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A REVIEW ON EBOLA VIRUS DISEASE

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1. ABSTRACT
Ebola virus disease (EVD), formerly known as Ebola hemorrhagic fever, is a severe, often fatal illness in humans. Ebola virus (EBOV) is transmitted through contact with blood or body fluids of a person who contracted or died from EVD, contaminated objects like needles and infected animals or bush meat. EVD has an incubation period of 2 to 21 days, and the infection has an acute onset without any carrier status. Currently, there is no standard treatment for EVD, so it is important to avoid infection or further spreading of the virus. Although historically the mortality of this infection exceeded 80%, modern medicine and public health measures have been able to lower this figure and reduce the impact of EBOV on individuals and communities. Its treatment involves early, aggressive supportive care with rehydration. Clinicians should consider the possibility of EVD in persons with travel or exposure history with the incubation period presenting constitutional symptoms in order to promptly identify diseased patients, and prevent further spreading of the diseases.

2. KEYWORDS: Ebola virus, bats, sudden influenza.

3. INTRODUCTION

Ebola virus disease (**EVD**), also known as **Ebola hemorrhagic fever** (**EHF**) or simply **Ebola**, is a viral hemorrhagic fever of humans and other primates caused by ebola viruses Signs and symptoms typically start between two days and three weeks after contracting the virus with a fever, sore throat, muscular pain, and headaches, vomiting diarrhea and rash usually follow, along with decreased function of the liver and kidneys, At this time, some people begin to bleed both internally and externally. The disease has a high risk of death, killing 25% to 90% of those infected, with an average of about 50%. This is often due to low blood pressure from fluid loss, and typically follows 6 to 16 days after symptoms appear.

The virus spreads through direct contact with body fluids, such as blood from infected humans or other animals. Spread may also occur from contact with items recently contaminated with bodily fluids. Spread of the disease through the air between primates, including humans, has not been documented in either laboratory or natural conditions. Semen or breast milk of a person after recovery from EVD may carry the virus for several weeks to months. Fruit bats are believed to be the normal carrier in nature, able to spread the virus without being affected by it Other diseases such as malaria, cholera, typhoid fever, meningitis and other viral hemorrhagic fevers may resemble EVD. Blood samples are tested for viral RNA, viral antibodies or for the virus itself to confirm the diagnosis.

The disease was first identified in 1976, in two simultaneous outbreaks: one in Nzara (a town in South Sudan) and the other in Yambuku (Democratic Republic of the Congo), a village near the Ebola River from which the disease takes its name. EVD outbreaks occur intermittently in tropical regions of sub-Saharan Africa Between 1976 and 2013, the World Health Organization reports 24 outbreaks involving 2,387 cases with 1,590 deaths 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 It was declared no longer an emergency on 29 March 2016. Other outbreaks in Africa began in the Democratic Republic of the Congo in May 2017, and 2018. In July 2019, the World Health Organization declared the Congo Ebola outbreak a world health emergency.

3. HISTORY

The first outbreak of EVD was in 1976 in Yambuku, Zaire(now democratic republic of Congo).

The outbreak recorded 318 cases and 280 deaths giving a case fatality rate of about 88%.

Most of the deaths were among patients who were given injections with contaminated needles.

At about the same time in 1976, another outbreak occurred in maridi, Sudan (present day south Sudan) that recorded 284 cases and 151 deaths with fatality rate of over 53%.

The name Ebola originated from Ebola river around which Yambuku, where the first outbreak that occurred was located.

Ngoy Mushola –a Congolese medical doctor was the first person to record a description of the Ebola virus in 1976.

The first patient to be diagnosed of EVD was Mayinga N'Seka: a nurse in Zaire in 1976.

Since after the 1976 outbreak in Zaire and Sudan, there have been several epidemics of the disease in other parts of Africa.

Table 1: Chronology of previous Ebola virus disease out breaks.

Year	Country of occurrence	EV species	Recorded cases	Deaths
1976	DRC	Zaire	318	280
1976	Sudan	Sudan	284	151
1977	DRC	Zaire	1	1
1979	Sudan	Sudan	34	22
1989	USA	Reston	4	0
1994	Gabon	Zaire	52	31
1994	Cote de'Ivoire	Tai Forest	1	0
1995	DRC	Zaire	315	254
1996(Jan-Apr)	Gabon	Zaire	31	21
1996(Jul-Dec)	Gabon	Zaire	60	45
1996	South Africa	Zaire	1	1
2000	Uganda	Sudan	425	224
2001-2002	Gabon	Zaire	65	53
2001-2002	Congo	Zaire	59	44
2003(Jan-Apr)	Congo	Zaire	143	128
2003(Nov-Dec)	Congo	Zaire	35	29
2004	Sudan	Sudan	17	7
2005	Congo	Zaire	12	10
2007	DR Congo	Zaire	264	187
2007	Uganda	Bundibugyo	149	37
2008	DR Congo	Zaire	32	14
2011	Uganda	Sudan	1	1
2012	Uganda	Sudan	24	17
2012	Uganda	Sudan	7	4
2012	DR Congo	Bundibugyo	57	2

CURRENT OUTBREAK

Current epidemic ravaging West African countries is the largest and most severe Ebola outbreak to occur since the virus was first identified in 1976, in terms of cases and deaths.

