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Virology

Ebola virus

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Introduction

Ebola virus was first discovered in 1976 near the Ebola River in what is now the Democratic Republic of Congo. Since then, the virus has been infecting people from time to time, leading to outbreaks in several African countries. Scientists do not know where Ebola virus comes from. However, based on the nature of similar viruses, they believe the virus is animal-borne, with bats or nonhuman primates with bats or non human primates (chimpanzees, apes, monkeys, etc.) being the most likely source. Infected animals carrying the virus can transmit it to other animals, like apes, monkeys, duikers and humans.

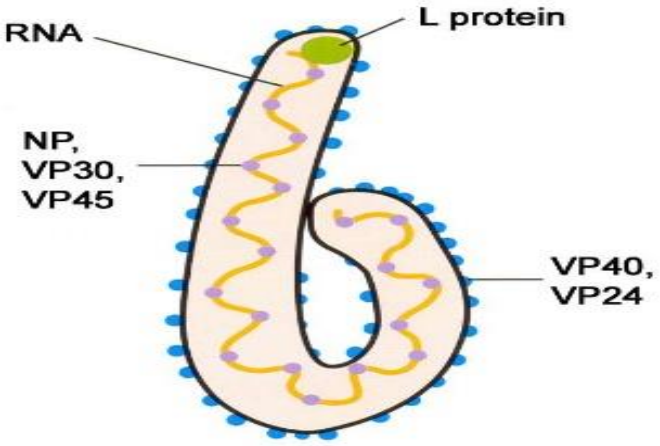
Ebola virus disease (EVD): is a deadly disease with occasional outbreaks that occur primarily on the African continent. EVD most commonly affects people and nonhuman primates (such as monkeys, gorillas, and chimpanzees). It is caused by an infection with a group of viruses within the genus ***Ebola virus***

The virus spreads to people initially through direct contact with the blood, body fluids and tissues of animals. Ebola virus then spreads to other people through direct contact with body fluids of a person who is sick with or has died from EVD. This can occur when a person touches these infected body fluids (or objects that are contaminated with them), and the virus gets in through broken skin or mucous membranes in the eyes, nose, or mouth. People can get the virus through sexual contact with someone who is sick with EVD, and also after recovery from EVD. The virus can persist in certain body fluids, like semen, after recovery from the illness.

General Characteristics

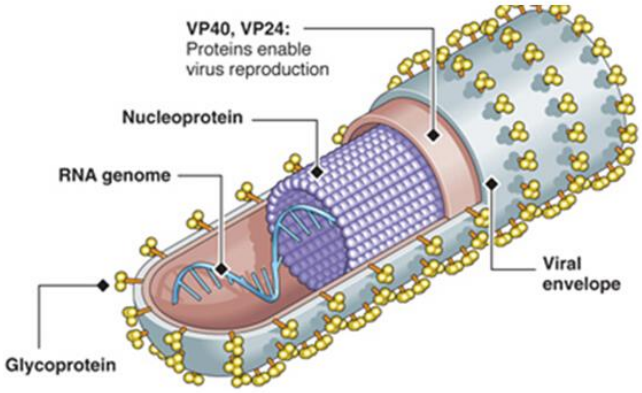
- Order : Mononegavirales
- Family : Filoviradae
- Genus : Marburgvirus
- Species : Marburg marburgvirus

- Synonyms : Marburg disease, Marburg hemorrhagic fever, African hemorrhagic fever, and green monkey disease.

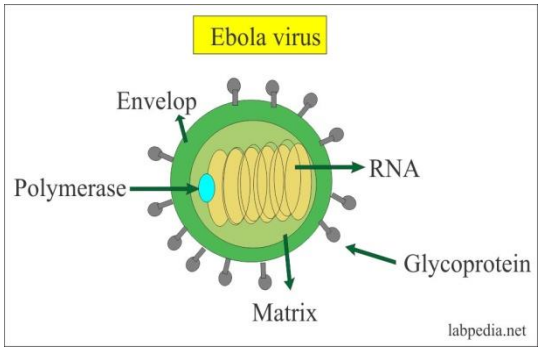


(it has the same structural properties as the Ebola virus)

Virion morphology and size:



Enveloped, helical, cross-striated nucleocapsid, filamentous or pleomorphic virions that are flexible with extensive branching, 80 nm in diameter and (970-1200 nm) in length.



Nucleic acid: Linear, negative-sense, single-stranded RNA, ~18,900 kb in length.

