



(CDC "Ebola")

The Evolution of the Ebola Virus (EBOD) along with its Effects On Society

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Introduction:

In 1976, a viral haemorrhagic fever denoted Ebola took the world by storm, eventually earning it 'pandemic' status. Having made its first appearance in two outbreaks in Africa, it derived its name from the Ebola River which flows through the villages in the Congo. It targeted humans and primates alike and due to its significant global effect, Ebola was studied to a great extent and much was learned from it. There are six strains of ebola, namely: Ebola, sudan, tai forest, bundibugyo, reston, and bombali. Contrary to Covid-19, transmission requires direct contact, meaning the Ebola virus is transmitted through close physical contact or through bodily fluids such as blood, urine and vomit through initial animal carriers. It then moves from person to person. To be diagnosed with Ebola, one must go to a doctor to get tests done. Despite its deceptively low transmission rate, its fatality rate is an average of 50%. The virus kills cells, targeting blood-clotting cells in particular and wrecking the immune system and organs, ultimately causing heavy internal bleeding. Death follows after the first 6 to 16 days of symptoms. On December 19, 2019, Ervebo was introduced as the first FDA approved vaccine. Ervebo has been genetically engineered to have a protein from the Zaire ebolavirus and is administered as a single-dose injection.

Origin:

The Ebola virus has been shown to affect both humans and animals, primarily in the region of Africa. In fact, the name "Ebola" was assigned to the virus due to the initial cases (observed by Dr. Peter Piot) that were recorded near the Ebola river, in a region now known as the Democratic Republic of Congo (Hasan et al. 1). The Ebola virus disease is the result of the viruses of the *Ebolavirus* genus under the *Filoviridae* family. There are six species in the *ebolavirus* genus - *Zaire ebolavirus*, *Sudan ebolavirus*, *Tai Forest ebolavirus*, *Reston Ebola virus*, *Bundibugyo ebolavirus*, and *the Bombali ebolavirus*. The six species respectively cause: the Ebola virus (EBOV), Sudan virus (SUDV), Tai Forest virus (TAFV), Reston virus (RESTV), Bundibugyo virus (BDBV), and the Bombali virus (BOMBV) (Languon and Quaye 1). Of the six viruses, only four are known to affect humans, including EBOV, SUDV, TAFV, and BDBV. (Languon and Quaye 1; CDC, "What Is Ebola Virus Disease?"). The primary hosts of the ebolavirus are fruit bats belonging to the *Pteropodidae* family. Transmittance to other animals such as primates occurs via consumption of contaminated fruits that were in contact with the fruit bats. Through these nonhuman primate intermediates, humans can come in contact with the disease and become infected (Hasan et al. 1-2).

In 1976, there were reports of outbreaks of the Ebola virus disease in both Sudan and Zaire (Democratic Republic of Congo). In Sudan, the four towns of Nzara, Tembura, Maridi, and Juba were associated with the outbreak, with Nzara determined as the original source. It is theorized that cotton factory workers were infected by the bats that crowded the beams of the factory. After patients' admittance into hospitals, the contagion then spread to other patients and people within that vicinity, who would then infect others unknowingly in nearby towns. In Zaire, the reason for the outbreak was similar to that in Sudan. However, instead of stemming from the main host or bats, infections followed a typical pattern through the intermediary source. The patient who was connected to the first case of the outbreak, known as 'patient zero', was a man

who was traveling from the Bumba Zone to northern Zaire by car. The patient had consumed smoked monkey meat which was presumed the intermediary source of the Ebola virus. With his admittance into Yambuku Hospital, he was treated with chloroquine injections, which is typically used against malaria. Since the needles were not sterilized for each usage, the patients that followed after him in the hospitals were then infected by the contaminated needles. Contaminated needles were a common reason for the outbreak of the EBOD. Even in a first world country such as England, an outbreak occurred after the usage of a contaminated needle that was in contact with a rodent with SUDV (Languon and Quaye, 4).