It began in Guinea in March 2014 and has since spread to Liberia, Sierra Leone, Nigeria and now DRC.

On 8 August 2014, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern.

Public Health Emergency of International Concern is a designation that invokes obligatory legal measures on disease prevention, surveillance, control and response by 194 signatory countries of WHO.

As at 20th August, 2014, a total of 2615 suspected cases with 1427 deaths have been reported by WHO, of which 1528 cases and 844 deaths have been confirmed to be EVD.

4. PATHOPHYSIOLOGY

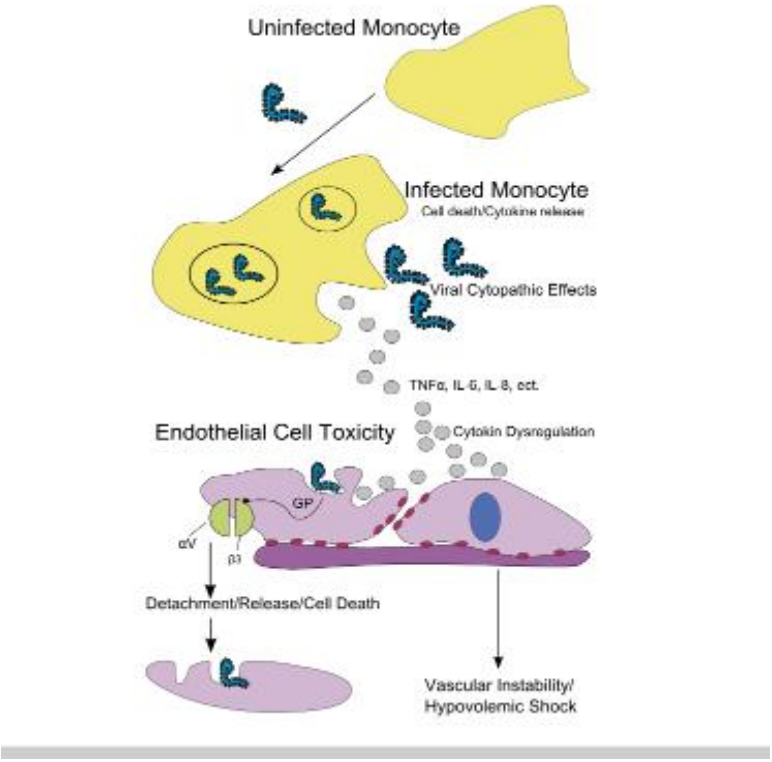

Figure 1: Pathophysiology of Ebola virus.

Like other filoviruses, EBOV replicates very efficiently in many cells, producing large amounts of virus in monocytes, macrophages, dendritic cells and other cells including liver cells, fibroblasts, and adrenal gland cells Viral replication triggers the high levels of inflammatory chemical signals and leads to a septic state. EBOV is thought to infect humans through contact with mucous membranes or skin breaks. After infection, endothelial cells (cells lining the inside of blood vessels), liver cells, and several types of immune cells such as macrophages, monocytes, and dendritic cells are the main targets of attack. Following infection, immune cells carry the virus to nearby lymph nodes where further reproduction of the virus takes place. From there the virus can enter the bloodstream and lymphatic system and spread throughout the body. Macrophages are the first cells infected with the virus, and this infection results in programmed cell death. Other types of white blood cells, such as lymphocytes, also undergo programmed cell death leading to an abnormally low concentration of lymphocytes in the blood. This contributes to the weakened immune response seen in those infected with EBOV. Endothelial cells may be infected within three days after exposure to the virus. The breakdown of endothelial cells leading to blood vessel injury can be attributed to EBOV glycoproteins. This damage occurs due to the synthesis of Ebola virus glycoprotein (GP), which reduces the availability of specific integrins responsible for cell adhesion to the intercellular structure and causes liver damage, leading to improper clotting. The widespread bleeding that occurs in affected people causes swelling and shock due to loss of blood volume.[91] The dysfunctional bleeding and clotting commonly seen in EVD has been attributed to increased activation of the extrinsic pathway of the coagulation cascade due to excessive tissue factor production by macrophages and monocytes.

After infection, a secreted glycoprotein, small soluble glycoprotein (sGP or GP) is synthesized. EBOV replication overwhelms protein synthesis of infected cells and the host immune defenses. The GP forms a trimeric complex, which tethers the virus to the endothelial cells. The sGP forms a dimeric protein that interferes with the signaling of neutrophils, another type of white blood cell. This enables the virus to evade the immune system by inhibiting early steps of neutrophil activation.

