Bioweapons, Proliferation, and the U.S. Anthrax Attack

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Introduction

For much of human history the toxic nature of certain biological substances was not seen as essentially different from that of toxic chemicals. Little if any distinction was made between the harmful effects of inanimate materials such as arsenic, biological toxins like snake venom, or "poisoned" air and other emissions from a plague victim. All were generally considered poisons and were sometimes used for hostile purposes. But the discovery in the 19th century that bacteria can cause disease led to their categorical distinction. The potential of living microorganisms to be used as weapons was formally recognized in the 1925 Geneva Protocol, which not only prohibited the use in war of poison gas but also of "bacteriological methods of warfare."[1] The prohibition of "bacterial" methods was later understood to apply as well to other biological agents such as viruses, fungi, and yeasts

The protocol, enacted after the widespread employment of chemical poisons in World War I, noted that the use of the proscribed weapons was "justly condemned by the general opinion of the civilized world." Still, in subsequent decades several nations continued to develop these agents, though they were rarely used. In fact, the only large-scale dissemination of biological agents as weapons occurred in the late 1930s and early 1940s when the Japanese released plague bacteria and other organisms over Chinese population centers.[2]

The Biological Weapons Convention (BWC), which was established in 1972, prohibits even the development or acquisition of biological and toxin weapons.[3] While many countries complied with the prohibition, some did not. After the 1991 Gulf War, Iraq was found to have developed a biological arsenal. And following the collapse of the Soviet Union, information surfaced about that country's massive biological program.[4] Such treaty violations would have been less likely if the BWC included provisions for verification of compliance, as does the Chemical Weapons Convention (CWC), established in 1993. Unlike the biological treaty, the CWC not only renounces chemical weapons but provides for international inspections to confirm compliance and punishment of violators.[5]

Despite the broad condemnation of biological and chemical weapons, some nations and sub-national groups are still seeking to acquire them. This chapter reviews the unique characteristics of bioweapons, concerns about their proliferation, and events in 2001 involving the dissemination of powdered anthrax spores through the U.S. mail.

Characteristics of Biological Weapons

Toxic biological agents, like chemical, radiological, and nuclear agents, are commonly described as weapons of mass destruction (WMD). But bioweapons are in many ways unique and should be assessed apart from any other weapon. Since bacteria, viruses, and other living microorganisms can reproduce, their increasing numbers may render an environment more dangerous to humans over time. In the case of radiation, which also can make an area uninhabitable, the peak effect occurs at the time of release and then gradually dissipates. But the unleashing of a living pathogen could be a springboard to a disease outbreak that can worsen over a period of months or years. This is especially true if the agent is contagious like the smallpox virus or the plague bacterium, each of which over the millennia have killed hundreds of millions of victims. Infected individuals themselves become biological weapons who spread the disease to others. One particularly notorious instance occurred between 1346 and 1350 when an epidemic caused by the plague bacterium, *Yersinia pestis*, killed one third of Europe's population.[6]

Since the advent of 20th century drugs, notably antibiotics and vaccines, many previously untreatable diseases are now amenable to prevention and cure. But not all. Some microorganisms may be drug resistant or otherwise not responsive to available therapies. Moreover, potentially useful medications require timely delivery to be effective.

Another distinctive aspect of biological weapons is that their harmful effects are usually not evident until some period after their release. The launching of a bioattack might not be apparent until people become ill perhaps weeks or months after exposure. (In the case of radiation, its ultimate carcinogenic effects would not manifest for many years after exposure and the terror effects during such a lengthy period are unclear.) The incubation period for anthrax, for example, may be as short as few days or as long as two or three months.[7] A final unique aspect of biological weapons relates to their size. A lethal volume of microorganisms can be so minuscule as to be invisible to the unaided eye. Yet these tiny quantities can have widespread physical and psychological effects. Thus, unlike most other weapons, a bioagent is invisible, without smell or taste, and with effects that may be long delayed. This combination renders such weapons unusually insidious and frightening. But herein lies a paradox. While biological weapons are potentially devastating, they often can be easy to protect against.

