Ebola

Joy Li, Francisco Chen, Alice Chen, Cindy Cheng, Hannah Pei, Sally Lin, Tiffany Chen

Ebola virus disease (EVD) is a severe and often fatal illness caused by the Ebola virus (EBOV). While ongoing medical workers focus on developing vaccines and treatment methods, the virus remains a significant public health challenge and presents a huge threat.

Introduction of research

Ebola virus (EBOV) is categorized into the Filoviridae family in which viruses under this family usually have high infectious rate and present to be lethal to humans. Ebola virus disease had been the main cause of some of the world's major pandemic, such as the famous and devastating 2014 West African outbreak which had claimed more lives than all previous outbreaks combined. This had gained significant global attention and scientists' curiosity towards investigating it, later they discovered that the transformation rate of the virus is incredibly high due to its capability of existence in a wide range of bodily fluids. EVD outbreaks usually will evolve from a single case of zoonotic transmission–transmission caused by virus or from animals, followed by high human-to-human transmission through direct contact with infected bodily fluids or contaminated surfaces. The disease can be reflected with some major symptoms such as fever, gastrointestinal discomfort, and multiple organ dysfunction, and most crucially it is associated with a high case fatality rate. Our group will analyze the properties and perform a comprehensive understanding of the disease based on research, helping readers to learn and recognize the disease, as well as how to prevent or minimize the potential risks in order to ensure individual personal health.

History

Ebola disease was discovered in the Democratic Republic of Congo back in 1976. However, Ebola can be dated back in 1974 in Uganda but only as a minor infection. This virus expanded in an exponential manner across Africa. Ebola is known to be the deadliest virus without any treatments. In all Ebola cases, up to 90% were fatal. In 2014-2016 there was the largest Ebola outbreak taking place in west Africa having more than 28,600 cases reported. In 2018-2020, there were a few cases reported around Uganda followed by many small outbreaks in Gabon, Congo, and South Africa.

Cause and virology

The agents that cause Ebola in humans belong to a family of viruses that are known as Filoviridae. The family Filoviridae consists of two distinctive species, Marburg and Ebola. Ebola Viruses (infectious agent) consists of five known species/strains, four of which can cause disease in humans and primates: (Ebola virus (Zaire ebolavirus); Sudan virus (Sudan ebolavirus); Taï Forest virus (Taï Forest ebolavirus, formerly Côte d'Ivoire ebolavirus); and Bundibugyo virus (Bundibugyo ebolavirus). The virus must invade the body cells of the host, either a primate or a human and replicate. The virus is believed to be initially spread by a bat, but how does it get passed onto humans? The virus can be spread through direct contact with contaminated bodily fluids: blood, saliva, vomit, urine, feces, sweat, breast milk, or semen. The virus enters the body through exposed skin and mucous membranes. Once the virus enters the body, it attacks and invades the immune system causing adverse symptoms. In a deeper sense, the Ebola virus primarily targets the white blood cells in the body, specifically dendritic cells and macrophages (white blood cells) that are responsible for eliciting an immune response. The

virus is able to protect itself in this aspect as the immune system is suppressed since it is unable to recognize and fight the virus. When the bodily cells are infected, they secret excessive inflammatory signals causing widespread inflammation. This inflammation can cause tissue and organ damage.

Stages and symptoms

Ebola starts with mild symptoms like fever, headache, sore throat, muscle pain, and fatigue, which can appear between 2 to 21 days after infection. As the illness worsens, more serious symptoms develop, including nausea, vomiting, skin rash, confusion, breathing difficulties, low blood pressure, and fluid leakage from blood vessels. In the late stage, Ebola can cause severe internal and external bleeding, organ failure, shock, and even unusual symptoms like persistent hiccups. The disease is only contagious once symptoms appear, but the virus can remain in the body even after death, making it dangerous. Survivors may experience long-term effects for months or even years, such as extreme fatigue, joint and muscle pain, vision problems, memory loss, hair loss, and emotional struggles like depression and anxiety.

Prevention

Ebola spreads through direct contact with body fluids from an infected person who has symptoms. These fluids are blood, urine, feces, vomit, saliva, sweat, semen, and breast milk. It spreads by touching things like needles or bedding that have the virus. Touching the body of someone who died from Ebola is also dangerous. Ebola does not spread through the air. It does not spread by sitting near an infected person (Centers for Disease Control and Prevention [CDC], 2023).

To lower the risk of infection, people should follow certain steps. Keeping clean is very important. Washing hands often with soap and water is the best way. If there is no soap and water, alcohol-based hand sanitizer is another option. Staying away from body fluids is also important. People should not touch fluids from sick individuals or those who died from Ebola. They should not touch clothing or bedding that may have the virus (Cleveland Clinic, 2023).