4.1-Immune system evasion

Filoviral infection also interferes with proper functioning of the innate immune system. EBOV proteins blunt the human immune system's response to viral infections by interfering with the cells' ability to produce and respond to interferon proteins such as interferon-alpha, interferon-beta, and interferon gamma. The VP24 and VP35 structural proteins of EBOV play a key role in this interference. When a cell is infected with EBOV, receptors located in the cell's cytosol (such as RIG-I and MDA5) or outside of the cytosol (such as Toll-like receptor 3 (TLR3), TLR7, TLR8 and TLR9) recognize infectious molecules associated with the virus. On TLR activation, proteins including interferon regulatory factor 3 and interferon regulatory factor 7 trigger a signaling

cascade that leads to the expression of type 1 interferons The type 1 interferons are then released and bind to the IFNAR1 and IFNAR2 receptors expressed on the surface of a neighboring cell. Once interferon has bound to its receptors on the neighboring cell, the signaling proteins STAT1 and STAT2 are activated and move to the cell's nucleus. This triggers the expression of interferon-stimulated genes, which code for proteins with antiviral properties. EBOV's V24 protein blocks the production of these antiviral proteins by preventing the STAT1 signaling protein in the neighboring cell from entering the nucleus. The VP35 protein directly inhibits the production of interferon-beta. By inhibiting these immune responses, EBOV may quickly spread throughout the body.

5. 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.

→1976

5.1.1→Sudan

Figure 2: Cotton factory in Nzara, South Sudan where the first outbreak occurred.

The first known outbreak of EVD was identified only after the fact. It occurred between June and November 1976, in Nzara, South Sudan (then part of Sudan), and was caused by Sudan virus (SUDV). The Sudan outbreak infected 284 people and killed 151. The first identifiable case in Sudan occurred on 27 June in a storekeeper in a cotton factory in Nzara, who was hospitalized on 30 June and died on 6 July. Although the WHO medical staff involved in the Sudan outbreak knew that they were dealing with a heretofore unknown disease, the actual "positive identification" process and the naming of the virus did not occur until some months later in Zaire.

5.1.2→Zaire

Figure 3: A CDC worker incinerates medical waste from Ebola patients in Zaire in 1976.

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 Ebola virus*, 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. However, his symptoms continued to worsen, and he was admitted to Yambuku Mission Hospital on 5 September. Lokela died on 8 September, 14 days after he began displaying symptoms. Soon after Lokela's death, others who had been in contact with him also died, and people in Yambuku began to panic. The country's Minister of Health and Zaire President Mobutu Sese Seko declared the entire region, including Yambuku and the country's capital, Kinshasa, a quarantine zone. No-one was permitted to enter or leave the area, and roads, waterways, and airfields were placed under martial law. Schools, businesses and social organizations were closed. Researchers from the Centers for Disease Control and Prevention (CDC), including Peter Piot, co-discoverer of Ebola, later arrived to assess the effects of the outbreak, observing that "the whole region was in panic." Piot concluded that Belgian nuns had inadvertently started the epidemic by giving unnecessary vitamin injections to pregnant women without sterilizing the syringes and needles. The outbreak lasted 26 days and the quarantine lasted two weeks. Researchers speculated that the disease disappeared due to the precautions taken by locals, the quarantine of the area, and discontinuing the injections. During this outbreak, Ngoy Mushola recorded the first clinical description of EVD in Yambuku, where he wrote the following in his daily log: "The illness is characterized with a high temperature of about 39 °C (102 °F), hematemesis, diarrhea with blood, retrosternal abdominal pain, prostration with 'heavy' articulations, and rapid evolution death after a mean of three days." The virus responsible for the initial outbreak, first thought to be Marburg virus, was later identified as a new type of virus related to Marburg viruses. Virus strain samples isolated from both outbreaks were named "Ebola virus" after the Ebola River, near the first-identified viral outbreak site in Zaire. Reports conflict about who initially coined the name: either Karl Johnson of the American CDC team or Belgian researchers. Subsequently, a number of other cases were reported, almost all centered on the Yambuku mission hospital or close contacts of another case. In all, 318 cases and 280 deaths (an 88% fatality rate) occurred in Zaire. Although the two outbreaks were at first believed connected, scientists later realized that they were caused by two distinct Ebola viruses, SUDV and EBOV. The Zaire outbreak was contained with the help of the World Health Organization and transport from the Congolese air force, by quarantining villagers, sterilizing medical equipment, and providing protective clothing.

6. TYPES OF EBOLA

There are 5 types of Ebola viruses

TABLE 2: Types of Ebola viruses.

S.NO	SPECIES NAME	VIRUS NAME (ABBREVIATION)
1	Bundibugyo Ebola virus	Bundibugyo virus(BDBV; previously BEBOV)
2	Reston Ebola virus	Reston virus(RESTV; previously REBOV)
3	Sudan Ebola virus	Sudan virus(SUDV; previously SEBOV)
4	Tai Farest Ebola virus	Tai Farest virus(TAFV; previously CIEBOV)
5	Zaire Ebola virus	Ebola virus(EBOV; previously ZEBOV)

7. Causes

EVD in humans is caused by four of five viruses of the genus *Ebola virus*. The four are Bundibugyo virus (BDBV), Sudan virus (SUDV), Taï Forest virus (TAFV) and one simply called Ebola virus (EBOV, formerly Zaire Ebola virus). EBOV, species *Zaire Ebola virus*, is the most dangerous of the known EVD-causing viruses, and is responsible for the largest number of outbreaks. The fifth virus, Reston virus (RESTV), is not thought to cause disease in humans, but has caused disease in other primates. All five viruses are closely related to Marburg viruses.

