"Biological warfare attacks have often been dismissed as science fiction or as so immoral to be beyond imagination (1)." However, both historical and recent events have shown otherwise. This paper will define bioterrorism and discuss its history. It will also address the ethical and moral parameters concerning bioterrorism. Furthermore, the role of a pharmacist in tackling this issue will be highlighted.

Bioterrorism refers to the intentional release of toxic biological agents to inflict harm and terrorize civilians, in the name of a political or other cause (2). According to the U.S. Centers for Disease Control and Prevention (CDC), a bioterrorism attack can be defined as the deliberate release of viruses, bacteria, or other germs to cause illness or death in people, animals, or plants (2). These agents are typically found in nature; however, they are often manipulated to increase their ability to cause disease, or to make them resistant to current medicines, or to amplify their effects to cause diffuse and widespread disease (2).

Bioterrorist attacks are carried out for the same purposes of war. Some of these reasons include religion, territorial gain, imperialism, racism, revenge, nationalism and the gain of resources (3). Bioterrorist attacks can be extremely difficult to detect and do not cause illness for several hours to several days (2). Also, these agents are relatively inexpensive to manufacture and may cause widespread harm and torture (2), (25). For these reasons, these deliberate attacks are performed in conjunction with conventional methods of war.

Delivery of these agents to the targeted population can occur via several means. Biological agents can be spread by air, water, or food (2). Also, some substances can be sent by mail, such as anthrax, or by much more sophisticated methods such as applying a toxic agent onto the warhead of a missile. Some bioterrorism agents, like the smallpox virus, can be spread from person to person and some, like anthrax, cannot (2). Other plausible methods of delivery include introducing a substance to a water supply or through air dispersal in the form of gas (4). Bioterrorism agents can be separated into three categories: A, B and C. Classification of agents into these categories depends on how easily they can be spread and the severity of illness or death they cause. Category A agents are considered the highest risk and Category C agents are those that are considered emerging threats for disease (2).

Biological attacks from terrorist groups pose a serious risk to both civilians and members of the armed forces. In other words, these attacks can generate fear, inflict pain and cause death not only to the military, but, also to the vulnerable public (5). Bioweapon attacks against the civilian populations may result in a greater magnitude of causalities and losses. This is due to the fact that civilian populations consist of the very young and the very old. Furthermore, the general population entails people of varying states of health. Moreover, military personnel are prophylactically vaccinated whereas unexpected civilian attacks will require rapid diagnosis and antimicrobial treatments wherever appropriate and available (5). Both, military members and ordinary civilians can be targeted with toxic biological agents by terrorist organizations.
To most people, it is clear that the endangerment of human life is wrong especially when the weak and vulnerable are targeted. However, stopping such activity is becoming increasingly difficult with the continued development of chemical and biological weaponry. In developing countries, where medical information and technology is lagging, a targeted bioterrorist attack may lead to detrimental effects since it may take a long time may lapse before realization that an attack has occurred. This may lead to the spread of the disease to other countries since many people may travel abroad and come home without realizing they are infected. Thus, all countries must take cautious and preventative measures in order to minimize potential harm (5). As outlined later in this paper, pharmacists play a critical role in this area.

HISTORY OF BIOTERRORISM

Biological warfare has occurred throughout history and dates as far back as the 6th century BC (6). Bioterrorism dates back to ancient Roman civilization, where dead and rotting animals were thrown into wells to poison water supplies in order to destroy enemy forces (7). The bioterrorism history of three category A agents, anthrax, small pox and botulinum toxin will be discussed below. The September 1984, Salmonella bioterrorist attack on US soil will also be described.

ANTHRAX

Anthrax is a very harmful disease caused by Bacillus anthracis, a microbe that thrives in soil (8). In 1970, the World Health Organization estimated that 50 kg of B anthracis released over an urban population of 5 million would sicken 250,000 people and kill 100,000 (28). It was also estimated that the release of 100 kg would yield the same effect of a hydrogen bomb (8).

It has been suspected that anthrax has been researched as a potentially harmful biological agent since the early 1930s by the Japanese, in a research project titled Unit 731 (9). During this research, Japan used people from Manchuria, northeast China, as an "endless supply of human experiment materials" (9). These human experiments were considered prisoners of war. One thousand of these Chinese subjects were exposed to aerosolized anthrax. It is estimated, up to 3,000 more prisoners and Chinese nationals may have died in this facility (9).

