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Biological Weapons:
A National Security Problem that Requires a Public Health Response

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Biological Weapons:
A National Security Problem that Requires A Public Health Response

Abstract

Biological weapons are a threat to the health and well-being of American citizens. The events of 11 September 2001 prove that terrorists are willing to sacrifice the lives of innocent civilians in order to further their agenda. The spread of anthrax through the United States mail system further demonstrates the willingness of terrorists to use non-conventional weapons against citizens.

This paper will clarify the definitions associated with biological weapons and chronicle the rising threat of biological weapons over time. Given the real threat of a large-scale biological attack, defense against biological weapons should not only be considered a national security issue, but also public health priority. Sustainable defense, response and deterrence against a biological attack are rooted in an effective public health system.

The public health infrastructure needs to be strengthened in order to successfully detect and respond to an attack, which will have the side benefit of enabling the public health system to better fulfill its commitment to protecting the health of the population.

Introduction to Biological Weapons

Definitions

Biological agents are living organisms capable of infecting and causing both sickness and death in people, animals and plants. There are seven types of biological agents: parasites, fungi and yeasts, bacteria, rickettsia and chlamydia, viruses, prions, and toxins. Of these biological agents only bacteria, viruses and toxins are considered when referring to agents that can be used in a biological attack. While toxins are included in the list of biological agents, they are not living organisms, but small proteins produced by bacteria that can poison a person, animal or plant. Bacteria, viruses and toxins can be spread through the contamination of food, water or fomites; via vectors such as insects; or as aerosols suspended in wet or dry formulations.[1]

There are four classifications for how biological agents can be used to harm or kill a person, animal or plant. Biological Warfare (BW) is the military use of biological agents, where targets of agents are predominately soldiers, governments, or resources that might hinder a nation's ability to attack and/or defend itself. Bioterrorism (BT) is the threat or use of biological agents that, like most forms of terrorism, is intended to make political, religious or personal statements to governments and populations through attacks primarily aimed at civilians or resources that affect the civilian economy. With few exceptions, bioterrorism is non-state sponsored. Biocrime (BC) is the threat or use of biological agents for individual objectives such as revenge or financial gain. The fourth classification is Bioaccident (BA), defined as the unintentional release of an agent from a laboratory or other facility. [2] Biocrimes and Bioaccidents comprise events that typically have small effects on populations and do not require specific plans for large-scale preparedness and response, and as such will not be considered further in this paper.

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[1] Zilinskas, R. Assessing the Threat of Bioterrorism. Congressional Testimony to Subcommittee on National Security, Veteran's Affairs and International Relations, US House of Representatives. October 20, 1999

[2] Definitions for Biocrime and Bioaccident taken from a talk given by Arnold Kaufmann on Basic Concepts of Infectious Diseases and Bioterrorism at the OFDA/CDC Workshop on Bioterrorism: A Public Health Emergency. 22 August 2001

In order for a biological agent to be effective for use in biological warfare or bioterrorism it should have the following characteristics: high toxicity, fast action, predictable in its impacts, capacity for survival outside of a host for sufficient time to establish itself in a victim, relative indestructibility with simple air, water and food purification methods, and susceptibility to treatments or vaccines available to the attacker, but not readily accessible to the victims.[3] In addition, according to criteria developed by the United States Army in 1964, biological agents should be manufacturable on a large scale, capable of efficient dissemination, stable after dissemination, difficult to detect or protect against, and able to produce desired psychological results. [4]

The Critical Agent List classifies a relatively short list of possible biological weapons to be used in either biological warfare or bioterrorism, and was created by the Centers for Disease Control and Prevention (CDC) in conjunction with military, intelligence, medical and public health agencies:

- Category A includes the highest priority agents because they are most likely to cause mass casualties, create panic and require a specific public health response. According to intelligence sources, these are the agents that are most likely to be used in a future attack, and are being researched and weaponized by biowarfare programs around the world.
- Category B are the second highest priority agents, including those agents that could contaminate food or water, are relatively easy to disseminate, and require enhanced disease surveillance and diagnostic capacity. Many of these agents, such as brucellosis, glanders and ricin, were either weaponized by state-sponsored programs in the past, or utilized successfully in biological warfare or terrorist incidents.[5]

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[3] Adapted from list by Victor Utgoff, in Roberts and Browder. Biological Weapons: Weapons of the Future? Center for Strategic and International Studies. Washington DC, 1993.

[4] US Departments of Army and Air Force, *Military Biology and Biological Agents*, Departments of Army and Air Force manual TM 3-216/ AFM 355-56, March 12, 1964, as quoted by Carus, Seth W. The Poor Man's Atomic Bomb?: Biological Weapons in the Middle East. The Washington Institute for Near East Policy. Policy Papers Number 23. Washington DC, 1991.

[5] See discussion on brief history of BT/BW. Brucellosis, for example, was the first agent ever weaponized by the United States government for use against humans and animals. Glanders was used by Germany in WWI to poison allied horses. Ricin was used to assassinate a political leader via injection.

- Category C includes emerging pathogens that could be weaponized in the future because of the relative ease of accessing, producing and disseminating the agents, as well as the high levels of morbidity and mortality these agents would cause.

Although the CDC has been able to categorize a list of agents that are likely to be used as bioweapons, there are additional diseases and variations of biological agents that are of great concern. The Critical Agent List specifies only twenty-one diseases, but there are at least seventy different types of biological agents that can be weaponized, not including agents that do not already exist in nature. Of the disease caused by these seventy agents, only 20-30% are currently treatable through reliable methods.[6] Of greater concern are the agents that have been altered by scientists. It is known that the former Soviet Union created antibiotic resistant strains of anthrax, changed smallpox in order to reduce the incubation period, and developed new diseases by combining agents such as Ebola and anthrax.[7] In addition, there are reports and suspicions that other nations and organizations are working towards genetically altering agents to target specific populations.[8] [9]

Critical List of Biological Agents		
Category A	**Category B**	**Category C**
smallpox	Q-fever	Agents identified by the CDC Emerging Infectious Disease Program, including:
anthrax	brucellosis	
Plague	glanders	
Botulism	melioidosis	
Tularemia	viral encephalitis	nipah virus
hemorrhagic fever	ricin	hantavirus
- Ebola	typhus	multidrug-resistant TB
- marburg	*Clostridium* toxin	
- lassa	*Staphylococcus enterotocin* B	
- junin (Argentinean Hemorrhagic Fever)	foodborne diseases	
	waterborne diseases	

Source: Khan A, et al. Public health preparedness for biological terrorism in the USA. Lancet 2000; 356:1179

[7] Ibid.
[8] Finnegan, William. *The Poison Keeper*. The New Yorker. January 15, 2001
[9] Dennis, C. "The bugs of war". Nature. 411: 232-235

Brief History

There is a long history of nations and peoples using biological agents as weapons. Many examples of use have been cited from as long ago as 190 BC, where Hannibal used venomous snakes to disrupt the enemy ships of Pergamus in Eurymedon.[10] It is difficult to determine if early examples of deliberate spread of biological agents, however oft cited, were effective in causing disease, or if the acts were confounded by other naturally occurring factors. For example, most references on the historical uses of biological weapons cite the siege of Kaffa in 1346, where De Mussis, leader of the attacking army, thought to use his plague stricken force to his advantage by catapulting corpses of plague victims into the city. An outbreak of plague broke out in the Kaffa, now known as Feodosia, Ukraine. The Genoese forces retreated back to Genoa, Venice and other Mediterranean ports, sparking the second wave of the plague epidemic in Europe. [11] [12] [13] While the outbreak of plague in Kaffa is usually attributed to the efforts of the attacking Tartars, other epidemiologic factors may have been responsible, such as the spread of flea-infested rats.

Another example of biological warfare often referred to in the historical record is the use of smallpox during the French and Indian War in 1763. Through the combined ingenuity of British Officers Sir Jeffrey Amherst and Colonel Henry Bouquet, smallpox infested blankets were given to the Indians at Fort Pitt, setting off an epidemic of smallpox that rendered the Indian tribes incapable of fighting off the British settlers.[14] [15]

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[10] Bellamy, R., Ed. Textbook of Military Medicine: Medical Aspects of Chemical and Biological Warfare. Washington DC, Borden Institute, Walter Reed Army Medical Center. 1997, Chapter 2: History of Chemical and Biological Warfare: an American Perspective.

[11] Ibid.