7.1→Virology

Main articles: *Ebola virus* (taxonomic group) and Ebola virus (specific virus).

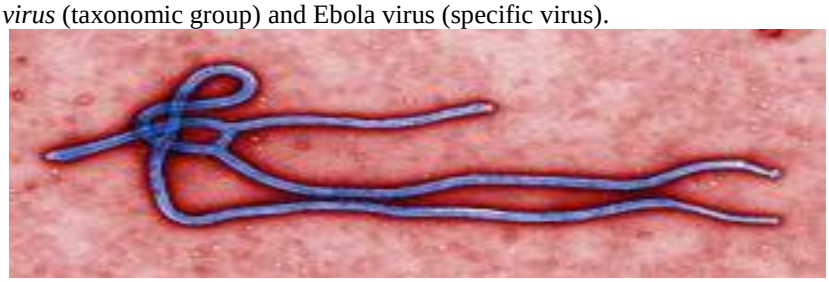

Figure 4: Electron micrograph of an Ebola virus virion.

Ebola viruses contain single-stranded, non-infectious RNA genomes. *Ebola virus* genomes contain seven genes including 3'-UTR-*NP-VP35-VP40-GP-VP30-VP24-L*-5'-UTR. The genomes of the five different Ebola viruses (BDBV, EBOV, RESTV, SUDV and TAFV) differ in sequence and the number and location of gene overlaps. As with all filoviruses, Ebola virus virions are filamentous particles that may appear in the shape of a shepherd's crook, of a "U" or of a "6," and they may be coiled, toroid or branched. In general, Ebola virions are 80 nanometers (nm) in width and may be as long as 14,000 nm. Their life cycle is thought to begin with a virion attaching to specific cell-surface receptors such as C-type lectins, DC-SIGN, or integrins, which is followed by fusion of the viral envelope with cellular membranes. The virions taken up by the cell then travel to acidic endosomes and lysosomes where the viral envelope glycoprotein GP is cleaved. This processing appears to allow the virus to bind to cellular proteins enabling it to fuse with internal cellular membranes and release the viral nucleo capsid. The *Ebola virus* structural glycoprotein (known as GP1,2) is responsible for the virus' ability to bind to and infect targeted cells. The viral RNA polymerase, encoded by the *L* gene, partially uncoats the nucleo capsid and transcribes the genes into positive-strand mRNAs, which are then translated into structural and nonstructural proteins. The most abundant protein produced is the nucleoprotein, whose concentration in the host cell determines when L switches from gene transcription to genome replication. Replication of the viral genome results in full-length, positive-strand antigenomes that are, in turn, transcribed into genome copies of negative-strand virus progeny. Newly synthesized structural proteins and genomes self-assemble and accumulate near the inside of the cell membrane. Virions bud off from the cell, gaining their envelopes from the cellular membrane from which they bud. The mature progeny particles then infect other cells to repeat the cycle. The genetics of the Ebola virus are difficult to study because of EBOV's virulent characteristics.

7.2→Transmission

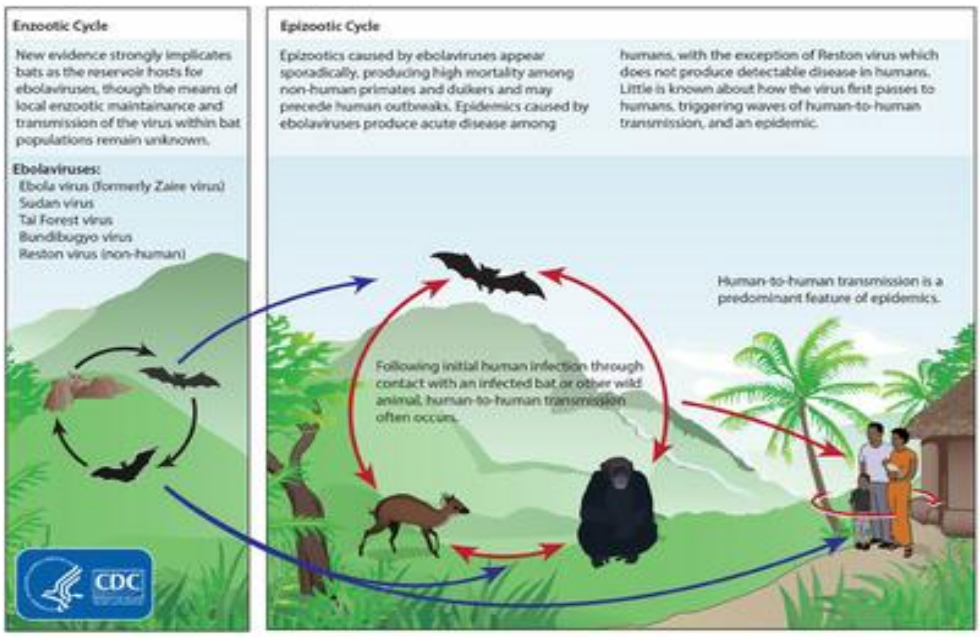

Figure 5: Life cycles of the Ebola virus.