The danger from almost all pathogens occurs when they are inhaled. If people in a targeted area are able to don gas masks before exposure, protection would be almost certain. Further, if the agent is a bacterium, timely administration of appropriate antibiotics often can prevent infection, or, if a patient is already ill, provide a cure. For several bacterial as well as viral diseases pre-exposure vaccination can prevent infection. In the case of viral illness, including smallpox, a vaccine may offer protection even if administered several days after an individual has been exposed to the causative agent. Thus the effects of many biological weapons, unlike other weapons, are amenable to prevention or reversal with post-exposure treatment.

Categories and Sources of Biological Weapons

In conjunction with officials in the U.S. military biological defense program, the Centers for Disease Control and Prevention (CDC) has listed more than seventy "select agents" that in varying degrees can be harmful to humans. The agents include a variety of living organisms such as bacteria, viruses, and fungi as well as toxins, which are the poisonous products of an organism. Ranked according to their priority of concern, each agent appears under one of three categories: A, B, or C. Category A includes agents and diseases of greatest concern and Category C the least. Among the Category C items are yellow fever, influenza, rabies, and emerging pathogens that could be engineered in the future for mass dissemination.[8] Category B agents are described as moderately easy to disseminate and likely to cause low mortality rates. Examples

include Q Fever, Glanders, ricin toxin, and various food safety threats (such as certain Salmonella and E. Coli strains).[9]

Category A, the highest priority, includes agents that could be easily disseminated or transmitted from person to person; cause high mortality and impact on public health; cause panic and social disruption; and require special action for public health preparedness. The six select agents identified in this category are:

- Anthrax (*Bacillus anthracis*)
- Botulism (*Clostridium botulinum* toxin)
- Plague (*Yersinia pestis*)
- Smallpox (variola major)
- Tularemia (*Francisella tularensis*)
- Viral hemorrhagic fevers (filoviruses [e.g., Ebola, Marburg] and arenaviruses [e.g., Lassa, Machupo]) [10]

Although these six agents all meet Category A criteria, their individual characteristics differ markedly. Botulism, unlike the others in this category, is caused by a toxin and not by infection from a living organism. Smallpox and the hemorrhagic fevers are caused by viruses and are therefore not amenable to antibiotic therapy. They are also highly contagious as is the plague bacterium. Anthrax, while not contagious, is considered unusually effective as a potential weapon because it is highly durable in spore form and often lethal if inhaled.

Some select agents are readily accessible while others can be extremely difficult to acquire. Ricin is a toxin derived from the castor bean, which can be purchased through the Internet or at agriculture feed and supply stores. The toxin itself is part of the waste mash in the production of castor oil. On the other hand, viral agents like Ebola and Marburg are difficult to obtain. The cause of occasional deadly outbreaks, they are dangerous to handle and are stored in a limited number of laboratories. In the case of smallpox, although the disease was eradicated worldwide in 1980, samples of the virus are retained at a repository in Russia and one at the CDC in Atlanta according to international agreement. Plans to destroy those stocks have been suspended. The suspension was due in part to suspicion that illegal samples might be held elsewhere that could be obtained by bioterrorists. Accordingly, continued research on the virus was considered desirable for defensive purposes.[11]

A bioagent might be acquired or produced for illicit purposes in a variety of ways. Legitimate investigation of virulent agents is common in numerous laboratories engaged in basic research as well as in the quest to develop vaccines and antidotes. An unsavory scientist or technician might try to obtain a sample from one of these laboratories and develop it as a weapon. A pathogen also could unintentionally be released as a result of accident or error and become accessible to inappropriate individuals.

Further, a select agent might be obtained through purchase, stealing, or smuggling. This was an explicit concern after the collapse of the Soviet Union in 1991, when laboratory security there was weakened and scientists who had access to pathogens were losing their jobs. Finally, since many agents exist in natural habitats, visiting these locations to acquire bioagents could be yet another source. The plague bacterium, for example, is endemic in the southwestern United States where field rodents may be infected. A knowledgeable person might seek to cultivate the bacterium from a captured animal.

