Developing Altered Standards of Care for a Tularemia Bioterrorist Attack

by

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Introduction

Each year new scientific advancements are made as nations around the globe attempt to compete with each other. They are fueled by the desire to not be left unprotected in a world in which numerous countries possess weapons of mass destruction. Nuclear weapons continue to be a nation’s symbol of power. Before the development of nuclear weapons, in ancient eras groups of people and nations utilized a primitive form of biological weapons. With the advancements made in microbiology, more sophisticated biological weapons have emerged as an alternative to nuclear weapons of mass destruction, likely to be used in terrorist attacks or warfare (Barras & Greub, 2014). Pathogenic infectious diseases are the biological agents that are most likely to be weaponized. Infectious diseases, especially those that are quickly disseminated, highly pathogenic, virulent and transmissible, and have a high mortality rate pose a significant threat to a nations’ health and stability.

To defend and withstand the threat of bioterrorism or biowarfare, a nation must have a defense framework in place. Global health security is considered the defense against both intentional and naturally occurring infectious diseases; it encompasses surveillance, preparedness objectives, and response plans essential to protect a nation's health from biological agents. A nation must be able to quickly respond to a bioterrorist attack in order to minimize public panic as well as protect the health of the nation. The term response measures, encompasses altered standards of care, which can impact the execution of epidemiological investigation, treatment of injured or infected persons, disease containment and making sure the environment is free from contamination (Khan, Levitt & Sage, 2000).

Altered standards of care has an immediate impact on how other response measures are carried out. Altered standards of care are guidelines that depict changes to certain procedures,
such as hospital function or protocol, in the event of a public health emergency. A public health emergency is defined as any event in which there is a threat to health in the form of bioterrorism, epidemic or pandemic disease (United States Department of Health & Human Services, 2017). Individuals with the authority to declare a public health emergency are, governors, the President and the Secretary of the Department of Health and Human Services (HHS) (U.S. Department HHS, 2017). This declaration allows for different public health measures to be put in motion, allowing for the utilization of altered standards of care. Altered standards of care should disclose protocols for allocation of resources and information during times of public health emergencies, because these events require an elevated level of response. Other issues that should be addressed in altered standards of care guidelines are leadership and dissemination of healthcare information. By having pre-made decisions before a tularemia bioterrorist attack strikes, responders and those impacted will have an idea of the measures that will take place following the attack. Altered standards of care also alleviate the pressure of having to make in the moment decisions that might be irrational due to the emotional impact of a terrorist attack.

A bioterrorist attack could possibly lead to public panic and the inability of healthcare facilities to function under atypical influxes of patients. Tularemia, a zoonotic vector-borne disease, is an infectious disease that has the potential to pose a high risk to national security. Research has found that the tularemia bacteria, *Francisella tularensis*, can be aerosolized and only ten microorganisms (bacteria) are required to cause infection in the human body (Dennis, Inglesby, & Henderson, 2014). Untreated, the mortality rate of tularemia can reach between 30-60% (Ulu-Kilic & Doganay, 2014). Tularemia is only one of the many biological weapons that have the potentiality to become weaponized and considered a weapon of mass destruction. It is vital that robust altered standards of care guidelines are available in order to guide the United
States’ public health officials and other leaders in the event of a tularemia bioterrorist attack. There are currently altered standards of care for pandemic influenza and mass casualty events in general (Agency for Healthcare Research and Quality, 2005). However, there are currently no altered standards of care for tularemia, a category A biological agent. Tularemia will be evaluated as a biological weapon to emphasize the importance of global health security and the need for altered standards of care in the event that the tularemia causing bacteria is released in a terrorist attack on the United States.

Global, and National Health Security

Global health security does not have a precise universal definition due to the different interpretations of the concept by nations around the globe. Western countries perceive global health security as protecting a nation’s own borders against specific infectious diseases or bioterrorist attacks while, developing nations view global health security as a part of public health in general, rather than seeing global health security as its entity (Ruston, 2011). A broad understanding of global health security that ties together the numerous definitions of global health is: protecting nations and individuals from threats to health by lessening vulnerability to a border-crossing infectious diseases (Heymann, 2015).

One aspect of the United States’ approach to global health security focuses on the resources that are required for global health security measures to be enacted, including funding for responses of the basic health systems such as surveillance, epidemiology investigation, and human resources (Miller & Dowell, 2012). These resources must be strengthened and updated to combat the new threats that emerge. No nation's policies and procedures will ever come to fruition if the nation does not have the funding to back them. The funding that global health security receives in a specific nation can reflect both the nation's economic standing as well as its
commitment to global health security. The United States also recognizes the importance of having a leading organization in the time of a public health emergency (Miller & Dowell, 2012). Similar to how the World Health Organization is seen as the leading advisor for global health issues, the Centers for Disease Control and Prevention (CDC) plays a leadership role in the United States. There must be strong leadership for a nation’s health security measures to be coordinated. Essentially, health security is built upon the strength of large and small public health organizations. In order for various levels of organizations to cooperate and effectively coordinate public health actions during a public health emergency, their purposes and objectives in the scope of health security must be clear.

**Purpose of Global Health Security Translated to a National Scale**

The purpose of global health security is to protect the health of a population and lessen its vulnerability to border crossing threats such as infectious diseases (Miller & Dowell, 2012). A significant portion of global health security is identifying the risks to prepare and protect nations and individuals. For individual nations it is important to protect its collective states, counties, towns, cities, and neighborhoods from diseases and illness that have the ability to cross state borders. The United States specifically, has the Stafford Act of 1988 in place that requires the federal government to aid states during disasters and states of emergency, which include public health emergencies (Association of State and Territorial Health Officials, n.d.).

Ruston (2011) states three reasons in support of the importance of global health security that can be translated to health security in general. The first one being that the interconnectedness of the modern world makes infectious diseases more dangerous to both individuals and nations as a whole. When traveling, even during a morning commute, individuals come in contact with some individuals who are not all traveling to the same location, it makes it difficult for those in
the global health security field to pinpoint not only the start of the outbreak but the primary source of the epidemic. The second reason Ruston gives in support of universal health security’s importance is the threat of weaponized biological agents has become more prominent than in the past due to advancements within the scientific community. If global health security is not valued, nations will not be prepared for the possibility of hostile governments or terrorist groups utilizing weaponized pathogens. This unpreparedness could lead to the infection of a large number of people forcing a public health response the nation might not be prepared to execute and could affect the state of society and the economy. The third reason is that the lack of global health security measures could lead to the spread of communicable diseases, which would place a heavy burden on a nations’ social, political, and economic stability. These negative consequences of not being prepared for public health emergencies can be minimized with an altered standards of care. The history of the use of biological weapons can reflect the significant impacts the arms can have on individuals and larger populations and it highlights the need for protocols in place to stop or, at the very least, respond to these kinds of attacks.

History of Biological Weapons

The threat of biological weapons dates back to 600 BC and as science continues to advance the threat of biological weapons has become enhanced. Bioterrorism is the use of a naturally occurring agent as a weapon to cause chaos and terror within a nation or population with the intent of disrupting or destabilizing a nation’s society (Anderson & Bokor, 2012). The history of bioterrorism is relatively unclear, but there has been some documentation of bioterrorism events. Hasan (2014) organized the timeline of biological weapons development into three phases based on available documented events. The first period encompasses the Ancient Era (600BC-1767AD). During the 600 century BC, Assyrians poisoned the wells of
their enemies resulting in disease. In 1600 BC, the Hittites, people who established an empire in Asia Minor, sent infected rams to their enemies, unknowingly introducing tularemia to the environment (Barras & Greub, 2014). However, the discovery of tularemia did not take place until several centuries later. The Holy Roman Empire employed similar tactics by utilizing the dead bodies of soldiers to contaminate its enemies’ water sources (Hasan, 2014). There are stories of the Mongols catapulting diseased cadavers into besieged cities with the purpose of causing their enemies to become ill and force a surrender (Barras & Greub, 2014). The first phase also includes the French-Indian War (1754-1767 AD) during which British Commander Sir Jefferey Amherst encouraged the spread of smallpox to the Native Indian population by giving the Native Americans blankets that had been used by individuals with smallpox (Hasan, 2014). During this period, it is unlikely that the groups that utilized these offensive tactics understood how they were causing their enemies to become ill, other than the surface understanding that by placing dead bodies and known poisonous substances in the vicinity of their enemies gave them the desired results. It is likely they did not fully understand how to control these diseases because microbiology did not become established until the 19th century AD.