Figure 6: An illustration of safe burial practices.

It is believed that between people, Ebola disease spreads only by direct contact with the blood or other body fluids of a person who has developed symptoms of the disease. Body fluids that may contain Ebola viruses include saliva, mucus, vomit, feces, sweat, tears, breast milk, urine and semen. The WHO states that only people who are very sick are able to spread Ebola disease in saliva, and whole virus has not been reported to be transmitted through sweat. Most people spread the virus through blood, feces and vomit. Entry points for the virus include the nose, mouth, eyes, open wounds, cuts and abrasions Ebola may be spread through large droplets; however, this is believed to occur only when a person is very sick This contamination can happen if a person is splashed with droplets. Contact with surfaces or objects contaminated by the virus, particularly needles and syringes, may also transmit the infection The virus is able to survive on objects for a few hours in a dried state, and can survive for a few days within body fluids outside of a person. The Ebola virus may be able to persist for more than 3 months in the semen after recovery, which could lead to infections via sexual intercourse. Virus persistence in semen for over a year has been recorded in a national screening programme. Ebola may also occur in the breast milk of women after recovery, and it is not known when it is safe to breastfeed again. The virus was also found in the eye of one patient in 2014, two months after it was cleared from his blood. Otherwise, people who have recovered are not infectious. The potential for widespread infections in countries with medical systems capable of observing correct medical isolation procedures is considered low. Usually when someone has symptoms of the disease, they are unable to travel without assistance. Dead bodies remain infectious; thus, people handling human remains in practices such as traditional burial rituals or more modern processes such as embalming are at risk. 69% of the cases of Ebola infections in Guinea during the 2014 outbreak are believed to have been contracted via unprotected (or unsuitably protected) contact with infected corpses during certain Guinean burial rituals.

Health-care workers treating people with Ebola are at greatest risk of infection. The risk increases when they do not have appropriate protective clothing such as masks, gowns, gloves and eye protection; do not wear it properly; or handle contaminated clothing incorrectly This risk is particularly common in parts of Africa where the disease mostly occurs and health systems function poorly. There has been transmission in hospitals in some African countries that reuse hypodermic needles. Some health-care centers caring for people with the disease do not have running water. In the United States the spread to two medical workers treating infected patients prompted criticism of inadequate training and procedures. Human-to-human transmission of EBOV through the air has not been reported to occur during EVD outbreaks, and airborne transmission has only been demonstrated in very strict laboratory conditions, and then only from pigs to primates, but not from primates to primates. Spread of EBOV by water, or food other than bush meat, has not been observed. No spread by mosquitos or other insects has been reported. Other possible methods of transmission are being studied. Airborne transmission among humans is theoretically possible due to the presence of Ebola virus particles in saliva, which can be discharged into the air with a cough or sneeze, but observational data from previous epidemics suggests the actual risk of airborne transmission is low. A number of studies examining airborne transmission broadly concluded that transmission from pigs to primates could happen without direct contact because, unlike humans and primates, pigs with EVD get very high Ebola virus concentrations in their lungs, and not their bloodstream. Therefore, pigs with EVD can spread the disease through droplets in the air or on the ground when they sneeze or cough. By contrast, humans and other primates accumulate the virus throughout their body and specifically in their blood, but not very much in their lungs. It is believed that this is the reason researchers have observed pig to primate transmission without physical contact, but no evidence has been found of primates being infected without actual contact, even in experiments were infected and uninfected primates shared the same air.

7.3→Initial case

Figure 7: Bush meat being prepared for cooking in Ghana. In Africa, wild animal including fruit bats are hunted for food and are referred to as bush meat in equatorial Africa, human consumption of bush meat has been linked to animal-to-human transmission of diseases, including Ebola.

Although it is not entirely clear how Ebola initially spreads from animals to humans, the spread is believed to involve direct contact with an infected wild animal or fruit bat. Besides bats, other wild animals sometimes infected with EBOV include several monkey species, chimpanzees, gorillas, baboons, and duikers.

Animals may become infected when they eat fruit partially eaten by bats carrying the virus. Fruit production, animal behavior and other factors may trigger outbreaks among animal populations. Evidence indicates that both domestic dogs and pigs can also be infected with EBOV. Dogs do not appear to develop symptoms when they carry the virus, and pigs appear to be able to transmit the virus to at least some primates. Although some dogs in an area in which a human outbreak occurred had antibodies to EBOV, it is unclear whether they played a role in spreading the disease to people.

