



Background: The Ebola virus causes an acute, serious illness which is often fatal if untreated. Ebola virus disease (EVD) first appeared in 1976 in 2 simultaneous outbreaks, one in Nzara, Sudan, and the other in Yambuku, Democratic Republic of Congo. The latter occurred in a village near the Ebola River, from which the disease takes its name.

The current outbreak in West Africa, (first cases notified in March 2014), is the largest and most complex Ebola outbreak since the Ebola virus was first discovered in 1976. There have been more cases and deaths in this outbreak than all others combined. It has also spread between countries starting in Guinea then spreading across land borders to Sierra Leone and Liberia, by air to Nigeria, and by land to Senegal.

The most severely affected countries, Guinea, Sierra Leone and Liberia have very weak health systems, lacking human and infrastructural resources, having only recently emerged from long periods of conflict and instability. On August 8, the WHO Director-General declared this outbreak a Public Health Emergency of International Concern.

The virus family Filoviridae includes 3 genera: Cuevavirus, Marburgvirus, and Ebolavirus. There are 5 species that have been identified: Zaire, Bundibugyo, Sudan, Reston and Tai Forest. The first 3, Bundibugyo ebolavirus, Zaire ebolavirus, and Sudan ebolavirus have been associated with large outbreaks in Africa. The virus causing the 2014 West African outbreak belongs to the Zaire species, the first species identified in 1976, with the highest recorded fatality rates.

Rates of genetic change are 100 times slower than influenza A in humans, but on the same magnitude as those of hepatitis B. Extrapolating backwards using these rates indicates that ebolaviruses and marburgviruses diverged several thousand years ago.^[53] However, paleoviruses (genomic fossils) of filoviruses (Filoviridae) found in mammals indicate that the family itself is at least tens of millions of years old.^[54] Fossilized viruses that are closely related to ebolaviruses have been found in the genome of the Chinese hamster.^[55]

It is thought that fruit bats of the Pteropodidae family are natural Ebola virus hosts. Ebola is introduced into the human population through close contact with the blood, secretions, organs or other bodily fluids of infected animals such as chimpanzees, gorillas, fruit bats, monkeys, forest antelope and porcupines found ill or dead or in the rainforest.

Ebola then spreads through human-to-human transmission via direct contact (through broken skin or mucous membranes) with the blood, secretions, organs or other bodily fluids of infected people, and with surfaces and materials (e.g. bedding, clothing) contaminated with these fluids.

The incubation period, that is, the time interval from infection with the virus to onset of symptoms is 2 to 21 days. Humans are not infectious until they develop symptoms. First symptoms are the sudden onset of fever fatigue, muscle pain, headache and sore throat. This is followed by vomiting, diarrhea, rash, symptoms of impaired kidney and liver function, and in some cases, both internal and external bleeding. Laboratory findings include low white blood cell and platelet counts and elevated liver enzymes.

People remain infectious as long as their blood and body fluids, including semen and breast milk, contain the virus. Men who have recovered from the disease can still transmit the virus through their semen for up to 7 weeks after recovery from illness.

Health-care workers have frequently been infected while treating patients with suspected or confirmed EVD. This has occurred through close contact with patients when infection control precautions are not strictly practiced. Recommended measures when caring for people infected with Ebola include barrier-isolation, sterilizing equipment and surfaces, and wearing protective clothing including masks, gloves, gowns, and goggles.^[31]

CHARACTERISTICS: Ebola, discovered in 1976, is a member of the Filoviridae family (previously part of Rhabdoviridae family, which were later given a family of their own based on their genetic structure). Five Ebola species have been identified: Zaire ebolavirus (ZEBOV), which was first identified in 1976 and is the most virulent; Sudan ebolavirus, (SEBOV); Tai Forest ebolavirus (formerly Ivory Coast ebolavirus); Ebola-Reston (REBOV), originating from the Philippines; and Bundibugyo ebolavirus (BEBOV), the most recent species discovered (2008)
[Footnote 1](#) [Footnote 3](#) [Footnote 5](#) [Footnote 6](#) [Footnote 7](#).

Ebola is an elongated filamentous virus, which can vary between 800 - 1000 nm in length, and can reach up to 14000 nm long (due to concatamerization) with a uniform diameter of 80 nm [Footnote 2](#) [Footnote 5](#) [Footnote 8](#) [Footnote 9](#). It contains a helical nucleocapsid (with a central axis), 20 - 30 nm in diameter, and is enveloped by a helical capsid, 40 - 50 nm in diameter, with 5 nm cross-striations [Footnote 2](#) [Footnote 5](#) [Footnote 8](#) [Footnote 9](#) [Footnote 10](#). The pleomorphic viral fragment may take on several distinct shapes (e.g., in the shape of a "6", a "U", or a circle), and are contained within a lipid membrane [Footnote 2](#) [Footnote 5](#). Each virion contains a single-strand of non-segmented, negative-sense viral genomic RNA [Footnote 5](#) [Footnote 11](#).