The second phase of the historical development of biological weapons is centered around World War I and World War II (1914-1945). According to historical documents, Germany infected horses and cattle with the bacterial infections anthrax and glanders and then shipped the infected animals to the United States and France (Hasan, 2014). This tactic was used in the hopes of causing illness in the countries and disrupting daily life. Germany virologists infected individuals with Rickettsia, hepatitis A, and malaria under Nazi rule to observe the effect these viruses had on the human body and also as a method for torture (Hasan, 2014). In the United
Kingdom, the Ministry of Supply weaponized tularemia, anthrax, botulism, and brucellosis to build up its weapons stock to compete with other nations that had biological weapons programs. The British also imported West African infected mosquitoes that resulted in the spread of yellow fever in India around the time of World War II (Hasan, 2014). This action might have been in response to Britain's fear that it would lose India to the axis powers (The History Channel, 2010).

During the 19th century, with the foundation of microbiology established, scientists were able to isolate and produce pathogens and control their dissemination. During the Cold War global powers raced to weaponize various pathogens and the United States developed a biological warfare program at Camp Detrick, Maryland in 1942 (Hasan, 2014). Germany, France, and the United States established biological warfare programs to compete with the other world powers and not be left defenseless and unable to retaliate.

The last phase of the historical development of biological weapons continues to modern day. The biological weapons and pathogens that are currently being researched are highly dangerous and have the high potentiality to wipe out large numbers of individuals. This phase includes the production and stockpiling of pathogens. The United States stores smallpox cultures that had been transported from Japan, Netherlands, and Britain (Hasan, 2014). The stockpiling of smallpox cultures either serves the purpose of research or building a biological weapons arsenal. The stockpiling of pathogens is controversial in the United States because of the risks associated with storing deadly pathogens. Some professionals believe that the preservation of the dangerous viruses and biological agents are necessary for research (Hasan, 2014). There is the risk of a disease outbreak from the mishandling of a virus or biological agent when housing and transporting the dangerous agents. There is also the possibility of hostile groups or nations attempting to steal stockpiled agents for their threatening uses. Smaller countries, such as Syria
and North Korea, have been accused of developing biological warfare programs. North Korea had allegedly created a lethal black pox and production capabilities for Anthrax while, Iran is the only nation to have supposedly been able to synthetically develop anthrax, Ebola, encephalitis, biological toxins, severe acute respiratory syndromes (SARS), smallpox, plague and cholera (Hasan, 2014). Biological weapons programs and the stockpiling of such weapons are banned by the Biological Weapons Act of 1989 which was enacted by the United States Congress (Rodriguez, 2013). However, if the programs are determined to have peaceful intentions, their continued work is permitted. Biological weapons have become a symbol of a nation's global power status, similar to the value of nuclear weapons. Guidelines for altered standards of care are created in preparation for the event of a bioterrorist attack. Surveillance measures are valuable in detecting outbreaks that result from bioterrorist attacks allowing for quicker diagnosis and treatment of those impacted.

*Health Security Surveillance Measures*

Surveillance is a critical component of global health pre-attack security measures in regards to identifying threats to health. Any primary surveillance system can detect and report any incidence of disease, analyze reported information to confirm an outbreak, help to provide quick responses and provide epidemiological intelligence. According to Kman and Bachmann (2012), the four main types of health surveillance systems are syndromic surveillance, alternative surveillance, environment surveillance and laboratory surveillance. Syndromic surveillance is based upon incorporating information received from different sources such as hospitals and other emergency departments to identify clues that can be used to determine a pattern and a possible outbreak of disease. General syndromic surveillance systems compile all the information that is obtained from its various sources to help professionals detect the early outbreak of illness.
Alternative surveillance systems encompass web-based surveillance systems that use data from internet searches and automated data mining to sift through "breaking news" trends to differentiate between high and low-impact problems. The broad scope of the internet allows access to a vast bank of data. However, these web-based surveillance systems are still flawed because there is not a standardized system for updates, which can result in an overload of information (Velasco, Agheneza, Denecke, Kirchner, & Eckmanns, 2014). Currently, web-based methods are still useful, but if they are improved, they will have a much more significant impact on global health security because most of the world is web-based. Environmental global health security surveillance is composed of remote detection systems that can identify aerosolized masses or clouds and point detection systems that make identifications from an environmental source. Laboratory surveillance includes the Laboratory Response Network (LRN). The LRN is a collection of laboratories that are equipped to handle a variety of public health emergencies on a daily basis and have the capabilities to sort through tests to identify possible biothreat specimens. There are three categories of laboratories that make up the LRN of the CDC, national laboratories, reference laboratories and sentinel laboratories (CDC, 2014). National laboratories include the U.S Army Medical Research Institute of Infectious Diseases (USAMRIID) and the Naval Medical Research Center (NMRC), the functions of these labs include forensics and handling highly infectious biological agents. Reference laboratories overlook the investigation of specimens, and these are smaller laboratories that are spread out throughout the country. The sentinel laboratories include commercial and private laboratories and are usually hospital-based and clinical institutions. Individually, each surveillance system alone is not enough to prevent and respond to public health emergencies and can only be used to their full potential when multilateral organizations cooperate and collaborate. Each type of surveillance system focuses on
different possible sources of an outbreak, the utilization of each type of surveillance system creates a whole picture when trying to identify a pattern. However, a nation cannot predict, prepare or identify a border crossing health threat if it does not have a surveillance system in other regions of the globe or an intelligence-sharing agreement with the other nation. On a national level, within the United States, there is an extensive network of government agencies that contribute to a more substantial biosurveillance network.

In the United States, the Department of Homeland Security oversees the National Biosurveillance Integration Center (NBIC) through the National Biosurveillance Integration System (NBIS). The focus of the NBIS is to gather and analyze information regarding general threats to health and other disease-related events. The NBIS categorizes its sources into three different groups, primary biosurveillance agencies, support biosurveillance agencies and biosurveillance information consumers (United States Government Accountability Office, 2015).

Primary biosurveillance agencies play a significant role in collecting and analyzing biosurveillance information. The goals of these organizations are to detect, monitor and respond to biological events. The Animal and Plant Health Inspection Service (APHIS), Armed Forces Health Surveillance Center (AFHSC), CDC, U.S Customs and Border Protection (CBP), Environmental Protection Agency (EPA), and the U.S Food and Drug Administration (FDA) are some of the agencies that are categorized as primary biosurveillance agencies. The support biosurveillance agencies are those which are not solely focused on biosurveillance yet still collect data or possess expertise that can be vital to the efforts of primary biosurveillance. The category of support biosurveillance agencies consists of the Federal Bureau of Investigation (FBI), National Oceanic and Atmospheric Administration (NOAA), United States Postal Service (USPS) and the Office of Intelligence and Analysis (I&A). Biosurveillance information
consumers such as the Department of State (DOS), Department of Transportation (DOT), and the Department of Energy (DOE) are agencies that consume biosurveillance news that may impact their specific functions, but these organizations sometimes play a part in responding to biological events.

The Centers for Disease Control and Prevention (CDC), a primary biosurveillance agency, plays a significant role in the surveillance of infectious diseases within the United States. The CDC upholds the surveillance strategies of standardizing health data and exchange systems, enhancing electronic health record systems, accelerating electronic laboratory reporting and modernizing mortality surveillance systems. The National Notifiable Diseases Surveillance System (NNDSS) is a surveillance platform that allows for the sharing of disease-related data across all levels of public health. The CDC’s Division of Health Informatics and Surveillance (DHIS) offers support to the NNDSS through funding, technical assistance, and access to electronic health information systems (Centers for Disease Control and Prevention, 2015c). The National Notifiable Diseases Surveillance System (NNDSS) is overseen by the CDC on a national level. This method handles the compilation, analysis, and release of data related to notifiable infectious diseases (Adams et al., 2015). The CDC report (2013) defines a notifiable disease as a condition or illness which requires continuously updated case information that is vital to the prevention or containment of the disease (Adams et al., 2013). Health care providers, hospitals, and laboratories are mandated at the state, territory and local levels to report to public health authorities regarding information on any disease that is classified as a notifiable disease by the CDC (Centers for Disease Control and Prevention, 2015c). Despite being fully functional and established, the NNDSS is not enough. Surveillance systems in the United States need to be
continually updated to accommodate emerging threats in order to take effective post-attack measures against pathogenic bioweapons, such as tularemia.

