Ebola Outbreak, Discourse and Policy

Dr. Chinyere Ogbonna-McGruder, Austin Peay State University, Professor, Public Management

Introduction

According to Jack Kerouac "The only people for me are the mad ones, the ones who are mad to live, mad to talk, mad to be saved, desirous of everything at the same time, the ones who never yawn or say a commonplace thing, but burn, burn, burn, like fabulous yellow Roman candles exploding like spiders across the stars, and in the middle, you see the blue center-light pop, and everybody goes ahh..."
A dedication to the Ebola disease Fighters, who followed their hearts and instincts to help despite the real "mad" danger to them.

The most recent Ebola outbreak has emerged as one of the deadliest and long lasting epidemics. As of mid 2015, the outbreak has killed more than 11,000 individuals and infected more than 26, 000 people. Inherent in effective control of spread of infectious disease outbreak, is focused effort at control of the infection at the source, prior to spread. Globalization and the ease of travel especially air travel makes it easier for spread of infections from their nuclei of origin. Accordingly, diseases that were usually local infections, now have the potential to transform into global pandemics. This paper examines global actions and progress towards the management and control of the Ebola outbreak as well as USA policy discourse regarding the outbreak.

Ebola: Policy and Discourse

Ebola is an infectious high mortality rate disease. Transmission is usually by direct contact with bodily fluids of an infected person. Such bodily fluids include blood, feces, sweat, semen, saliva and vomit. The disease is usually characterized by severe flu like symptoms, such as headaches, fever, nausea, stomach pain, vomiting, coughing, muscle weakness and sore throat. In later stages the virus can lead to kidney and liver function failure as well as bleeding through the mouth, nose, ears and eyes. Sometimes a rash may occur that can result in sloughing off of the skin. It has a fatality rate ranging from 50 to 90%. This makes it, one of the most deadly viral diseases. According to Centers for Disease control (CDC) as of October 25th 2014, there were 10,114 total Ebola infection cases, of which 5666 were lab confirmed and out of those infected 4912, had died from the infection. [i]

This current outbreak is the largest outbreak and is caused by the Ebola Zaire species virus, the spread of this disease is stupefying. For comparison purposes, as of September 7th 2014, there were about 1848 suspected case deaths and 2106 laboratory confirmed cases.[ii] But by December 19th 2014, there were 19,031, cases within the 3 most affected countries (Sierra Leone, Guinea and Liberia), with 12,041 laboratory confirmed cases and 7373 total deaths.[iii] And less than a week later, on the 21st of December 2014, WHO reported that the number of global cases had risen to 19,497 confirmed cases and 7588 deaths. [iv] The virus appeared to be still spreading rapidly in Sierra Leone, up to the week of the 21st of December 2014, with 315 new confirmed cases leading up to the week.[v]

According to NPR the current outbreak has been centered mainly within Guinea, Liberia and Sierra Leone, with introduction of the Virus to Nigeria by a Liberian American (Patrick Sawyer) who flew to Lagos, Nigeria and subsequently died at one of the Lagos Hospitals.[vi] The disease was reported in two cities in Nigeria, namely Lagos and Port Harcourt. But Nigerian officials set off a vigorous process of contact tracing, which helped with stopping the spread. It must be noted that a Dr. Adadevoh at the First Consultant Hospital in Lagos where Patrick Sawyer was being treated after he collapsed at the Nigerian airport, suspected Ebola after noticing his bloodshot eyes and the fact that he was passing bloody urine. She

subsequently left instructions that the patient should not be released from the hospital under any circumstances. That directive was followed and Patrick Sawyer was not released from the hospital even when he became aggressive. He eventually died at the hospital, and so did Dr. Adadevoh, but the fact that he was isolated at the hospital, helped reduce the number of individuals that he eventually infected. Further contact tracking and isolation by the Nigerian federal and state Governments in conjunction with WHO , helped ensure that the virus did not spread drastically, especially within such a populous city as Lagos. Subsequently, on Monday the 20th of October, WHO declared Nigeria Ebola free. According to BBC News Africa, "The WHO can declare an Ebola outbreak over if two incubation periods of 21 days pass with no new cases. That means if there are no reported cases of Ebola, 42 days after the last case contact. And of course there has to be active monitoring and surveillance to ensure that there is no new case within that 42 days period. For health care workers, their date of last contact is when (the day) the last patient they treated for Ebola tests negative for the virus. If that happens then WHO can declare the place Ebola free. The last reported case in Nigeria - Africa's most populous country - was discovered on 5 September. "The virus is gone for now. The outbreak in Nigeria has been defeated," WHO Nigerian representative Rui Gama Vaz said on Monday." [vii]