[12] Derbes VJ. De Mussis and the great plague of 1348: A forgotten episode of bacteriological warfare. JAMA 1966: 196 (1): 59-62

[13] Christopher G, Cieslak TJ, Pavlin J, Eitzen E. Biological warfare; a historical perspective. JAMA. 1997, 278(5): 412-417

[14] Garrett, Laurie. Betrayal of Trust: The Collapse of Global Public Health. Hyperion, New York. 2000

[15] Inglesby, T. The Germs of War: how biological weapons could threaten civilian populations. The Washington Post. Washington DC. December 9, 1999. H1

[16] In this instance, it is not clear if the blankets themselves caused the outbreak of smallpox or whether it was due to previous exposure to the Europeans. Regardless, this method of biological warfare was used again during the American Civil War, when Dr. Luke Blackburn of Kentucky sold smallpox and yellow fever infected clothing to Union troops in an effort to support the efforts of the Confederacy. [17]

Use of biological agents continued over time, and the evidence of their effectiveness strengthened in the post Koch's postulates age. In World War I, the Germans utilized biological warfare by attacking allied horses and cattle, covertly inoculating them with anthrax (*Bacillus anthracis)* and glanders (*Burkholderia (Pseudomonas) mallei)* as they were shipped out of ports in the United States to allied forces in Europe[18] [19]. There were also reports that the Germans used plague against the Russians in 1915, and attempted to use cholera against Italy. [20] Between 1933 and the late 1940's, Japan researched biological warfare at a compound known as Unit 731, where over 10,000 prisoners of war used for research purposes died of anthrax, meningitis, cholera and plague.[21] Japan followed its experiments with prisoners of war by using biological agents against the people of China, causing outbreaks of typhus, cholera and plague, resulting in the deaths of tens of thousands of Chinese civilians. One method used by the Japanese in Manchuria was dropping rice and plague infected fleas out of airplanes. The rice attracted rats, which then became infected with the fleas, thus creating efficient epidemiologic conditions by which the disease spread to humans over a large geographic area. [22] When the League of Nations sent a commission to investigate Japan's actions in Manchuria, Japanese military officials attempted, unsuccessfully, to poison their food with cholera. [23]

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[16] Christopher, et al.
[17] Bellamy. Chapter 2
[18] Ibid.
[19] Carus, Seth. The Threat of Bioterrorism. National Defense University Strategic Forum. No. 127, September 1997
[20] Bellamy. Chapter 2
[21] Inglesby, 1999
[22] Regis, E. The Biology of Doom: the history of America's secret germ warfare project. New York, Henry Holt and Company. 1999
[23] This information was obtained from Prince Mikasa of Japan in 1994. Bio-Terry.com. Chronological History of Biological Warfare and Terrorism. https://bioterry.com/History_of_Biological_Terrorism.asp (accessed 8/28/01)

Following World War II and revelations about the Japanese biowarfare program, the United States initiated its own biological weapons program, focusing initially on the weaponization of anti-plant pathogens for use primarily against cereal crops. The first agent weaponized by the United States for use against humans was Brucellosis (*Brucella suis)*, an agent that also infects animals. Other agents weaponized and stockpiled by the US military were anthrax, botulism, tularemia, Q-fever, staphylococcus enterotocin B, Venezuelan Equine Encephalitis, rice blast, rye stem rust, and wheat stem rust.[24] By 1969, however, the United States had disbanded its offensive biological warfare program and in 1972 signed the Biological Weapons Convention of 1972, banning the development, production and stockpiling of biological agents for offensive use.

The only successful recent biological attack in the United States, before the events of September-October 2001, was in 1984. Members of the Rajneeshee cult in The Dalles, Oregon used *Salmonella typhimurium* to poison salad bars at ten local restaurants. Their purpose was to influence a local election by reducing the number of local citizens who would go to the polls. Seven hundred and fifty-one cases of Salmonella were documented, and authorities only found out about the Rajneeshee role in the outbreak during an unrelated investigation a year later. [25] This example underscores the difficulty of detecting biological attacks and the inability of surveillance methods to determine the cause of the outbreak.

Characterizing The Threat of Biological Weapons

On 11 September 2001, terrorists used hijacked passenger planes loaded with jet fuel as explosion devices at the Pentagon and World Trade Center, killing approximately 3000. This attack awakened the American public to the idea that terrorists have the will and the means of inflicting harm on citizens of the United States within their national borders. Following the September 11th attack, letters with anthrax were mailed to a targeted list of media and political personalities. There are many reasons why biological agents are effective means of spreading terror and may become the weapon of choice, or at least a very real part of the arsenal for terrorist organizations and hostile states

[24] Christopher , et al.
[25] Osterholm M, Schwartz J. Living Terrors: What America needs to know to survive the coming bioterrorist catastrophe. Delacorte Press, New York. 2000

contemplating an attack against the United States. Depending on the choice of agent and method of dissemination, biological agents can be used as indiscriminate weapons of mass destruction (WMD), a means of targeting racial or ethnic groups, or a way to attack a population at a specific place and time. Even the threat of biological weapons can provoke widespread panic; the actual use of an agent against the United States could create mass disorder, leading to a breakdown of civil society. A government or organization eager to incapacitate or kill Americans and incite disorder might be tempted to use biological weapons because of their availability, increasing ease of production through technology and information, cost, dissemination techniques, lethality, anonymity and difficulty of detection, and lack of collateral damage. These characteristics of biological weapons make them a prime candidate for use in an attack against the United States.

Availability

Biological agents are often simpler to acquire and produce than nuclear, chemical or some conventional weapons. The material for biological agents can be easily grown or purchased. Some agents, such as anthrax or brucellosis, occur naturally in animals in certain parts of the world, and individuals can easily travel the globe to acquire biological agents from regions where such diseases occur naturally. For example, the Aum Shinrikyo cult was reported to have gone to Zaire to collect strains of Ebola for use in its bioweapons program. Until recently, anyone could order agents from supply houses around the world.[26] In 1995, American Type Culture Collection (ATCC), a mail order company that provides biological products, shipped anthrax to Saddam Hussein's biowarfare program in Iraq, and plague to Larry Wayne Harris- a right wing zealot associated with Aryan Nation.[27]

[26] 1991- Congress passed export control laws barring US companies from trading with countries believed to have biowarfare programs. And in 1989, Congress passed the Biological Weapons Act- prohibits any American to possess, trade, sell or manufacture biological weapons. Although these laws are in place for the United States, other nations are less strict about trade of biological agents.

[27] Garret, L

Access to Technology

Technological advances over the last two decades in the field of biology have made it easier to produce biological weapons. Techniques once considered beyond the capacity of scientists are now commonplace, particularly in the field of genetic engineering. Bioengineers are now armed with the knowledge needed to create antibiotic resistant strains of agents, combine aspects of two agents, weaponize agents, and possibly target particular populations. The creation of antibiotic resistant strains of anthrax was a key component of the Soviet biowarfare program. [28] The Soviets were also successful in creating a more virulent strains of the disease, capable of bypassing the available anthrax vaccine currently given to United States active duty forces. [29] Bioengineers are also now able to combine two agents to complicate the presentation of a disease in humans. Again, it was the Soviets who first used this technology by using recombinant DNA to combine features of smallpox and Ebola, and in 1995, Russian scientists presenting at a scientific conference in England, reported that they had combined a food poisoning organism with anthrax. [30] [31] In congressional testimony in 1999, Ray Zilinskas, a biological weapons expert at the Monterey Institute of International Studies, suggested that protein engineering might be used to stabilize toxin molecules. This would enable the toxin to withstand exposure to a dissemination device and remain dangerous to humans for a longer period of time. Yet another area of research enabled by advances in molecular biology and the unlocking of the human genome is the creation of biological warfare agents that could target a particular race or ethnic group. [32] In an article in *The New Yorker* on Dr. Wouter Basson of South Africa, the author revealed that Dr. Basson directed research on biological agents that would target only Black Africans in the community. A researcher working for Basson concluded that in fact, it was possible to bioengineer such a germ weapon[33].