**Epidemiology of Tularemia**

Tularemia, a relatively new disease, is endemic to parts of North America and Europe. It is a vector-borne zoonotic disease, meaning the transmission of the virus relies upon its living reservoirs or vectors. Both ticks and rodents are reservoirs of the tularemia bacterium, *Francisella tularensis*. There are several types of tularemia: ulceroglandular, glandular, oculoglandular, oropharyngeal, pneumonic, and syphiodial (Cleveland, 2016). The different forms of tularemia are distinguished by how the bacteria enter the body as well as the local symptoms resulting from infection. Infection can occur from consuming contaminated food or water, handling infected animals, being bitten by infected animals or breathing in dust or air containing the *F. tularensis* bacteria (Cleveland, 2016). There is a low natural occurrence of tularemia in the United States, and any outbreak of the disease, regardless of the scale, could be investigated as an intentional dissemination. There are known specific prevention methods and treatments; however, there is no vaccine that is currently available. And in the event of a tularemia bioterrorist attack there is no possible way to prevent the onset of disease. Tularemia is a highly infectious disease and has been categorized as a high priority biological threat classified in the top biosafety level in regards to laboratory handling guidelines (Centers for Disease Control and Prevention, 2009). Because of its categorization in high biosafety levels and potential use for bioterrorism, research on tularemia for defense and response purposes is continued.

*History of Tularemia*
In 1907, Dr. Ancil Martin wrote a novel focused on five human cases of eye infections found in his ophthalmology practice (Siderovski, 2006). It is extremely likely that one of the five eye infections that were observed was a case of oculoglandular tularemia. However, tularemia had not been clinically diagnosed or identified as a disease at this point. The knowledge that rodents and ticks act as living reservoirs for the tularemia bacteria stemmed from Dr. George Walter McCoy's investigation of a "plague-like" disease in rodents in Tulare County, California in 1911 and Dr. R.A Pearse’s research on six human cases of deer-fly fever (Siderovski, 2006). Dr. McCoy and Charles Chapin later discovered that the "plague-like" symptoms that they had found in rodents were caused by a bacteria, which they named \textit{B.tularense} (Siderovski, 2006). In 1914 Dr. William Buchanan Wherry published the first report of a confirmed human case of a \textit{B.tularense} infection. Seven years later, in 1922 Dr. Edward Francis reported on six cases of tularemia in laboratory workers (Siderovski, 2006). These reports were evidence that the disease was highly infectious and that laboratory workers were at an increased risk of becoming infected. In 1959 the tularemia bacteria name \textit{B.tularense} was changed to \textit{Francisella} tularensis in honor of Dr. Francis for his tularemia research achievements (Siderovski, 2006). The research done by Dr. Francis was never noted to be related to the biological weapons program.

During the World War II period, many of the world powers including the United States and the Soviet Union stockpiled and ran research programs focused on tularemia (Johns Hopkins Bloomberg School of Public Health, 2001). The United States biological weapons program was later disbanded in compliance with the Biological Weapons Act of 1989 (Rodriguez, 2013). Cases of tularemia have also occurred outside of the laboratory in naturally occurring instances. While the Midwestern states usually have a higher reported incidence of tularemia, Martha’s Vineyard has a distinct history of naturally occurring cases. In 1978 the first known cluster of
pneumonic tularemia was identified on Martha's Vineyard, however, in this case, the source was not detected (Feldman et al., 2001). Later in 2000 five cases of pneumonic tularemia were reported, and in this instance the infection had resulted from mowing lawns or cut brushing over an infected animal (Feldman et al., 2001).

**Causes of Tularemia**

Tularemia is a zoonotic vector-borne disease, caused by the *Francisella tularensis* (*F. tularensis*) bacteria and is one of the most virulent microorganisms (Carvalho, Carvalho, Zé-Zé, Núncio, & Duarte, 2014). *F. tularensis* is a pathogenic species that can be divided into four subspecies: *tularensis* (Type A), *Holarctica* (Type B), *novocida*, and *mediaasiatica* (Johns Hopkins School of Public Health Center for Health Security, 2014). The subspecies are differentiated by specific virulence and geographic distributions (Carvalho et al., 2014). The *tularensis* subspecies is of interest because it is the most common subspecies in North America and has high virulence in both humans and animals. The distinction between each clinical presentation of tularemia is how the bacteria entered the body and the signs and symptoms (Centers for Disease Control and Prevention, 2015d). Ulceroglandular and glandular tularemia occur when *F. tularensis* enters a person’s body through the skin after a deer fly or tick bite or after handling an infected animal. Oculoglandular tularemia is a result of the *F. tularensis* bacteria entering through an individual’s eye, which would occur if an individual rubs their eyes after handling an infected animal. When an individual consumes contaminated water or food the form of tularemia that will develop is oropharyngeal. Pneumonic tularemia, the most deadly form of tularemia, occurs when an individual inhales dust or aerosols with the *F. tularensis* bacteria or when another kind of tularemia goes untreated. The distinction between the other
forms of tularemia and typhoidal tularemia is made by the signs and symptoms because the mode of transmission for these types is unclear.

*Modes of Transmission*

The main reservoirs of *F. tularensis* are insects such as ticks, deer flies, and arthropods. These organisms infect human beings and other animals through their bite or if humans and animals handle or consume infected animals or water. In the United States, Finland, and Russia, tularemia is mainly transmitted via insect bite (Carvalho et al., 2014). Within the United States, the modes of transmission vary throughout the country. Western states are more threatened by ticks and deer flies while the eastern states are mainly threatened by ticks (Carvalho et al., 2014). This differentiation is most likely due to the different climates and environments in which deer flies and ticks can survive. According to Carvalho et al. (2014), transmission via handling an infected animal, and consumption of contaminated food or water is more common in Western and Central Europe. The different modes of transmission can be attributed to the different types of ecosystems in the area as well as the habits of the human beings living in the area. Areas in which individuals are more inclined to participate in outdoor activities in wooded areas with high incidence of tularemia are more likely to become infected than those who live in a city and do not frequently participate in outdoor activities. In addition to consuming an infected animal, the disease can be transmitted through the inhalation of *F. tularensis* or if the microorganism makes contact with an open wound. Due to its high potentiality of being used as a bioterrorism agent, researchers have studied the transmission of tularemia via aerosol. Research has shown that a human being would only have to inhale as little as ten organisms of *F. tularensis* to develop tularemia (Dennis et al., 2014). The small infective dose makes the chance of becoming infected by inhalation of aerosolized *F. tularensis* microorganisms much higher especially if the
dissemination is intentional. When *F. tularensis* enters the human body, it presents a set of signs and symptoms that help medical professionals to identify a specific form of the disease.

*Symptoms and Progression of Tularemia*

The six forms of tularemia share some symptoms, but there are distinctive differences that separate them as six individual forms. The most common symptoms associated with all sorts of tularemia are sudden fever and chills, headache, pulse-temperature disassociation, fatigue, pharyngitis, abdominal pain and secondary pneumonitis (Cleveland, 2016). Ulceroglandular tularemia occurs when *F. tularensis* enters the body through a break in the skin and spreads to the lymph nodes, and within 1-10 days a small bump on the surface appears at the site and becomes an ulcer 2-3 days later (Cleveland, 2016). It is the ulcers associated with ulceroglandular tularemia that separates it from the other forms of tularemia. Glandular tularemia presents similar symptoms to ulceroglandular tularemia, except glandular tularemia does not leave any evidence on the skin and the bacteria can spread through the blood in addition to spreading to different lymph nodes (Cleveland, 2016). Glandular tularemia can be more dangerous in comparison to ulceroglandular tularemia because the symptoms are not as apparent to the naked eye which can lead to a delay in the diagnosis and treatment process. Oculoglandular tularemia is associated with irritation and inflammation of the eyes and swollen lymph nodes proximal to the ear (Centers for Disease Control and Prevention, 2015d). The symptoms of pneumonic tularemia include coughing, chest pain and difficulty breathing as the bacteria move to the lungs (Centers for Disease Control and Prevention, 2015d). Typhoidal tularemia does not have any distinct symptoms of its own, and it usually presents a mixture of the shared traits of tularemia (Centers for Disease Control and Prevention, 2015d). Despite having slightly different symptoms, the progression of each form of the disease is considered the same.
The average incubation period of tularemia is approximately 3-5 days but can range from 1-20 days (Carvalho et al., 2014). In general cases, tularemia multiplies locally and spreads to the nearest lymph nodes within 48-96 hours (Oz et al., 2014). The impact on the lymph nodes can be organized into three phases. The first period occurs approximately one week after infection. This stage includes a swollen area at the site of infection containing a collection of dead cells. The second phase occurs 2-6 weeks after infection in which a mass of granulation tissue is formed. The third period takes place after the 6th week post-infection during which the disease progresses to caseous necrosis, which is a collection of diseased, dead tissue (Oz et al., 2014). The appearance of the swollen lymph nodes can help a medical professional identify what stage of the disease the patient is in so that the medical professional can determine the best form of treatment. If tularemia goes untreated, the condition can continue to progress in severity for approximately 3-5 weeks (Barel, Grall, & Charbitl, 2015). Untreated tularemia can be fatal, and at the minimum, delayed treatment can drastically increase the mortality rate of tularemia.