Likewise, on October 17th, Senegal was declared Ebola virus free by WHO, after the introduction of the virus into Senegal by a young man that traveled to Dakar, Senegal by road from Guinea on August 29th 2014. Senegal in conjunction with its ministry of Health, CDC, Médecins sans Frontières and WHO , quickly acted to stop the disease from spreading. The government identified and monitored about 74 close contacts of the patients. It also set up surveillance at the country's entry points. The patient has since recovered and tested negative for the virus on September 5th. After 42 days (double the 21 days maximum incubation period) there has been no new cases of the infection in Senegal. [viii] There was an isolated case in Mali, with the patient expiring and yet another isolated case in Spain. The infected person in Spain is a woman that helped treat a Spanish priest that had been working in Africa. The priest subsequently died despite his medical evacuation to Spain for treatment. One of his nurses in Spain got infected, but she has since recovered from the disease. In United Kingdom, there has been 2 reported cases of Ebola disease. In both instances the individuals were nurses that had travelled to Africa to help with the outbreak.[ix] One of the nurses, a William Pooley was successfully treated at Royal Free Hospital in UK with Z Mapp and released in September 2014. The other nurse, Pauline Cafferkey, was successfully treated at Royal Free Hospital and released in January 2015.
Incidentally, there was also a recent Ebola Virus Disease (EVD) outbreak in Congo which is unrelated to the current West African outbreak. According to Centers of Disease Control (CDC), as of August 26th 2014, there were 24 suspected case count with 13 suspected case deaths, and no laboratory confirmed case.[x]

Within USA there have been about 10 confirmed cases of EVD, and it is important to note that apart from the cases of the 2 nurses that got infected while treating a patient (a Mr. Duncan) that flew in from Liberia, all the other cases were journalist, missionaries or doctors that were helping out in affected countries in Africa. Upon getting infected they were medically evacuated to USA for successful treatment. A Dr Spenser, on the other hand was asymptomatic when he came back to USA, and subsequently developed symptoms after a few days in New York, he has since been treated and recovered from the infection.

There is no standard recognized care, and no approved treatment or vaccine for Ebola, though there are indications that human serum or blood transfusion from someone whom had recovered from the disease can help with recovery of infected individuals. Likewise some experimental drugs, like Z Mapp seem to proffer better prognosis for those infected with the disease. These indications were borne out in the cases of two Americans (Dr. Brantley and a missionary worker Ms Writebol) who were infected with the deadly disease in July of 2014. They were given the experimental Z Mapp, prior to being medically evacuated to Emory Hospital in Atlanta. (Z Mapp is a monoclonal antibody. Monoclonal antibodies are substances produced within the lab to target and attach to specific molecules, in this instance to the Ebola glycoprotein. This glycoprotein is one of the 7 genes of the Ebola virus and this gene is necessary for the attachment of

the virus to human cells. Without the attachment of the virus to the cells the virus will die. Z Mapp is an experimental drug, thus it can only be given to Ebola patients under strict Food and Drug Administration (FDA) guidelines.) They have since recovered and been released from hospital.

The Z Mapp serum in a nutshell could possibly have been made by injecting mice with the virus and letting the mice fight off the Ebola virus and then develop antibodies within the process. The serum would ultimately be harvested, with the resultant antibodies, which were possibly used on the 2 Americans infected with the Ebola virus. Another possibility would be that, blood plasma that is separated from the red blood cells with its attendant antibodies to the virus, were taken from someone that had survived that particular species of Ebola, and given to the infected Americans. The antibodies would have been separated from the survivor's blood and concentrated prior to being given to the two patients. Dr Kent Brantley actually donated about a gallon of his blood after he successfully recovered from his Ebola infection. His blood plasma was subsequently successfully utilized in treating Nurse Vinson and Nurse Pham whom both got infected while treating Mr. Duncan at Texas Presbyterian hospital. The donor's blood has to match the recipients prior to the donation of blood plasma occurring. Dr Brantley had previously received blood plasma from a 14 year old Liberian patient that he had previously treated that recovered from EVD.

Prior to the injection of the serum Dr Brantley and Ms. Writebol were both gravely ill, but most importantly, after the administration of the serum they were both able to make the trip separately back to USA. They were subsequently released in August 2014, from Emory University Hospital in Atlanta after recovering from the disease. It must be noted that such treatment had never been used for Ebola and neither has there been any human clinical trials for the treatment. These two Americans were the first individuals that the serum has been used on. Accordingly there was a lot of backlash centering on the fact that these two lone Americans were provided treatment when a lot of infected health care providers within infected countries in Africa were not provided treatment, experimental or otherwise. Incidentally, another American doctor that was infected with the deadly virus, was flown back into USA from Liberia on Thursday the 4th of September. He was treated at Nebraska Medical Unit in Omaha and his condition subsequently improved with round the clock care. He has since been successfully treated and released from the hospital. Likewise in the recent case of an American, camera man for NBC news, Ashoka Mukpo, who got infected while working as a photojournalist in Liberia. He was flown to the Omaha Nebraska hospital which had successfully treated a prior infected USA doctor. He was given BMx001. The drug was chosen based on recommendation by CDC. The drug is different from Z map taken by the 2 Americans treated at the Atlanta medical facility. Z map is a monoclonal antibody that is premade, while on the other hand, BMX001, is an antiviral medication that has been used in other viral infections and interferes with viral development.