Creating sophisticated biological weapons that could be deployed in missiles or bombs requires vast expertise and an expensive infrastructure. However, it is relatively

[28] Alibek, K
[29] Miller J, Engelberg S, Broad W. US germ Warfare Research Pushes Treaty Limits. New York Times. September 4, 2001
[30] Ibid.
[31] Alibek, K
[32] Dennis, C.
[33] Finnegan

simple and inexpensive to create biological weapons for deployment through less complicated means, such as through the contamination of food or water. According to Ken Alibek, who supervised the Soviet biowarfare program, "Although the most sophisticated and effective versions [of biological weapons] require considerable equipment and scientific expertise, primitive versions can be produced in a small area with minimal equipment by someone with limited training…. They would be relatively inexpensive and easy to produce." [34] The equipment needed to create a biowarfare laboratory is widely available through commercial means, because it is often the same equipment used in legitimate research laboratories. To prove how easy it is to build a germ warfare facility, the Pentagon secretly and successfully constructed a germ factory in Nevada using only commercially available material. [35]

To generate bioweapons, a state or terrorist organization must have access to scientists with at least some graduate training in microbiology or genetic engineering, expertise that is widely available around the world. More specific training, however, might be needed to establish more complicated bioweapons programs that would include fitting biological agents to missiles or warheads. This expertise is available to states or organizations with strong financial resources. The political and economic situation in Russia created a supply of biowarfare scientists who were not being paid and were unable to provide for themselves or their families. Regardless of the political, moral and ethical standards of these scientists, it is reasonable to expect that a sufficient number are now working for terrorist organizations or states with bioweapons programs that were able to offer inviting financial incentives.

Access to Information

Information on how to create sophisticated biological weapons can be taken from articles published in the scientific literature on a variety of topics, but it requires a trained scientist to understand the relevance of published findings to the creation of weapons. However, information on how to weaponize simpler biological agents is widely available and understandable to people with limited technological training. The Internet has

[34] Alibek
[35] Miller, et al.

created a forum by which terrorists or rogue groups can reach out, recruit members, spread messages and engage in topical dialogues. It has also made a large library of information accessible to just about anyone who is interested. One such resource is *Bacteriological Warfare: A Major Threat to North America*, written by Larry Wayne Harris of the Aryan Nation. This manual describes the reproduction and growth of biological agents and can be purchased over the Internet for less than $30. [36] Another book available through the Internet is called *Silent Death*, which instructs readers in ways to kill using chemical and biological poisons. According to the book's author, who is trained in biology and chemistry, it sells thousands of copies each year.[37] In addition to books like these, there are numerous web pages with detailed description of how to create and use biological weapons.

Cost

The cost of producing and deploying biological weapons is much less expensive than either chemical or nuclear weapons. The materials, equipment and production space are all inexpensive. According to an Office of Technical Assessment (OTA) Report, the cheapest overt production of one nuclear bomb costs around $200 million, with larger programs costing up to 50 times more. In contrast, a large arsenal of biological weapons costs less than $10 million. [38] Kathleen Bailey, an expert on defense and arms control issues at the National Institute for Public Policy, found through interviews with professors, students and pharmaceutical companies, that all that was needed to create a biological weapons program capable of producing large amounts of an agents would be several biologists with $10,000 worth of equipment- all of which could fit into a small room. [39]

Ease of Dissemination

Dissemination of biological agents can be simple, inexpensive, and delivered through a variety of means. The simplest methods of dissemination are through the

[36] Stern, J. The Ultimate Terrorists. Cambridge, Massachusetts. Harvard University Press. 1999
[37] Garret, L
[38] U.S. Congress, Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction: Assessing the Risks,* OTA-ISC-559 (Washington DC: U.S Government Princeton Office, August 1993)
[39] Stern, J

contamination of food products or water. This method requires only direct access to the food or water- preferably after any purification stages. Agents can also be dispersed through the contamination of agriculture, indirect transmission through animals, and direct contact, such as the assassination of Georgi Markov in 1978 through an injection of ricin, or the use of the postal system to send agents to targeted recipients.[40] [41] Dissemination via an aerosol or vapor into either an enclosed area or the open air is more complicated. Biological agents released into the air, such as through the release of vapors from a crop duster, are subject to atmospheric thermal stability, wind speed, terrain, biological decay and physical decay. In order for an airborne agent to maintain the concentration needed to deliver an infectious dose, there should be a layer of warm air over a cooler surface air, and a gentle wind speed of 10-12 miles per hour. The dissemination of agents is more predictable in rural areas than urban regions, and the agent itself must be strong enough to withstand the stress of the dissemination, environmental factors and physical obstructions.[42] Any one of these factors can thwart the airborne dissemination of a biological agent, limiting the possibility of a successful open-air attack. Researchers have found, however, that dissemination of agents at night or in enclosed dark areas, such as subways, can be particularly effective.

Lethality

Biological agents can be extremely lethal, with some agents creating much more deadly affects than others. According to the Department of Defense, ten kilograms of anthrax could cause more casualties that a 10- kiloton nuclear weapon. [43] In a model comparing the lethality of a chemical, biological and nuclear attack on Washington, DC, OTA estimated that an anthrax attack would yield between 30,000-100,000 deaths per kilometer squared. In contrast, an atomic bomb would result in 23,000-80,000 deaths per kilometer squared, and a Sarin gas attack would cause between 60-200 deaths per

[40] Carus, S. 1997
[41] Donahue, Arthur ("Mick"). Terrorist Organizations and the Potential Use of Biological Weapons. In: Potomac Institute for Policy Studies. Counter Biological Terrorism Panel. Countering Biological Terrorism in the US: An Understanding of Issues and Status. Oceana Publications, New York. 1999
[42] Kaufmann lecture, 2001
[43] DoD. National Defense University. *Strategic Assessment 1996*. As cited in : Kupperman and Siegrist. Strategic Firepower in the Hands of Many? In: Countering biological terrorism in the United States: an understanding of the issues and status. Potomac Institute for Policy Studies. 1999

kilometer squared. This model assumes that Washington DC is not prepared to respond to an anthrax attack and that the attack is performed under ideal atmospheric conditions. [44]

Anthrax is a non- communicable disease, which means that only the people who are exposed to the initial attack will become ill or die. Communicable diseases, on the other hand, not only infect an initial cohort of exposed people, but then those individuals can transmit the disease to whomever they came in contact with, depending on the virulence and infectiousness of the agent. Smallpox was eradicated from humans in the 1970's, but samples of the agent were kept in storage in the United States and Siberia. Some of the samples kept in Siberia were used by the Soviets to create weaponized versions of the virus, and in recent years the security at the storage site in Siberia has been compromised and no one can say with certainty where all the samples of the virus are located. Smallpox is a top candidate for use as a bioweapon because of its high mortality rate (one in three infected people die) and infectiousness (on average, one person will infect three additional people). In addition, people are no longer vaccinated against the disease, and the vaccinations given before 1970 are no longer protective. If smallpox were used today in an attack, it is possible that in the complete absence of prevention and control measures, up to 2 billion people could die. [45]

Difficulty of Detection

Unlike conventional or nuclear weapons, it is possible to covertly launch a biological attack. Biological agents are small and easy to transport. William Patrick, who led the US biological weapons development program until 1969, regularly carries a vial containing a simulant for anthrax to test whether or not it is detected. In 1999, he brought the vial with him into a hearing of the House Permanent Select Committee on Intelligence without being detected, and claimed to have done the same thing at the State Department, the Pentagon and the CIA. [46] Others have traveled through airports around the world carrying equipment for deploying biological agents through the air, and were never stopped or asked to explain the purpose of the equipment.

[44] US Congress, OTA
[45] Garrett, L.
[46] Osterholm, M

The first signs of an attack may not come until weeks after an agent has been deployed, due to the long latency periods of some biological agents. Thus, by the time authorities determine that an attack has taken place, the perpetrators could be anywhere in the world. Biological attacks may also be mistaken to be naturally occurring disease outbreaks, in which case no one even thinks to look for a would be assailant. Because of the difficulty in detecting a biological weapons attack, it is almost impossible to lay blame on a particular group or individual, therefore virtually eliminating fears of reparation.

Lack of Collateral Damage

While biological agents may indiscriminately kill or injure humans, animals and plants, they do not destroy structures. This aspect of biological agents may be of interest to groups who desire to kill residents of an area, but protect surrounding assets, such as religious shrines, historical buildings, or industrial plants. [47] This may be particularly important in situations where one group is trying to gain control of a region it hopes to inhabit.

All of the above described characteristics of biological weapons make them an attractive choice over nuclear, chemical or conventional weapons for use in an attack against the United States.