Prevalence, Incidence and Case Fatality

Statistics that are often associated with analyzing infectious diseases include prevalence rate, incidence rate, and case fatality rate. The prevalence rate describes the number of total individuals that have been infected at a specific point in time, while incidence rate represents the number of new individuals that have become affected during a specified period. Case fatality rate is the statistic that gives the proportion of deaths that have resulted from the disease in question. The prevalence of naturally occurring tularemia in humans within the United States is extremely low. Since 1939, there has only been approximately 100-200 total reported cases annually (Sanyaolu & Okorie, 2016). The Center for Disease Control and Prevention (2015e) reported the incidence rate of tularemia in the United States in the year 2015 was 0.10 for every 100,000
residents in the country. The states with the highest incidence rates of tularemia were Wyoming (3.58) and South Dakota (2.91). The states with the highest incidence rates of tularemia are depicted in Table 1. Based on the data from Table 1 it is apparent that the number of reported cases of tularemia in the United States has been inconsistent and spiked in 2015. This sudden spike in reported cases of tularemia might have resulted from increased incidence in ticks, deer flies, and rodents in Wyoming, South Dakota, and Nebraska. While states outside of the Midwest region such as Connecticut, Delaware, New York, Maryland, and South Carolina had an incidence rate of 0.0 for 2015.

Table 1

*Reported Cases of Tularemia in the U.S. 2005-2010*

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Incidence rates of tularemia in the United States are also illustrated in Figure 1 which shows, that the majority of the reported cases of tularemia are concentrated in the central states...
of the country. The high number of reported cases in this specific region of the United States might correlate with the types of rodent and insect species that are specific to that area. This information is valuable for travelers and inhabitants of this region to take precautions to prevent and reduce the risks of becoming infected with tularemia.


The case fatality for the types of tularemia can differ depending on how much time passes before treatment. If a patient is given proper treatment for tularemia, the mortality or case fatality rate is 1-2.5%. However, if treatment is delayed or negated, the mortality rate increases to 35% (Gulacti et al., 2014). Pneumonic tularemia, the most dangerous type of tularemia reaches a case fatality range of 30-60% if left untreated (Ulu-Kilic & Doganay, 2014).
Prevention methods specific to tularemia are utilized to reduce the risk of becoming infected with the disease, especially while in a high incidence area.

**Prevention Methods**

Human beings can become infected with tularemia if they consume contaminated food or water, handle infected animals, inhale contaminated dust or aerosols, or are bitten by infected deer flies, ticks or rodents. Infection via natural occurrence is preventable if the right precautions are taken. The best ways to prevent tularemia are to avoid handling infected or diseased animals and avoid consuming any contaminated food or water. However, this method of prevention is not always feasible, because an individual might not be aware of whether or not the food or water has been contaminated. When traveling to an unfamiliar area or into wooded areas, it is best to boil or filter water if possible before drinking. In regards to food, it is important to wash fruits and vegetables as well as cook meat thoroughly. Additional individual prevention methods include hand washing, applying DEET and wearing long sleeves and pants when spending time in wooded areas to prevent tick bites. It is also essential to check for ticks after spending time in the woods and if ticks are found they should be extracted with great care (Barel, Grall, & Charbit, 2015).

Prevention methods that are geared towards protecting larger groups or populations include education and surveillance. At risk populations, such as hunters, veterinarians, and laboratory personnel should be educated about the risks of contamination, symptoms of the disease and how to protect themselves (Barel, Grall, & Charbit, 2015). Individuals should report to veterinary services if there is a suspicion of tularemia in an animal or seek medical help if they notice signs of tularemia in themselves. Veterinarians and other healthcare workers should have knowledge regarding the signs and symptoms of tularemia in order to report the occurrence of
the disease (Centers for Disease Control and Prevention, 2015c). Reports regarding possible cases of tularemia are often integrated into the local, regional or national surveillance system. If an individual is unable to prevent infection, there is a valid method of treatment that is proven to cure tularemia.

Treatment

Tularemia is a treatable disease, and the mortality rate of appropriately treated patients is significantly lower than the mortality rate of individuals who are left untreated. The primary form of treatment of tularemia is antibacterial therapy. The most common drug utilized during treatment therapy are streptomycin and gentamicin (Harik, 2013). Streptomycin is preferred over gentamicin because streptomycin has a cure rate of 97% and gentamicin’s cure rate is 86%. Additionally, for the treatment of tularemia, only streptomycin is approved by the FDA (Alias, Fallahzadeh, & Berhe, 2017). However, streptomycin use is limited because it is not readily available in most hospitals in large quantities (Alias, Fallahzadeh, & Berhe, 2017). In the pharmaceutical field, antibiotic development is lacking. This deficiency is thought to be because antibiotic drugs are less profitable for pharmaceutical companies (Ventola, 2015). Alternative medical treatment includes doxycycline and ciprofloxacin; however, these drugs are not replacements for streptomycin or gentamicin because these alternative therapies lead to a more extended treatment period and have high relapse rates (Harik, 2013). Currently there are no vaccines available for tularemia; however, researchers continue attempts to develop a capable vaccine because of its potential to be used as a biological weapon.

Tularemia as a Biological Weapon

Multiple biological weapons programs around the world have invested in the research of tularemia as a biological weapon either for offensive or defensive purposes. Defensive biological
agents' programs focused on strategies for combating weaponized tularemia have determined a plan of action. However, these goals have still not been achieved. Maurin (2014) suggests three possible strategies for combating weaponized tularemia: (1) developing drugs that prevent the growth of tularemia in living organisms, (2) developing drugs that reduce the virulence of *F.tularensis* while enhancing the effectiveness of current antibiotic treatment and (3) enhancing the hosts’ ability to respond to *F. tularensis*. If a drug can create an environment that makes it difficult for *F.tularensis* to survive, it can decrease the infectiousness of the disease. Drugs that reduce the virulence of the bacteria would lessen the impact of an intentional dissemination of the disease; however, the supply of the drug would have to match the demand. In addition to medications that attack the bacteria itself, vaccines need to be developed in order to help the human body fight off the bacteria. Research continues to take place to create drugs that will render tularemia ineffective as a biological weapon because if used intentionally it can have long-lasting effects. In the meantime, developed response measures guided by altered standards of care, created before the event of a tularemia bioterrorist attack, are important in protecting the health of the nation.

The history of tularemia as a biological weapon began during World War II. The bacteria that causes tularemia, *F.tularensis*, was being used in a biological weapons research program that led to the deaths of 300,000 individuals (Rodriguez, 2013). Japan had been infecting the Chinese with *F.tularensis* while occupying Manchuria; the research facility is widely known as Unit 721 (Rodriguez, 2013). This practice doubled as a method of torture and research to observe the effects of the disease on the human body. During the 1960’s the U.S military stockpiled tularemia until all of it was destroyed in 1973 after an executive order from President Nixon to end the offensive biological weapons programs (Christopher, Cieslak, Pavlin, & Eitzen, 1997).
But before the destruction of the tularemia stockpiles, the disease was used for research purposes. The U.S. biological weapons program carried out a trial of tularemia named Shady Grove, during which aerosolized tularemia was tested on rhesus monkeys (Guillemin, 2006). Also during this period, the Soviet Union continued attempts to produce an anti-biotic and vaccine-resistant strain of tularemia until the 1990's (Johns Hopkins Bloomberg School of Public Health, 2001). The WHO expert committee of 1969 proclaimed that 50 kilograms of aerosolized *F. tularensis* would result in 250,000 debilitating casualties and 19,000 fatalities in a population of 5 million people (World Health Organization, 1970). Aerosolized tularemia used in a bioterrorist attack would also result in considerable economic damage. Based on the WHO expert committee report, the CDC estimated that it would cost the United States 5.4 billion dollars per 100,000 people exposed (World Health Organization, 1970).