By the summer of 2014, the CDC had issued a health alert and surveillance to health care workers to be on the lookout for symptoms from anyone who has recently travelled to West Africa and could have had contact there with an infected person. Nonetheless, a hospital in Texas missed diagnosing a man that had recently returned from a trip to West Africa. The man Thomas Eric Duncan, presented at a Dallas Texas hospital with stomach pain and fever of about 103 degrees, the hospital nurse released him despite the protocol in place and despite the fact that he had informed the nurse that he had recently come from Liberia, Three days later he was taken by an ambulance back to the hospital when he died on October 8th. Subsequently, by 14th October 2014, two health care workers that helped care for Mr Duncan, had tested positive for Ebola infection. This suggests a breach of treatment protocol. In USA part of the protocol issued by CDC for treating Ebola patients, consists of ensuring that somebody else puts the protective unit on the caregiver and someone else helps take it off, thereby putatively reducing risk of human error. The Dallas hospital has since closed its emergency section. As per protocol, the infected female health care workers had been self-monitoring themselves and isolated themselves upon onset of symptoms. The individuals were transported to Emory hospital and NIH where they were successfully treated and discharged.

Another American, a Dr, Rick Sacra of Boston hospital, who was helping provide medical assistance during the outbreak, in Monrovia, Liberia, got infected and was flown back to USA on September 5th. He likewise received a donation of Dr Brantley's plasma, and was also treated with TKM Ebola, which is an experimental drug, that was approved for wider use, under U.S Food and Drug administration's Investigational New drug application (IND) rule. This usually applies when a drug shows great promise for immediately life threatening diseases.[xi] He was subsequently released about 3 weeks later after being successfully treated at the Nebraska Medical center.

Also, Ashoka Mukpo, an American Citizen was flown on October 6th to Nebraska Medical Center in USA after being infected while working as a journalist in Liberia. He has since been successfully treated and discharged from the hospital. Likewise for Dr. Craig Spenser who works for New York's Columbia Presbyterian Hospital. Upon coming back from Guinea on October 17th , 2014, he subsequently developed EVD symptoms a few day later. He was diagnosed with Ebola infection on 21st October, and hospitalized. He had been working with Doctors without Borders. He was declared Ebola free and discharged on Tuesday the 11th of November after receiving treatment at New York's Bellevue Hospital. Some citizens of New York were initially concerned about possible spread of the virus in the city especially, after the media reported that he had bowled, gone jogging and rode on the subway prior to the advent of his symptoms. New York officials including the Mayor Bill Blasio, stressed to the public there was hardly any risk to the public since Dr. Spenser was asymptomatic when he used NY City's public facilities,.

It is noteworthy that, Dr Spenser was treated at New York's Bellvue hospital, especially considering the fact that, there are 4 hospitals that have special isolation units that were specifically designed to contain high risk infections such as Ebola. In fact, CDC previously considered the possibility of utilizing only these 4 medical facilities nationwide for treatment of ebola cases, since they are better able to treat and manage high risk infections and as such have specialized isolation treatment rooms. The four facilities are University of Nebraska Medical Center, St Patrick hospital in Missoula Montana, the National Institutes of Health and Emory University Hospital in Atlanta, which has also successfully treated EVD patients without health care staff getting infected.

Another USA doctor, Dr. Martin Salia, a native of Sierra Leone and a legal USA resident got infected after he had gone back to Sierra Leone to proffer medical services during the outbreak. By the time he was medically evacuated to Nebraska medical center, his condition was reportedly critical and his organs were on the verge of failure. He succumbed to the disease shortly after arriving at the medical center, despite being given a dose of ZMapp and a blood transfusion from an Ebola survivor.

As of December 17th 2014, Dr Spenser is the last American to be diagnosed and successfully treated of Ebola. Mayor Bill Blasio triumphantly declared New York City Ebola free. Amid conspiracy theories and charges that President Obama was not doing much to protect Americans in the midst of the Ebola outbreak and specifically not temporarily banning travel from affected African countries, republicans had some electoral success during the November 4th 2014 elections, which focused to some extent on strengthening the national border to alleviate the possibility of bringing diseases into USA. Less than 2 weeks after the November 4th elections, the hysteria and panic surrounding Ebola infections seems to be waning. There were no headlines blasting the discharge of Dr. Spenser from Bellevue Hospital on November 11th when he was released from the hospital. Nor were there repeated news reports about the death of Dr. Salia. Likewise, President Obama mentioned in a news conference on Dec 2nd 2014 that the Ebola "fight is nowhere close to being over," even as America's public attention has focused elsewhere. [xii]

Ebola Outbreak Policy Response and Discourse

The Ebola furor and fear in USA has led to some unique political discourse with some Republicans clearly indicating that we are in peril because President Obama has failed to cut travel from affected West African

Countries. In fact some republicans and democrats called for a travel ban to and from the affected countries in Africa. The questions that begs to be asked with regards to this discourse is this, will such politicians call for cutting off travel to affected European countries, if it is found that some individuals in Europe have been infected?. In lieu of such fear mongering, the discourse should be on stemming the epidemic such that globally we all would be safer, regardless of our travel inclinations. It should be noted that USA has never really banned citizens of a certain country from coming into USA due to an epidemic. But, President Ronald Regan, did have a policy that went into effect in 1987, which specifically banned immigrants or tourists infected with HIV/AIDS from entering the USA. Under the policy, HIV/AIDS was classified under "communicable diseases of public health significance" and as such infected foreigners seeking entry into USA were denied. There were waivers for heterosexual married individuals but not for gay individuals. The policy was in effect for 22 years, until January 4th, 2010 when a new federal rule under President Obama went into effect nullifying the ban. [xiii]