In late April of 1979, an outbreak of pulmonary anthrax occurred in Sverdlovsk, in the former Soviet Union. The final death toll was estimated between 200 and 1,000 (9). It was discovered that the cause of these deaths was due to the release of aerosolized anthrax from the Soviet Military bioweapons facility. The death toll in animals living in the area was even greater (9).

Anthrax became especially notorious after the 2001 bioterrorism attacks in the US. In these attacks, anthrax was purposely spread through U.S. mail. This resulted in the death of five people and left twenty two sick (10).
SMALL POX

Smallpox is caused by the variola virus and has killed more people throughout history than any other infectious disease (11). This virus was responsible for the death of many people throughout the world, including Africans, Chinese and Europeans. In the 15th century, Pizarro, a Spanish conquistador (soldier leader), reportedly infected the clothing that was headed for South American natives with the smallpox virus in order to spread the disease (9).

Another incident occurred during the French-Indian War. In this war, the British gave the contaminated blankets used by smallpox victims to the Native Americans and this resulted in the rage of smallpox throughout the Native American community (9).

In 1864, during the US Civil War, Dr. Blackburn, a physician and philanthropist that served as the Governor of Kentucky from 1879 to 1883, was involved in a bioterrorism attack (13). This physician sailed to the Caribbean islands and to southern states in order to treat yellow fever and smallpox (9). He arranged for the contaminated clothing used by his patients to be imported to the Northern cities, believing that these diseases could be introduced into the area this way (13).

Fortunately Edward Jenner, developed a vaccine that was used to prevent smallpox and treat the disease in its early stages (12). In 1967, the World Health Organization started a world wide campaign to eradicate smallpox by mass vaccination methods (29). However, in 1972, the US stopped vaccinating the general population, which currently leaves many people in the US vulnerable to an attack by this virus (14). Also, in late 2001, the governments of United States and United Kingdom considered stockpiling smallpox vaccines, even while assuring the public that there was no "specific or credible" threat of bioterrorism (24).

BOTULINUM TOXIN

Botulinum toxin is a very deadly toxin that is produced by the bacterium Clostridium Botulinum. Botulinum causes death by respiratory failure and paralysis (15). It is estimated that one gram of botulinum toxin could result in the death of more than one million people (16). Botulinum toxin could be used to contaminate food supplies, or employed in an aerosolized form to contaminate the air (16).

During the Gulf War, Iraq produced 20,000 L of botulinum toxin, using 12,000 L for field-testing and to fill warheads. Furthermore, scientists of both Japan and the former Soviet Union experimented with Botulinum toxin (16).

SALMONELLA

The most notorious and successful bioterrorist attack in the US is the attack of September 1984. Salad bars in The Dalles, Oregon were contaminated with Salmonella Typhimurium by followers of the Indian mystic and spiritual teacher, Bhagwan Shree Rajneesh (9) (30). This act was performed to influence future elections polls in the area.
Unfortunately, this bioterrorist attack resulted in over 750 salmonella cased gastroenteritis cases in the area (9).

ETHICS AND BIOTERRORISM

As illustrated above, throughout history, bioterrorist attacks have caused many casualties. In order to prevent bioterrorism from reoccurring, it has been noted that ethics can serve as a weapons to counter bioterrorism (17). The code of ethics concerning the misuse of scientific information and the ethics principles nonmaleficence and beneficence will be discussed. Also, bioterrorism from a religious viewpoint will be outlined below.

MISUSE OF SCIENTIFIC INFORMATION

The misuse of scientific information plays a key role in the development and utilization of toxic biological agents since acquiring and using biological substances would require terrorists to have particular knowledge and skills in order to carry out their intentions. For example, instead of researching the pathophysiology and characteristics of the infectious Salmonella agent in order to develop a cure, some terrorists, utilize this information to find more sophisticated ways to spread the disease. In other words, instead of conducting research for the advancement of scientific information, research may be conducted for the advancement of military power. Moreover, since the anthrax events following September 11, 2001, there has been much debate concerning what research should and should not be conducted and what information should and should not be disseminated in the open literature. Thus, a code of ethics was established by Margaret Somerville and Ronald Atlas to prevent the misuse of scientific information (Figure one) (17).

