

## Ebola

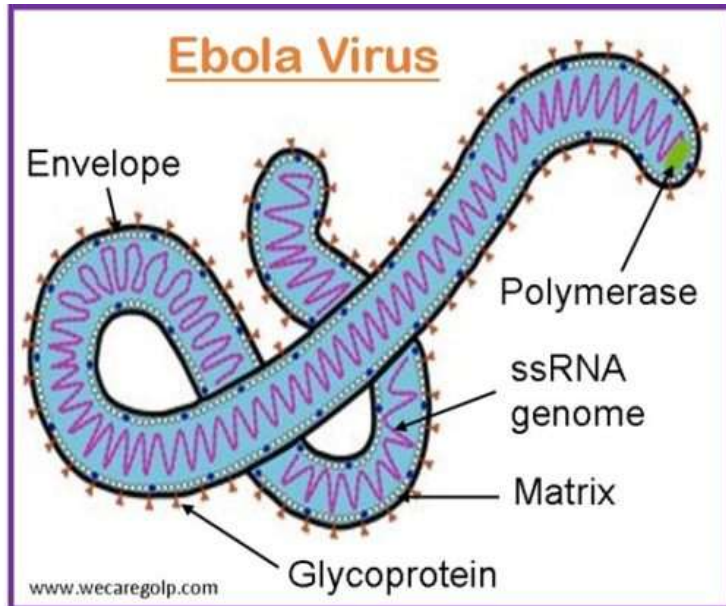
### General Facts

Ebola virus disease (EVD), AKA Ebola hemorrhagic fever (EHF), is very contagious and deadly.



### Causative Agent & Biological Characteristics:

- EVD is caused by ebolaviruses, a group of filamentous, enveloped RNA viruses
- The envelope has glycoproteins on its surface and is 80 nanometers in diameter
  - Linked to the nucleocapsid via matrix proteins
- The nucleocapsid contains the single-stranded, positive-sense RNA genome (–ssRNA), which is around 19,000 nucleotides long, and RNA-dependent RNA polymerase



### Ebola Virus Types

Four Ebola virus species infect humans:

1. Ebola (Zaire) virus – EBOV (most common and deadly)
  - a. Responsible for the largest outbreaks, including West Africa (2014–2016)

- b. Only type with approved antibody treatments and vaccine
- 2. Sudan virus – SUDV
  - a. High fatality rate but no approved vaccines or antibody treatments
  - b. Treated mainly with supportive care
- 3. Bundibugyo virus – BDBV
  - a. Identified in Uganda in 2007
  - b. Typically causes less severe disease than EBOV
  - c. No specific treatments or vaccines available
- 4. Tai Forest virus – TAFV
  - a. Very rare in humans
  - b. Few recorded human cases and lower mortality
  - c. No specific treatments or vaccines available

### **Reservoirs**

- Natural reservoir likely fruit bats
- Non-human primates (monkeys, apes) can be infected
- Spillover occurs when humans contact infected wildlife or bodily fluids