As of Mid-October 2014, USA government in conjunction with CDC, started screening passengers travelling from Sierra Leone, Guinea and Liberia. The passengers from those countries can only enter into USA, through 5 international USA airports within New York, Washington, D.C., Atlanta, Chicago and Newark, New Jersey. These Airports are Dulles, Chicago O'Hare, John F. Kennedy, Newark Liberty and Hartsfield-Jackson Atlanta International Airports. The passengers are screened at the point of entry for signs of Ebola, and part of the screening includes a temperature analysis as well as a CDC contact questionnaire analysis. This edit took effect in October, despite the fact that CDC acknowledges that there is more efficacy in monitoring prospective travelers in Africa prior to boarding their flights. The efficacy of this practice is also somewhat limited considering the fact that Ebola has an incubation period ranging from 2 to 21 days.

Comparatively when the SARS and MERS outbreaks were occurring, there were no calls from either political party, to cut of travel to affected countries within the Middle East region. Middle East Respiratory Syndrome Coronavirus (MERS-CoV is an acute respiratory infection that originated from around the Arabian Peninsula. It is a coronavirus which is similar to the human coronavirus that most people get in their lifetime, which usually causes mild to moderate upper respiratory infection.[xiv] MERS is different from human Coronavirus in that it cause serious and sometimes fatal upper respiratory infection. According to World health Organization (WHO), there has been officially reported, worldwide 701 laboratory-confirmed cases of infection with a minimum of 249 related reported deaths[xv]. That is about 35.52% Fatality from the disease. Conversely in USA there has been 10 reported/confirmed cases of Ebola in USA with two deaths, that is a 20% mortality. Yet the outbreak of Ebola in Africa and the 8 confirmed cases in USA had some politicians, especially conservatives calling for temporal or permanent international bans on travels to affected countries. Generally EVD fatality rate ranges from 25% to 90% with an average fatality rate of 50% .

MERS was first reported in Saudi Arabia in 2012, and has since spread to Asia, Europe , Africa and USA through travel. **MERS-CoV** is considered mainly a zoonotic disease. A zoonotic disease is an infection of animals and sometimes insects that can be transmitted to humans via contact with infected animals or insects It is believed that bats are the animal reservoirs of MERS-CoV, though different animals can be infected , such as camels Infected individuals present with cough, shortness of breath, fever and sometimes diarrhea, vomiting and renal failure can occur. Human to human transmission occur upon close contact with infected individual

In USA, Centers for Disease Control issued an advisory during the outbreak that essentially said that individuals should not change their travel plans due to MERS. The advisory, "advises travelers going to countries in or near the Arabian Peninsula to provide healthcare services to practice CDC's recommendations for infection control of confirmed or suspected cases and to monitor their health closely. Travelers who are going to the area for other reasons are advised to follow standard precautions, such as hand washing and avoiding contact with people who are ill." [xvi] Likewise World Health organization

(WHO), did not indicate any travel or trade restrictions or bans, nor did it specify the need for special screenings at points of entry. [xvii] There was also no prolonged hysteria or fears within the USA public that the disease was a threat in USA.

The 2003 SARS epidemic is another infectious disease outbreak that shows divergent public response from the current Ebola epidemic. Severe acute respiratory syndrome (SARS) is caused by a coronavirus that causes infection that is characterized by fever, headache, body aches and sometimes mild respiratory symptoms, diarrhea and cough. Most patents end up developing pneumonia. It is spread by close person to person contact. Transmission is by contact from droplets from the cough or sneeze of an infected individual. There is a possibility that it is also airborne.[xviii]

According to WHO, the case fatality ratio of SARS range from 0-50%. The fatality ratio is dependent on a number of factors including route and dose of exposure of virus, age, health of the individual and access to immediate medical care. Generally the fatality rate on average is about 14 to 15%. [xix] As of 7th May 2003, there were a total of 6903 probable SARS cases and 495 deaths, cumulatively reported from 29 countries.[xx] According to CDC, there were 3 criteria that were utilized in the medical determination of SARS. These included the symptoms of patient, the probability that the patient was exposed to the infection, and conclusive lab results. Accordingly, CDC reported that "During the outbreak, state and local health departments reported 1,460 unexplained respiratory illnesses to CDC. Of those, 398 appeared to be SARS based on patient symptoms and possible exposure through travel. Only 72 of the 398 had chest X-rays that looked like pneumonia moving them from possible cases to probable cases of SARS. Only eight of the 72 probable cases were confirmed by lab results to be SARS. No one died from SARS in the United States." [xxi] During the SARS Outbreak just as in the current Ebola outbreak CDC issued a travel advisory which basically indicated that non-essential travel should be avoided. Usually, there are three levels of travel notices that are issued by CDC when warranted.