The threat of the natural occurrence of tularemia has been identified by various health organizations that enact specific safety precautions. Biosafety level (BSL) depicts the biocontainment guidelines used when handling dangerous biological agents such as tularemia. There are four biosafety levels: BSL-1 is the lowest level, and BSL-4 is the highest regarding safety precautions. *F. tularensis* is categorized as a biosafety level 3 (Carvalho et al., 2014). Because of this categorization, laboratories that handle the bacteria have more safety precautions and regulations that laboratory workers must abide. Examples of specialized practices specific to biosafety level 3 agents include the requirements that all manipulation of the infectious agent must be done within a physical containment device and when stored the agents must be in a durable, leak-proof container from collection to transportation (Centers for Disease Control, 2009). This biosafety level correlates with the CDC classification of potential bioterrorism agents.
The CDC organizes potential bioterrorism into three categories: Category A, Category B, and Category C. The categorization of possible bioterrorism is done based upon the potential threat posed by the agents. Category A agents, are distinguished by quick transmission and dissemination, can result in a high mortality rate, require particular preparedness actions and are likely to cause public panic (Baylor College of Medicine, 2017). Tularemia is one of the Category A potential bioterrorism agents. The tularemia bacteria \textit{F.tularensis} is especially infectious when disseminated through aerosols as it only takes a small dose of 10 organisms to cause infection (Dennis et al., 2014). There is currently no vaccine for tularemia and only a selected number of antibiotics that can treat those infected with tularemia. The limited availability of streptomycin could also leave some people untreated and put them at a higher risk of death, highlighting the importance of outlining altered standards of care.

This disease is one that lingers in an environment and infects organisms for an extended time which can be detrimental if it is released intentionally (Maurin, 2014). Decontamination of the environment would require specially skilled professionals and equipment. If there were a widespread intentional dissemination of tularemia, there would be both health and economic consequences that would be long lasting with the possibility of the target area remaining a tularemia endemic area for an extended period (Maurin, 2014). Because of its attributes, the risk of tularemia being used as a biological weapon should not be ignored.

As a result of rising proliferation of biological weapons amongst an increasing number of nations, concerns have increased leading to growing public awareness of bioterrorism (Soomro, 2015). Smaller governments have begun to invest in biological weapons programs to compete with more powerful countries of the world and also as a measure of defense and retaliation. Biological weapons are sometimes desired opposed to nuclear weapons because they are more
easily obtained, being dubbed the poor man's atomic bomb or the poor man's weapons of mass destruction (Soomro, 2015). The reputation of biological weapons being easily obtainable should present a threat that should be taken seriously. Research programs focused on methods to correctly identify an intentional dissemination of biological weapons should be invested in, specifically for tularemia.

The most likely method of intentional dissemination of tularemia as part of a terrorist attack or during biological warfare would be in aerosolized form because of its potential for increased human exposure via inhalation (Rodriguez, 2013). Because of the low incidence and prevalence rates of tularemia in the United States, any outbreak of tularemia should be regarded as a red flag for a possible intentional spread of the disease (Rodriguez, 2013). The identification of tularemia is dependent on the technology and surveillance systems that are available, and it is essential that these systems work in cooperation with each other to be successful. Rodriguez (2013) notes after an intentional dissemination the two locations that would have the highest rates of tularemia infections would be the targeted location as well as the production site of the weaponized *F. tularensis*. Terrorist groups that would use biological agents as weapons would most likely target highly populated areas to cause public panic (Rodriguez, 2013). In the event of a tularemia bioterrorist attack it is important public health authorities and healthcare workers know how to respond before the event occurs. Altered standards of care for tularemia offers a guideline for responders to follow in order to respond as quickly and efficiently as possible, avoiding the need to hold conferences and create task forces in the middle of a public health emergency.

The Role of Ethics in Public Health
The main objective of public health and public health associated organizations is to protect the public’s health from harm. Threats such as border-crossing infectious diseases have the potential to disrupt society’s infrastructure as a result of a public health emergency (Fonkwo, 2008). In order to protect the health of the public, most organizations look to prevention, preventing the event before it can even occur. There are three categories of prevention measures, primary, secondary, and tertiary (World Health Organization Regional Office for Europe, n.d.).

In the context of tularemia, there is no approved vaccine that can be given to the public, which would act as a form of primary prevention. Secondary prevention in the form of screening for tularemia is helpful in determining that there has been a bioterrorist attack that utilized aerosolized tularemia. Because tularemia is not known to be transmitted person-to-person, there is no concern about the disease spreading, so screening individuals does not aid in preventing future infections. Altered standards of care act as a means of tertiary prevention, these plans of action are important because they can reduce long-term impacts of the attack.

In order to come to decisions that can address the public health emergency without negatively impacting the public, the decisions must be ethical. There are many questions that arise during public health emergencies, such as, when resources are limited, who should be treated first? Without answers to questions similar to this one, it is difficult to have a cohesive response to a public health emergency, which can ultimately lead to the loss of life. If ethical guidelines or standards of care are already in place, plans for action can become clearer and more effective and can possibly result in decreased collateral damage and increase trust and solidarity amongst health care workers and organizations (Thompson, Faith, Gibson, & Upshur, 2006).

**Overview of Substantive and Procedural Values**
There are ten substantive values and five procedural values that are outlined in *Stand on Guard for Thee*, a Canadian document developed by the University of Toronto Joint Centre for Bioethics Pandemic Influenza Working Group depicting the ethical considerations in preparedness planning for pandemic influenza (2005). This document highlights the importance of having altered standards of care established prior to an emergency situation, rather than trying to make difficult decisions with questionable ethics during the emergency. Having a plan of action prior to the event allows for response measures to be carried out more smoothly because people will have had an understanding of why the decisions were made, and will be able to carry out those decisions without too much of a second thought. Although there is a plethora of guidelines that address how the spread of certain infectious diseases should be handled, *Stand on Guard for Thee*, emphasizes the importance of conveying to the public, why decisions are being made by backing them with ethics. The substantive values were created to guide ethical decisions in terms of questions that should be answered prior to coming to a conclusion. The procedural values depict how the decisions should be made, the criteria. The ten substantive values were defined in order to guide ethical decision-making, specifically influenza (University of Toronto, 2005). However, these substantive values could be applicable to other public health emergencies.

The substantive values are: individual liberty, protection of the public from harm, proportionality, privacy, duty to provide (care), reciprocity, equity, trust, solidarity and stewardship (University of Toronto, 2005). The five procedural values or criteria require the decision making and decision to be reasonable, open and transparent, inclusive, responsive and accountable (University of Toronto, 2005). The value of individual liberty encapsulates the idea that in the event of a public health emergency, individuals’ liberties might have to be restricted in
order to protect the health of the public (i.e. travel bans). In order to justify limiting individual liberty, the decision must be proportional, relevant to the situation, least restrictive as possible and be applied equally, meaning one group is not more restricted than another (University of Toronto, 2005). Protecting the privacy of individuals in a health care setting is important, but altered standards of care should have the capacity to override this value if it benefits the public (i.e. the sharing of medical records across surveillance platforms in order to contain a breakout).

Duty to care is the code of certain professionals in the health care field, such as medical professionals, that ask them to work to save the lives of others without exception. However, during times of emergencies, such as the Ebola outbreak in West Africa, some medical professionals refused to care for infected individuals because they feared for their lives as well as the lives of their family. It is important that any altered standard of care guideline explains why health care and medical workers should be held accountable to continue to save the lives of others based on ethical reasoning. Proportionality is named as a substantive value because it is important that the measures that are taken in response to the public health emergency fit the situation itself, and that it is not causing more harm or distress to the public than necessary.

Reciprocity follows a similar thread to proportionality, however its focus is to make sure that society supports those who are disproportionately burdened (i.e. health care workers on the front lines of a public health emergency and those who suffered from health inequity previous to the emergency). The substantive value of equity aims to address the questions of who and what conditions should be treated during a public health emergency and which must be placed at a lower priority. Trust is a significant component in handling a public health emergency, public health organizations, the government and their respective employees must gain the trust of the public in order to minimize public panic and increase compliancy. Solidarity among different
health care institutions (government, state and local) in order to collaborate efforts to stop the spread of disease. Lastly stewardship, is the trust that is placed in leaders who make decisions during public health emergencies. It is imperative that leadership takes this trust that was given to them seriously, and should let it guide them in good decision-making and ethical behavior, in order to protect the health of the public by using the least restrictive means (University of Toronto, 2005). Despite there being ten different named substantive values, when creating guidelines for altered standards of care the substantive values all become interwoven when addressing certain issues.