7.4→Reservoir

The natural reservoir for Ebola has yet to be confirmed; however, bats are considered to be the most likely candidate species Three types of fruit bats (*Hypsignathus monstrosus*, *Epomops franqueti* and *Myonycteris torquata*) were found to possibly carry the virus without getting sick.[81] As of 2013, whether other animals are involved in its spread is not known Plants, arthropods, rodents, and birds have also been considered possible viral reservoirs.

Bats were known to roost in the cotton factory in which the first cases of the 1976 and 1979 outbreaks were observed, and they have also been implicated in Marburg virus infections in 1975 and 1980. Of 24 plant and 19 vertebrate species experimentally inoculated with EBOV, only bats became infected. The bats displayed no clinical signs of disease, which is considered evidence that these bats are a reservoir species of EBOV. In a 2002–2003 survey of 1,030 animals including 679 bats from Gabon and the Republic of the Congo, 13 fruit bats were found to contain EBOV RNA. Antibodies against Zaire and Reston viruses have been found in fruit bats in Bangladesh, suggesting that these bats are also potential hosts of the virus and that the filoviruses are present in Asia. Between 1976 and 1998, in 30,000 mammals, birds, reptiles, amphibians and arthropods sampled from regions of EBOV outbreaks, no Ebola virus was detected apart from some genetic traces found in six rodents (belonging to the species *Mus setulosus* and *Praomys*) and one shrew (*Sylvisorex ollula*) collected from the Central African Republic. However, further research efforts have not confirmed rodents as a reservoir. Traces of EBOV were detected in the carcasses of gorillas and chimpanzees during outbreaks in 2001 and 2003, which later became the source of human infections. However, the high rates of death in these species resulting from EBOV infection make it unlikely that these species represent a natural reservoir for the virus. Deforestation has been mentioned as a possible contributor to recent outbreaks, including the West African Ebola virus epidemic. Index cases of EVD have often been close to recently deforested lands.

8. Signs and symptoms

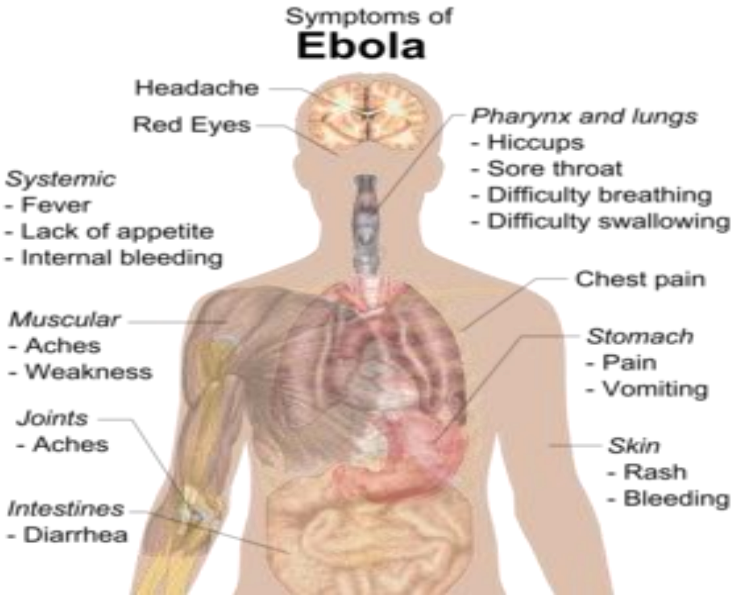

Figure 8: Signs and symptoms of Ebola.

8.1→Onset

The length of time between exposure to the virus and the development of symptoms (incubation period) is between 2 and 21 days, and usually between 4 and 10 days. However, recent estimates based on mathematical models predict that around 5% of cases may take greater than 21 days to develop.

Symptoms usually begin with a sudden influenza-like stage characterized by feeling tired, fever, weakness, decreased appetite, muscular pain, joint pain, headache, and sore throat The fever is usually higher than 38.3 °C (101 °F) This is often followed by nausea, vomiting, diarrhea, abdominal pain, and sometimes hiccups The combination of severe vomiting and diarrhea often leads to severe dehydration. Next, shortness of breath and chest pain may occur, along with swelling, headaches, and confusion In about half of the cases, the skin may develop a maculopapular rash, a flat red area covered with small bumps, five to seven days after symptoms begin.

8.2→Bleeding

In some cases, internal and external bleeding may occur. This typically begins five to seven days after the first symptoms all infected people show some decreased blood clotting. Bleeding from mucous membranes or from sites of needle punctures has been reported in 40–50% of cases. This may cause vomiting blood, coughing up of blood, or blood in stool. Bleeding into the skin may create petechiae, purpura, ecchymoses or hematomas (especially around needle injection sites). Bleeding into the whites of the eyes may also occur. Heavy bleeding is uncommon; if it occurs, it is usually in the gastrointestinal tract. The incidence of bleeding into the gastrointestinal tract has decreased since earlier epidemics and is now estimated to be approximately 10% with improved prevention of disseminated intravascular coagulation.