They are:
"Warning Level 3, Avoid Nonessential Travel, and this indicates that there is high risk to travelers
Alert Level 2, Practice Enhanced Precautions
Watch Level 1, Practice Usual Precaution."[xxii]

Invariably travel notices, issued by CDC are meant to inform both clinicians and travelers about health related issues pertaining to the specific destinations that they are travelling to. These health related issues can occur due to disease outbreaks special events or gatherings, natural disasters, or other conditions that may affect travelers' health. For instance the earthquake in Haiti, triggered a CDC level 3 warning, while the yellow fever outbreak in Brazil triggered a level 2 warning calling for travelers to that region to get vaccinated against yellow fever. [xxiii] Similar to the SARS outbreak CDC also issued a Warning level 3 for travel related to Sierra Leona, Liberia and Guinea.[xxiv] But the similarity with the SAS outbreak, end there, because the level of panic and calls by USA politicians for closing of borders with affected African countries, as seen during the current Ebola outbreak were not documented during the SARS outbreak.
According to WHO, "The likelihood of dying from SARS in a given area has been shown to depend on the profile of the cases, including the age group most affected and the presence of underlying disease. Based on data received by WHO to date, the case fatality ratio is estimated to be less than 1% in persons aged 24 years or younger, 6% in persons aged 25 to 44 years, 15% in persons aged 45 to 64 years, and greater than 50% in persons aged 65 years and older."[xxv]

Thus USA policy responses to SARS and MERS should be logically contrasted with the Ebola response. There was no discourse during the SARS and MERS outbreaks that specifically called for possibly permanent travel bans to countries of the outbreak origins.

The Index case for the current EVD outbreak, is believed to have been a young boy, Emile Ouamouno from a rainforest village in Southern Guinea. It is not documented how the young boy got infected but, researchers believe the boy got infected by playing in a hollowed out tree in his village that was habited by infected bats. The boy subsequently developed a fever, black stool and vomiting. By December 6th 2013, he was dead. He had also invariably passed on the infection to his sister, mother and grandmother. The disease subsequently spread when people attended the grandmother's funeral.[xxvi] Part of the traditional rituals for burying the death in parts of Guinea, Liberia and Sierra Leone involve family members carrying out the burying process in lieu of funereal homes. As such, the body is touched by family members as the body is manually washed and prepared for burial. The very process lends itself to contamination of participants with the Ebola virus. Infected individuals are the most contagious when they are sick and especially more so when they die from the infection, their bodily fluids are rife with the virus. Thus when the outbreak first started, family members would carry out the process as was the norm in most parts of the 3 heavily affected African countries. This practice lent itself to the initial voracious spread of the infection. Subsequently as the infection spread, and individuals started being educated about the dangers of burying family members, the practice has since been replaced for the most part by the utilization of Ebola burial teams. These burial teams are part of the ongoing process to curtail the infection rate. Members of the burial team are supposed to wear PPE.

In all, a total of 10 Ebola patients have been treated within USA, all but 2 of them survived. Thus the infection in USA has about a 20% mortality rate whereas the mortality rate for the disease (using the infection versus death ratio data from CDC's December 17th update) within the 3 most affected African countries is about 38.74%. It would therefore be concluded, that the disease has a higher mortality rate in Africa than in United States. Part of the high mortality attributed to EVD, can be traced partly to the pathology of the virus on the human body and partly as a consequence of profuse loss of electrolytes from the body from copious diarrhea and vomiting. The western countries have highly developed medical health care facilities and systems that can provide supportive care as well as help carefully titrate and replace lost electrolytes depleted by the infection. This somewhat helps explain the disparity in mortality rates, in Africa versus USA.

This disease mortality disparity, reflects the health care disparities that exist between United States and countries in West Africa where the disease is spreading. There were non-sufficient or almost no medical system structure within the African countries where the disease is spreading to help curtail the spread and aid in treatment of infected individuals. On the other hand, with the exception of the 2 patients that died, the 8 other formerly infected American patients began to recover quickly once they got good supportive care, treatments and good nutrition.[xxvii] Hopefully the tide may be turning with regards to the outbreak, as there has been a wealth of effort by countries in the western hemisphere to provide protective gear, medical personnel and support to help battle the outbreak in Africa. The general consensus, seems to be that if there had been global prompt action at the beginning of the outbreak, it would have been stamped out quickly and not spread as it has thus far.

Currently as mentioned previously EVD is transmitted through contact with bodily fluids or blood of an infected person, but top infectious disease experts worry that the virus could mutate and be transmissible by coughing or Sneezing. According to Dr. Michael Osterholm, director of the Center for Infectious Disease Research and Policy at the University of Minnesota, "It's the single greatest concern I've ever had in my 40-year public health career." He went on to say, "I can't imagine anything in my career -- and this includes HIV -- that would be more devastating to the world than a respiratory transmissible Ebola virus."[xxviii] Though viruses do not usually transition from being non-airborne in humans to airborne, there is a slight possibility of that occurring with the continual spread of the EVD. With each new infection there is the possibility of mutation of the virus.[xxix]

Ebola was recognized more than 35 years ago, in 1976, during an outbreak within the Congo region of Africa. According to Centers for Disease Control and Prevention, there were 318 human cases in that particular outbreak and 280 reported deaths.[xxx] That is 88 % mortality. The centers for Disease Prevention and Control also delineated the Chronology of cases and outbreaks of Ebola Hemorrhagic fever, shown within the below table. [xxxi]