These values can help those making public health preparedness decisions and plans for emergency situations to develop standards of care. With clear standards of care licensed health care workers and others responding to the emergency know what to do and when to do it and do not have to waste time trying to make difficult decisions in the moment.

**Altered Standards of Care: Tularemia Bioterrorist Attack**

In the event of a tularemia bioterrorist attack, ethical guidelines should advise public health action and response measures. The types of tularemia that are most likely to be weaponized in aerosolized form are pneumonic, typhoidal and oropharyngeal, because these forms have higher mortality rates if left untreated (VanMeter & Hubert, 2015). During an epidemic of infectious disease such as influenza, the substantive values, duty to care and individual liberties regarding freedom to travel, are heavily impacted. However, these substantive values are not impacted in the same manner in the case of tularemia due to the current understanding that tularemia is not transmitted person-to-person. The substantive values of stewardship, allocation of resources, health equity, reciprocity and individual rights such as privacy, all have the capacity to become impacted by a tularemia bioterrorist attack. This
proposed altered standards of care guideline focuses on those substantive values in the context of certain issues: leadership, allocation of resources, health equity and the dissemination of health information.

Stewardship and Transparency

Stewardship is defined as the job of supervision, which references an organization or property (University of Toronto, 2005). Stewardship is named as a substantive value by the University of Toronto because of its overarching importance, it can impact the vision and the effectiveness of a proposed altered standards of care. Leadership is important when responding to a public health emergency, having a strong and decisive leader allows for those implementing the decisions and individuals who will be impacted by the decisions to trust in the response measures. If there is a lack of leadership, response efforts become disorganized and less effective.

Centers for Disease Control and Prevention (CDC) is the United States’ leading public health organization, this national organization supports public health activities. The CDC is often seen as a leader and coordinator between various state and local public health departments. Other federal departments such as the Department of Homeland Security, the Federal Emergency Management Agency and the Department of Health and Human Services play a role in the response to bioterrorism attacks. These organizations are entrusted by the public to make good ethical decisions (University of Toronto, 2005). In order for these various organizations to gain the trust of the public and ensure a respectable decision making process, there must be transparency. Transparency is defined by the World Health Organization (WHO) as the dissemination of quality (factual, accurate and easily understood) information needed by people to protect their health and prevent the spread of disease, in a manner that promotes trust (World
Health Organization, 2009). In order for there to be cooperation and unity during a public health emergency there must be transparency. Transparency is one of the five procedural values, which guides how the substantive values are carried out. Transparency is a mechanism for stewardship, in that it helps leadership convey to the public that they are looking out for their best interests.

Stakeholders, such as infected individuals, healthcare workers, other public health workers and the public should understand why decisions are being made. Factors in understanding the decision-making process include: (1) facts or evidence supporting the decision; (2) the goals of the intervention; (3) measures enacted to protect individuals’ rights; (4) reasons for the decision; and (5) how the decision can be altered or revised (Gostin & Wiley, 2016). History has shown that when public health and healthcare agencies are transparent in their decision-making, allowing for the feedback of results to reach professionals and the public, there are improved results in regards to public health responses and actions (García-Altés & Argimon, 2016).

After the SARS pandemic, the World Health Organization stated that information should be shared transparently, acutely and quickly, in order to determine measures to manage the public health emergency and protect the public’s health and reduce economic and psychosocial impacts from the public health emergency (World Health Organization, 2009). Giving the public and professionals information and some form of input during a public health emergency allows public health organizations and the government to be held accountable for making decisions that protect the public’s health. Disseminating information regarding the bioterrorist attack would be vital for individuals who might be infected, so that they know to seek medical attention. Other information that should be shared in the event of a tularemia bioterrorist attack includes: specific actions that individuals and specific groups should take to protect their health, incidence rates,
risk assessments, what is known and unknown regarding control measures, ethical considerations and policies that might impact control decisions, and who and how exactly decisions are being made (World Health Organization, 2009). Decisions that need to be made include how limited resources will be distributed in order to minimize chaos.

Allocation of Resources

During an epidemic, emergency departments, hospitals, and other care centers’ resources can become scarce, leaving these healthcare departments unable to operate effectively at surge capacity. There are several categories of resources that are vital to the functioning of healthcare centers: space, staff, supplies and other special equipment. These resources become scarce when there is a large influx of patients due to a bioterrorist attack in addition to individuals with nonrelated diseases or emergencies. It is important for protocols to be in place in the event of a tularemia bioterrorist attack so that healthcare providers can effectively utilize scarce resources available to protect the most lives.

Space

Healthcare centers must have enough space to triage and treat patients, in the event of a surge, space will be limited. There is a fixed number of beds in hospital settings, there are few additional beds that can be placed in unconventional spaces, however the square footage of the hospital itself does not expand. The triage-system used during a tularemia bioterrorist attack should reflect the concept that those with the most severe cases, that can benefit from staying in the hospital should be treated at the hospital, while those with less severe cases should be given treatment to be taken at home (Reilly & Markenson, 2011). This triage system frees up beds for the most severe cases, and allows for medical staff to focus on a fewer number of patients, and the hospital itself to be less crowded. This only makes sense if there is enough medication to treat
those severe cases. if there is not enough medication for individuals staying the hospital beds they may just receive palliative care. This triage system embodies the two main components that are important for dealing with a large unexpected influx of patients: rapid patient discharge and increasing inpatient bed capacity (Reilly & Markenson, 2011).

Staff

Staff during an epidemic will be stressed and stretched thin and can be easily overwhelmed by a surge of patients. In some instances, such as the severe acute respiratory syndrome (SARS) epidemic, healthcare workers chose not to report to duty out of concern for their own health as well as the health of their families (Ruderman et al., 2006). Because tularemia transmission person-to-person has not been documented, this fear should be alleviated from the minds of healthcare workers. However, it is still important for the healthcare worker staff to be supported so that individuals continue to carry out their duties. There should be measures in place to support the family of responders and healthcare workers who are primary caregivers, so that these individuals do not feel as though they are leaving their loved ones unprotected while they respond to the emergency (Agency for Health Care Research and Quality, 2005). Reciprocity and duty to care are both substantive values that support this aspect of allocation of resources. Without reciprocity to support and strengthen health care workers’ duty to care, it is possible that some healthcare workers will not respond to a tularemia bioterrorist attack if they do not feel as though the benefit outweighs the risk. Even if hospitals were fully staffed, a surge of patients resulting from an emergency can still be overwhelmed. If some healthcare workers to do not respond to the call of duty, hospitals can be left severely understaffed and unprepared to handle a large surge of patients.
In order to accommodate a surge of patients it will be important to have adequate staff numbers. It is recommended that hospitals and emergency departments should contact medically skilled personnel such as retired hospital staff, medical university staff and students and volunteers to fulfill specific roles (World Health Organization, 2014). In the instance that a specific location or city is affected by a tularemia bioterrorist attack, the state should temporarily modify certification and licensing requirements so that licensed practitioners from surrounding states can be utilized and aid in increasing the surge capacity of hospitals’ in the affected areas (Agency for Health Care Research and Quality, 2005). Additionally, individuals who typically serve in a nonemergency capacity should be brought into the areas of high need, as long as their skill set matches the need (Agency for Health Care Research and Quality, 2005). It is important to make sure that individuals are assigned to roles in which they are capable and licensed to fulfill. If volunteers are recruited they must be credentialed and the recruiting agency must have liability protection (World Health Organization, 2014). Bringing in more staff to an area of need will allow the staff of the impacted area to not become overwhelmed and allow for a more favorable staff to patient ratio.

Healthcare workers should be able to identify individuals with tularemia due to a bioterrorist attack without the aid of bioterrorism agent specific diagnostic tools. It might not be possible for a laboratory confirmation of the disease so healthcare workers will have to identify epidemiologic features to determine whether or not a patient’s illness is the result of an endemic disease or an unexpected concerning situation (Association for Professionals in Infectino Control and Epidemiology Bioterrorism Task Force, 1999). The most important epidemiologic feature is any patient that arrives with a combination of signs and symptoms specific to tularemia because
tularemia does not naturally occur in high incidences in the United States (Association for Professionals in Infection Control and Epidemiology Bioterrorism Task Force, 1999).