Although all research institutions have agreed with the code of ethics, there have been many problems with implementing the code (17). Some of these problems include: the code may be ineffective, it may hinder the advancement of scientific knowledge, and the scientists that must learn about the code are highly ethical individuals meaning that the code is targeting the wrong individuals (17). It was also indicated that teaching about this code of ethics may be a financial burden to some institutions (17).
CODE OF ETHICS FOR THE LIFE SCIENCES

All persons and institutions engaged in any aspect of the life sciences must

1. **Work to ensure that their discoveries and knowledge do no harm**

   (i) by refusing to engage in any research that is intended to facilitate or that has a high probability of being used to facilitate bioterrorism or biowarfare; and

   (ii) by never knowingly or recklessly contributing to development, production, or acquisition of microbial or other biological agents or toxins, whatever their origin or method of production, of types or in quantities that cannot be justified on the basis that they are necessary for prophylactic, protective, therapeutic, or other peaceful purposes.

2. **Work for ethical and beneficent advancement, development, and use of scientific knowledge.**

3. **Call to the attention of the public, or appropriate authorities, activities (including unethical research) that there are reasonable grounds to believe are likely to contribute to bioterrorism or biowarfare.**

4. **Seek to allow access to biological agents that could be used as biological weapons only to individuals for whom there are reasonable grounds to believe that they will not misuse them.**

5. **Seek to restrict dissemination of dual-use information and knowledge to those who need to know in cases where there are reasonable grounds to believe that the information or knowledge could be readily misused through bioterrorism or biowarfare.**

6. **Subject research activities to ethics and safety reviews and monitoring to ensure that**

   (i) legitimate benefits are being sought and that they outweigh the risks and harms; and

   (ii) involvement of human or animal subjects is ethical and essential for carrying out highly important research.

7. **Abide by laws and regulations that apply to the conduct of science unless to do so would be unethical and recognize a responsibility to work through societal institutions to change laws and regulations that conflict with ethics.**

8. **Recognize, without penalty, all persons' rights of conscientious objection to participation in research that they consider ethically or morally objectionable.**

9. **Faithfully transmit this code and the ethical principles**

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Figure One: Code of Ethics by Margaret Somerville and Ronald Atlas (17)
Without teaching and implementing this code of ethics to biology scientists and to healthcare professionals, “dual use” of scientific information could result (18). The dual use dilemma results when information published by researchers can be employed for the advancement of life sciences and medicine or can be potentially misused to plot a bioterrorist attack (18). Ultimately, the question raised is, is it ethical to hinder the publication of scientific information that could possibly be misused, even if this information could result in the advancement of medicine and science?

The answer to this question is contentious topic of debate since scientific research and technological progress over “the last decades has changed the face of our civilization, creating new opportunities for improving people’s lives and also bringing new risks and problems. The emergence of the bioterrorism threat reflects this process (31)”.

NONMALEFICENCE & BENEFICIENCE

Nonmaleficence and Beneficence are two ethical principles concerning bioterrorism. Nonmaleficence describes the principle of not doing harm to patients. Thus, scientist, physicians, pharmacists and others conducting biological research must not utilize any of the gained information to deliberately cause harm. When any of these personnel are involved in bioterrorist attacks, they have violated this ethical principle since they are purposely causing harm to others. Therefore, healthcare professionals must keep in mind the Hippocratic Oath, the promise they have with society: first do no harm.

Beneficence describes the ethical principle of doing good and avoiding evil (19). Scientists and healthcare professionals dealing with biological research, abide by this rule when their careers are devoted to help patients and to the advancement of scientific knowledge and abstain from wrong doing. When bioterrorist attacks are carried out, this principle is violated, since these personnel are not utilizing the obtained information to promote health and avoid evil.

RELIGION

Many religions are against bioterrorism because they have high respect for human life. Below, bioterrorism and Catholicism, Islam and Hinduism will be discussed.

CATHOLICISM AND BIOTERRORISM

From the Catechism of the Catholic Church, "Human life is sacred because from its beginning it involves the creative action... God alone is the Lord of life from its beginning until its end. No one can under any circumstances claim for himself the right directly to destroy an innocent human being (20)." From this quote, it can be deduced that the killing of innocent human beings unacceptable. In other words, Catholicism stands against the employment of toxic biologic agents for the killing of innocent civilians.

Another quote from the Catechism of the Catholic Church that further illustrates the peace promoted by the Catholic religion is as follows: “the Lord recalls the commandment; you shall not kill, and adds to it the proscription of anger, hatred, and vengeance. Going
further, Christ asks his disciples to turn the other cheek, to love their enemies. He did not defend himself and told Peter to leave his sword in its sheath (20).” From this quote, it can be concluded that Catholicism prohibits the killing of the innocent and the enemies even for anger, hatred and revenge which are some of the reasons bioterrorist attacks are carried out. Furthermore, this religion promotes peace even towards enemies which is the opposite of what occurs when bioterrorist attacks are performed.