***(Ebola virus* structure)**

Physicochemical properties:

1-Stable at room temperature and can resist desiccation

2- Inactivated at 60°C for 30 minutes; infectivity greatly reduced or destroyed by UV light and gamma irradiation, lipid solvents, b-propiolactone, formaldehyde, sodium hypochlorite, and phenolic disinfectants

Epidemiology

The disease typically occurs in outbreaks in tropical regions of Sub-Saharan Africa From 1976 (when it was first identified) through 2013, the WHO reported 2,387 confirmed cases with 1,590 overall fatalities. The largest outbreak to date was the ***Ebola virus*** **epidemic in West Africa**, which caused a large number of deaths in **Guinea, Sierra Leone, and Liberia.**

On 26 August 1976, a second outbreak of EVD began in Yambuku, a small rural village in Mongala District in northern Zaire (now known as the Democratic Republic of the Congo). This outbreak was caused by EBOV, formerly designated *Zaire ebolavirus*, a different member of the genus *Ebola virus* than in the first Sudan outbreak. The first person infected with the disease was the village school's headmaster Mabalo Lokela, who began displaying symptoms on 26 August 1976.Lokela had returned from a trip to Northern Zaire near the border of the Central African Republic, after visiting the Ebola River between 12 and 22 August. He was originally believed to have malaria and given quinine

The second major outbreak occurred in Zaire now the Democratic Republic of the Congo, DRC), in 1995, affecting 315 and killing 254.

In 2000, Uganda had an outbreak infecting 425 and killing 224; in this case, the Sudan virus was found to be the Ebola species responsible for the outbreak.

In 2003, an outbreak in the DRC infected 143 and killed 128, a 90% death rate, the highest of a genus *Ebola virus* outbreak to date. In 2004, a Russian scientist died from Ebola after sticking herself with an infected needle.

Between April and August 2007, a fever epidemic in a four-village region of the DRC was confirmed in September to have been cases of Ebola. Many people who attended the recent funeral of a local village chief died. The 2007 outbreak eventually infected 264 individuals and killed 187.

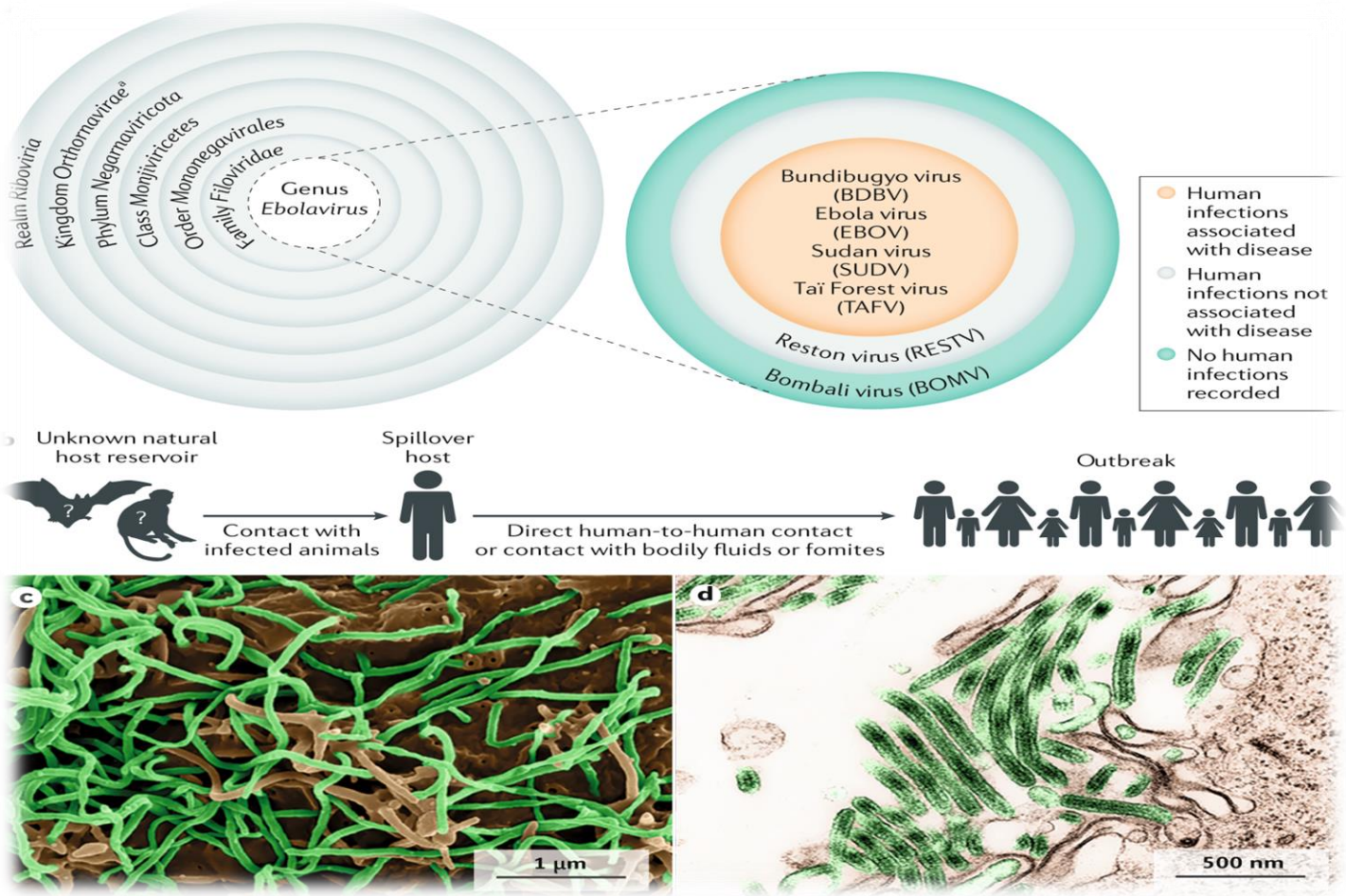
The WHO confirmed two small outbreaks in Uganda in 2012, both caused by the Sudan variant. The first outbreak affected seven people, killing four, and the second affected 24, killing 17.