Group Categories That Pose Potential Threats

Four group categories can be identified as posing a potential biological weapons (BW) threat. The first group consists of countries that are presumed to have BW programs. The number of such

countries and the extent of the programs are somewhat murky. A U.S. Department of Defense publication in 2006 maintained that “more than ten countries have, or are developing, a biological warfare capability.”[12]

Compilations from news and open government sources in recent years included 11 countries with presumed BW programs: China, Cuba, Egypt, Iran, Iraq, Israel, Libya, North Korea, Russia, Syria, and Taiwan.[13] At least two of these countries can no longer be considered part of this group. Neither biological weapons nor an active program to develop them were found in Iraq after the defeat of that country’s regime in 2003. And in 2004 Libya began to dismantle all its unconventional weapons programs under international verification.[14] Some analysts have also raised doubts that Cuba and perhaps other states are developing bioweapons.[15]

The number of countries of concern is further reduced when crosschecked against those that are named by the U.S. State Department as sponsors of terrorism. This second group category includes countries presumed to have a BW program *and* sponsor terrorism or are otherwise of concern. Iran, North Korea, and Syria fit the first two criteria. Cuba may not have a BW program, but is on the list of state sponsors of terrorism.[16] Although Russia is not on the terrorism list, its refusal to permit outside inspection of some former biological weapons facilities has created concerns about its activities.[17]

A third category includes sub-state groups that are presumed to have BW programs. A U.S. State Department report in 2006 noted: “Among present-day terrorist organizations, al-Qaeda is believed to have made the greatest effort to acquire and develop biological weapons. U.S. forces discovered a partially built biological weapon laboratory near Kandahar after expelling the Taliban from Afghanistan.”[18] Al-Qaeda’s interest in developing biological weapons was also confirmed in documents and on computers captured in Afghanistan. Whether any biological agents were actually developed as weapons is questionable. Author Ron Suskind reported that intelligence officials told him that in 2003 the CIA found “extremely virulent” anthrax in an Afghanistan laboratory. The claim has not been publicly substantiated by any other authority.[19]

Besides al-Qaeda, Palestinian terrorist groups including Hamas have expressed interest in developing biological and chemical weapons and claimed success in acquiring them.[20] In June 2006, the Aksa Martyrs Brigades, which is part of the Palestinian Authority, announced it had produced “at least 20 different types of biological and chemical weapons.”[21] However doubtful the validity of these claims may seem, they cannot be ignored. At the least they are an affront to the international norm that deems biological weapons “repugnant to the conscience of mankind,” in the words of the BWC.

The fourth categorical group that poses a potential BW threat includes laboratories around the world that are engaged in the development of emerging biotechnologies. Innovations in biotechnology are aggressively being pursued in a variety of fields from medicine and agriculture to communications and robotics. In 2001, for example, “nano-drugs” were being developed to affect gene expression. The intention is to find drugs that might cure disease. But such research could as easily lead to the development of drugs that affect gene expression in harmful ways. Similarly, the discovery in 2002 of “interfering” RNA molecules offers the potential to block gene expression in the pathway of disease. Here too, the technique conceivably could be used for harmful purposes—to enhance gene expression that causes disease.[22]

Concern about such dual use possibility has prompted a report by the National Institute of Medicine (IOM) to warn that the “accelerating pace of discovery in the life sciences has fundamentally altered the threat spectrum.” This heightened pace renders the immune, neurological, and endocrine systems vulnerable to manipulation of bioregulators, a situation described in the IOM report as “an increasingly apparent dual-use risk.”[23]

Other advances in molecular genetics further underscore the growing potential for the misuse of new knowledge. In 2002, based on the knowledge of its genetic sequence, the poliovirus was synthesized in a laboratory from snippets of DNA that were commercially obtained.[24] Similarly, in 2005, scientists synthesized the Spanish flu virus (H1N1) that killed an estimated 50 million people in the 1918-1919 pandemic.[25] Although the structures of these viruses are less complex than that of the variola virus, which causes smallpox, few doubt that a concerted effort could eventually synthesize a host of threat agents including the smallpox virus.