From these two quotes, it can be verified that the Catholic religion does not promote the use of toxic biological agents to cause harm to human beings.

**ISLAM & BIOTERRORISM**

The word Islam is comes from the Arabic word “salam” that means peace. Throughout the Qur'an Allah (SWT), promotes peace and harmony.

Allah has said in the Qur'an that He does not love those who create trouble in the Earth. (16:90, 9:111) (21). Almighty Allah states in the Qur'an [...Whoso slays a soul not to retaliate for a soul killed, nor for corruption done in the land, should be as if he had killed mankind altogether and if any one saved a life, it would be as if he saved the life of all mankind]. (5:32) (21). This verse means that if one innocent person is killed, the magnitude of the punishment on the Day of Judgment is equivalent to a person who has killed all of mankind. The reverse is also true; a person that saves a single life is rewarded on the Day of Judgment with the same reward as a person who has saved all of mankind. Islam also is against the killing of women, children, the elderly and the wounded. Since the purpose of bioterrorist attacks are to cause widespread harm, including to the innocent and the weak, Islam is against bioterrorism.

Furthermore, Islam grants rights to prisoners of war. These prisoners cannot be killed. In addition, they must be treated with respect, fed and clothed properly. Thus, these prisoners cannot be used as a human supply for research and torture with toxic biologic agents. Prophet Muhammad (peace be upon him) demonstrated the hospitality that the prisoners of war should be treated with when he removed his own shirt so a war prisoner could be clothed.

As demonstrated above, Islam is against the employment of biowarfare to cause death and harm to innocent individuals. Islam does not permit the use of biological weapons on prisoners of war. Instead, Islam promotes peace.

**HINDUISM AND BIOTERRORISM**

According to Nine Beliefs of Hinduism, published by the Himalayan Academy of San Francisco: "Hindus believe that all life is sacred, to be loved and revered, and therefore practice ahimsa or nonviolence (22)." Thus, all life is considered sacred because all creatures are manifestations of the Supreme Being (22).

Like most religions, Hinduism condemns violence and war and includes teachings that promote it, such as in the case of self defense. However, the conduct of war, as a set of rules is explicitly outlined in the Rig Veda (23). These rules include:
• do not poison the tip of your arrow
• do not attack the sick or old
• do not attack a child or a woman

From these rules, it can be deduced that Hinduism is against bioterrorism. This is due to the fact that Hinduism forbids the poisoning of the tip of weaponry which is a common practice employed by bioterrorists. Also, attacks on the sick, the old, the women and the children are frowned upon in this religion. Since bioterrorist attacks, often times, target civilians which include these populations, it can be concluded that Hinduism forbids bioterrorism.

THE ROLE OF PHARMACISTS

With the growth of scientific information in the area of microbiology and genomic engineering, bioterrorism attacks may become even more catastrophic. Thus, a biological attack will demand a coordinated, immediate response. Currently, pharmacists are involved in emergency planning committees. These committees are determining the roles of a pharmacist in preventing attacks as well as during the event of an attack. In fact, state and federal authorities in the USA have recognized pharmacists as vital personnel in the event of an attack. Pharmacists will serve many roles: response integration, patient management, pharmaceutical supplies distribution, policy coordination, education, finding alternative medication plans and in the administration of vaccines (25) (26).

RESPONSE INTEGRATION

All pharmacists, especially health system pharmacists, will be part of the medical response team which will include a variety of different healthcare personnel. Thus, pharmacists will be involved in medical response operations during an attack (25). The pharmacists will serve as resourceful drug experts that physicians and nurses can rely on. Pharmacists will also ensure proper deployment of pharmaceuticals to those in order of need. Pharmacists must make certain they are well informed on bioterrorism topics (25). Moreover, pharmacists must develop and maintain first aid and CRP skills so they may participate in the initial steps of helping patients along with physicians and nurses (25). They will also assist in patient triage and counseling along with other healthcare professionals. As shown, pharmacist will serve as an integrated part of the medical response team.