8.3-Recovery and Death

Recovery may begin between 7 and 14 days after first symptoms Death, if it occurs, follows typically 6 to 16 days from first symptoms and is often due to low blood pressure from fluid loss. In general, bleeding often indicates a worse outcome, and blood loss may result in death People are often in a coma near the end of life. Those who survive often have ongoing muscular and joint pain, liver inflammation, decreased hearing, and may have continued tiredness, continued weakness, decreased appetite, and difficulty returning to pre-illness weight. Problems with vision may develop. Survivors develop antibodies against Ebola that last at least 10 years, but it is unclear whether they are immune to additional infections.

9. Diagnosis

When EVD is suspected, travel, work history, and exposure to wildlife are important factors with respect to further diagnostic efforts.

9.1→Laboratory testing

Possible non-specific laboratory indicators of EVD include a low platelet count; an initially decreased white blood cell count followed by an increased white blood cell count; elevated levels of the liver enzymes alanine aminotransferase (ALT) and aspartate aminotransferase (AST); and abnormalities in blood clotting often consistent with disseminated intravascular coagulation (DIC) such as a prolonged prothrombin time, partial thromboplastin time, and bleeding time. Filovirions such as EBOV may be identified by their unique filamentous shapes in cell cultures examined with electron microscopy.

The specific diagnosis of EVD is confirmed by isolating the virus, detecting its RNA or proteins, or detecting antibodies against the virus in a person's blood. Isolating the virus by cell culture, detecting the viral RNA by polymerase chain reaction (PCR) and detecting proteins by enzyme-linked immunosorbent assay (ELISA) are methods best used in the early stages of the disease and also for detecting the virus in human remains. Detecting antibodies against the virus is most reliable in the later stages of the disease and in those who recover. IgM antibodies are detectable two days after symptom onset and IgG antibodies can be detected six to 18 days after symptom onset. During an outbreak, isolation of the virus with cell culture methods is often not feasible. In field or mobile hospitals, the most common and sensitive diagnostic methods are real-time PCR and ELISA. In 2014, with new mobile testing facilities deployed in parts of Liberia, test results were obtained 3–5 hours after sample submission. In 2015, a rapid antigen test which gives results in 15 minutes was approved for use by WHO. It is able to confirm Ebola in 92% of those affected and rule it out in 85% of those not affected.

9.2→Differential diagnosis

Early symptoms of EVD may be similar to those of other diseases common in Africa, including malaria and dengue fever. The symptoms are also similar to those of other viral hemorrhagic fevers such as Marburg virus disease, Crimean Congo hemorrhagic fever, and Lassa fever.

The complete differential diagnosis is extensive and requires consideration of many other infectious diseases such as typhoid fever, shigellosis, rickettsial diseases, cholera, sepsis, borreliosis, EHEC enteritis, leptospirosis, scrub typhus, plague, Q fever, candidiasis, histoplasmosis, trypanosomiasis, visceralleishmaniasis, measles, and viral hepatitis among others. Non-infectious diseases that may result in symptoms similar to those of EVD include acute promyelocytic leukemia, hemolytic uremic syndrome, snake envenomation, clotting factor deficiencies/platelet disorders, thrombotic thrombocytopenic purpura, hereditary hemorrhagic telangiectasia, Kawasaki disease, and warfarin poisoning.

10. Research

10.1→Treatment

As of July 2015, no medication has been proven safe and effective for treating Ebola. By the time the Ebola virus epidemic in West Africa began in 2013, there were at least nine different candidate treatments. Several trials were conducted in late 2014, and early 2015, but some

were abandoned due to lack of efficacy or lack of people to study.

As of August 2019, two experimental treatments known as REGN-EB3 and mAb-114 were found to be 90% effective.

10.2→Diagnostic tests

The diagnostic tests currently available require specialized equipment and highly trained personnel. Since there are few suitable testing centers in West Africa, this leads to delay in diagnosis.

On 29 November 2014, a new 15-minute Ebola test was reported that if successful, "not only gives patients a better chance of survival, but it prevents transmission of the virus to other people." The new equipment, about the size of a laptop and solar-powered, allows testing to be done in remote areas.

On 29 December 2014, the FDA approved the Light Mix Ebola Zaire rRT-PCR test for patients with symptoms of Ebola.

11. Prevention

11.1→Vaccines

Many Ebola vaccine candidates had been developed in the decade prior to 2014 but as of November 2014, none had been approved for use in humans in the United States In December 2016, Ebola was found to be 70–100% prevented by rVSV-ZEBOV vaccine, making it the first proven vaccine against the disease. More than 100,000 people have been vaccinated against Ebola as of 2019.

11.2→Infection control

Figure 9: Precautions.