In 2014, an outbreak occurred in the DRC. Genome-sequencing showed that this outbreak was not related to the 2014–15 West Africa Ebola virus outbreak, but was the same EBOV species, the Zaire species. It began in August 2014, and was declared over in November with 66 cases and 49 deaths.

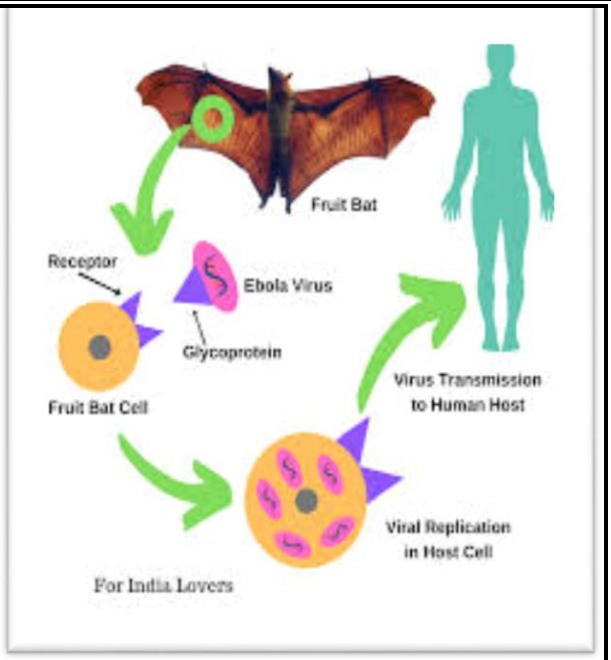
This was the 7th outbreak in the DRC, three of which occurred during the period when the country was known as Zaire.

On 14 May 2018, the World Health Organization reported that "the Democratic Republic of Congo reported 39 suspected, probable or confirmed cases of Ebola between 4 April and 13 May, including 19 deaths." Some 393 people identified as contacts of Ebola patients were being followed up. The outbreak centred on the Bikoro, Iboko, and Wangata areas in Equateur province, including in the large city of Mbandaka. The DRC Ministry of Public Health approved the use of an experimental vaccine.On 13 May 2018, WHO Director-General Tedros Adhanom Ghebreyesus visited Bikoro Reports emerged that maps of the area were inaccurate, not so much hampering medical providers as epidemiologists and officials trying to assess the outbreak and containment efforts The 2018 outbreak in the DRC was declared over on 24 July 2018.

in July 2019, an infected man travelled to Goma, home to more than two million people.One week later, on 17 July 2019, the WHO declared the Ebola outbreak a global health emergency, the fifth time such a declaration has been made by the organisation. A government spokesman said that half of the Ebola cases are unidentified, and he added that the current outbreak could last up to three years.



Transmission



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

1-Blood or body fluids (urine, saliva, sweat, feces, vomit, breast milk, and semen) of a person who is sick with or has died from Ebola virus disease (EVD).

2-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.

3-Infected fruit bats or nonhuman primates (such as apes and monkeys).

4-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.