**Numbers reflect laboratory confirmed cases only.*

Known Cases and Outbreaks of Ebola Hemorrhagic Fever, in Chronological Order:					
Years	**Country**	**Ebola subtype**	**Reported number of Human cases**	**Reported number (%) of deaths among cases**	**Situation**
1976	Zaire (Democratic Republic of the Congo - DRC)	Ebola virus	318	280 (88%)	Occurred in Yambuku and surrounding area. Disease was spread by close personal contact and by use of contaminated needles and syringes in hospitals/clinics. This outbreak was the first recognition of the disease.[1]
1976	Sudan (South Sudan)	Sudan virus	284	151 (53%)	Occurred in Nzara, Maridi and the surrounding area. Disease was spread mainly through close personal contact within hospitals. Many medical care personnel were infected. [2]
1976	England	Sudan virus	1	0	Laboratory infection by accidental stick of contaminated needle. [3]
1977	Zaire	Ebola virus	1	1 (100%)	Noted retrospectively in the village of Tandala. [4]
1979	Sudan (South Sudan)	Sudan virus	34	22 (65%)	Occurred in Nzara, Maridi. Recurrent outbreak at the same site as the 1976 Sudan epidemic. [5]
1989	USA	Reston virus	0	0	Ebola-Reston virus was introduced into quarantine facilities in Virginia and Pennsylvania by monkeys imported from the Philippines. [6]
1990	USA	Reston virus	4 (asymptomatic)	0	Ebola-Reston virus was introduced once again into quarantine facilities in Virginia, and Texas by monkeys imported from the Philippines. Four humans developed antibodies but did not get sick. [7]
1989-1990	Philippines	Reston virus	3 (asymptomatic)	0	High mortality among cynomolgus macaques in a primate facility responsible for exporting animals in the USA. [8] Three workers in the animal facility developed antibodies but did not get sick. [9]

1992	Italy	Reston virus	0	0	Ebola-Reston virus was introduced into quarantine facilities in Sienna by monkeys imported from the same export facility in the Philippines that was involved in the episodes in the United States. No humans were infected. [10]
1994	Gabon	Ebola virus	52	31 (60%)	Occurred in Mékouka and other gold-mining camps deep in the rain forest. Initially thought to be yellow fever; identified as Ebola hemorrhagic fever in 1995. [11]
1994	Ivory Coast	Taï Forest virus	1	0	Scientist became ill after conducting an autopsy on a wild chimpanzee in the Tai Forest. The patient was treated in Switzerland. [12]
1995	Democratic Republic of the Congo (formerly Zaire)	Ebola virus	315	250 (81%)	Occurred in Kikwit and surrounding area. Traced to index case-patient who worked in forest adjoining the city. Epidemic spread through families and hospitals. [13]
1996 (Jan.-Apr.)	Gabon	Ebola virus	37	21 (57%)	Occurred in Mayibout area. A chimpanzee found dead in the forest was eaten by people hunting for food. Nineteen people who were involved in the butchery of the animal became ill; other cases occurred in family members. [11]
1996-1997 (Jul.-Jan.)	Gabon	Ebola virus	60	45 (74%)	Occurred in Booué area with transport of patients to Libreville. Index case-patient was a hunter who lived in a forest camp. Disease was spread by close contact with infected persons. A dead chimpanzee found in the forest at the time was determined to be infected. [11]
1996	South Africa	Ebola virus	2	1 (50%)	A medical professional traveled from Gabon to Johannesburg, South Africa, after having treated Ebola virus-infected patients and thus having been exposed to the virus. He was hospitalized, and a nurse who took care of him became infected and died. [14]
1996	USA	Reston virus	0	0	Ebola-Reston virus was introduced into a quarantine facility in Texas by monkeys imported from the Philippines. No human infections were identified. [15]

1996	Philippines	Reston virus	0	0	Ebola-Reston virus was identified in a mokey export facility in the Philippines. No human infections were identified. [16]
1996	Russia	Ebola virus	1	1 (100%)	Laboratory contamination [17]
2000-2001	Uganda	Sudan virus	425	224 (53%)	Occurred in Gulu, Masindi, and Mbarara districts of Uganda. The three most important risks associated with Ebola virus infection were attending funerals of Ebola hemorrhagic fever case-patients, having contact with case-patients in one's family, and providing medical care to Ebola case-patients without using adequate personal protective measures. [18]
Oct. 2001-Mar. 2002	Gabon	Ebola virus	65	53 (82%)	Outbreak occured over the border of Gabon and the Republic of the Congo. [19]
Oct. 2001-Mar. 2002	Republic of Congo	Ebola virus	57	43 (75%)	Outbreak occurred over the border of Gabon and the Republic of the Congo. This was the first time that Ebola hemorrhagic fever was reported in the Republic of the Congo. [19]
Dec. 2002-Apr. 2003	Republic of Congo	Ebola virus	143	128 (89%)	Outbreak occurred in the districts of Mbomo and Kéllé in Cuvette Ouest Département. [20]
Nov. - Dec. 2003	Republic of Congo	Ebola virus	35	29 (83%)	Outbreak occured in Mbomo and Mbandza villages located in Mbomo distric, Cuvette Ouest Département. [21]
2004	Sudan (South Sudan)	Sudan virus	17	7 (41%)	Outbreak occurred in Yambio county of southern Sudan. This outbreak was concurrent with an outbreak of measles in the same area, and several suspected EHF cases were later reclassified as measeles cases. [22]
2004	Russia	Ebola virus	1	1 (100%)	Laboratory contamination.[23]
2007	Democratic Republic of Congo	Ebola virus	264	187 (71%)	Outbreak occurred in Kasai Occidental Province. The outbreak was declared over November 20. Last confirmed case on October 4 and last death on October 10. [24] [25]