Thousands of laboratories around the world are engaged in biotechnology and nanotechnology research and development. Many are in the U.S. and Europe, but also in Argentina, Brazil, Chile, China, India, Japan, Russia, South Korea, Thailand, and more. Thus, apart from concerns about the classical select agents and traditionally understood sources of bioterrorism, advances in biotechnology have created an added potential risk from life science research. This recent concern has prompted an urgent call for national and international codes of conduct and ethics for life scientists.[26]

Efforts to Block Pathways to BW Proliferation

Several initiatives to minimize the chances of BW proliferation have been undertaken in recent years. Apart from the prohibitions expressed in the BWC and CWC, several countries, known as the Australia Group, now exercise export controls over materials that could be used to manufacture chemical or biological agents. The group was established in 1985 at the suggestion of Australia and has grown to include some forty western oriented countries. Among the lists of controlled items for export are the 70-odd select biological agents and dual use biological equipment such as centrifuges, fermenters, and freeze dryers.[27]

Beyond international efforts, several U.S. domestic initiatives have also been undertaken. In 1991, for example, congress enacted legislation proposed by Senators Sam Nunn and Richard Lugar to help employ former Soviet weapons scientists in non-military projects.[28] By the mid-1990s around 3,000 of more than 100,000 former nuclear-chemical-biological weapons scientists were being funded by Nunn-Lugar money for research in non-defense projects.[29] Subsequently, more ex-weapons scientists were similarly funded, though underemployment remained a problem among ex-Soviet scientists.

In 1996 a new law required that interstate transfer of select agents from one laboratory to another must be registered with the CDC.[30] Prior to enactment of this legislation, laboratories exchanged highly virulent microorganisms and toxins without registering the transactions with any outside party. Thus records of these exchanges, if they were kept at all, had been entirely within the purview of the laboratories.

The USA Patriot Act, which was enacted after 9/11 and the anthrax attacks, placed restrictions on who could have access to select agents in American laboratories. Specifically prohibited were nationals of Cuba, Iran, Iraq, Libya, North Korea, Sudan, Syria, or any other country designated by the State Department as a sponsor of terrorism.[31]

However helpful these requirements may have been, they did not address the central issue of accountability by laboratories of their stocks of organisms. This situation was belatedly rectified in 2002 with legislation that requires laboratories to report their possession of select agents and register with the CDC.[32] Until passage of this law no party outside the laboratory was necessarily aware of which select agents were being stored or investigated in any particular laboratory. The earlier 1996 antiterrorism act had required registration with the CDC only if a select agent was being sent to or received from another laboratory.

Beyond legislation, concerns have surfaced about various biological research programs in the United States along with notions about how to control them. Richard Ebright, a biochemist at Rutgers University, worries that the large increase in governmental spending on bioweapons research creates new risks. He estimated that 300 U.S. institutions now have access to live bioweapons agents and that 16,500 individuals are approved to work with them. Many of the investigators previously had no experience with such organisms but were drawn to study them by newly available funds for biodefense research. Their inexperience increases the risk of accidental release of these organisms. Ebright also worries that the expanding pool of individuals with expertise increases the risk that some will engage in illicit activity.[33] Accordingly, Ebright supports reduction of the number of laboratories and investigators dealing with select agents.

These concerns are focused on the threat associated with the classical agents deemed to be potential bioweapons. They have little relationship to the emerging threats associated with biotechnology. The complexity of this growing challenge is underscored by the questionable effectiveness of proposals by some scientists who seek to enhance protection and prevention. George Church, a geneticist at the Harvard medical school suggests licensing the bio-supply chain of materials and equipment used in biotechnology. He would require registration of all researchers working with select agents or on immune system responses to pathogens as well.[34]

Given the number of items to register, the proposal seems unworkable. Trying to register DNA synthesizers alone would be formidable. A DNA synthesizer costs around $5,000 and there are at least 50,000 of them throughout the world. But blueprints for constructing a DNA synthesizer are on the Internet, which could allow them to be built without notification to an outside authority.[35] Some scientists reveal a sense of futility about trying to curb the dark possibilities of biotechnology. Serguei Popov, formerly a germ weapons scientist in the Soviet biological weapons program who now works at George Mason University, acknowledges that he sees no solution now. But the first step, he suggests, is to make the public aware of the danger.[36]