Evidence of an Increasing Threat

Until recently, most United States policymakers did not think biological weapons were a threat to be concerned about, but nor did they think in real terms about massive loss of civilian lives due to a terrorist attack on American cities. Our government assumed that nations and organizations would find the use of biological weapons morally repugnant. There was a general consensus that unleashing a disease on society was just not an acceptable thing to do, and that no group or nation wanted to be viewed as a people with such disregard for humanity. In addition to moral objections, popular belief held that biological agents were too technologically difficult for small nations or

[47] Kupperman, R, Siegrist D. Strategic Firepower in the Hands of Many? In: Potomac Institute for Policy Studies. Counter Biological Terrorism Panel. Countering Biological Terrorism in the US: An Understanding of Issues and Status. Oceana Publications, New York. 1999

organizations to weaponize. It was assumed that terrorists groups were not familiar with how to use biological agents effectively. Of particular concern was dissemination of airborne agents, given the challenge of designing methods of deployment that enabled agents to reach the intended target.

Above all, the United States had faith in the Biological Weapons Convention of 1972, signed and ratified by 140 nations. The treaty banned the development, production and stockpiling of biological agents for offensive use. The US disbanded its offensive biological warfare program in 1969, and wrongfully assumed that other nations, specifically the Soviet Union, had done the same with the signing of the 1972 treaty.

Over the last five years, and even more so in the past weeks, policy makers have been coming to understand that biological weapons pose a very real threat to the United States. The threat of a biological weapons attack comes from two main groups- terrorists organizations and nations hostile to the US. Understanding the motivation of these two potential users of biological weapons is important for deterrence efforts and to try to predict the timing and nature of an attack.

Terrorists

In the past, it was generally thought that terrorists had little use for weapons that killed large numbers of people indiscriminately. Terrorists were believed to be more interested in making political statements than causing large numbers of casualties. In fact, the violence associated with terrorism tended to be symbolic- more concerned with gaining recognition than causing deaths. Terrorist groups wished to garner sympathy for this cause, and in many cases wished to eventually take political control of a nation. Injuring or killing large numbers of people would have caused supporters to lose sympathy and lessen the terrorists' legitimacy if and when they became legitimate leaders.[48]

Clearly, the characteristics and goals of many terrorist organizations have changed. According to Jessica Stern of Harvard, terrorist organizations are more inclined to use a nuclear, biological or chemical (NBC) due to five main reasons:

[48] Donahue, A

1. Instead of aspirations for power, many groups today are motivated by ethnic struggles and religious beliefs,
2. Current terrorist organizations have demonstrated a trend towards more extreme acts of violence,
3. With the breakup of the former Soviet Union, there is a black market for NBC weapons and individuals with the technical knowledge to use them,
4. Chemical and Biological weapons are much more common than was previously the case, particularly in states that sponsor terrorism, and
5. Advances in technology have made the use of NBC more feasible. [49]

Terrorists may also be more inclined to engage in large-scale acts of violence after the success of the September 11th attack on the United States. The attack, like no other prior terrorist incident, demonstrated that a well-organized strategy of terror can produce the terrorists' desired affect, and that a small group of willing people can inflict great damage on a powerful nation.

Although the likelihood of a terrorist organization utilizing a nuclear, biological or chemical weapon is greater now than in the past, it is important to remember that the overall likelihood of such an event is still very low. Only a few organizations are well enough organized and have sufficient funding to engage in weapon development, and only a few organizations desire to kill massive amounts of people. The terrorist threat, however, is of great concern to the United States because of the massive loss of life in the event of an attack. According to US Intelligence sources, twenty-five terrorist organizations have expressed an interest in biological weapons and eight have acquired them. [50] This list of organizations includes Osama Bin Ladin, who referred to the acquisition of biological weapons as a "religious duty". [51]

[49] Stern, J
[50] Carus, S. Testimony before the subcommittee on national security, veteran's affairs and international relations of the house committee on government reform. July 26, 2000
[51] Lauder, John. Unclassified Statement for the Record by Special Assistant to the DCI for Nonproliferation on the Worldwide WMD Threat. Commission to Assess the Organization of the Federal Government to Combat the Proliferation of Weapons of Mass Destruction. 29 April 1999

Hostile States

Many experts seem to think that the most likely user of a weapon of mass destruction (WMD), and biological weapons in particular, will be a hostile state, and not a terrorist group. Because of mass proliferation, WMD have become symbols of power and the ability to back a threat. During the cold war era, most nations would not deploy WMD against another out of the realistic fear of mutually assured destruction. [52] New enemies are more willing to take risks, especially if the survival of their nation or people is at stake. [53] These hostile states are often less concerned with retaliation for their actions, and are more willing to take responsibility for large losses of life, particularly those lives that do not conform to a specific religion or ideology. Biological weapons are of particular interest to these states because the United States currently has limited capacity to deter their use.

States with confirmed (and unclassified) biowarfare programs include Russia, Iran, Iraq, North Korea, South Africa, Libya and Pakistan. In addition, it is believed that China, Taiwan, Cuba, Egypt, South Korea, Israel, Vietnam, Laos, Bulgaria, India, Sudan and Syria also have at least basic research programs in biological warfare. [54] [55] [56] It remains extremely difficult to determine the extent or even the existence of any bioweapons program. The US government has gained detailed information about the Iraqi and Soviet programs due almost entirely to two key defections in the early 1990s.

The Iraqi biological warfare program began in the mid 1980's, and researchers successfully cultivated anthrax, botulism, ricin and aflatoxin. By 1996, when the UN inspectors found and destroyed a major germ war facility, Iraq had amassed an arsenal of at least 85,000 liters of liquid anthrax and missile warheads armed with anthrax, botulism and aflatoxin. [57] In 1998, the US attacked biological and chemical storages sites in Iraq,

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[52] U.S. Congress, OTA
[53] Carus, S. 2000
[54] US ARMY. Biological Defense Operations, Corps/Company tactics, techniques and procedures. Field Manual 30101-6. March 1999
[55] Tucker, Jonathan. Motivations for and Against Proliferation: The Case of the Middle East. In: In Biological Warfare: Modern Offense and Defense. Edited by Raymond Zilinskas. Lynne Rienner, Boulder. 2000
[56] Alibek, K
[57] Osterholm, M

but the government has found it nearly impossible to confirm what Iraq still has in its possession.

The Soviet biowarfare program was much more extensive, employing 32,000 civilian scientists and 10,000 scientists from the Ministry of Defense, operating at 47 laboratories and testing sites throughout the country. The program produced massive quantities of smallpox, and devised ways to reduce its incubation period. Scientists successfully developed and weaponized 2,000 strains of anthrax, antibiotic resistant plague, Marburg virus, tularemia and brucellosis. The program ran until at least 1992, and government officials suspect that at least part of the program is still in place. [58]

The Soviets not only had a bioweapons program in place, but it had specific plans for deployment of biological weapons as part of its national defense strategy. In the event of a nuclear attack, the Soviets planned to launch missiles with smallpox as a follow up to nuclear weapons. The warheads of at least four inter-continental ballistic missiles (ICBM) were equipped with special warheads filled with smallpox and primarily stored in silos near the Arctic Circle on a launch ready status. On the target list for the missiles was New York, Seattle, Chicago and Boston, and Chinese cities were added after 1968. [59]

This evidence on the Iraqi and Soviet programs demonstrates the very real biological weapons threat faced by the United States. While many terrorist organizations and states have bioweapons programs, the fact that a plan existed for a smallpox attack on the US and disease filled missiles were aimed at American cities makes the threat of an attack all that more tangible. This threat, along with the recent anthrax mailings, moves the debate over biological weapons from one of an historical review and theoretical advantages to a more pertinent discussion of how the US needs to prepare itself to respond to this problem. Unlike other threats to national security, the detection, response and even deterrence of biological weapons lies directly with the public health sector. The next section of this paper will illustrate the relationship between biological weapons and public health, and present an argument for why the public health system needs more funding to effectively respond to the threat of a biological attack.

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[58] Alibek, K

[59] Windrem, Robert. Soviets Planned Smallpox Attack. NBC News, New York. August 21, 2001. www.msnbc.com/news/616710.asp#BODY (accessed 8/22/01)

Biological Weapons and Public Health

In order to understand how bioterrorism relates to the public health system, one must first understand what public health means. The World Health Organization (WHO) defines health as " a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." [60] In contrast to the field of medicine where the physician's main responsibility is to the health of an individual, a public health official's main responsibility is the greater community. A 1988 Institute of Medicine (IOM) report on the future of public health defined the mission of public health as to "fulfill society's interest in assuring conditions in which people can be healthy."[61]

The scope of public health is enormous. According to the IOM, it is the responsibility of the American public health system to "serve as stewards of the basic health needs of entire populations, but at the same time avert impending disasters and provide personal health care to those rejected by the rest of the health system."[62] The public health system is the champion of clean water, safe food, sanitary living conditions, personal hygiene, and overall safe and healthy living. Given all of its responsibilities, the public health system works with limited financial and human resources, forcing it to prioritize. The CDC recently published of what it felt are the ten major public health challenges currently facing the American public health system. Included on this list was the need to prepare and respond to emerging infectious diseases, with the dual purpose of preparing for a bioterrorist attack.