THERAPY MANAGEMENT

Optimal medication therapy management will be essential to help those infected and those vulnerable to infection. In the event of an attack, pharmacists will be expected to be able to choose the most efficacious and safest treatment. This is vital, since these toxic biologic agents may be manipulated to become resistant to the current indicated treatment. In other words, the “monitoring of susceptibility patterns and therapy progression is critical in achieving a positive outcome, especially during a bioterrorism attack, when wasted time and mistakes in therapy selection may quickly lead to fatalities” (25). As shown, pharmacists may serve as an indispensible resource for selecting the appropriate therapy during an attack.
PHARMACEUTICAL SUPPLIES

In case of a bioterrorist attack, pharmacists have a role in the selection of appropriate therapies for stockpile in civilian and federal sectors (25). Pharmacists will be responsible for maintaining an effective system of medication distribution making certain patients have access to medications in order of need. Pharmacists will be responsible for compiling specific, accurate and complete therapeutic and patient records (25). As shown above, pharmacists play an essential role in dealing with pharmaceutical supplies during a bioterrorist attack.

POLICY COORDINATION

Pharmacists play a key role in developing and coordinating emergency response guidelines and algorithms (25). In this role, pharmacists must make certain to avoid unnecessary duplicated medication stockpiles, repeated diagnostic steps that may result in wasted time and resources (25). Pharmacists must educate other pharmacists and healthcare professional concerning the coordinated protocols in the event of a bioterrorism attack. In other words, they should take action to make sure that the step-by-step protocol is available to all pharmacists and health professionals in case of an attack.

DETECTION OF ATTACKS

Pharmacists in the community setting are responsible for the detection of an increase in antibiotic prescriptions in the event of a bioterrorist attack (26). Many studies have been carried out to demonstrate the change in the dispensing pattern of Ciprofloxacin during the 2001 anthrax attacks in the US (26). In the event of a similar attack trained pharmacist, will be able to recognize these changes and notify government agencies of the possible attack. It is not uncommon for pharmacists to realize unusual dispensing patterns. It was noted that a pharmacist in the Midwest noted an unusual sale of Pepto Bismol, upon further investigation it was found that the surrounding community had water quality issues with its drinking water (32). As shown, pharmacists may serve a role in detecting bioterrorist attacks.

EDUCATION

Since pharmacists are the most readily available healthcare professional to the public, they will play a key role in educating the public concerning the attacks and the associated medication, antidotes and vaccines. In the event of an attack, pharmacists will be responsible for teaching and supporting the general public, by explaining the science in understandable terms (27). As shown, pharmacists will play a key role in educating patients in the public.

ALTERNATIVE MEDICATION PLANS

There has been emphasis on keeping small inventories of certain medications that may be needed during a bioterrorist attacks. This may be problematic if a large number of doses of antibiotics are required in the event of a large biological incident. Pharmacy managers and
directors should be knowledgeable concerning effective alternative plans and options in the case of shortage (27). For example, pharmacists should be knowledgeable concerning some effective alternative treatment regimens to some of these agents. By being knowledgeable in this area, the lives of many people could be saved meanwhile more supplies are being manufactured and shipped to the appropriate area.

ADMINISTRATION OF VACCINES

Depending on the attack at hand, vaccination of patients may be a method employed to prevent the spread of the disease. Pharmacists will be responsible for the administration of vaccines especially if mass vaccination is required.

As shown above, pharmacists will play many roles during a bioterrorist attack. Thus, pharmacists must be knowledgeable in this area of science. Hence, there should be more training in schools of pharmacy and more available continuing education classes.

OPINION

I, a third year pharmacy student, am absolutely against the use of toxic biological agents that could result in harm or death to people. Even when biowarfare is employed for political, religious or other purposes, I believe that there are much better ways to solve conflict. Causing pain, torture others or killing them is not one of these ways.

I also believe that the Code of Ethics of Life sciences should be implemented in every institution. This Code of Ethics could serve as a means to protect the nation from a bioterrorist attack. Furthermore, by limiting the publication of information that could get into the wrong hands, the dual use dilemma could be avoided, thus, protecting the public from an attack.

Being a Muslim has further influenced my decision to stand against bioterrorism. As stated in the Qur’an, the killing of a single innocent human being will result in a punishment on the Day of Judgment as if the offender has killed all of mankind. Also, the use of human subjects or prisoners of war, as experiment materials is also forbidden in Islam.

As a student geared towards becoming a pharmacist, it is evident that I admire helping people by promoting health and well being. Bioterrorism is employed to cause widespread harm and disease, the exact opposite of what pharmacists strive to prevent and manage!

In the future, as a pharmacist, I plan on seeking training in this area. By doing so, I will be knowledgeable concerning the steps I will need to take to prevent, detect and handle a bioterrorism attack.
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