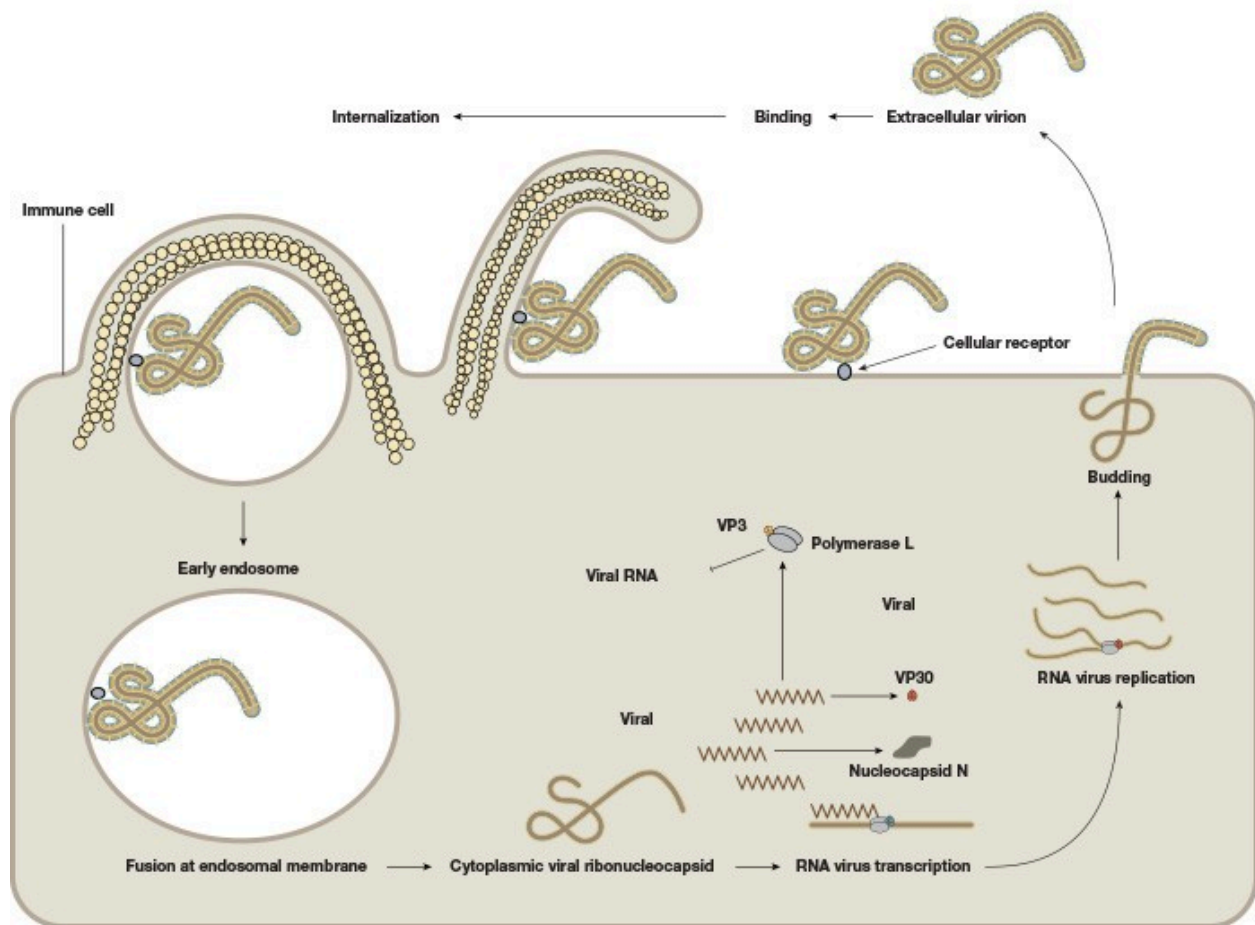
### **Transmission**

- Spread through direct contact with bodily fluids:
  - Blood, vomit, diarrhea, urine, feces, sweat, saliva, breast milk, semen
- Spread via contaminated objects (fomites) such as needles, syringes, bedding, or clothing
- Not airborne
- Person-to-person transmission occurs when symptoms are present

### **Pathogenesis: Life Cycle**

- Virus enters body through mucous membranes and wounds
- Virus enters host cell via receptor-mediated endocytosis

- Specifically, macropinocytosis: cell uses actin cytoskeleton to non-selectively engulf extracellular fluid into a large vesicle, called a macropinosome, usually to absorb nutrients or antigens
- Virus envelope fuses with the macropinosome membrane, releasing nucleocapsid into the cytoplasm
- Viral RNA polymerase uses (–)ssRNA as a template for mRNA synthesis; mRNA is translated into viral proteins by the host cell's cellular machinery
  - mRNA is single-stranded, positive-sense; it serves as an intermediary between the RNA genome and proteins
- After enough viral proteins are made, RNA polymerase uses (–)ssRNA as a template for synthesis of (+)ssRNA antigenome, which will also be used as a template to synthesize new (–)ssRNA for new Ebola virus virions
- Viral proteins and RNA associate at the plasma membrane before exiting the cell via budding, using the plasma membrane to form new envelopes
  - The budding process kills the host cell as a result



### Pathogenesis: Suppressed Immunity

- Leukocytes—specifically monocytes, macrophages, and dendritic cells—are the preferred targets of the Ebola virus
- Infected leukocytes bring the virus to lymph nodes, where it can spread and infect other cells throughout the circulatory system
- Infected immune cells are impaired
  - EX: infected macrophages and dendritic cells do not mature or function properly (e.g., presenting antigens), so they cannot signal other immune cells and initiate an adaptive immune response
  - Both innate and adaptive immunity are suppressed, allowing virus to proliferate
- Infected immune cells eventually undergo apoptosis, releasing cytokines that trigger an inflammatory response, causing other immune cells to also undergo apoptosis
- Apoptosis and subsequent inflammation results in an overproduction of cytokines, known as a “cytokine storm.”
  - This cytokine storm causes extreme inflammatory responses that damages the body and induces severe symptoms of EVD, eventually killing the patient

### **Signs and Symptoms**

- Early (“Dry”) Stage – Days 1–3
  - Fever
  - Severe headache
  - Muscle & joint pain
  - Weakness & fatigue
  - Sore throat
- Progressive (“Wet”) Stage – Days 4–5
  - Vomiting
  - Rash
  - Diarrhea
  - Nausea
  - Abdominal pain
  - Loss of appetite
- Severe / Late Stage – Day 7+
  - Internal and external bleeding (gums, mouth, eyes, rectum)
  - Organ failure
  - Encephalitis & seizures
  - Shock
- Untreated: ~50–90% fatality rate
- Treated: ~25–40% fatality rate (lower with antibodies)



## **Treatments**

- No known cure for Ebola
- Early diagnosis is critical
- Treatment focuses on supportive care:
  - IV fluids & electrolytes
  - Oxygen therapy
  - Blood pressure management
  - Pain and fever control
- **Antibody Treatments**
  - Approved only for Zaire ebolavirus:
    - Ebanga® (single monoclonal antibody)
    - Inmazeb® (three monoclonal antibodies)
- Other Ebola virus types treated mainly with supportive care
- **Vaccines**
  - ERVEBO® (rVSV-ZEBOV)
    - FDA-approved
    - Live, recombinant vesicular stomatitis virus (rVSV) vaccine
    - Effective only against Zaire ebolavirus
- Used in outbreak response
- Ervebo works by using a weakened virus (rVSV) that carries a protein from the Zaire ebolavirus to trigger an immune response

## **Current Events**

- No current Ebola cases in the United States
- Overall U.S. risk remains very low
- Outbreak reported in Kasai Province, DRC (2025)
  - 64 confirmed/probable cases
  - 45 deaths
- Over 42,000 people vaccinated during outbreak response
- Dec. 1, 2025: DRC declared end of its 16th Ebola outbreak