Infectious Disease- A public health priority

As long as humans have roamed the earth, there have been infectious diseases. By the middle of the 20th century, however, medical and public health professionals began to feel that they were winning the war against infectious diseases and the microbes that cause them through the development and use of vaccines and antibiotics. In 1967, then Surgeon General William H. Stewart declared a victory against infectious diseases,

[60] www.who.int/aboutwho/en/definition.html accessed on 9/5/01
[61] Institute of Medicine. Future of Public Health. National Academy Press. Washington DC. 1988
[62] Ibid.

and by the 1970's resources were being diverted to fight chronic illness and medical students were being steered away from infectious diseases as a specialty. [63]

Infectious diseases, however, did not disappear from the earth by the grace of drugs and vaccines. Problematic infectious diseases never left less developed countries with limited resources to care for citizens. Additionally, infectious diseases have re-materialized in more developed nations over the last 20 years. Infectious diseases are currently the second leading cause of death worldwide and the leading cause of morbidity measured by disability adjusted life years (DALY). In the United States, infectious diseases are the third leading cause of death, and are predicted to become even more pervasive.[64] The prevalence of infectious diseases in the 21st century is primarily due to a combination of emerging diseases, re-emerging diseases and antibiotic resistant microbes.

Emerging diseases refer to infections that are either new in the population or are rapidly moving into new geographic regions or new species.[65] Since the mid- 1970's emerging diseases have included Legionnaires' disease, *E. coli* 0157:H7, HIV, Hepatitis C and E, *Vibrio cholerae* 0139, Hantavirus pulmonary syndrome (Sin Nombre), Hendra virus, New Variant Creutzfelt-Jacob disease (human version of mad cow), H5N1 (avian influenza A), Lyme Disease and Nipah virus.[66] [67] Many factors have contributed to emergence of these diseases. The earth is more densely inhabited than ever before, which has led to urbanization and overcrowding, creating unsanitary living conditions and increasing people's exposure to communicable diseases. Overcrowding has also been a factor in the increasing number of humans venturing into tropical forests to both mine resources and establish homes, both of which alter the balance of microbes in tropical regions and expose humans to new diseases. Changes in human behavior also lead to disease emergence, such as HIV and the spread of the virus through shared needles. Increased travel and the globalization of the food trade give microbes new ways to travel

[63] Fauci, A. Infectious diseases: considerations for the 21st century. Clinical Infectious Diseases. 2001. 32:675-85
[64] Ibid.
[65] Morse, SS. Examining the origins of emerging viruses. In: Morse, SS, Ed. Emerging Viruses. Oxford, Oxford University Press. 1993
[66] Ibid.
[67] Institute of Medicine. Emerging Infectious Diseases From the Global to the Local Perspective. Ed. Davis and Lederberg. National Academy Press. Washington DC. 2001

around the world and enter new geographic regions. Microbes themselves also contribute to emergence of diseases by continuously adapting in an effort to survive.

Re-emerging diseases are those that were once a great problem for humans, were seemingly controlled through treatment and control measures, and have recently come back to infect large numbers of people. Re-emergence of diseases can be caused by the same factors that contribute to emergence, and often happens when immunization, control and surveillance of a disease are neglected. This is the case for Diphtheria in Russia (cessation of universal vaccination with fall of Soviet Union), plague in India (neglecting of surveillance and control program) and Tuberculosis in New York (drop in funding for surveillance and control, combined with increase in homelessness and rise in an immunocompromised population).

The rise in antibiotic resistant microbes results from human activity, notably antibiotic over prescription and use and the behavior of the microbes themselves. Bacteria are amazingly adaptable. It can be assumed that over time, bacteria will outwit an antibiotic in order to ensure its survival. As a result of human and microbial behavior, resistant strains of a number of infectious diseases, including pneumococci, staphylococci, malaria and tuberculosis, have appeared around the world.
of Humans contribute to the development of the microbes through the inappropriate use of antibiotics. Resistant strains of a number of infectious diseases have appeared around the world, including pneumococci, staphylococci, malaria and tuberculosis.

Infectious diseases as a public health problem may be much more widespread than most experts feared. (With the notable exception of certain scientists and infectious disease experts.) New research suggests that infectious agents may actually cause many of the diseases classified as chronic. Chronic diseases whose etiologies have proven to be infectious include peptic ulcers (caused by *Helicobacter pylori*), cervical cancer (caused by human papilomavirus), Hepatocellular cancer (caused by Hepatitis B and C), and Lyme disease (caused by *Borrelia burgdorferi).* It is currently estimated that approximately 16% of all cancers are associated with an infectious agent.[68] Paul Ewald of Amherst College proposes that, in fact, many cancers and other chronic diseases may

[68] Fauci, A

require the presence of an infectious agent.[69]

Emerging infections, re-emerging infections, antibiotic resistance microbes, and infections causing chronic diseases all contribute to establishing infectious diseases as a public health priority that will continue to threaten the health of Americans. Despite the overwhelming evidence of new threats to the public's health, the public health infrastructure does not presently have the resources needed to effectively manage outbreaks of infectious diseases without quickly becoming overwhelmed. For example, one case of meningitis on a college campus rapidly monopolized an entire state's office of communicable diseases, stretching even a well-funded state's resources to care for the sick patient, provide prophylactic antibiotics for everyone the sick student came into contact with during a given period of time, distribute vaccinations for the rest of the student body, and quell the fears of panicked parents and the general public. [70] It is essential to note that in this meningitis outbreak, only one person became ill. This incident makes the important point that a communicable disease outbreak where hundreds or thousands of people become ill and die is completely beyond the scope of most health departments.

Bioterrorism preparedness- as a public health priority

Bioterrorism can be viewed as a public health priority through two mechanisms:

1. As a stand-alone threat that the public health system must be prepared for, and
2. 2. As a subset of emerging infections and infectious diseases.

In the event of a biological weapons attack on the United States, it can be assumed that a large number of people will fall ill and possibly die. Although the likelihood of an attack is much smaller than, for instance, the likelihood of people developing diabetes or lung cancer, the incredible number of people whose health and lives would simultaneously be affected necessitate that the public health community appropriate time and resources towards developing a bioterrorism response plan. The second reason why bioterrorism preparedness should be considered a top public health priority is that it

[69] Ewald, P. Plague Time: how stealth infections cause cancer, heart disease and other deadly ailments. New York, The Free Press. 2000
[70] Osterholm, M

overlaps with preparedness for emerging infectious disease and naturally occurring outbreaks of communicable and non-communicable diseases. The core functions of public health are assessment, policy development and assurance. Therefore, among other responsibilities, the public health system is tasked with providing ongoing surveillance of infectious diseases, as well as ensuring that people will have access to health services if necessary. The infrastructure needed to quickly identify and properly respond to a naturally occurring infectious disease outbreak will also identify an infectious disease outbreak caused by a biological weapon attack.

Preparedness and Response to Biological Weapons in the United States

Even before the September 11th attack, there was an increase in political attention to the threat of bioterrorism, resulting in Congress assigning to government agencies the responsibility of ensuring that if and when a biological attack happens, America will be prepared. Preparedness for biological weapons comes in two phases: pre- and post-attack strategies.

Pre- attack

Pre- attack prevention strategies consist of defensive measures, offensive measures, and political maneuvers. Pre- attack defensives measures try to make vulnerable populations less susceptible to attack. [71] This can include the use of protective clothing, such as gas masks, or vaccination programs to make soldiers and citizens immune to particular biological agents. Increasing security in areas that are likely venues for an attack is also considered under the rubric of defense measures. This implies the need to secure heating, ventilation and air conditioning (HVAC) systems in potential target buildings, blocking public access to water storage areas and food processing plants, and changing the search requirements at the entrances to government buildings.