Since its discovery in 1976, sporadic Ebola cases and relatively small outbreaks have occurred not only in Africa, but also in other parts of the world like the US. This is the result of transporting primates (which act as intermediaries), and interacting with them through laboratory experiments and dissections. . Transmission also occurred through interactions between people who were in contact with EBOD patients or corpses (Languon and Quaye 5-7). In other words, EBOD spread through contact with clothes, corpses, or bodily fluids (sweat, saliva, sexual fluids, etc.) of EBOD patients (Hasan et al. 1-2). However, it was not until December 2013 that the dangers of EBOD were fully unveiled, particularly in West Africa. In 2013, the index case, in Africa, was a young child of two years infected by insectivorous bats. The lack of urgency and regulations from the medical field resulted in many preventable deaths (Languon and Quaye, 7). Most commonly, EBOD results from a lack of resources and funding in underdeveloped third world countries, where outbreaks are exacerbated by the lack of sanitation and containment procedures. Hence, the most affected countries by the outbreak were Guinea, Sierra Leone, Liberia, and Nigeria (Holmes et al. 2).

Information & Disinformation:

Although Ebola has been portrayed in the media as a dangerous virus, it isn't as highly infectious as Covid-19. Transmission requires direct contact with the viral particles. Ebola's transmission rate, however, does not correlate with its fatality rate. As stated before, according to the World Health Organization, Ebola has a mortality rate of almost 90%. Thus death is common, after just 6 to 16 days symptoms began to appear. (World Health Organization, "Ebola Virus Disease"). Thankfully, on December 19, 2019, the first FDA approved vaccine for Ebola, Ervebo, was introduced. Containing the protein found in the Zaire ebolavirus Kikwit strain glycoprotein (ZEBOV-GP), Ervebo was recorded to have an efficacy rate of 95-100%, and helped numerous civilians recover from the Ebola virus both in Africa and across the world (Sharp et al.).

As the Ebola virus persisted throughout the years, it had severe impacts on the economy and public health. During the 2015 ebola outbreak, an estimated \$2.2 million dollars were lost due to restrictions on agriculture and trade. These agricultural restrictions were originally made to ensure that products would not get contaminated, containing the spread of the virus. Trade was also restricted for the same reasons (CDC, "Cost of the Ebola Epidemic Error Processing SSI File"). From a healthcare standpoint, many healthcare workers who were on the frontlines defending against the virus died from infection. From the start of the outbreak in 2014 until November 2015, Liberia lost 8% of its doctors, nurses, and midwives. Along with other

socioeconomic factors, this epidemic resulted in thousands of orphans (CDC, “Cost of the Ebola Epidemic Error Processing SSI File”).

Despite determined efforts, it is not possible to completely prevent the spread of misinformation throughout the world. Social unrest, along with other issues, plays a prominent role in the advancements of a virus. By undermining proven scientific studies and creating false rumors, misinformation threatens our understanding of viruses, leading to panic or arrogance. When a rumor surfaced stating that Ebola was spread through cough particles, water droplets, and mosquito bites, many were fearful. People were filled with a sense of desperation and anxiety with their inability. With this helplessness, they started to scapegoat other people, usually the marginalized and those who already faced prejudice. This scapegoating and discrimination was also observed during the Black Plague, where Jews were framed in conspiracies that they poisoned wells.

Online misinformation is a big problem that health officials face when spreading awareness on diseases. Due to the anonymity of the Internet, it is extremely easy to spread false information and baseless conspiracy theories on social media about various diseases. During the Ebola outbreak in Africa in 2014, Russian internet trolls accused the United States of bringing Ebola to that region (Fidler, “Disinformation and Disease: Social Media and the Ebola Epidemic in the Democratic Republic of the Congo”). Rather than focusing on the virus itself, everyone became hyper focused on assigning blame. Covid-19 is a current example of this; not too long after the initial outbreak, there were speculations that the disease had been leaked from a Wuhan laboratory. This soon became a politicized blame game between China and the United States, with each country using misinformation for political gain.

A lack of trust in technology and government officials further contributed to the rising number of Ebola cases. A study conducted in 2018 found that among the 961 respondents, only 349 trusted that the local authorities acted on public interest. Nearly 230 respondents argued that the ebola outbreak was not real. This belief in misinformation tended to be associated with an overall decreased willingness to submit to preventive manners or behaviors, such as the acceptance of certain vaccines (Abraham et al. 6). Overall, the study found that the cohort of individuals who did not believe in the ebola virus had a higher risk of contracting the disease.

