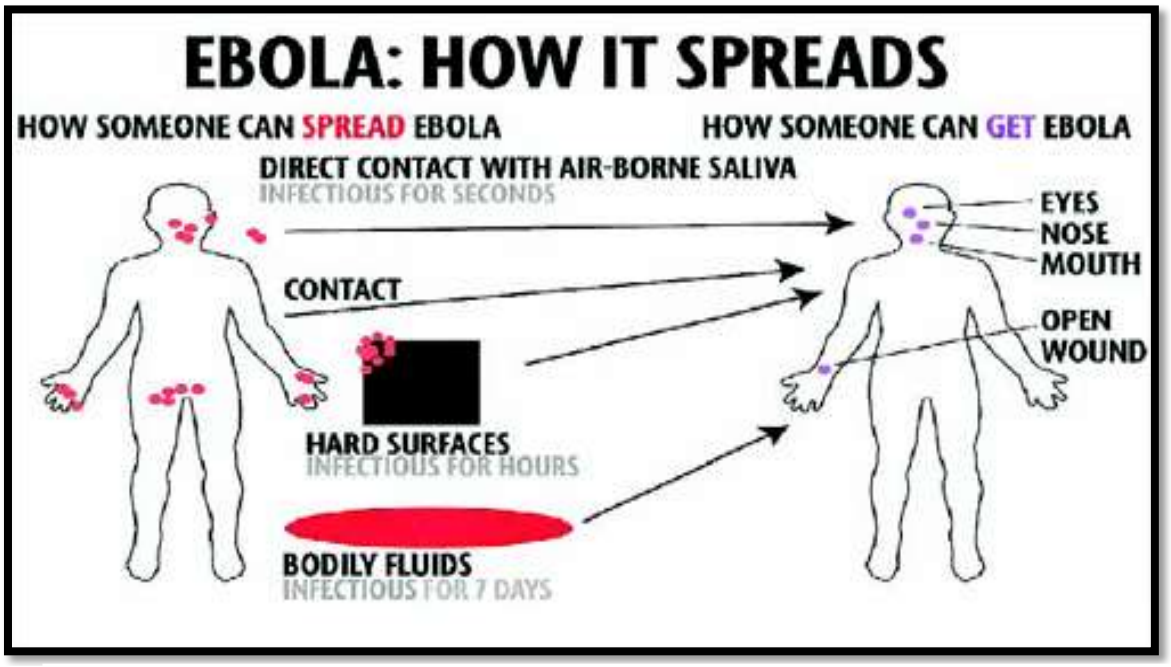
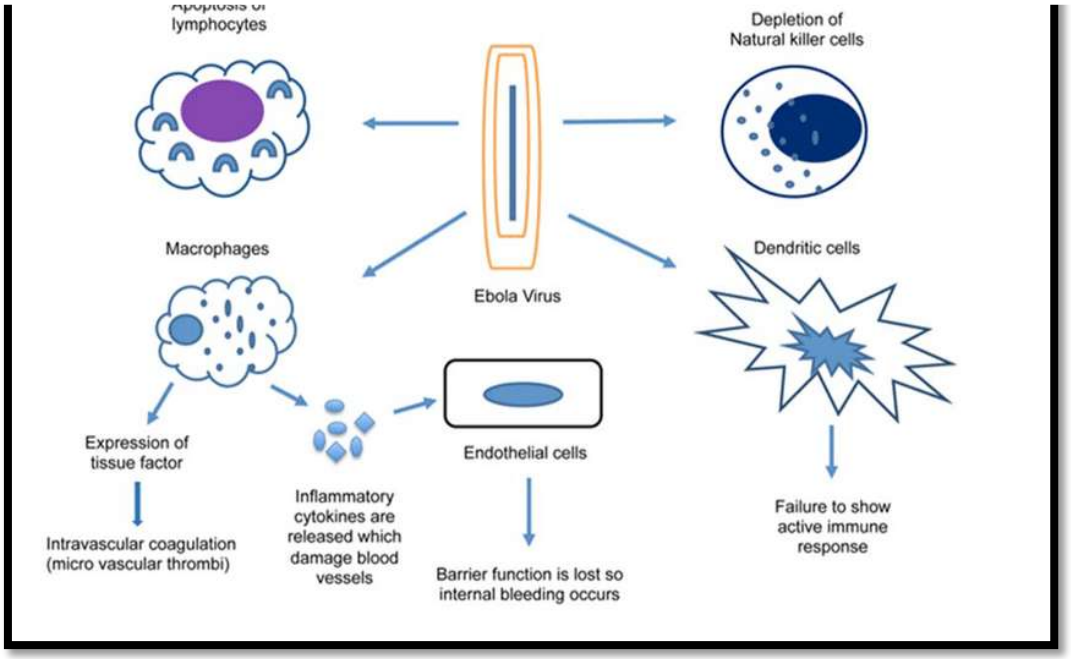