Offensive measures for pre-attack prevention refer to physically disabling terrorists or nations from using biological weapons. This method requires exceptional

[71] Bosma, John. Bio-Terrorist Attack Pathways and Social/Civil Infrastructure. In: Potomac Institute for Policy Studies. Counter Biological Terrorism Panel. Countering Biological Terrorism in the US: An Understanding of Issues and Status. Oceana Publications, New York. 1999

intelligence on what groups or nations have weapons, where those weapons are kept, and for what purpose they are intended intent. After intelligence is garnered and interpreted, the next step is either political maneuvers to dissuade nations or groups from deploying the weapons, or surprise attacks that wipe out arsenals.

Post- attack

Due to the difficulties inherent in the detection of biological weapons (both production sites and initial releases), the bulk of preparedness is for post-attack scenarios, which requires clear and coordinated response and consequence management plans to make certain that the smallest number of people possible is affected by an attack. There are many aspects to an effective post- attack strategy. The first is early detection of a biological weapons attack. Detection can come in two forms: pre-infection and post-infection. Pre-infection detection of a biological attack is attained through the use of sophisticated sensors that monitor air, ground, water and food for unusual biological agents. Post infection detection is accomplished through a complex surveillance system where physicians are trained to identify infections of biological agents; laboratories are able to efficiently culture and provide microbiologic confirmation of an agent, and epidemiologists are able to determine the time and place and agent was dispersed and the population that was exposed.

Post- attack strategies require the enforcement of public order to facilitate population mobilization for treatment, vaccination and distribution of prophylactic antibiotics; subdue public fears; and enact quarantine procedures if necessary. These requirements necessitate that public health and emergency management laws designed for such situations to be in place before an event occurs. Concurrent with the management of a specific event, law enforcement officers must be able to mount a quick response in order to collect evidence and track down the assailant of the attack.

Arguably the most important part of a post- attack response, aside from rapid detection of the attack, is provision of medical services to limit the extent of any illness or death among the population. Adequate preparation requires that a stockpile of drugs

and vaccines be available, as well as the implementation of a predetermined plan for the distribution to affected persons. Additionally, physicians in every corner of the country must be trained to recognize and treat diseases that result from the release of the biological weapon, and hospitals must be equipped to handle large numbers of infectious patients.

Current State of Preparedness

Several years ago, the US government began its response to bioterrorism by appropriating funds, although the allocation of these funds have been inconsistent with the allocation of responsibility of detection and response, should an attack occur. Most of the federal funding to combat bioterrorism is appropriated to the Departments of Defense, Justice and Energy, with only 3% of the total anti-terrorism budget going to the Department of Health and Human Services in FY2000. Although each of the federal departments listed below have a specific role to play in the event of a biological weapons attack, the detection and management of an attack will be handled primarily by Health and Human Services (encompasses the public health service), and, as such deserves a larger proportion of the total funding.

Federal Funding to Combat Terrorism, Including Defense Against Weapons of Mass Destruction, By Agency, Fiscal Year 2000 and 2001[72]
(in millions)

Agency	FY2000	FY2001 (requested)
Federal Government Total	**$8,419.7**	**$9,311.3**
National Security Community (including Department of Defense)	$5,117.2	$5,124,1
Department of Justice (includes FBI)	$782.0	$949.3
Department of Energy	$647.6	$663.5
Department of State	$781	$1,312
Department of the Treasury	$348	$440.2
Department of Transportation	$277.2	$298.2
Department of Health and Human Services (includes CDC and NIH)	**$277.6**	**$265.4**
General Services Administration	$92.8	$117.0

[72] Executive Office of the President, Office of Management and Budget. *Annual report to Congress on Combating Terrorism.* Pursuant to FY 1998 National Defense Authorization Act (Public Law 105-85) May 18,2000, p. 47-51, 58-65. Downloaded from https://cns.miis.edu/research/cbw/terfund.htm

Federal Emergency Management Agency	$30.8	$34.5
Department of Commerce	$22.4	$33.6
Department of Agriculture	$12.3	$41.3
Department of Interior	$9.7	$9.7
US AID	$5.4	$5.0
Nuclear Regulatory Commission	$3.2	$3.2
Environmental Protection Agency	$2	$3.2

In 1997, $52.6 million was given to set up a Domestic Preparedness Program for training first responders in 120 cities. Commonly referred to as the Nunn-Lugar-Domenici program, most of the focus was aimed at responding to overt chemical terrorist attacks, with only limited attention paid to biological weapons response. In 1999, Congress appropriated $121 million to the CDC for improving the national disease surveillance system, and for fiscal year 2000, $1.4 billion was set aside to create or enhance urban response teams, protect buildings (particularly embassies), improve the disease surveillance system, and create vaccines. [73] These funds were helpful, but not sufficient to perform the necessary overhaul of the infections disease surveillance system. Interestingly, also appropriated if FY2000 was $300 million (more than all of HHS funding) to create approximately fifty 22-man National Guard units to respond to bioterrorist activities. [74] Because they are not properly trained to serve in this capacity, the usefulness of theses National Guard units is questionable at best, making it hard justify the $300 million investment in their creation.

There have been recent government efforts to support the development of vaccines, specifically against anthrax and smallpox. Currently the military possesses a vaccine for anthrax, but the vaccine is not available for civilians, as there is not even enough for all members of the armed services. Tests are currently being conducted at the Pentagon to see if the vaccine is protective against more potent variants of anthrax that were first created by the Russian biowarfare program.[75] The United States used to keep a stockpile of vaccine against smallpox, but much of that vaccine has deteriorated over the years and there are now only 15.4 million doses available in the US. Contracts have gone

[73] Alibek, K
[74] Garrett, L
[75] Windrem, R.

out to a pharmaceutical company to develop more, but the development process has been slow and expensive. The Department of Defense has a contract for 300,000 doses, costing $22.4 million, and it will not be ready until 2006.[76] The CDC has its own contract for smallpox doses, but production had been very costly and complicated due to problems with the contracted pharmaceutical company. Recent reports, however, suggest that renewed pressure on the pharmaceutical company will result in approximately 40 million doses available by 2003, and research is ongoing as to whether the existing 15 million doses can be diluted to serve more people. [77]

Over the last several yeas, the US has started to devote resources to post-attack strategies. To improve detection, the Defense Advanced Research Project Agency (DARPA) is working on miniaturized sensors, methods of environmental detection of agents, and ways to speed up laboratory tests to identify agents. [78] DARPA also has a project named "Bio-Surveillance System" that is designed to detect biological weapons by tracking viruses in the general public, monitoring days of school or work missed, and the number of colds reported by hospitals. [79] These DARPA programs, though, are untested and it is not clear how effective they will be in identifying an attack.

The Centers for Disease Control and Prevention is working hard to improve its infectious disease surveillance system and has provided funds to local health departments to create a Health Alert Network. The Association of Public Health Laboratories (APHL) is working to update public health laboratories and improve communication between labs and health departments, but it still takes weeks for an agent to be identified, and there are only three labs in the country capable of handling extremely contagious and dangerous agents- CDC in Atlanta, CDC in Fort Collins, Colorado, and USAMRID at Fort Detrick, Maryland.

The CDC has taken the lead in creating the National Pharmaceutical Stockpile Program, the purpose of which is to maintain a national repository of drugs and medical material to be delivered to the site of a biological attack. This program runs on $52

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[76] Osterholm, M

[77] William Broad. U.S. acts to make vaccines and drugs against smallpox. The New York Times. October 9, 2001. www.nytimes.com/2001/10/09/health/anatomy/09SMAL.html (accessed 10/9/01)

[78] Morse. Stephen S. Detection of Biological Warfare Agents. In Biological Warfare: Modern Offense and Defense. Edited by Raymond Zilinskas. 2000

[79] PRNewswire Press Release. U.S. Military Launches Surveillance Project to Track Web Sites and Electronic Databases for Signs of Bioterrorism. Interactive Week. January 8, 2001.

million a year and can presently deliver packets of drugs and medical equipment, along with a small team to help with distribution, to any site in the country within 12 hours. [80] The program has done remarkably well in establishing itself with such limited funds, but further resources are needed to enhance the programs ability to respond to a greater variety of situations. With additional funds, more drugs can be stocked in a larger variety of locations around the country. There could also be more intensive training for local authorities in distribution strategies, and larger teams of experts could be dispatched in the case of an emergency.

The Justice Department is providing grants totaling $69.5 million for states and cities to purchase protective gear for police and first responders. Eighty million dollars has been appropriated to train firefighters and EMS personnel in biological terrorism, and $50 million has gone to the Department of Defense to create medical strike teams and domestic terrorism response teams. [81] The coordination and chain of command between these response teams and civilian responders is still being worked out.