When people become infected with Ebola, they do not start developing signs or symptoms right away. This period between exposure to an illness and having symptoms is known as the incubation period. **A person can only spread Ebola to other people after they develop signs and symptoms of Ebola.**

Additionally, Ebola virus is not known to be transmitted through food. However, in certain parts of the world, Ebola virus may spread through the handling and consumption of wild animal meat or hunted wild animals infected with Ebola. There is no evidence that mosquitoes or other insects can transmit Ebola virus.

Signs and Symptoms

Symptoms may appear anywhere from **2 to 21 days** after contact with the virus, with an average of 8 to 10 days. 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.

Primary signs and symptoms of Ebola often include some or several of the following:

- **Fever**
- **Aches and pains, such as severe headache, muscle and joint pain, and abdominal (stomach) pain**
- **Weakness and fatigue**
- **Gastrointestinal symptoms including diarrhea and vomiting**
- **Abdominal (stomach) pain**
- **Unexplained hemorrhaging, bleeding or bruising**

Other symptoms may include **red eyes, skin rash, and hiccups (late stage).**

Many common illnesses can have the same symptoms as EVD, including influenza (flu), malaria, or typhoid fever.

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. 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.

Diagnosis

Diagnosing Ebola virus disease (EVD) shortly after infection can be difficult. Early symptoms of EVD such as fever, headache, and weakness are not specific to Ebola virus infection and often are seen in patients with other more common diseases, like malaria and typhoid fever.

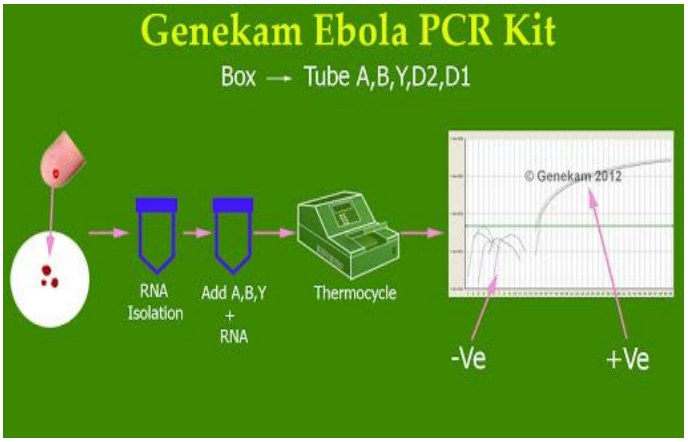
To determine whether EVD is a possible diagnosis, there must be a combination of symptoms suggestive of EVD **AND** a possible exposure to EVD within 21 days before the onset of symptoms.

If a person shows signs of EVD and has had a possible exposure, he or she should be isolated (separated from other people) .

Blood samples from the patient should be collected and tested to confirm infection. Ebola virus can be **detected in blood** after onset of symptoms. It may take up to three days after symptoms start for the virus to reach detectable levels.

Polymerase chain reaction (PCR) is one of the most commonly used diagnostic methods because of its ability to detect low levels of Ebola virus. PCR methods can detect the presence of a few virus particles in small amounts of blood, but the ability to detect the virus increases as the amount of virus increases during an active infection. When the virus is no longer present in great enough numbers in a patient's blood, PCR methods will no longer be effective. Other methods, based on the detection of antibodies an EVD case produces to an infection, can then be used to confirm a patient's exposure and infection by Ebola virus.

A positive laboratory test means that Ebola infection is confirmed. Public health authorities will conduct a public health investigation, including identifying and monitoring all possibly exposed contacts.



Treatment

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

1-Providing fluids and electrolytes (body salts) through infusion into the vein (intravenously).

2-Offering oxygen therapy to maintain oxygen status.

3-Using medication to support blood pressure, reduce vomiting and diarrhea and to manage fever and pain.

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.

Ebola Vaccine:The U.S. Food and Drug Administration (FDA) approved the **Ebola vaccine rVSV-ZEBOV (tradename "Ervebo")** on 2019. The **rVSV-ZEBOV** vaccine is a single dose vaccine regimen that has been found to be safe and protective against only the ***Zaire ebolavirus*** species of *Ebola virus*.

This is the first FDA approval of a vaccine for Ebola.Another investigational vaccine was developed and introduced under a research protocol in 2019 to combat an Ebola outbreak in the Democratic Republic of the Congo. This vaccine leverages two different vaccine components (**Ad26.ZEBOV and MVA-BN-Filo)** and requires two doses with an initial dose followed by a second "**booster"** dose 56 days later. The second vaccine is also designed to protect against only the *Zaire* ***Ebola virus*** species of Ebola.

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