Along with misinformation, the lack of knowledge or respect for known issues with the virus further hindered prevention of the spread of the Ebola virus. For example, traditional burial requires relatives to clean the body of the deceased, but this direct contact would expose people to the risk of contracting the disease if the deceased was infected. While the WHO tried to prevent such burial practices, many Africans hid infected patients and held traditional funerals secretly. As many as 68% of infected cases in Guinea were linked to this issue (Hasan et al.) Additionally, according to the World Health Organization, as many as 80% of the West Africans relied on traditional medicine for Ebola treatment. Traditional healers who didn't study modern medicine spread false information in many rural communities. For instance, they claimed that taking saltwater baths would prevent people from getting Ebola (Fung et al.). As a result, the virus was able to spread even faster from the deceased to the living. Culture and tradition played major roles in the outbreak, as many Africans refused to comply with public health or government restrictions.

The lack of awareness, as well as the rampant spread of misinformation, had devastating impacts on affected international communities. Many who are exposed to misleading information developed skepticism towards government officials and the information they provide. For example in the Ebola outbreak in August of 2018, violence and armed rebel groups were prevalent due to people's distrust of the government (Fidler, "Disinformation and Disease: Social Media and the Ebola Epidemic in the Democratic Republic of the Congo"). They also developed distrust towards the West, when the West offered to lend a helping hand. Without foreign help, it was inevitable that the outbreak became an international emergency. Due to a lack of proper education and information, many people believed the lies and conspiracies told to them by people on the internet and many around them. They proceeded to continue their lives blatantly ignoring the precautions and rules set by the government, ultimately causing the Ebola outbreak to reach such a great magnitude.

Evolution of Medical History:

Ebola viruses are known for their ability to mutate inside their hosts and adapt in order to ensure its rate of survival. These genetic mutations alter the genotype and the phenotype of the virus to ensure it is able to better infiltrate and hijack host cells more efficiently.

The first case of the Sudan ebolavirus was first discovered in 1976 in the United Kingdom. In 1977, one individual was infected with the Zaire ebolavirus and died from it. By 1979, there was a steep increase in the number of cases. 34 people were infected with the Sudan ebolavirus and 22 individuals died as a result, raising the fatality rate to 65%. In 1989, Reston ebolavirus was detected in 3 individuals, but fortunately, no deaths were caused since the Reston ebolavirus does not cause illness in humans. The Reston ebolavirus was detected again in 1990 in the USA with only 4 cases. In 1994, the first case of Taï Forest ebolavirus was discovered in Cote d'Ivoire, and no deaths were reported. In the year 1995, a whopping 315 cases of Zaire ebolavirus was discovered in the Democratic Republic of Congo, and of the 315 infected individuals, 254 died, making the fatality rate 81%. By 1996, the ebola virus had spread to many major countries around the globe, including Russia, Philippines, USA, South Africa, and Gabon. In Gabon, 91 individuals were infected and 66 died. From 2001 to 2008, almost all of the cases reported were caused by the Zaire ebolavirus, with the fatality rates ranging from 47%-89%. On March 26, 2016, a total of 28,616 cases of EVD and 11,310 deaths were reported in places like Guinea, Liberia, and Sierra Leone. In 2018, the infected individuals totaled to 3470 and the number of fatal cases was totaled to 2287, making the fatality rate 66% (CDC, "Years of Ebola Virus Disease Outbreaks").

In the late 1980s, it was evident that there was a significant spike in the number of documented cases. A major factor behind this dramatic jump was a lack of medical understanding about nursing and improper usage of medical equipment. According to the CDC, "nurses in the Yambuku mission hospital reportedly used five syringes for 300 to 600 patients a day." This evidently led to the transmission of the ebola virus through patients' bodily fluids. However, by 1994, the situation took a turn for the better. In the Cote d'Ivoire outbreak, scientists were able to dramatically reduce the transmission of the ebola virus by using PPE such as face masks, gloves, and gowns. In addition, the usage of disposable single-use needles and equipment helped reduce the rate of transmission. Communities heavily affected by ebola started

to take matters seriously after extensive education on the transmission mechanisms of Ebola and prevention measures (CDC, “History of Ebola Virus Disease”).