Safe burial practices help stop the virus from spreading. People taking part in burial rituals should not touch the body without protection. Keeping clean during these practices also lowers the risk. Avoiding risky places and activities also helps prevent infection. People should stay away from areas with Ebola outbreaks. If they must go there, they should avoid sick people and not handle or eat bushmeat (Government of Canada, 2023).

Ebola stays in semen for at least 12 months after recovery. Men who had Ebola should not have sex for at least 12 months. If they do, they should always use condoms until tests show the virus is gone. Healthcare workers should wear protective clothing, such as gloves, masks, gowns, and eye protection when caring for infected people. In hospitals and treatment centers, following infection control rules is very important to stop the virus from spreading (CDC, 2023).

Vaccine

The first approved Ebola vaccine, **Ervebo® (rVSV-ZEBOV)**, was made to protect against the Zaire strain of the virus. The **European Medicines Agency** approved it in 2019. Later, the World Health Organization approved it, too. It has been used in high-risk areas like the **Democratic Republic of Congo**, where Ebola outbreaks happen often. Ervebo® works by using a weakened virus that helps the immune system. This helps the body recognize and fight Ebola before a person gets sick.

Canada has played a big role in Ebola vaccine research. The National Microbiology Laboratory (NML) made the **VSV-EBOV vaccine**, which works before and after exposure to the virus. But this vaccine is not approved for general use in Canada. The Canadian government approved Ervebo®, but it is not a routine vaccine. It is mainly for healthcare workers and humanitarian aid workers who go to places with Ebola. If someone in Canada is exposed to Ebola, they should get the vaccine within 72 hours to lower the risk of infection.

Ervebo® protects against the **Zaire Ebola virus**. But it does not work against other strains, like the **Sudan Ebola virus**. Scientists are working on new vaccines to fix this problem. In February 2025, Uganda started the first clinical trial for a vaccine against the Sudan Ebola virus. This trial is an important step in making vaccines that protect against all kinds of Ebola.

Treatment

Currently, there are no approved antiviral treatments for EVD. Experimental therapies are under development , but there is a lack of data on the efficacy and tolerance of these treatments in humans.

Convalescent serum is a procedure that works by giving patients the blood of the patients that recovered from Ebola. This is the only treatment approved by the World Health Organization(WHO) to treat affected patients. This method needs to be used in a efficacious and safe condition, especially in conditions where an epidemic is present.

Other than convalescent serum treatment, there are 3 other most trustful treatments that are still developing. The first one is called TKMEbola, which uses an ‘‘interfering’’ RNA molecule to prevent the expression of two genes that the Ebola virus needs to replicate to

survive. However, it had concerns due to symptoms such as confusion, seizures, and low blood pressure when given high doses.

Second, Favipiravir (T-705), a protein molecule, known as viral RNA polymerase inhibitor that can be taken through the mouth, works by preventing protein to be made in viruses for their survival. Data from Japan has shown good tolerance of this drug and it is almost ready for distribution and use. Include data

Third, BCX4430, which is a compound that is called a nucleoside analog that prevents the RNA(genetic information of a virus) from being made. However, more data is needed for this drug to be distributed. More recently, there was a drug of the same compound that can be taken through the mouth, showing good performance. This drug is called brincidofovir, and it can act against DNA viruses, including viruses in the herpes virus family and adenovirus(diseases caused by those include chicken pox and shingles).

Statistic

Brief title & description of table

Year (s)	Location	Virus Species	Cases	Deaths	Fatality Rate
2014-2016	*West Africa* (Guinea, Liberia, Sierra Leone)	Zaire ebolavirus (EBOV)	~28,610	11,308	~39%
2014	*Democratic Republic of*	Zaire ebolavirus	69	49	71%

	the Congo (DRC) – Équateur Province	(EBOV)			
2017	*DRC* – Bas-Uélé (Likati)	Zaire Ebolavirus (EBOV)	8	4	50%
2018	*DRC* – Équateur (Bikoro/Mbandaka)	Zaire Ebolavirus (EBOV)	54	33	61%
2018-2020	*DRC* – North Kivu/Ituri (Kivu Epidemic)	Zaire Ebolavirus (EBOV)	3,470	2,287	66%
2020	*DRC* – Équateur (Mbandaka)	Zaire Ebolavirus (EBOV)	130	55	42%
2021	*DRC* – North Kivu (Biena/Butem	Zaire Ebolavirus (EBOV)	12	6	50%

	bo)				
2021	*Guinea* – N'Zérékoré	Zaire Ebolavirus (EBOV)	23	12	52%
2021	*DRC* – North Kivu (Beni)	Zaire Ebolavirus (EBOV)	11	9	82%
2022	*DRC* – Équateur (Mbandaka)	Zaire Ebolavirus (EBOV)	5	5	100%
2022	*DRC* – North Kivu (Beni)	Zaire Ebolavirus (EBOV)	1	1	100%
2022-2023	*Uganda* – Mubende/Kassanda (Sudan virus outbreak)	Sudan Ebolavirus (SUDV)	164	77	~47%
2024	Rwanda	Marburg virus disease	66	15	~23%

		(MVD)			

Totals: In sum, these outbreaks resulted in over 32,000 confirmed and probable cases of Ebola virus disease and over 14,000 deaths worldwide in the last ten years (the vast majority from the West African epidemic of 2014-2016).