Added to the limited ability to control or even monitor the development of illicit weapons is the recognition that scientific expertise is for sale. By 1999 at least five former Soviet biological weapons scientists reportedly had been hired to work in Iran. Their salaries, around $5,000 per month, far exceeded their incomes at home.[37] A survey conducted in 2003 found that 21 percent of Russian scientists (including physicists, chemists, and biologists) would consider working in Iran, Syria, or North Korea for at least one year.[38]

Developing a nuclear weapon is technically complex and must draw from expertise in several fields including mathematics, nuclear and materials physics, chemical and electrical engineering, and more. The notorious case of Abdul Qadeer Khan, the reputed Pakistani “father of the Islamic bomb,” underscores the point. Khan had stolen design plans to enrich uranium from a Dutch centrifuge plant where he worked in the early 1970s. In 1976 he became head of a secret Pakistani effort to produce weapons-grade uranium.[39] But it took nearly a decade, billions of dollars, and a cadre of Western-trained trained physicists and engineers before Pakistan’s centrifuges began to produce highly enriched uranium. Another ten years passed before Pakistan actually tested a weapon.[40]

By contrast, in the biological sphere, a lone individual with a modicum of microbiology laboratory training, and with access to a select agent, could produce a biological arsenal in a few weeks. The effectiveness of an agent as a weapon varies according to the nature of the organism and the form of production. Virulent anthrax bacteria, for example, can easily be produced in a wet form by growing the organism in a nutrient medium. But an unrefined mixture of moist anthrax spores would be less potent than a dry product that could float and easily be inhaled. A more challenging next step would be to process the dry spores, which tend to cling to each other, as individual particles. Free floating individual spores, after being inhaled, could more easily reach the alveoli at the end of the respiratory tree. There they are engulfed by macrophages, white cells

that ordinarily destroy foreign particles. But once inside a macrophage an anthrax spore can transform into a reproducing organism that releases lethal toxin.

In February 2003, while addressing the UN Security Council, U.S. Secretary of State Colin Powell held aloft a small vial of white powder. In emphasizing the dangers of biological weapons he said, “Less than a teaspoonful of dry anthrax, a little bit, about this amount . . . shut down the United States Senate in the fall of 2001.”[41] Powell was speaking on the eve of the invasion of Iraq by U.S.-led coalition forces and was warning about that regime’s presumed arsenal of anthrax and other non-conventional weapons.

After the invasion no such weapons were found, but Powell’s description of the effect of the poison powder was, if anything, understated. Not only the Senate but the entire Capitol was closed along with the office buildings of members of the Senate and House of Representatives. At various periods during the anthrax scare in the fall of 2001, reports of spores elsewhere resulted in the shutting down of much of official Washington. Actual or suspected anthrax contamination prompted closing parts of the Pentagon, the Federal Reserve Building, offices of the State Department, the Supreme Court, and major postal facilities.[42] A review of the anthrax events offers an instructive account of the only intentional bioattack in the United States known to have resulted in the loss of life.

The Anthrax Attack Through the U.S. Mail

The anthrax bacterium has long been considered a prime biological weapon. In spore form, the organism is hardy, durable, and potentially lethal if inhaled. During World War II, British and American experiments demonstrated that the inhalation of airborne spores would kill livestock and, presumably, humans.

In the 1950s and 1960s, the U.S. Army conducted hundreds of germ warfare tests in populated areas throughout the United States. Mock biowarfare agents were released from boats, slow-flying airplanes, automobiles, germ-packed lightbulbs, perforated suitcases, and wind-generating machines. The test agents included the bacteria *Serratia marcescens* and *Bacillus subtilitis*, and the chemical zinc cadmium sulfide. (Although less dangerous than real warfare agents, the test bacteria and chemicals posed some risks.) Cities and states including San Francisco, Minneapolis, St. Louis, and parts of Illinois, Ohio, and Hawaii were blanketed with these agents. Some attacks were more focused, such as those in which bacteria were released in the New York subway and on the Pennsylvania Turnpike. In each instance, the spread and survivability of the bacteria were measured to assess the country’s vulnerability to a germ attack.[43] But apparently the testers never considered the U.S. mail as a possible vehicle. In the fall of 2001, the effectiveness of the mail as a delivery system suddenly became evident.