Source: https://www.vanguardngr.com/2018/05/ebola-101-answers-questions-causes-symptoms-transmission-treatments/?hcb=1

PATHOPHYSIOLOGY[4]

429928_Current_and_Futubmbre_Diagnostic_Tests_for_Ebola_Virus_Disease



Source: https://www.researchgate.net/publication/312429928_Current_and_Future_Diagnostic_Tests_for_Ebola_Virus_Disease

DIAGNOSIS

It can be difficult to clinically distinguish EVD from other infectious diseases such as malaria, typhoid fever and meningitis. Many symptoms of pregnancy and Ebola disease are also quite similar. Because of risks to the pregnancy, pregnant women should ideally be tested rapidly if Ebola is suspected.[29]

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Confirmation that symptoms are caused by Ebola virus infection are made using the following diagnostic methods:[30]

- Antibody-capture enzyme-linked immunosorbent assay (ELISA)
- Antigen-capture detection tests
- Serum neutralization test
- Reverse transcriptase polymerase chain reaction (RT-PCR) assay
- Electron microscopy
- Virus isolation by cell culture.

Careful consideration should be given to the selection of diagnostic tests, which take into account technical specifications, disease incidence and prevalence, and social and medical implications of test results. It is strongly recommended that diagnostic tests, which have undergone an independent and international evaluation, be considered for use.[33]

- Diagnostic tests evaluated through the WHO Emergency Use Assessment and Listing process

Current WHO recommended tests include:

- Automated or semi-automated nucleic acid tests (NAT) for routine diagnostic management.
- Rapid antigen detection tests for use in remote settings where NATs are not readily available. These tests are recommended for screening purposes as part of surveillance activities, however reactive tests should be confirmed with NATs.

The preferred specimens for diagnosis include:

- Whole blood collected in ethylenediaminetetraacetic acid (EDTA) from live patients exhibiting symptoms.
- Oral fluid specimen stored in universal transport medium collected from deceased patients or when blood collection is not possible.

Samples collected from patients are an extreme biohazard risk; laboratory testing on non-inactivated samples should be conducted under maximum biological containment conditions. All biological specimens should be packaged using the triple packaging system when transported nationally and internationally.[31]

DIFFERENTIAL DIAGNOSIS

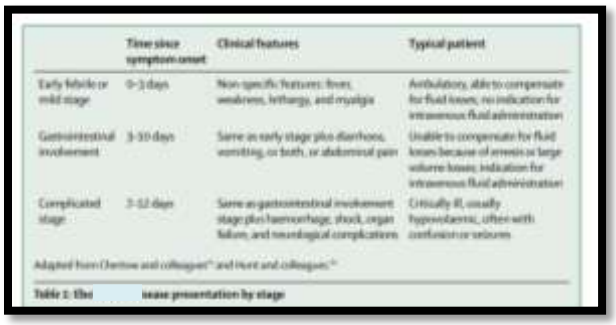
Diseases to be ruled out before diagnosis of ebolavirus:[32]

- Malaria
- Plaque
- Typhoid
- Relapsing Fever
- Cholera
- Meningitis
- Hepatitis
- Rickettsial Fever
- Dengue
- Shigellosis
- Leptospirosis

TREATMENT

Symptoms of Ebola virus disease (EVD) are treated as they appear. When used early, basic interventions can significantly improve the chances of survival.[3,34] These include:

- Providing fluids and electrolytes (body salts) through infusion into the vein (intravenously).
- Offering oxygen therapy to maintain oxygen status.
- Using medication to support blood pressure, reduce vomiting and diarrhea and to manage fever and pain.
- Treating other infections, if they occur.