**Supplies**

Supplies are usually limited during an epidemic; hospitals have limited budgets. Hospitals do not usually keep a surplus of medical supplies in order to minimize financial losses, due to the theoretical ideal that large scale epidemics do not occur too frequently (Reilly & Markenson, 2011). Some hospitals rely, almost solely, on the financial aid of federal, state, and local resources, however these resources do not arrive quickly enough in the case of emergencies (Reilly & Markenson, 2011). Even when hospitals have secure resource suppliers, these resource suppliers might be contributing to multiple hospitals in the area, and might become overwhelmed in the event of a surge to multiple hospitals (Reilly & Markenson, 2011). During a tularemia bioterrorist attack it is estimated that 50kg of aerosolized *F.*tularensis in a city of 5 million inhabitants would result in approximately 19,000 deaths and 25,000 total casualties (Dennis et al., 2001). The two medications that are used for the treatment of tularemia patients, streptomycin and gentamicin, are only stored in quantities that are adequate to meet the daily needs of a hospital (Alias, Fallahzadeh, & Berhe, 2017). These stores do not include the amount necessary to handle a tularemia epidemic, when there are 25,000 individuals who need streptomycin and gentamicin in addition to individuals who might need the medication for other reasons.

In the event of a surge, the typical hospital stores will not meet the needs of the large influx of patients. Healthcare providers will need to accurately triage incoming patients to determine which individuals will receive immediate treatment and which individuals will need to wait until medical stores are restocked (antibiotic medication takes time to produce). Guidelines
for dealing with epidemics like influenza, which is transmitted person to person, advise that healthcare workers should be made a priority to receive vaccines and treatments, because they have the skills and capacity to aid in the management of the epidemic (University of Toronto, 2005). The North Carolina Institute of Medicine/Department of Public Health Task Force identified three goals for the allocation of resources during an influenza pandemic: (1) preserve the lives of healthcare workers critical to the management of the situation (2) prevent the spread of disease (3) treat people who would benefit from the treatment (Tong, 2008).

In the event of a tularemia bioterrorist attack the first priority would still be to preserve the most number of lives. The first priority during a tularemia bioterrorist event would be to treat individuals that can benefit from treatment. Tularemia is different from influenza, in that, tularemia has not been recorded to be transmitted from person to person, and there is no vaccine for the disease, so preventing the spread of disease would not be as large a concern or priority when allocating resources. In regards to treating healthcare workers first, it is important to take into account recovery time; if treatment does not allow for healthcare workers to return to work when they are needed it is not completely justifiable to treat them first (White, Katz, Luce, & Lo, 2009). The whole argument for treating healthcare workers first is based on the concept that their skills will allow them to treat others, if treatment and recovery time will not let them do that, it does not make sense to put them before others. Completion of tularemia treatment can take 10-21 days, the severity of the illness can cause a longer treatment time (treatment involves taking an antibiotic) (Centers for Disease Control and Prevention, 2015a). If the healthcare worker has a less severe case of tularemia that would allow them to care for others during the time of their treatment, they should be prioritized. This is only possible because the transmission ability of tularemia person-to-person has not been confirmed. However, healthcare workers that have a
more severe case of the disease that requires more medication and treatment time should not be prioritized.

Overall, individuals that would need to be treated with the greatest urgency would be those who are the least ill, the ones that will respond best to treatment. There is a better chance that the individual who is less ill will respond better to tularemia treatments. It is important that limited resources are used efficiently. Individuals who have a more severe reaction to the aerosolized *F. tularensis* might require a higher dose of streptomycin, but this larger dose is better used to save multiple people rather than just one individual.

In terms of treating patients there should be a multi-principle approach. There are two principles that are typically used in triage, one that is based on an individual’s years of life, and the life cycle principle. These two principles would be employed under the overarching umbrella of “saving the most lives possible” concept. The maximizing life-years principle dictates that those who will go on to live more years post-treatment should be treated first, this works in conjunction with the concept of who will benefit more from treatment (White et al., 2009). The life cycle principle takes into account which stage of life someone is in, under the ideal that everyone should be able to live through most stages of life (White et al., 2009). The life stages principle would guide healthcare workers to prioritize treatment of children and younger adults over the elderly. White et al., (2009) suggests that patients should be scored on each “principle”, meaning that an individual would receive a numerical score for maximizing life years, life cycle and benefit from treatment. The scoring system would be on a 4-point scale, and individuals with the lowest total score would get the highest priority of treatment because based on this system, they would have the greatest benefit from getting treated (White et al., 2009). Individuals that would receive the greatest benefit from treatment would go onto live a longer life and are
currently in a younger stage of life should be priorities for receiving treatment during a tularemia bioterrorist attack. Utilizing a simple system like so would allow for treatment centers to save the most lives possible, by not employing complex time-consuming systems. In order to effectively execute this system, the healthcare worker fulfilling the triage duty would need to be experienced and knowledgeable enough to quickly assess a large number of patients in a short amount of time.

After the initial attack it will be important for all individuals in the area to report to equipped medical facilities in order to confirm a tularemia diagnosis before treatment. It is important to treat the most ill and establish treatment centers in areas with the highest rates of infection to treat the greatest number of people possible (World Health Organization, 2016). Placing treatment centers in the area of most need satisfies the ideal of saving the most lives possible.

Special Equipment

In the event of naturally occurring tularemia, diagnostic tools utilized in a laboratory, are typically not utilized until 1-2 weeks after an individual develops symptoms (Celebi, Kilic, Yesilyurt, & Acar, 2014). Other tools and methods that are used are culture and serology, however both have limitations, and in the event of a tularemia bioterrorist attack the tools used must be quick and accurate (Celebi et al., 2014). Public health workers and health care workers cannot spend a great amount of time diagnosing individuals; diagnostic tools must be quick enough so that patients can receive care as quickly as possible, and should be accurate, so that treatment is not given to individuals who are not infected. A new Toolbox, containing various instruments, equipment, and solutions necessary to effectively identify tularemia and other bioterrorism agents in the field (Celebi et al., 2014). This Toolbox has proven to be accurate and
is easily used in remote areas (Celebi et al., 2014). In the case of an emergency it is not feasible to wait for laboratory confirmation or other diagnostic tools that might take hours (Association for Professionals in Infection Control and Epidemiology Bioterrorism Task Force, 1999). Healthcare workers will be responsible for identifying individuals who have been infected by a tularemia bioterrorist attack.

**Reciprocity and Solidarity**

Reciprocity is a value that heavily ties into allocation of care, especially to staff resources. During public health emergencies, healthcare workers and first responders are called upon to protect the health of the public, in the process these individuals might make personal sacrifices. Reciprocity is supporting those who are disproportionately affected by a tularemia bioterrorist attack in terms of putting their lives in danger to help others, such as healthcare workers and first responders (Thompson et al., 2006). This support is supposed to come from society as a whole. Reciprocity is, supporting healthcare workers by encouraging health care workers from the surrounding area to help in a large public health emergency affecting one area (Tong, 2008). Solidarity is another substantive value that works with reciprocity, it employs the idea that if one area is affected by a public health emergency the rest of the state or nation should stand with the area. Surrounding areas of an impacted area or city, should give financial aid, in transport and accommodation, and possibly address the staff issues of the affected areas. Typically, non-impacted areas aid other areas with the main motivation of preventing the spread of disease to their area, but in the case of tularemia the disease would not spread. However, under the Public Health Emergency Declaration, published by the United States Department of Health & Human Services, the Secretary can give the Governor of the affected area, the power to reassign state and local public health department during the emergency (2017).
Health equity is a substantive value that encompasses the ideal that everyone should have equal opportunity to receive care, but this is hard to achieve even under normal circumstances. In the United States there are health inequities, which can become amplified during a public health emergency. It is important that these inequities are addressed through measures that are specific to a public health emergency in order to make sure that everyone who needs care has an equal opportunity to receive care, that does not necessarily mean that they will all receive it.

Contributors to health inequities during an infectious disease public health emergency include: differential exposure, differential susceptibility and differential access to health care (Quinn, Kumar & Kumar, 2014). Differential exposure depicts individuals who live in low-income areas with high rates of crowding and lack of access to clean water and sanitation (Quinn et al., 2014). Differential exposure is tied to differential susceptibility in that, low-income individuals have greater psychological stress, impaired immune function leaving them more susceptible to diseases (Quinn et al., 2014). And the highly pathogenic bacteria, F. tularensis, would have a greater impact on an individual with a weaker immune system than a healthy individual. Lastly, differential access to health care is characterized by the following behaviors such as delaying medical care (Quinn et al., 2014). Additionally, some individuals may only have access to healthcare facilities that are of lower quality, or healthcare facilities that do not offer the medication necessary to treat tularemia (Quinn et al., 2014).