Some programs have been initiated to train physicians to recognize diseases associated with biological weapons, but coordinators have found it difficult to get doctors to take time out of busy schedules to come to voluntary training sessions. The government has, however, sponsored major training drills, where top city and state officials and hospital personnel participated in exercises designed to test the city's ability to respond to a biological attack. [82] These training exercises have demonstrated the need for future training and have highlighted the inability of local municipalities to appropriately respond to and control a biological weapons attack.

While all of these above-described anti-bioweapons activities are steps in the right direction, more needs to be done. Activities and programs in all areas of the government must be coordinated. Wasteful spending on items appropriate for nuclear or chemical attacks, but completely useless against a biological attack, must be eliminated. And funding to enhance the public health infrastructure must be increased.

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[80] Yeskey, Kevin. The National Pharmaceutical Stockpile Program. Presentation given at the OFDA/CDC Workshop on Bioterrorism: A Public Health Emergency. 22 August 2001

[81] Osterholm, M

[82] Inglesby T, Grossman R, O'Toole T. A plague on your city: observations from TOPOFF. Clinical Infectious Diseases. 2001. 32:436-445

Increased Funding for Public Health

If a terrorist group or hostile nation releases a biological weapon on the American public, the first sign of an attack is likely to be the apparently innocent event of a small number of people going to their private doctors' office or the emergency room at their local hospital, complaining of flu-like symptoms. Patients may be arriving at hospitals all over a geographic region, so that no one hospital has raised suspicions that there is an outbreak of some disease within the community. In order to determine exactly what is wrong with the patients, samples of their blood will need to be sent to local laboratories, and possibly on to state or federal laboratories depending on the initial suspicions of the physicians treating the patients, or the inability of a local lab to identify an agent.

The longer it takes for the public health system to identify what is happening, the more people will become sick or die, and the costlier it will be to society. According to a study conducted by Kaufmann, Meltzer and Schmid, if an anthrax attack on a population of 100,000 is identified and proper doses of antibiotics are distributed to the exposed population within 24 hours, then approximately 5000 people will die and the cost to society both in health care expenditures and economic loss will be around $128 million. If, on the other hand, the attack is not identified for six days, and only then are doses of antibiotic prophylaxes given to the exposed population, approximately 33,000 people will die at a cost of $26.2 billion.[83]

The public health system, as it stands today, is not capable of quickly identifying and responding to an outbreak the size of which would occur in a biological weapons attack. According to the CISET report on *Global Microbial Threats in the 1990s,* $500 million a year is needed to bring the US surveillance and public health laboratory system up to proper standards and build capacity in epidemiological services.[84] In 2001 testimony to Congress, Secretary Thompson suggested that $800 million in FY2002 would be needed to bring the public health system up to the needed standards.[85] A study

[83] Kaufmann A, Meltzer M, Schmid G. The economic impact of a bioterrorist event: are prevention and postattack intervention programs justifiable? Emerging Infectious Diseases. 1997. 3(2): 83-94
[84] United States, National Science and Technology Council, Committee on International Science, Engineering, and Technology Policy (CISET), Working Group on Emerging and Re-emerging Infectious Diseases, *Global Microbial Threats in the 1990s*, http://www.whitehouse.gov/WH/EOP/OSTP/CISET/html/toc.html. (Accessed 9/05/01)
[85] Allen, Jamie. Change needed to combat bioterr threat. CNN.com. October 3, 2001. www.cnn.com/2001/us/10/03/rec.bioterrorism/index.html (accessed 10/9/01)

in 1999 performed by Harvard found that public health leaders felt they were only performing one third of the functions essential to protecting the health of the American public, primarily because of insufficient resources.[86] Limited funding was available for infectious disease surveillance throughout the 1980s and the majority of the 1990s, and almost all public health departments at the state and local level were too understaffed and overworked to make use even of available resources. For example, in 1992, there were twelve states with no one on the payrolls responsible for monitoring foodborne and waterborne diseases (the two easiest pathways for bioterrorists to release a biological weapons). [87] While some funds have flowed to the public health system in recent yeas to address these problems, much more needs to be done to bring public health departments up to sufficient operating capacity.

To fix these problems, there are seven main areas of the public health system that require improved support to function at a level sufficient to effectively respond to a biological weapons attack. The first area is hospital readiness. Currently, hospitals in the United States are operating at close to full capacity, and there are barely enough hospital beds and nurses available to respond to the annual flu epidemics. In addition, most metropolitan areas have only a limited number of beds in rooms specially designed to isolate infectious patients. The entire Washington, DC area has fewer than 100 of these isolation beds, all of which would be quickly filled if there were a biological weapons attack of smallpox or some type of hemorrhagic fever. The second main area that needs to be improved upon is training of physicians and first responders. Most physicians in the United States today have never seen a case of smallpox and would thus be challenged to present a differential diagnosis of the disease without laboratory confirmation. While some training programs have been initiated, more attention needs to be paid to educating medical students, residents, and paramedics in the presentation and treatment of infectious agents, particularly agents identified by the CDC as possible biological weapons.

Improving laboratory capacity is the third area for improvement. The CDC has recently received funding to begin improvements to the public health laboratory system,

[86] Garrett, L
[87] Osterholm, M

but remains fiscally challenged to give local and state laboratories the proper equipment to test for certain infectious agents, create computer systems by which the results of lab tests can be quickly shared with state and federal authorities, and make sure that enough personnel are trained and available to work in public laboratories. The fourth area for improvement is communication. Up until the mid 1990s there were still local health departments around that country that did not have touchtone phones, or computers with Internet or email service. The CDC allocated $40 million in grants to local and state health departments to upgrade their communication capacity as part of the Health Alert Network, but more funding is necessary to ensure that all public health officials in all areas of the country are able to quickly communicate to state and federal officials suspicious outbreaks, unusual presentations of patients, or an increase in the expected number of patients with flu-like symptoms. The fifth area is personnel. There are not enough trained epidemiologists and public health officials to track down every suspected outbreak. More funding must be given to schools of public health and fellowship programs to ensure that there is a cadre of highly trained professionals available, as well as room in local and state budgets to hire experts in infectious disease epidemiology.

The last two areas in need of resources are vaccine development and research into the microbes themselves. New and improved vaccines are necessary to defend against the agents most likely to be used in a biological attack. This means producing enough smallpox vaccine for first responders and an initial target area, and having the capacity to quickly produce large quantities of vaccine for distribution to the greater public. The anthrax vaccine also needs to be improved upon to ensure protection against altered strains of the bacteria and to make certain that the vaccine that currently exists meets the highest standards of efficacy. Research into the genetic makeup of microbes is also essential for understanding the development of antibiotic resistance. This type of research should provide the foundation for the development of new antimicrobials that would be the next line of defense should the current antimicrobials fail to be effective against biological agents.

Finally, one of the strongest arguments for funding the public health system for

bioterrorism preparedness is the dual use benefit of anti-bioterrorism programs. In the 1950s, the CDC was allocated funds to set up an Epidemic Intelligence Service (EIS), designed to create a cadre of professionals who could serve as "an early warning system against biological warfare and man-made epidemics". [88] The Epidemic Intelligence Service has been in existence for 50 years, and while it has never responded to an actual bioterrorist event, it has played a key role in combating epidemics all over the world, including eradicating smallpox, discovering how AIDS is transmitted, documenting the epidemic of obesity in the US, and studying public health problems in America. The EIS program has also trained many of the medical and public health leaders in the United States, including the current director of the CDC, deans of prominent schools of public health, and practicing physicians around the world.

Increasing surveillance capacity, improving public health laboratories, helping hospitals set up methods for attending to large numbers of infectious patients, increasing infectious disease knowledge among medical professionals, supporting research to better understand microbes and investing in better vaccines are all wise investments. As essential as these services will be in the event of a biological attack, they are also necessary for the day-to-day functions of the public health system, to protect the public against naturally occurring infectious agents.

Summary

The threat of a biological weapons attack on the United States is more real that at any previous time in our history. The goals and actions of terrorists and hostile states have changed in a way that makes the use of biological weapons more within the realm of possibility, while technological advances have made the weaponization of biological agents more feasible than in decades and centuries past.