Dec. 2007-Jan. 2008	Uganda	Bundibugyo virus	149	37 (25%)	Outbreak occurred in Bundibugyo District in western Uganda. First reported occurance of a new strain. [26]
Nov. 2008	Philippines	Reston virus	6 (asymptomatic)	0	First known occurrence of Ebola-Reston in pigs. Strain closely similar to earlier strains. Six workers from the pig farm and slaughterhouse developed antibodies but did not become sick. [27] [28]
Dec. 2008-Feb. 2009	Democratic Republic of Congo	Ebola virus	32	15 (47%)	Outbreak occurred in the Mweka and luebo health zones of the Province of Kasai Occidental. [29]
May 2011	Uganda	Sudan virus	1	1 (100%)	The Ugandan Ministry of Health informed the public that a patient with suspected Ebola Hemorrhagic fever died on May 6, 2011 in the Luwero district, Uganda. The quick diagnosis from a blood sample of Ebola virus was provided by the new CDC Viral Hemorrhagic Fever laboratory installed at the Uganda Viral Research Institute (UVRI). [30]
Jun. - Oct. 2012	Uganda	Sudan virus	11*	4* (36.4%)	Outbreak occurred in the Kibaale District of Uganda. Laboratory tests of blood samples were conducted by the UVRI and the U.S. Centers for Disease Control and Prevention (CDC). [31]
Jun.- Nov. 2012	Democratic Republic of the Congo	Bundibugyo virus	36*	13* (36.1%)	Outbreak occurred in DRC's Province Orientale. Laboratory support was provided through CDC and the Public Health Agency of Canada (PHAC)'s field laboratory in Isiro, and through the CDC/UVRI lab in Uganda. The outbreak in DRC has no epidemiologic link to the near contemporaneous Ebola outbreak in the Kibaale district of Uganda. [31]
Nov. 2012-Jan. 2013	Uganda	Sudan virus	6*	3* (50%)	Outbreak occurred in the Luwero District. CDC assisted the Ministry of Health in the epidemiologic and diagnostic aspects of the outbreak. Testing of samples by CDC's Viral Special Pathogens Branch occurred at UVRI in Entebbe. [31]

Mar. 2014-Present	Guinea, Liberia, Sierra, Leone, Nigeria	Ebola virus	1310*	712 (54.4%)*	Ongoing outbreak across Guinea, northern Liberia, and now eastern Sierra Leone. Numbers of patients is constantly evolving due to the on-going investigation. [32]

Source: Centers for Disease Control and Prevention. *Ebola Hemorrhagic Fever: Outbreak Chronology. Accessed August 15, 2014*

In the past, Ebola outbreaks, had been localized in tropical regions till recently. Ebola infection is one of a group of infections that comprise viral hemorrhagic fevers (VHFs) that can infect humans. These Viral hemorrhagic fevers are caused by different specific families of viruses. This current outbreak, is the worst outbreak of Ebola in recent history and the affected African Countries are scrambling to contain the break. The Ebola virus was known about 30 years ago. Though Ebola is infectious, it is only transmitted via contact with bodily fluids or fluid contaminated materials of infected Ebola victims. The current outbreak is deadly killing about 20-60% of those infected. It is also worth mentioning the fact that despite utilizing Personal Protective Equipment (PPE), highly medically trained individuals, including Doctors and Nurses, continue to get infected while aiding in the fight against this deadly infectious disease. It is improbable that the virus could penetrate a PPE , so invariably the health care personnel that got infected, probably did so due to potential lapses in protocol while carrying out their medical duties. This fact underscores the necessity and importance of global mobilization to halt the spread of deadly infectious diseases at the source prior to global spread. It is much easier epidemiologically to stop an infection at the source, rather than trying to stop it once it has had the opportunity to spread. The opportunity to do so with this current outbreak was missed but the ease of air travel and globalization made the current outbreak different from former outbreaks in that it is not localized but managed to spread to other countries, such as USA, UK, Spain, Senegal , Mali and Nigeria via infected individuals.

Since the onset of the 2014, Ebola outbreak, there has been a lot of strides made in the fight against the disease. While there is yet no concrete medically accepted cure for the infection, there has been some degree of success with utilization of different therapies used on those infected. Z map has been used, as well as convalescent serum and anti-retroviral drugs. Good supportive care with titrated electrolyte fluid supplementation appears likewise to offer some benefits.