Source: https://pubmed.ncbi.nlm.nih.gov/30777297/

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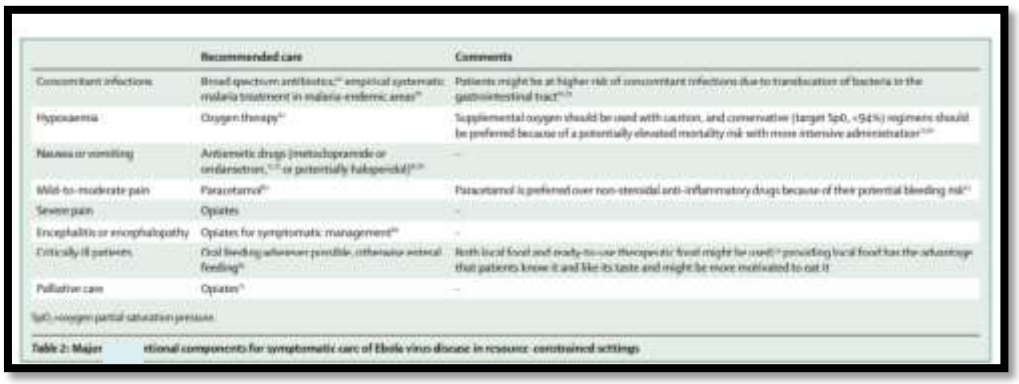
ANTIVIRAL DRUGS : There is currently no antiviral drug licensed by the U.S. Food and Drug Administration (FDA) to treat EVD in people.During the 2018 eastern Democratic Republic of the Congo outbreak, four investigational treatments were initially available to treat patients with confirmed Ebola. For two of those treatments, called regeneron (REGN-EB3) and mAb114, overall survival was much higher. These two antiviral drugs currently remain in use for patients with confirmed Ebola.Drugs that are being developed to treat EVD work by stopping the virus from making copies of itself.[35]



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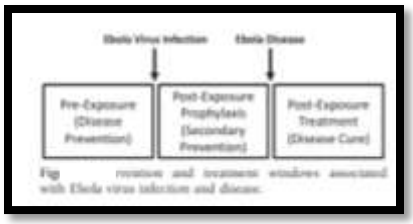
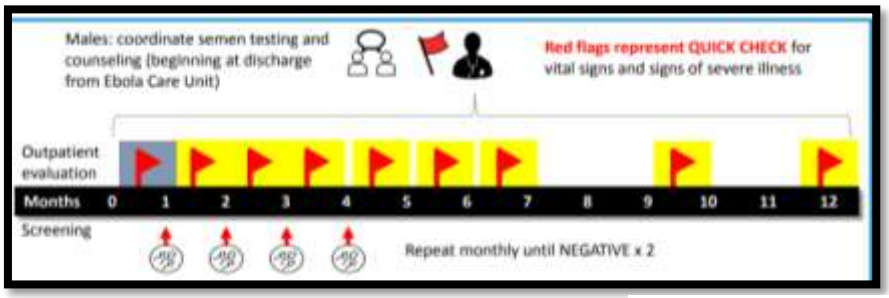
PREVENTION AND PRECAUTIONS



Source:https://pubmed.ncbi.nlm.nih.gov/25630412/

When living in or traveling to a region where Ebola virus is potentially present, there are a number of ways to protect yourself and prevent the spread of EVD.[24]

- Avoid contact with blood and body fluids (such as urine, feces, saliva, sweat, vomit, breast milk, amniotic fluid, semen, and vaginal fluids) of people who are sick
- Avoid contact with semen from a man who has recovered from EVD, until testing shows that the virus is gone from his semen.



Source: World Health Organization

- Avoid contact with items that may have come in contact with an infected person's blood or body fluids (such as clothes, bedding, needles, and medical equipment).
- Avoid funeral or burial practices that involve touching the body of someone who died from EVD or suspect EVD.

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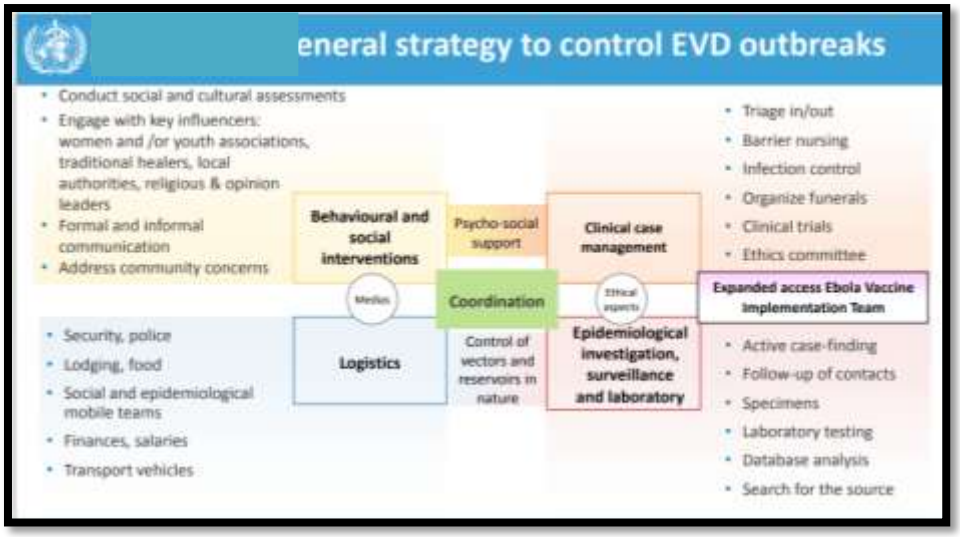
- Avoid contact with bats, forest antelopes, and nonhuman primates (such as monkeys and chimpanzees) blood, fluids, or raw meat prepared from these or unknown animals (bushmeat).



