
The Ebola Virus and the Threat of Bioterrorism

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This paper argues that Ebola can be used as a successful bioterrorism agent. While technologically advanced medical-disease surveillance measures can detect a possible natural outbreak, if the Ebola virus were deliberately introduced into a densely populated city, the outcome would be disastrous. Making matters worse are the less tangible but serious psychological effects of the outbreak, which are felt worldwide. Hysteria and stigma attached to the disease disrupts day-to-day life and hinders socioeconomic activity.

The research on the Ebola virus presented here is focused on a comparative analysis with the potential bioterrorist agent smallpox (*variola major*) and the already employed bio-agent anthrax. This structured analysis attempts to determine the potential of Ebola as an effective agent in a bioterrorist attack, and the consequences of such an event, taking into account the transnational nature of pandemics and the dynamics of world politics.

A comparative approach was selected as the most suitable methodology for this analysis because primary data on the relationship between the Ebola virus and bioterrorism is limited. The method of structured, focused comparison is a prevalent approach in military research that uses qualitative data or literature available to trace a hypothesized process.¹ For the purposes of this paper, the structure will focus on five characteristics necessary for a biological agent to become a successful bioterrorism agent: pathogenesis and etiology, infectiousness and symptoms, dissemination methods, capacity for weaponization, and the available prophylaxis. Based

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on these characteristics this study concludes that the Ebola virus is capable of being a successful bio-agent, analogous to smallpox and anthrax. In certain factors such as infectiousness and prophylaxis, Ebola is, in fact, a more suitable bioterror agent than smallpox or anthrax.

BIO-AGENTS AND BIOTERRORISM

Bioterrorism is defined as “the use or threatened use of biological agents against a person, group, or larger population to create fear or illnesses for purposes of intimidation, gaining an advantage, interruption of normal activities, or ideological objectives.”² The effects from a biological agent exposure range from mild illnesses to acute adverse manifestations or even death.³ Bioterrorism agents are complex and varying, and perpetrators take

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The Centers for Disease Control and Prevention (CDC) in the United States classifies viruses, bacteria, and other pathogens into three categories, Categories A, B, and C, that are tabulated according to the likelihood that the agent will be used and the severity of the outbreaks that would result if the agent were used in an act of bioterrorism.⁴

Category A represents the highest threat, with biological agents that cause high levels of morbidity and mortality, while agents in Categories B and C represent subsequently lesser threats to the population. This categorization scheme provides a holistic guideline that may be considered as a reference guide to existing biological agents. The bioterrorist attacks in the United States in 2001, for instance, involved the Category A agent *Bacillus anthracis*, commonly known as “anthrax.”

The recent Ebola hemorrhagic fever (EHF) outbreak in Africa has reinvigorated the discussion on Ebola as a potential agent of bioterrorism. Since the first recorded Ebola outbreak in Sudan and the Democratic Republic of Congo in 1976, there have been sporadic outbreaks of an endemic nature that have been primarily restricted to Central and West Africa.⁵ But the 2014 Ebola outbreak that began in West Africa poses an unprecedented threat—and signals the potential for a global pandemic.

The World Health Organization’s (WHO) Global Alert Response

on the Ebola virus reported 5,335 probable, confirmed, and suspected cases of the virus in Guinea, Liberia, and Sierra Leone as of September 14, 2014, with 2,622 confirmed deaths.⁶ Despite the efforts to contain the disease, recent data mapping indicates an increase in the rate of infection and a widening of the disease's geographical distribution. According to the CDC's Morbidity and Mortality Weekly Report (MMWR) published on September 24, the approximate number of cases in Liberia and Sierra Leone will increase to between 500,000 and 1.4 million by January 2015, based on the prevailing trend of infection.⁷

POTENTIAL FOR EBOLA IN BIOTERRORISM

To understand the present context of the threat of bioterrorism, it is vital to illuminate the historical developments of biological warfare. Early accounts of biological warfare involve the strategic use of feces, cadavers, and other fomites to spread disease and coerce the enemy to surrender.⁸ Tatar forces used plague victims in Kaffa to spread disease in the fourteenth century, and British forces used smallpox to destroy the Native American population in the eighteenth century.⁹ Biological weapons were also integrated into the strategic "cult of the offensive" during the First World War and resulted in state-funded biological weapons programs.¹⁰ The legitimacy of biological weapons as sanctioned by the state motivated the wide use of *glanders*, an infectious disease that primarily affects horses, donkeys, and mules, and *anthracis* (anthrax) by German forces during the war.^{11,12}