Public Measures:

As medical understanding evolved, prevention measures against diseases developed. When Ebola first appeared, panic surfaced worldwide. Because Ebola was new and had first made its appearance so abruptly, very little information was confirmed. Therefore, prevention methods were not present nor effective at the start of the epidemic. Ebola was present mostly in Africa, so to outsiders in the US, it was an epidemic of fear. The overall observation among public health officials about the Ebola epidemic was that it was the result of extreme poverty in Western Africa, the poorly established infection control and the weak practices of patient care within the US. The epidemic began in late 2013 but was not officially labeled as a public health emergency of international concern by the WHO until August 8th, 2014 (George 343). There were no protocols within the US to deal with the epidemic. In Western Africa, poverty and lack of knowledge of the epidemic stood in the way of people receiving the medical assistance and care they needed. Though an Ebola vaccine should be prioritized, attention should also be given to public health actions, while continuing research developments in medical treatment. When a cure is not yet available, the next best thing is to slow down the spread of the disease as much as possible. In the current pandemic of Covid-19, quarantine measures have been placed in hopes of slowing down the spread of the virus as much as possible, because we do not currently have a cure for it. Limiting the exposure of a disease helps to maintain a calm environment rather than chaos. Other potential public actions include training health care workers to properly identify, diagnose, treat, and care for Ebola patients. Developing a rapid lab test for Ebola allows us to isolate and care for Ebola patients earlier on, stopping any further spread and damage to other patients. Isolation is a common method of slowing the spread, and we are utilizing this method even now for COVID-19. Passenger screenings were placed at airports to identify anyone that showed symptoms of Ebola.

In Western Africa however, the case was different. A study was done with 65 participants (25 Ebola survivors, 24 community members of affected Ebola areas, and 16 health care workers) in Sierra Leone to analyze the primary theme of “When Ebola is Real”, focusing on the denial, knowledge, and acceptance of those in Sierra Leone. The term “denial” was frequently used by participants to describe a range of attitudes and beliefs towards Ebola. Many participants claimed to not have believed in Ebola, rejecting it until the disease burst through their doors. Denial was associated with the absence of knowledge, direct experience, or exposure to Ebola. Because people in Sierra Leone were not educated about Ebola, many ignored the epidemic, causing many public health measures to fall through. Participants explained that Ebola was new to them, and it led to misconceptions, mistrust, and uncertainty amongst the population. There was also a lack of knowledge within the public health workers. Early Ebola patients explained that they received very little support from the Ebola Management Centre. They also witnessed many deaths in the EMC, which further convinced them that health workers would not be able to help them at all (Gray et al. 4-6). Without this crucial relationship of trust between the

healthcare worker and the patient, the journey of recovery was severely hindered. This highlights the importance of educating people about the disease and providing as much accurate information as possible to help battle against fear and uncertainty within the population. The Ebola experience confirmed several principles that should guide public health measures when governments are faced with a future epidemic. To begin, prevention of the spread of disease should be the primary goal; it should always come before the development of a vaccine. Additionally, the government should take responsibility for the health of the people. They should not discriminate against anyone and should provide the same medical help and access to everyone. Interventions between countries should be aimed to help build a strong health care system and infrastructure (George, 353- 354). Finally, everyone must participate in public health measures when a vaccine has not been formulated just yet.

In December of 2019, the First FDA-approved vaccine was created to stop the spread of the Ebola Virus. This marked a critical turning point due to the extreme susceptibility of patients infected with the Ebola Virus Diseases. Among 2108 individuals, the vaccine Ervebo managed to be “100% effective” in stopping Ebola symptoms under 11 days (FDA, “First FDA-approved vaccine for the prevention of Ebola virus disease, marking a critical milestone in public health preparedness and response”).

Social & Economic Impact:

Diseases not only present the shortcomings of our medical understanding, but also exposes societal problems. Before the outbreak of Ebola, a series of civil wars left many West African countries in political instability. Thus, some governments failed to react quickly when Ebola outbreaks began. In Guinea, for instance, it took days for ambulances to come. When they did come, many patients died on their way to the hospital because of the poor road conditions. (WHO, “One year into the Ebola epidemic: a deadly, tenacious and unforgiving virus” 13). The poor decisions made by the government during the Ebola virus generated further frustration with the government and exposed the citizen’s distrust of their government.

While the government sought help from the World Health Organization, African communities were resistant to foreign help since the WHO tried to stop people from practicing traditional burial practices. Refusing to give up traditions, family members would hide patients from health officials and hold funerals secretly. Additionally, the illiteracy rate in rural communities made people vulnerable to conspiracies. These theories that the government made up Ebola in order to gain more funds from Western countries led to more protests against the response teams. In a violent protest in Guinea, eight response team members were killed by villagers, who claimed that the workers had been spreading the disease. Such protests threaten the safety of the response team and hinder their efforts to help fight the disease.