Source: World Health Organization

Hand hygiene (including alcohol-based hand rubs, soap and water, and correct glove use) is a basic component of personal and community hygiene and is an important way to prevent the spread of infections while providing healthcare. Alcohol-based hand sanitizers are the preferred method for cleaning your hands in most clinical situations. When hands are visibly soiled with blood or other body fluids, wash hands with soap and water.

- Use **alcohol-based hand sanitizer** when hands are not visibly soiled. These products usually contain 60-95% ethanol or isopropanol. Alcohol-based hand sanitizer **should not be used** when hands are visibly soiled with dirt, blood, or other body fluids.
- Use **soap and water** when hands are visibly soiled with dirt, blood, or other body fluids and as an alternative to alcohol-based hand sanitizer.
- Use mild (0.05%) chlorine solution where hand sanitizer and soap are not available. Repeated use of 0.05% chlorine solution can cause skin irritation.

These same prevention methods should be used when living in or traveling to an area experiencing an Ebola outbreak. After returning from an area experiencing an Ebola outbreak, people should monitor their health for 21 days and seek medical care immediately if they develop symptoms of EVD.[36]

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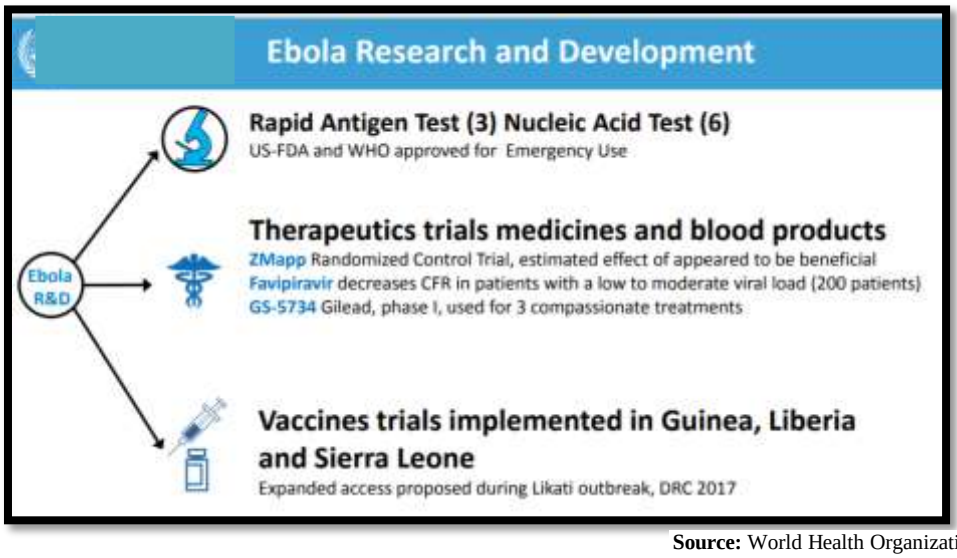

Source: World Health Organization

II. CONCLUSION

The ongoing outbreak of EVD in West Africa has led to a record number of cases and deaths.Control of this current EVD outbreak and future epidemics is likely to require a multifactorial strategy that includes high-quality disease surveillance, rapid diagnosis, and access to safe and effective therapies.Studies looking at Ebola virus disease survivors who could have long term immunity against Ebola virus might enable the development of new approaches for treatment options.

Awareness about ebola and its symptoms and addressing them adequately will be crucial for the management of future epidemics in underprivileged and remote areas where Ebola disease and other deadly infectious diseases could typically re-emerge

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