Even though these acts of cruelty were conducted under the mantle of strategic military objectives, many countries pushed for the prohibition of biological warfare. Along with asphyxiating, poisonous, and other gases and chemicals, bacteriological methods of warfare were banned under the 1925 Geneva Protocol.¹³ But world powers continued to produce and utilize biological weapons during World War II. For example, Japan continued its bio-agents weapons research program in occupied Manchuria from 1932 to the end of the war.¹⁴ The horrors committed during these conflicts bolstered the international community's efforts toward a comprehensive ban of state funded biological weapons programs. In 1975, the Biological and Toxin Weapons Convention (BWC), a multilateral effort to prohibit the development, production, and stockpiling of these weapons, went into force.¹⁵ Political discord concerning verification and implementation mechanisms, along with a lack of punitive action for violations under the BWC and the Geneva Convention remain. Still, states have largely refrained from weaponizing biological agents for the purpose

of avoiding unnecessary suffering in war, as embodied under the Law of Armed Conflict (LOAC).

Such concerns for international law are hardly present in terrorist ideology. It is highly unlikely today that a state would resort to producing biological agents for conventional warfare. This makes it more important to investigate the role of non-state actors and their ability or interest in using biological agents in acts of terrorism. Non-state actors are bounded by rationality, and pursuing a weapon of ultimate power would be beneficial to attain their higher social, ideological, and political goals leading to perverse tactics not accepted by the international community.

Even small bioterrorist attacks disproportionately spread fear and terror, and the threat of such an event is not unfounded in past experiences. To illustrate, Oregon's Rajneeshee cult intentionally contaminated salad bars with *Salmonella Typhimurium* in 1984, causing 751 reported infections and 45 accounts of hospitalizations.¹⁶ The Japanese cult Aum Shinrikyo used *Sarin* gas in an attack at the Tokyo subway.¹⁷ The cult was also accused of sending members to Zaire in 1992 to obtain weaponizable

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strands of the Ebola virus.¹⁸ The United States experienced the most recent event of bioterrorism following 9/11, when perpetrators delivered *Bacillus anthracis* spores contained in envelopes to media centers and government officials.¹⁹ This attack resulted in twenty-

two cases of anthrax infections, eleven of which were inhalation anthrax and the remaining eleven were cutaneous anthrax (although four were only suspected cases).²⁰ While Al Qaeda has been actively seeking nuclear weapons to cause mass casualties within the western world,²¹ scholars have explained that the difficulties in attaining nuclear weapons and the cost of operating them are much greater than for biological agents.²² It follows that it may be easier and more advantageous for a terrorist group to use less costly bioweapons. In fact, recent data from a recently recovered Islamic State of Iraq and the Levant (ISIL) laptop from Syria indicate the Jihadist's intention to weaponize bubonic plague in order to inflict mass casualties.²³

Critics have noted that the danger of handling biological agents, whether it be through research, development, weaponization, or delivery, may make such bioterrorism unlikely. But terrorists endure similarly dangerous threats in their more typical operations, and have proven willing to die for the cause. Considering the trends in suicide bombings, it is possible to conclude that the risks terrorists are willing to accept are limitless. It is not

fanciful to expect a hierarchically organized and sufficiently funded terrorist organization to resort to bioterrorism when the followers are willing to do whatever that is necessary to support their ideological beliefs.

MAPPING EBOLA WITH THE FIVE-FACTOR STRUCTURED, FOCUSED COMPARISON: PATHOGENESIS AND ETIOLOGY

The first dimension of the structured, focused comparison is the biological agent's pathogenesis and etiology. Pathogenesis of the agent is an indispensable variable in an act of bioterrorism. The pathological analysis of Ebola is contrasted here to anthrax and smallpox (*variola major*) and shows that if successfully weaponized, Ebola is a more suitable bioterrorism agent due to its potency and acute effects.

Compared with anthrax and smallpox, the pathogenesis and etiology of the Ebola virus have distinct characteristics. Anthrax and smallpox infections are primarily spread by inhalation of aerosol droplets, while the Ebola virus infects by "direct contact with blood, secretions, or tissue of humans."²⁴ Although it may seem like Ebola is less potent as a bioterrorist agent, in reality it has the capacity to infect with minor contact, through multiple entry routes. In addition, research indicates that contact with infected skin of Ebola patients can transmit the disease.²⁵ Cutaneous contraction is highly possible when disposing of the dead bodies, whether it may be during funeral traditions or burial processes. The mutating factor of the Ebola virus increases the risk of spread because it is difficult to predict the incubation time and the time for infection symptoms to appear in victims. And though anthrax, smallpox, and Ebola can all cause fatalities, Ebola causes far more severe necrosis than the other two bio-agents. Ebola therefore has a higher "terror factor" than anthrax or smallpox. Moreover, the rapid development of the Ebola virus within the infected individual and person-to-person transmission, which helps to create mass public panic, serves the purpose as a bioterrorism agent.