Health equity encompasses the principle of equal access to health care which states, “…every person who shares the same type and degree of health need must be given an equally effective chance of receiving appropriate treatment of equal quality so long as that treatment is available to everyone” (Gutmann, 1999, 256). In order to address health inequity during a public health emergency, measures specific to an infectious disease public health emergency are necessary.
health emergency, risk communication must be done effectively and tularemia treatment centers should be set up in areas of high incidence and close enough to people who would not have access to treatment without the pop-up centers. Assuming that the bioterrorist attack impacted a specific area or city, other healthcare workers from around the country would be recruited to help at these tularemia treatment centers. However, it is likely that despite the measures taken, health inequity will not be adequately addressed as a whole, during a public health emergency. So, it is important that for this specific document to justify why health equity might not be possible in the context of a tularemia bioterrorist attack, this means decisions regarding allocation of care should be transparent and allow for public engagement. Although, validating every individual’s claim to healthcare might not be possible, it is still important to use the least restrictive means and protect the individual liberties and rights of the public as best as possible, without jeopardizing the public’s health.

*Informational Privacy*

The United States’ Constitution does not explicitly cover the individual right to privacy, however the Supreme Court has stated that the combination of several amendments such as the Fourth Amendment, cover the right to privacy (American Civil Liberties Union, n.d.). But because the right to privacy is not explicitly stated and even then it appears to just be referencing privacy in general, it does not fully or effectively address privacy in the context of today’s technology. Despite not explicitly having a right to privacy in the age of technology, there are laws that have been enacted to protect certain information.

Modern day technology allows for quick dissemination of information. The dissemination of health-related information across different departments, agencies and healthcare facilities is important during a public health emergency such as a tularemia bioterrorist attack.
Various types of data, such as surveillance, epidemiological and laboratory, are necessary for the effectiveness of public health measures (O’Connor & Matthews, 2011). Data is used to identify epidemics and guide the decision making process to manage and respond to outbreaks (O’Connor & Matthews, 2011). This health-related data must be transmitted quickly to speed up public health responses or interventions, which is possible with the electronic capacity available. However, this means health-related data may contain personal identifiers that an individual might not want disseminated to various organizations. Although syndromic surveillance can use data without personal health identifiers, in the case of a bioterrorist attack, some identifiers may be necessary to identify the location of the source (Association of State and Territorial Health Officials, 2012).

In the Privacy Act of 1974, Congress determined that the misuse of information systems can endanger a person’s right to employment and due process; additionally, the right to privacy is fundamental and is protected under the Constitution (Pozgar, 2016). However, this protection is not explicit, it is assumed under multiple statements in the Constitution and does not mention technological privacy. So public health authorities must be clear with the public regarding what information is being shared and that individuals’ privacy is not being trampled.

There are various federal statues in place that protect an individual’s health-related information by limiting the dissemination of this information. The Freedom of Information Act, the Privacy Act of 1974, and the Federal Drug and Alcohol Confidentiality provisions are some of the statues in place regarding the protection of health-related information (O’Connor & Matthews, 2011). The HIPPA Privacy Rule moves to protect individual’s privacy by stating that organizations can de-identify individuals by removing 18 personal health identifiers, as long as the remaining information is not known and can result in the identification of an individual
The 18 personal health identifiers include: name, address (smaller than state), dates (birthdate, admission date, discharge date, date of death, and exact age if over 89), telephone number, fax number, email address, social security number, medical record number, health plan beneficiary number, account number, certificate or license number, vehicle serial number, web URL, Internet Protocol (IP) Address, finger or voice print, photographic image, and any other uniquely identifying characteristic (Duke University School of Medicine, n.d.).

However, in the case of public health emergency, individuals’ right to privacy might be disregarded. Information such as address and medical records are vital to determining the possible location of a tularemia bioterrorist attack. If multiple individuals arrive at a hospital and appear to live in the same area and all have typically been healthy, healthcare workers might be able to identify a pattern and more information regarding the possible attack. In the case of public health emergencies there are exemptions to the HIPAA rule to retrieve certain identifying data. There are several exemptions in the HIPPA rule that allow personal health identifying information to be given to public health agencies without patient authorization. The exemptions include: (1) treatment of the patient, or payment for treatment, (2) family and friends, when the patient cannot consent, (3) prevent a threat to health or safety of both the individual and the public, (4) protection of national security, (5) law enforcement, if the situation meets a certain criteria and (6) for administrative or judicial processes (Association of State and Territorial Health Officials, n.d.). In order for these exemptions to take place, public health organizations must provide proof. Unless the tularemia bioterrorist attack location is identified before individuals seek treatment at healthcare facilities, public health organizations will have to invoke these HIPAA exemptions in order to investigate the possible source or location of the attack.
This data should stay confidential amongst the public health organizations and should under no circumstances be released to the public without the consent of the individual because tularemia is not transmitted person-to-person, it is not necessary to identify a case zero or contact points.

Summary of Tularemia Bioterrorist Attack Altered Standards of Care

In the event of a tularemia bioterrorist attack in the United States, there must be altered standards of care to adequately manage the situation. In this proposed altered standards of care, the main issues that are addressed are allocation of resources, leadership during the emergency, and the dissemination of health information. These issues are interwoven with the substantive values of stewardship, health equity, reciprocity, trust, transparency, solidarity, and privacy. This proposed altered standards of care should act as a guideline for response as well as a spring board for discussion. The public should be engaged in public health decisions, such as the ones that are outlined in the proposed altered standards of care, because they will be directly impacted by the decisions. Allowing the public to voice their opinion would allow for the decision making to be fair, gain the public’s trust and ultimately gain a buy in to the proposed altered standards of care.

Conclusion

Health security is a broad field that seeks to protect the health of individuals by preventing the spread of infectious diseases and other health threats. Global health security is the primary defense against potential bioweapons, bioterrorist attacks, and biowarfare. Measures of all health security include policies, surveillance systems, and response protocols. The continual scientific advancements require health security programs to be updated at the same rate to maintain effectiveness. There are laws within the United States and around the world that ban the production, stockpiling, and transportation of specific biological agents as a means of defense.
Surveillance systems in place are used to track potential outbreaks of diseases or intentional releases of specific biological agents. Protection and response measures to biological attacks or infectious disease outbreaks are the last line of defense regarding global health security. Research is done on various potential biological weapons such as tularemia to develop effective global health security measures specific to tularemia. It is important to use any and all quality data collected regarding tularemia in order to update and revise altered standards of care in the event of a tularemia bioterrorist attack.

Tularemia is an infectious bacterial disease that had the potential to be aerosolized and used in a bioterrorist attack. This condition is highly infectious, only requiring ten organisms to infect a human being (Dennis et al., 2014). No vaccine is currently available for the prevention of tularemia; the current suggested prevention methods would be rendered ineffective during a bioterrorist attack. If tularemia is left untreated, pneumonic tularemia specifically, it can result in a case fatality rate range of 30-60% (Ulu-Kilic & Doganay, 2014). Researchers continue to work towards creating an effective tularemia vaccine. However, global health programs within the United States do not receive as much funding as other government-funded programs, and only a portion of the funding is allocated for protecting the nation's people from infectious diseases.

The United States’ relies upon global health security surveillance, preparedness objectives and response plans in the case of a bioterrorist attack. However, these types of defense measures are relatively untested, and there have been severe criticisms of global health surveillance networks in general after the most recent Ebola outbreak, so responsible action guidelines are valuable. But, United States lacks a specific altered standards of care guidelines for tularemia, which would be critical during a tularemia bioterrorist attack. With the prominent threat of weaponized infectious diseases, it is crucial that the United States needs to improve its
commitment to continually updating its global health security framework to match the continuously changing environment of the world. The proposed altered standards of care provide pre-emptively made decisions that are based on ethical grounds, allowing those responding to the tularemia bioterrorist attack, and those affected by the attack to have an understanding of the actions that will take place in the management of the emergency. This type of emergency preparedness can have a large impact on the way that the nation and its states respond to emergencies; it can help preserve more lives, while effectively utilizing resources and will allow the government to retain the trust of the public.
References


American Civil Liberties Union. (n.d.). *Students: Your right to privacy*. Retrieved from https://www.aclu.org/other/students-your-right-privacy


University of Toronto Joint Centre for Bioethics. (2005). *Stand on guard for thee: ethical considerations in preparedness planning for pandemic influenza*. Toronto, Ontario: University of Toronto