Case fatality rates (CFR) have varied by outbreak, ranging from about 40% up to 100% in some small outbreaks. The **overall CFR across all outbreaks** in the past ten years is roughly **50%** (in line with the historical average).

Reference

Judson, S., Prescott, J., & Munster, V. (2015). Understanding Ebola Virus Transmission. *Viruses*, *7*(2), 511-521.

https://doi.org/10.3390/v7020511

https://www.nejm.org/doi/full/10.1056/NEJMra1901594

https://www.cdc.gov/ebola/outbreaks/index.html

https://pmc.ncbi.nlm.nih.gov/articles/PMC4695518/

Centers for Disease Control and Prevention. (2023). About Ebola virus disease.

https://www.cdc.gov/ebola/about/index.html

Cleveland Clinic. (2023). Ebola virus disease.

https://my.clevelandclinic.org/health/diseases/15606-ebola-virus-disease

Government of Canada. (2023). Prevention of Ebola.

https://www.canada.ca/en/public-health/services/diseases/ebola/prevention-ebola.html

https://www.physio-pedia.com/Ebola_Virus

https://www.who.int/news-room/fact-sheets/detail/ebola-virus-disease

Synapse

https://synapse.patsnap.com/article/what-are-rna-polymerase-inhibitors-and-how-do-they-work

Treatment of Ebola virus disease(2015)Yazdan Yazdanpanah, Jose Ramon Arribas, Denis Malvy

file:///Users/joyli/Downloads/s00134-014-3529-8

Cleveland Clinic *Ebola Virus disease*

https://my.clevelandclinic.org/health/diseases/15606-ebola-virus-disease

Public Health Agency of Canada. (2023). Ebola virus vaccine: Canadian immunization guide.

https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-4-active-vaccines/ebola-virus.html

World Health Organization. (2019). Major milestone for WHO-supported Ebola vaccine. https://www.who.int/zh/news/item/18-10-2019-major-milestone-for-who-supported-ebola-vaccine

World Health Organization. (2020). Ebola virus disease: Vaccines. https://www.who.int/news-room/questions-and-answers/item/ebola-vaccines

World Health Organization. (2025). Groundbreaking Ebola vaccination trial launches today in Uganda. https://www.who.int/zh/news/item/03-02-2025-groundbreaking-ebola-vaccination-trial-launches-today-in-uganda

World Health Organization. (2016). Ebola situation report – 30 March 2016. en.wikipedia.org

World Health Organization. (2014). Ebola virus disease – Democratic Republic of Congo. vox.com+2en.wikipedia.org+2wsj.com+2

World Health Organization. (2017). Ebola virus disease – Democratic Republic of the Congo. zh.wikipedia.org+2apnews.com+2en.wikipedia.org+2

World Health Organization. (2018). Ebola virus disease – Democratic Republic of the Congo.

World Health Organization. (2020). Ebola virus disease – Democratic Republic of the Congo. zh.wikipedia.org+2apnews.com+2en.wikipedia.org+2

World Health Organization. (2021). Ebola virus disease – Democratic Republic of the Congo.

World Health Organization. (2021). Ebola virus disease – Guinea. en.wikipedia.org

World Health Organization. (2021). Ebola virus disease – Democratic Republic of the Congo.

World Health Organization. (2022). Ebola virus disease – Democratic Republic of the Congo.

zh.wikipedia.org+2apnews.com+2en.wikipedia.org+2

World Health Organization. (2022). Ebola virus disease – Democratic Republic of the Congo.

World Health Organization. (2022). Ebola virus disease – Democratic Republic of the Congo.

World Health Organization. (2022). Ebola virus disease – Uganda.

en.wikipedia.org+8apnews.com+8apnews.com+8

World Health Organization. (n.d.). *Ebola virus disease*. Retrieved March 8, 2025, from

https://www.who.int/health-topics/ebola

Centers for Disease Control and Prevention. (n.d.). *Ebola (Ebola virus disease)*. Retrieved March 8, 2025

https://www.cdc.gov/vhf/ebola/index.html

United Nations Children's Fund. (n.d.). *Ebola outbreak*. Retrieved March 8, 2025, from

https://www.unicef.org/emergencies/ebola

Gavi, the Vaccine Alliance. (n.d.). *Ebola vaccines*. Retrieved March 8, 2025, from

https://www.gavi.org/vaccines/ebola