INFECTIOUSNESS

Infectiousness and the resulting symptoms are key properties in a bioterrorist agent. Infectiousness defines the capacity of the agent to spread among the targeted population. The infective dose of smallpox in aerosol condition ranges from 10 to 100 organisms and the anthrax aerosol infective dose is between 8,000 to 50,000 spores.^{26,27} However, the infective dose for a viral hemorrhagic fever such as Ebola is considered extremely

low at 1 to 10 organisms in an aerosol calculation.²⁸ Thus, compared to anthrax and smallpox, the infective dose of Ebola is extremely low. With such capacity, Ebola would become an ideal weapon for bioterrorism.

The Ebola infection's symptomatic effects are also unique compared to anthrax and smallpox. The Ebola virus causes a viral hemorrhagic fever that severely degrades the human body. The transition to the often fatal EHF will result in "progressive hemorrhagic diathesis, such as petechiae, mucous membrane, and conjunctival hemorrhage."²⁹ These acute diatheses become a cause of death in the infected patients. While there is no doubt that anthrax and smallpox have the capacity to cause acute effects and result in severe suffering, the gruesomeness of the Ebola virus communicates greater fear to the target population.

DISSEMINATION

Dissemination comprises two parts: the method of spreading the disease and the area of the infective zone. The primary and secondary Ebola virus infection is dependent on direct contact. An epidemic can begin with the primary infection occurring from a zoonotic infection (transmission between different species of animals) or an exposure to a viral reservoir (pathogen-carrying host). The secondary infections are primarily dependent on person-to-person contact. Because the Ebola virus has multiple infection routes and only requires a very low infective dose, the initial dissemination does not necessitate a large target area. For instance, primary transmission can be initiated by exposing the population deliberately to an infected individual or animal, and the targeted population will spread the virus through person-to-person contact. The mutating property of the Ebola virus will hinder symptomatic detection and exacerbate the condition to EHF, potentially causing mass mortalities.

Furthermore, in a bioterrorist attack, the Ebola virus could be introduced to the target population simultaneously at multiple locations. This tactic would increase the virus' dispersion and cause rapid infections in the target population. Although the Ebola virus lacks the capacity for aerosol dispersion, as the present outbreak in West Africa indicates, the virus can propagate through the population and be transmitted across borders. Further, substandard public health measures will exacerbate the situation and increase the spread of the Ebola virus. Therefore, as a bioterrorism agent, if Ebola is to be introduced into a target population, the extremely high contagiousness and the multiple infectious routes could create an epidemic.

Additionally, the extremely high infectiveness of the Ebola virus could

develop a substantive infected area with the targeted territory. The infective area in an Ebola outbreak will continue to expand until the infected population is isolated and public health systems can contain the transmissions with no further person-to-person contact. For instance, since the first reported case of Ebola infection from Guinea on March 22, 2014,³⁰ the epidemic has affected large swaths of Guinea, Liberia, and Sierra Leone with widespread transmission within eight months.³¹ Far more than anthrax and smallpox, the Ebola virus has shown that it can be disseminated in a small area of the target population and transmitted through primary and secondary infections.

WEAPONIZATION

The weaponizing capability of an agent is essential to utilizing a bio-agent successfully in bioterrorism. Weaponizing can be categorized into two types: explosive and non-explosive weapons. The explosive weapon category does not necessarily correlate to a thermal explosion device but to a weapon that can spread the bio-agent instantaneously. The non-explosive weapon disperses the bio-agents without any explosive force. An exploding device or a bomb with a delivery mechanism can be used to spread the biological agent over a target area. On the other hand, a terrorist organization could weaponize bio-agents to be disseminated using bio-aerosols as non-explosive paint-sprayers, handheld atomizers, insecticide sprayers, and handheld drug delivery systems.³² A terrorist organization would select the method based on the availability of the bio weapon, access to such a weapon, the funds required to acquiring the weapon, and the target characteristics and the objectives of the bioterrorism attack.