SUSCEPTIBILITY TO DISINFECTANTS: Ebolavirus is susceptible to 3% acetic acid, 1% glutaraldehyde, alcohol-based products, and dilutions (1:10-1:100 for ≥10 minutes) of 5.25% household bleach (sodium hypochlorite), and calcium hypochlorite (bleach powder) [Footnote 48](#) [Footnote 49](#) [Footnote 50](#) [Footnote 62](#) [Footnote 63](#). The WHO recommendations for cleaning up spills of blood or body fluids suggest flooding the area with a 1:10 dilutions of 5.25% household bleach for 10 minutes for surfaces that can tolerate stronger bleach solutions (e.g., cement, metal) [Footnote 62](#). For surfaces that may corrode or discolor, they recommend careful cleaning to remove visible stains followed by contact with a 1:100 dilution of 5.25% household bleach for more than 10 minutes.

PHYSICAL INACTIVATION: Ebola are moderately thermolabile and can be inactivated by heating for 30 minutes to 60 minutes at 60°C, boiling for 5 minutes, or gamma irradiation (1.2 x10⁶ rads to 1.27 x10⁶ rads) combined with 1% glutaraldehyde [Footnote 10](#) [Footnote 48](#) [Footnote 50](#). Ebolavirus has also been determined to be moderately sensitive to UVC radiation [Footnote 51](#).

SURVIVAL OUTSIDE HOST: Filoviruses have been reported capable to survive for weeks in blood and can also survive on contaminated surfaces, particularly at low temperatures (4°C) [Footnote 52](#) [Footnote 61](#). One study could not recover any Ebolavirus from experimentally contaminated surfaces (plastic, metal or glass) at room temperature [Footnote 61](#). In another study, Ebolavirus dried onto glass, polymeric silicone rubber, or painted aluminum alloy is able to survive in the dark for several hours under ambient conditions (between 20°C and 25°C and 30–40% relative humidity) (amount of virus reduced to 37% after 15.4 hours), but is less stable than some other viral hemorrhagic fevers (Lassa) [Footnote 53](#). When dried in tissue culture media onto glass and stored at 4 °C, Zaire ebolavirus survived for over 50 days [Footnote 61](#). This information is based on experimental findings only and not based on observations in nature. This information is intended to be used to support local risk assessments in a laboratory setting.

A study on transmission of ebolavirus from fomites in an isolation ward concludes that the risk of transmission is low when recommended infection control guidelines for viral hemorrhagic fevers are followed [Footnote 64](#). Infection control protocols included decontamination of floors with 0.5% bleach daily and decontamination of visibly contaminated surfaces with 0.05% bleach as necessary.

RISK GROUP CLASSIFICATION: Risk Group 4 [Footnote 58](#).

CONTAINMENT REQUIREMENTS: Containment Level 4 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, and cultures.

PROTECTIVE CLOTHING: Personnel entering the laboratory must remove street clothing, including undergarments, and jewelry, and change into dedicated laboratory clothing and shoes, or don full coverage protective clothing (i.e., completely covering all street clothing). Additional protection may be worn over laboratory clothing when infectious materials are directly handled, such as solid-front gowns with tight fitting wrists, gloves, and respiratory protection. Eye protection must be used where there is a known or potential risk of exposure to splashes.

OTHER PRECAUTIONS: All activities with infectious material should be conducted in a biological safety cabinet (BSC) in combination with a positive pressure suit, or within a class III BSC line. Centrifugation of infected materials must be carried out in closed containers placed in sealed safety cups, or in rotors that are unloaded in a biological safety cabinet. The integrity of positive pressure suits must be routinely checked for leaks. The use of needles, syringes, and other sharp objects should be strictly limited. Open wounds, cuts, scratches, and grazes should be covered with waterproof dressings. Additional precautions should be considered with work involving animal activities.

SPILLS: Allow aerosols to settle and, wearing protective clothing, gently cover spill with paper towels and apply suitable disinfectant, starting at the perimeter and working towards the center. Allow sufficient contact time before clean-up.

DISPOSAL: Decontaminate all materials for disposal from the containment laboratory by steam sterilization, chemical disinfection, incineration or by gaseous methods. Contaminated materials include both liquid and solid wastes.

STORAGE: In sealed, leak-proof containers that are appropriately labeled and locked in a Containment Level 4 laboratory.

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