This community resistance adds even more pressure on the health care workers, who are at a higher risk of infection. Among the total Ebola deaths in West Africa from 2014-2016, health care workers account for approximately 5% of the deaths. This may seem like a small percentage but it results in a great loss to the health care system, which is already weak considering the insufficient number of health workers in the region. In Guinea, Liberia, and Sierra Leone, health care services were reduced by nearly 50%. Thus, West Africans had less access to health care and couldn’t get treatments for other severe diseases, including malaria. The

number of deaths due to untreated disease almost matches that of Ebola, totalling 10,600 and 11,310, respectively (CDC, “Cost of Ebola” 4). Furthermore, the indirect impacts of Ebola on public health is nearly as devastating as Ebola itself.

Since the Ebola virus was so dangerous, there were many restrictions on travel, social events, school, and delivery systems all around the world. The economy suffered a great loss of gross domestic output and trade and service delivery was disrupted all around the world. At the height of the epidemic, the number of traders decreased by as much as 20% (Mercycorps 3). This decrease in trade lowered farmers’ income and led to unstable crop prices. Furthermore, investors lost confidence in companies located near Ebola-infected areas such as Liberia or Sierra Leone, and additional companies were forced to shut down. The closing of factories led to an increase in unemployment in these areas, further damaging the economy. Healthcare systems were also affected as resources were diverted to treat the virus, causing a reduction in the quality of care offered and the emergence of other diseases. In turn, greater costs and resources were necessary to treat those illnesses. Guinea, Liberia, and Sierra Leone lost \$2.2 billion in GDP in 2015 in order to combat the pandemic. The United States also donated approximately \$2.3 billion dollars to fight the pandemic and fund response teams (CDC, “Cost of Ebola” 3). A more recent study estimates the total economic and societal costs of the epidemic to be over \$53 billion.

Both those affected by the ebola virus and those working to combat it face social stigma. As people were advised not to touch one another, human relationships between friends began to weaken and social norms broke down. This is common in times of infectious disease outbreak. Six hundred years ago, when the Black Death swept across Europe, Europeans experienced a similar societal breakdown as people fled cities or isolated themselves to avoid the deadly disease. Indeed, diseases challenge humanity. Even the most firmly established perspectives fall to diseases.

In the times of Black Death, Christians and Muslims explained the plague as a punishment from God, and gathered together to pray for God’s protection. However, people soon realized that prayers didn’t protect them from the Black Death. When religion failed them, they looked for explanations themselves. Through observations and experiments, researchers made major medical advances, which helped them deal with future pandemics. A notable prevention measure was the implementation of quarantines to prevent the spread of diseases. Despite these successful scientific advances, religion still held an important role in society. For the most part, a mix of religion and science was used to explain diseases in the Middle Ages. Paintings of plague saints taking care of patients were a perfect depiction of this mix, demonstrating that people understood how the disease was contagious, while hoping that God would help them overcome this hurdle. Nowadays, religion no longer has as heavy of an impact on the medical system. Scientific knowledge is now firm enough to stand on its own. Most misinformation regarding COVID-19 is based on pseudoscience rather than religion, suggesting that most people now believe that science holds stronger reasoning than religion. At the time of the Ebola outbreaks however, conflicts between religion and science were prevalent, especially because most cases were in isolated rural communities, where the medical systems were weak and the illiteracy rate was high.

Conclusion:

Ebola has proven to be a substantial boulder in humanity's survival and has tested our patience and abilities to adapt in order to survive. As technologically advanced as we are, there are still remaining impacts of Ebola on civilization, and in some parts of the world, Ebola is still a dangerous daily struggle. With its origins in one of the least advanced continents, Africa, containment efforts were hindered. In this region secluded from much of the world, religion played a big part in how the locals reacted to the virus, and this distrust only ended up hurting them. It didn't help that the majority of these countries were in political turmoil and economic instability at the time. When the rest of the world tried to step in, they were only met with resistance, denial, and secrecy, further endangering the lives of many. Currently, though we know a lot more about Ebola than we did a few years ago, we still do not understand enough to stop the disease from ravaging communities and families in Africa. As time progresses and as humanity is faced with more obstacles like Ebola and Covid-19, we will have to learn to rise to the occasion, tap into our knowledge of the past, and piece together a solution for the future.

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