In the case of anthrax, the United States weaponized *Bacillus anthracis* spores into bombs in May 1944 at Camp Detrick.³³ Likewise, the former Soviet Union's biological weapons research laboratories weaponized anthrax into bombs and spray tanks that could be delivered from aircraft and ballistic missiles.³⁴ As opposed to the explosive biological weapons method, bioterrorist attacks in 2001 used non-explosive letter envelopes to specifically target individuals, which successfully created panic among the public, even beyond the targeted countries.

The smallpox virus was weaponized as an explosive aerosol weapon by the former Soviet Union and the same approach could incentivize a bioterrorist attack.³⁵ Additionally, smallpox can also be weaponized using non-explosive fomites or contagious individuals to spread the disease among a target population.

Nonetheless, a large-scale explosive release of a bio-agent faces intrinsic difficulties. For example, a smallpox bomb's success lessens depending on weather conditions and vulnerability to sunlight and ultraviolet rays.³⁶ Notwithstanding, a terrorist organization can weaponize smallpox using explosive or non-explosive means, even though the disease was proclaimed eradicated in 1977 and the only available stocks are maintained by the United Kingdom, United States, South Africa, and Russia.³⁷ If a terrorist organization wanted to conduct a deliberate bioterrorist attack using smallpox, they must covertly acquire a weaponizable strain from one of the high security viral research laboratories. Though the process might be extremely difficult, the threat still exists of a bioterrorism attack using smallpox *variola major*.

Weaponizing the Ebola virus requires a unique and creative approach. There is no recorded explosive weaponization of the Ebola virus even from the bioweapons research programs that existed during the Cold

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War era. However, a filoviridae virus, such as Marburg, was weaponized by the former Soviet Union and a terrorist organization might similarly hope to develop an explosive weapon using the Ebola virus.³⁸ Notwithstanding, the Ebola virus can be effectively weapon-

ized by non-explosive methods. As the Ebola virus is effectively transmitted by direct contact, weaponizing the virus will focus on increasing person-to-person or zoonotic interaction.

First, an infected human can be used as a non-explosive Ebola virus weapon,³⁹ used to spread the disease within the targeted population. Analogous to suicide bombers, in bioterrorism infected humans will become the biological weapon. This delivery method is called "implantation," where the infected individual or the group of people becomes the Ebola vector that will maintain person-to-person contact and attempt to spread the illness by body fluids, saliva, and skin exposure.⁴⁰ Hypothetically, a successful bioterrorist attack can be conducted on a target population by transporting the infected individual or group by mass rapid transport systems such as trains and busses at peak hours. The highly congested public transportation will create an ideal environment for direct contact with the target population and simply transmit the Ebola virus. Further, deploying infected human weapons during the festive seasons, political rallies and events that result in mass congregations could be an effective option. In the contemporary context, the ongoing epidemic in West Africa

is an ideal opportunity for an interested terrorist organization to acquire infected individuals or cadavers to produce human weapons.

Second, the Ebola virus can be weaponized as an inoculating injection. The infected body fluids and blood can be directly introduced into the targeted individuals to transmit the Ebola virus. A similar method was used in the 1978 umbrella killings that inoculated ricin toxin using tiny pellets.⁴¹ Analogously, the inoculating injection can be delivered using a dart or a syringe. This non-explosive weapon can spread the virus to individual or multiple targets simultaneously. Further, the viral reservoir to weaponize the injection could be acquired from an infected individual. Inoculating injection is an ideal weapon for a covert bioterrorist strike. Moreover, if Ebola is introduced with coordinated multiple bioterrorist attacks, it is highly likely that it will continue to become an epidemic and spread fear among the population.

Third, an infected animal reservoir can also be used as an Ebola virus weapon.⁴² Non-human primates, bats, and rodents are Ebola virus infectors and they could be used as a viral reservoir to spread the disease among the population. The animal reservoir could be attained by direct exposure to contaminated cadavers or by inoculation, and the infected animal group can be released among the target population. This might result in multiple zoonotic infections and subsequently permeate the population through person-to-person contact. Hence, the Ebola virus has a higher likelihood of being weaponized through non-explosive methods than explosive methods. Compared to anthrax and smallpox, mass dispersion by explosive means is limited in the Ebola virus, but the non-explosive weapon options can be effectively used to infect the target population. Moreover, creating a non-explosive Ebola weapon is effective and plausible; a terrorist organization might seek to develop a non-explosive Ebola weapon and use it to cause fatalities, terror, and panic among the target population.