People who care for those infected with Ebola should wear protective clothing including masks, gloves, gowns and goggles. The U.S. Centers for Disease Control (CDC) recommend that the protective gear leaves no skin exposed these measures are also recommended for those who may handle objects contaminated by an infected person's body fluids. In 2014, the CDC began recommending that medical personnel receive training on the proper suit-up and removal of personal protective equipment (PPE); in addition, a designated person, appropriately trained in biosafety, should be watching each step of these procedures to ensure they are done correctly. In Sierra Leone, the typical training period for the use of such safety equipment lasts approximately 12 days. The infected person should be in barrier-isolation from other people. All equipment, medical waste, patient waste and surfaces that may have come into contact with body fluids need to be disinfected. During the 2014 outbreak, kits were put together to help families treat Ebola disease in their homes, which included protective clothing as well as chlorine powder and other cleaning supplies. Education of caregivers in these techniques, and providing such barrier-separation supplies has been a priority of Doctors without Borders. Ebola viruses can be eliminated with heat (heating for 30 to 60 minutes at 60 °C or boiling for 5 minutes). To disinfect surfaces, some lipid solvents such as some alcohol-based products, detergents, sodium hypochlorite (bleach) or calcium hypochlorite (bleaching powder), and other suitable disinfectants may be used at appropriate concentrations. Education of the general public about the risk factors for Ebola infection and of the protective measures individuals may take to prevent infection is recommended by the World Health Organization. These measures include avoiding direct contact with infected people and regular hand washing using soap and water. Bush meat, an important source of protein in the diet of some Africans, should be handled and prepared with appropriate protective clothing and thoroughly cooked before consumption. Some research suggests that an outbreak of Ebola disease in the wild animals used for consumption may result in a corresponding human outbreak. Since 2003, such animal outbreaks have been monitored to predict and prevent Ebola outbreaks in humans. If a person with Ebola disease dies, direct contact with the body should be avoided. Certain burial

rituals, which may have included making various direct contacts with a dead body, require reformulation so that they consistently maintain a proper protective barrier between the dead body and the living. Social anthropologists may help find alternatives to traditional rules for burials. Transportation crews are instructed to follow a certain isolation procedure, should anyone exhibit symptoms resembling EVD. As of August 2014, the WHO does not consider travel bans to be useful in decreasing spread of the disease. In October 2014, the CDC defined four risk levels used to determine the level of 21-day monitoring for symptoms and restrictions on public activities. In the United States, the CDC recommends that restrictions on public activity, including travel restrictions, are not required for the following defined risk levels having been in a country with widespread Ebola disease transmission and having no known exposure (low risk); or having been in that country more than 21 days ago (no risk) encounter with a person showing symptoms; but not within three feet of the person with Ebola without wearing PPE; and no direct contact with body fluids having had brief skin contact with a person showing symptoms of Ebola disease when the person was believed to be not very contagious (low risk) in countries without widespread Ebola disease transmission: direct contact with a person showing symptoms of the disease while wearing PPE (low risk).

Contact with a person with Ebola disease before the person was showing symptoms (no risk).

The CDC recommends monitoring for the symptoms of Ebola disease for those both at "low risk" and at higher risk. In laboratories where diagnostic testing is carried out, biosafety level 4-equivalent containment is required. Laboratory researchers must be properly trained in BSL-4 practices and wear proper PPE.

11.3→Isolation

Isolation refers to separating those who are sick from those who are not. Quarantine refers to separating those who may have been exposed to a disease until they either show signs of the disease or are no longer at risk. Quarantine, also known as enforced isolation, is usually effective in decreasing spread. Governments often quarantine areas where the disease is occurring or individuals who may transmit the disease outside of an initial area. In the United States, the law allows quarantine of those infected with Ebola viruses.

11.4→Contact tracing

Contact tracing is considered important to contain an outbreak. It involves finding everyone who had close contact with infected individuals and monitoring them for signs of illness for 21 days. If any of these contacts comes down with the disease, they should be isolated, tested and treated. Then the process is repeated, tracing the contacts' contacts.

12. CONCLUSION

Ebola virus has been a threat to human health due to dangerous, highly lethal and infectious behavior since its discovery in 1976. Ebola fever has come out as one of the most fatal identified forms of hemorrhagic fever, for which there is no specific no remedy available. The spread among humans occurs mainly through the exchange of blood and body secretions. Other noticeable forms of transmission include hospital acquired infection and inadequate hygiene practices. There is an urgent requirement of dissemination of information to community and training programmes for doctors, nurses and other hospital staffs.

The feature endeavors required the emphasis on the understanding on the differences among species of Ebola virus. There is an urgent demand for more field studies into the ecology of reservoir species and shedding procedures. The discovery of novel targets for intervention tactics requires more exhaustive research into the pathophysiology of Ebola virus infections with laboratory animals the best method to lower the cases and epidemic is to prevent the spread of the disease the awareness programmes should organized on large scale to develop the attentiveness about disease for its eradication. The research should also essentially be focused on establishment of rapid and simple diagnostic kits for Ebola infection. It is anticipated that outcome of research investigations would result in development of easily available and affordable drug for treatment of Ebola virus. A great effort with clear strategy is needed for transforming the potential drugs and vaccines from lab to clinical trials and ultimately for treatment of patients with Ebola infections.

13. REFERENCES

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