[88] Epidemic Intelligence Service. www.cdc.gov/eis/ (accessed on 8/29/01)

Preparedness against a biological attack is complicated, and requires the coordination of many branches of government that have not historically worked together. Rapid detection and consequence management of an attack, though, will be the primary responsibility of the public health system. As it stands today, the public health system would quickly be overwhelmed by a biological weapons attack. In order for the public health system to be effective in its detection and response roles, more attention must be paid towards fixing the public health infrastructure and the infectious disease surveillance system, in particular.

Unlike other national security defense measure such as the proposed missile defense system, defense measures against biological weapon attacks have convenient dual use implications that would benefit American citizens in an emergency and in daily life. Improving the public health infrastructure not only protects Americans in the case of biological weapons attack, but will also help identify and control naturally occurring infectious disease outbreaks in times of peace.

Reference

Alibek, Ken (with Stephen Handelman). Biohazard. Random House, New York. 1999

Allen, Jamie. Change needed to combat bioterr threat. CNN.com. October 3, 2001. www.cnn.com/2001/us/10/03/rec.bioterrorism/index.html (accessed 10/9/01)

Bellamy, R., Ed. Textbook of Military Medicine: Medical Aspects of Chemical and Biological Warfare. Washington DC, Borden Institute, Walter Reed Army Medical Center. 1997

Bio-Terry.com. Chronological History of Biological Warfare and Terrorism. https://bioterry.com/History_of_Biological_Terrorism.asp (accessed 8/28/01)

Bosma, John. Bio-Terrorist Attack Pathways and Social/Civil Infrastructure. In: Potomac Institute for Policy Studies. Counter Biological Terrorism Panel. Countering Biological Terrorism in the US: An Understanding of Issues and Status. Oceana Publications, New York. 1999

Broad, William. U.S. acts to make vaccines and drugs against smallpox. The New York Times. October 9, 2001. www.nytimes.com/2001/10/09/health/anatomy/09SMAL.html (accessed 10/9/01)

Carus, Seth W. The Poor Man's Atomic Bomb?: Biological Weapons in the Middle East. The Washington Institute for Near East Policy. Policy Papers Number 23. Washington DC. 1991

Carus, Seth. The Threat of Bioterrorism. National Defense University Strategic Forum. No. 127, September 1997

Carus, S. Testimony before the Subcommittee on National Security, Veterans Affairs and International Relations of the House Committee on Government Reform. July 26, 2000

Christopher G, Cieslak TJ, Pavlin J, and Eitzen E. Biological warfare; a historical perspective. JAMA. 1997, 278(5): 412-417

Derbes VJ. De Mussis and the great plague of 1348: A forgotten episode of bacteriological warfare. JAMA 1966: 196 (1): 59-62

Dennis, C. The bugs of war. Nature. 411: 232-235. 2001

DoD. National Defense University. *Strategic Assessment 1996*. As cited in :

Kupperman and Siegrist. Strategic Firepower in the Hands of Many? In: Countering biological terrorism in the United States: an understanding of the issues and status. Potomac Institute for Policy Studies. 1999

Donahue, Arthur ("Mick"). Terrorist Organizations and the Potential Use of Biological Weapons. In: Potomac Institute for Policy Studies. Counter Biological Terrorism Panel. Countering Biological Terrorism in the US: An Understanding of Issues and Status. Oceana Publications, New York. 1999

Epidemic Intelligence Service. www.cdc.gov/eis/ (accessed on 8/29/01)

Ewald, P. Plague Time: how stealth infections cause cancer, heart disease and other deadly ailments. New York, The Free Press. 2000

Executive Office of the President, Office of Management and Budget. *Annual report to Congress on Combating Terrorism.* Pursuant to FY 1998 National Defense Authorization Act (Public Law 105-85) May 18,2000, p. 47-51, 58-65. Downloaded from https://cns.miis.edu/research/cbw/terfund.htm (accessed 9/6/01)

Fauci, A. Infectious diseases: considerations for the 21st century. Clinical Infectious Diseases. 2001. 32:675-85

Finnegan, William. *The Poison Keeper*. The New Yorker. January 15, 2001

Garrett, Laurie. Betrayal of Trust: The Collapse of Global Public Health. Hyperion, New York. 2000

Inglesby, T. The Germs of War: how biological weapons could threaten civilian populations. The Washington Post. Washington DC. December 9, 1999. H1

Inglesby T, Grossman R, O'Toole T. A plague on your city: observations from TOPOFF. Clinical Infectious Diseases. 2001. 32:436-445

Institute of Medicine. Future of Public Health. National Academy Press. Washington DC. 1988

Institute of Medicine. Emerging Infectious Diseases From the Global to the Local Perspective. Ed. Davis and Lederberg. National Academy Press. Washington DC. 2001

Kaufmann, Arnold. "Basic Concepts of Infectious Diseases and Bioterrorism". Presentation at the OFDA/CDC Workshop on Bioterrorism:

A Public Health Emergency. 22 August 2001

Kaufmann A, Meltzer M, Schmid G. The economic impact of a bioterrorist event: are prevention and postattack intervention programs justifiable? Emerging Infectious Diseases. 1997. 3(2): 83-94

Khan A, et al. Public health preparedness for biological terrorism in the USA. Lancet 2000; 356:1179

Kupperman, R, Siegrist D. Strategic Firepower in the Hands of Many? In: Potomac Institute for Policy Studies. Counter Biological Terrorism Panel. Countering Biological Terrorism in the US: An Understanding of Issues and Status. Oceana Publications, New York. 1999

Lauder, John. Unclassified Statement for the Record by Special Assistant to the DCI for Nonproliferation on the Worldwide WMD Threat. Commission to Assess the Organization of the Federal Government to Combat the Proliferation of Weapons of Mass Destruction. 29 April 1999

Miller J., Engelberg S., SNF Broad W. US Germ Warfare Research Pushes Treaty Limits. New York Times. September 4, 2001

Morse, Stephen S. Examining the origins of emerging viruses. In: Morse, SS, Ed. Emerging Viruses. Oxford, Oxford University Press. 1993

Morse, Stephen S. Detection of Biological Warfare Agents. In: Zilinskas, R, Ed. Biological Warfare: Modern Offense and Defense. Lynne Rienner Publishers. Boulder. 2000

Osterholm M., and Schwartz J. Living Terrors: What America needs to know to survive the coming bioterrorist catastrophe. Delacorte Press, New York. 2000

PRNewswire Press Release. U.S. Military Launches Surveillance Project to Track Web Sites and Electronic Databases for Signs of Bioterrorism. Interactive Week. January 8, 2001.

Regis, E. The Biology of Doom: the history of America's secret germ warfare project. New York, Henry Holt and Company. 1999

Stern, J. The Ultimate Terrorists. Cambridge, Massachusetts. Harvard University Press. 1999

Tucker, Jonathan. Motivations for and Against Proliferation: The Case of the Middle East. In: In Biological Warfare: Modern Offense and Defense.

Edited by Raymond Zilinskas. Lynne Rienner, Boulder. 2000

United States, National Science and Technology Council, Committee on International Science, Engineering, and Technology Policy (CISET), Working Group on Emerging and Re-emerging Infectious Diseases, *Global Microbial Threats in the 1990s*, http://www.whitehouse.gov/WH/EOP/OSTP/CISET/html/toc.html. (Accessed 9/05/01)

U.S. Congress, Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction: Assessing the Risks,* OTA-ISC-559 (Washington DC: U.S Government Princeton Office, August 1993)

US ARMY. Biological Defense Operations, Corps/Company tactics, techniques and procedures. Field Manual 30101-6. March 1999

US Departments of Army and Air Force, *Military Biology and Biological Agents*, Departments of Army and Air Force manual TM 3-216/ AFM 355-56, March 12, 1964.

Utgoff, Victor. The Biotechnology Revolution and its Potential Military Implications. In: Roberts and Browder. Biological Weapons: Weapons of the Future? Center for Strategic and International Studies. Washington DC, 1993.

Windrem, Robert. Soviets Planned Smallpox Attack. NBC News, New York. August 21, 2001. www.msnbc.com/news/616710.asp#BODY (accessed 8/22/01) World Health Organization. www.who.int/aboutwho/en/definition.html (accessed 9/04/01)

Yeskey, Kevin. The National Pharmaceutical Stockpile Program. Presentation given at the OFDA/CDC Workshop on Bioterrorism: A Public Health Emergency. 22 August 2001

Zilinskas, R. Assessing the Threat of Bioterrorism. Congressional Testimony to Subcommittee on National Security, Veteran's Affairs and International Relations, US House of Representatives. October 20, 1999