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PROPHYLAXIS

The prophylaxis methods available to counter a bioterrorist agent are crucial to the agent's success in an act of bioterrorism. Substantial prophylaxis methods used against the diseases can subside the intended public

terror and suffering. Prophylaxis against a bio-agent consists of vaccinations, prevention, and treatment.

There is no approved vaccination against the Ebola virus,⁴³ unlike both anthrax and smallpox. The post exposure treatment focuses on supportive therapy because there is no approved antiviral or antimicrobial medication for the disease, again unlike anthrax (which is treatable) and smallpox (which has an approved vaccine).^{44,45} This would exacerbate the situation after a deliberate bioterrorist attack, as the chance for survival or recovery after an Ebola infection is reduced.

The major focus after an Ebola outbreak is directed toward infection control. The control measures include patient isolation to prevent person-to-person contact, quarantine and containment locations in the hospital, and special personal protective equipment such as double gloves, N-95 masks, face shields, goggles, and impermeable gowns.⁴⁶ Similar to smallpox, any research on the Ebola virus is only conducted at BSL-4 high containment laboratories.⁴⁷ Furthermore, mortuary practices must avoid any skin contact with the diseased patient to avoid cutaneous transmission of the virus. Hence, postmortem practices must also adhere to secure containment that prevents person-to-person transmission.⁴⁸ The lack of any vaccine and antiviral medication to prevent or treat in pre- or post-exposure scenarios makes the Ebola virus a highly suitable candidate as an agent for a bioterrorist attack.

CONCLUSION

A structured, focused comparison with anthrax and smallpox reveals that the Ebola virus is a highly effective biological agent. The pathogenesis and the etiology of the virus indicate that it is a stable, highly fatal, and mutative virus that could cause acute Ebola hemorrhagic fever. Furthermore, the infectiousness of the virus indicates that it can spread rapidly among a target population through person-to-person contact via multiple entry routes into the human body. In addition, a terrorist organization can cause primary infections in a small population and then allow the infection to spread by secondary transmission. Even though the Ebola virus cannot be spread through aerosol dispersion, the relatively small infective dose makes the virus highly susceptible for direct transmission.

The present Ebola outbreak provides any terrorist organization interested in bioterrorism an Ebola virus reservoir of infected individuals or infected dead bodies, lessening the difficulty of covertly acquiring the virus strain. Without proper public infection control mechanisms, this outbreak could rapidly rise to an epidemic level.

Weaponizing Ebola would primarily depend on non-explosive methods that suit bioterrorism. A coordinated deliberate release of the virus using infected humans as “weapons,” targeted infections by the use of injections, or exposure to infected animals can cause a small outbreak within the target population and then consequently propagate the virus throughout the country via person-to-person contact.

Finally, the lack of a vaccine or any antiviral or antimicrobial drug to treat Ebola patients makes it a highly effective bio-agent that can cause mass fatalities, public panic, and public health system failure. Moreover, infection control is extremely difficult in an Ebola outbreak because it is highly infectious through person-to-person contact. The requirement of containment facilities, infection control protocols, and extreme personal protection equipment to handle the virus and the infected patients is more likely to cause nosocomial and public infections. Therefore, Ebola is well suited as a bio-agent in modern bioterrorism.

The world must be prepared to cope with the possibility of a bioterrorist attack that utilizes the Ebola virus. The key measure is to strengthen the public health management system for early detection, to provide mass treatment, and to have the resources to

implement infection control measures. Public awareness and the government’s capacity to control a bioterrorist attack can reduce the panic. Therefore, governments must develop a bioterrorism action plan that will concurrently employ public health management organs such as health ministries, departments, hospitals, medical laboratories, and the state security forces. Bioterrorism surveillance measures such as “illness monitoring” and “syndromic surveillance” must be

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utilized for early detection and control an outbreak.⁴⁹ Hospitals should be equipped to provide large-scale treatment and infection control by patient quarantine in an emergency situation.⁵⁰

Furthermore, establishing high containment BSL-4 medical laboratories is essential to handle bio-agents such as the Ebola virus. It is vital that the international community supports the relief efforts after a bioterrorist attack and establishes an international bioterrorism surveillance program. It is an arduous task to prevent a bioterrorist attack without holistic surveillance and

early threat-detection capabilities. Given the characteristics of the virus, and given the current outbreak in Western Africa, the world must realize that the Ebola virus does indeed pose a threat. *f*

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