Most importantly, there have been initial promising trials for potential treatments such as Interferon, AVI 737 (Sarepta), BCX4430 (Biocryst), Hyperimmune globulin and TKM-100802 Lipid Nanoparticle Small Interfering Ribonucleic acid (siRNA) or Tekmira. Tekmira, precludes viral gene replication by attacking 2 essential viral replication genes. In trials, this therapy demonstrated survival range in monkeys of 67-83% depending on whether therapy was initiated, within 48 hours after exposure or 72 hours after exposure, thus the therapy is more effective the sooner it is initiated in exposed animals. The therapy is well tolerated though at Single dose therapy, there were reported side effects, in humans including headache, dizziness, increased heart rate and chest tightness. Hyperimmune globulin, usually is formulated by extracting, purifying and concentration plasma that is derived from previously infected or immunized individuals. This has good tolerability in humans. They are made safe prior to use by inactivation and purification processes that destroy potential blood borne pathogens. Interferon (which is usually used to treat chronic hepatitis and multiple sclerosis), offers the ability to interfere or disrupt viral replication within the cells of the body, thus disrupting the potential spread of the virus within the human body. BCX4430 made by Biocryst, prevents viral replication. It indicated promising results in infected rodents, with a survival range of 80-100%, though safety studies in humans have not been carried out. AVI 7537 made by Sarepta, showed survival range of 60-80 % in infected monkey trials, and very importantly, early human studies indicate good tolerability.[xxxii]

Different pharmaceutical companies as well as health agencies/research institutions are racing against time, towards the development of a vaccine, if not a cure for the EVD. Some of the pharmaceutical companies,

that are working on the development of Ebola vaccines include, GlaxoSmithKline, Johnson and Johnson, Merck and NewLink. United States gigantic pharmaceutical company, Johnson & Johnson, announced during the first week of January 2015 that it has started its phase 1 testing on human trials on a possible vaccine for Ebola. The hope is that by April of 2015, the company would be able to expand its trials on large groups of patients.[xxxiii] Likewise GlaxoSmithKline in conjunction with the National Institute of Allergy and Infectious Diseases, announced during the latter part of 2014 that phase 1 trials of their Ebola vaccine show promising results. Antibodies to the Ebola virus were detected in 20 healthy individuals that were given varying doses of the vaccine, and there were no appreciable side effects to the vaccine. The vaccine was made by structural modification of chimpanzee cold virus to deliver segments of genetic material from two species of the Ebola virus-the Sudan Ebola and the Zaire species, which is responsible for the current Ebola outbreak.[xxxiv] And WHO announced in January 2015, that final stage vaccine test trials would be carried out towards the end of January or start of February. These trials would be carried out in the worst Ebola affected countries in Africa, namely Sierra Leone, Guinea and Liberia. If the vaccines prove effective, then they would be available for use a few months later. Two vaccines that have already passed the initial safety trials would probably be utilized for the vaccine trials. The potential vaccines include one from GlaxoSmithkline and another one developed by Merck and NewLink Genetics.[xxxv] Human Vaccine trials usually involve the utilization of a comparison group. The comparison group helps lend credence to the efficacy of the vaccine. Because if the comparison group show no protection to the virus while the treatment or vaccinated group does, then there more confidence that the vaccine, actually generated immunity within the vaccinated subjects. Successful development of effective vaccines will help minimize if not totally end future Ebola outbreaks. On a brighter note, according to WHO there are signs in January of 2015, that indicate that the outbreak may be levelling off, especially in Sierra Leone, the country worst affected by the outbreak. The organization stated that "There are signs that case incidence may have leveled off in Sierra Leone, although with 248 new confirmed cases reported in the week to 4 January 2015, it remains by far the worst-affected country at present." [xxxvi] Thus there is reason to be optimistic that the outbreak will not reach close to prior worst case scenarios projections. Support, though belated from the global community helped mitigate the expansion and magnitude of the ongoing outbreak.

Conclusions

At the time of the writing of this paper the Ebola outbreak was still ongoing though the intensity appears to be waning. According to Dr. Peter Piot, one of the scientists, that discovered the Ebola virus about 40 years ago, “beating Ebola” is possible if there is the will as well as early action to combat the infection. He went on to cite the instances of Nigeria and Senegal. These 2 countries despites having the infection imported into the countries by travelers were able to curtail the disease from spreading further and the 2 countries were subsequently declared Ebola free by WHO. Dr Piot also indicated that the epidemic in Serra Leone, Liberia and Guinea, spiraled out of control because local, national as well as global health authorities failed to quickly recognize the scale and extent of the threat and respond accordingly. Dr. Piot went on to say that, “"We must make sure that we can draw lessons from this for the future.”[xxxvii] The hope is that in the future, if and when a deadly infectious disease emerges, the global community will have the political will and resources to collaboratively work on ensuring that the disease is curtailed prior to having the opportunity to spread. Curtailing the spread on any deadly infectious disease at its local source will put less people globally at risk for exposure, more so than the political closure of international borders.

The most current Ebola outbreak, reinforces the necessity of having resources to globally aid, manage and curtail infectious diseases including emerging ones. There is discourse about the immediacy of the response to the Ebola outbreak, and some believe that the world did not initially take the outbreak seriously and thus did not mobilize to stop the outbreak at the onset. Within the current global economy, there is a degree of unprecedented interconnectedness that cannot be ignored. There is travel between countries which allow the possibility of diseases that were previously endemic to specific region to disseminate through travel. As

such, it is of the utmost importance that there is a global concerted effort at prevention, treatment and support for emerging infections globally and specifically within developing countries, especially when there is the potential that once endemic infections, left unchecked could result in a global pandemic. If nothing else the Ebola outbreak, has heightened the need for a global health policy especially when the possibility of a global pandemic looms when there is inaction.

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