On October 4, 2001, the U.S. Centers for Disease Control and Prevention (CDC) confirmed a Florida state laboratory finding that a 63-year-old man tested positive for anthrax. The patient, Robert Stevens, was a photo-editor for the *Sun*, a supermarket tabloid published by American Media, Inc. (AMI) in Boca Raton. He died the next day. The cause was inhalation anthrax, an infection resulting from breathing in the bacterium. Inhalation anthrax is so rare that only eighteen cases in the United States had been recorded in the 20th century. The most recent instance before 2001 was in 1976 when a California weaver was infected by spores from wool that had been imported from Pakistan.[44]

In the wake of 9/11, and with recent publicity about anthrax as a potential biological weapon, some people suspected that Stevens’s infection might be associated with bioterrorism. But federal and state officials initially discounted that possibility. State public health authorities in Florida and North Carolina, where Stevens had just vacationed, insisted that his infection in no

way implied terrorism. Tommy Thompson, the U.S. Secretary of Health and Human Services, flatly declared, “There is no terrorism.”[45]

Meanwhile, CDC officials investigated dozens of places that Stevens had frequented in the months before his diagnosis. They collected samples and swabbed surfaces for analysis in restaurants, shops, parks, his home in Lantana, and his workplace in the AMI building. On October 7, two days after his death, tests indicated the presence of anthrax spores on Stevens’s computer keyboard and in the AMI mailroom. These findings made clear that the dismissal of bioterrorism as a possible cause of his death had been premature. During the following weeks *Bacillus anthracis* was found to have infected residents of Washington DC and of seven east coast states: Florida, Virginia, Maryland, Pennsylvania, New Jersey, New York, and Connecticut. All told, eleven people were stricken with inhalation anthrax including the five who died. Another eleven had contracted the less dangerous cutaneous form of the disease and all survived.[46]

The last reported case was a 94-year old Connecticut woman who died of inhalation anthrax on November 21. During the two-month roll out of infections, it became understood that the bacterium had been disseminated through the United States mail. Most victims were postal workers or otherwise known to have been in contact with contaminated mail. Four letters, each containing 1-2 grams of dry anthrax spores, were found during this period. All were postmarked “Trenton, NJ” which meant they were mailed in the Princeton-Trenton area and processed at the Postal Sorting and Distribution Center (PSDC) in nearby Hamilton, New Jersey. Two envelopes were postmarked September 18, 2001, one addressed to the editor of the *New York Post* and the other to Tom Brokaw at NBC-TV. The message on a sheet inside was a copy of an original that evidently was kept by the mailer. Under “09-11-01,” in handwritten block letters, the text read:

This is next
Take penacilin [sic] now
Death to america
Death to israel
Allah is great[47]

The other two recovered envelopes, postmarked October 9, 2001, were addressed to Senator Tom Daschle and Senator Patrick Leahy. The text in both letters was identical, though somewhat different from the wording in the first pair. Dated “09-11-01” they read:

You cannot stop us.
We have this anthrax.
You die now.
Are you afraid?
Death to America.
Death to Israel.
Allah is great.[48]

Anthrax letters were presumably also sent to the ABC and CBS television studios in New York as well as the offices of the *Sun* and another AMI tabloid, the *National Inquirer*. This assumption is based on the trails of spores found in these places and the identification of infected individuals who had been in their proximity. Since the envelope flaps were sealed with tape the anthrax spores, each around one micron in diameter, apparently had been leaking through the envelope paper whose pores exceeded twenty microns in size. Although bacteria could have been transported to these locations by cross-contaminated mail, their large concentrations suggested the likely source was an original threat letter.

In most instances, initial diagnoses of the victims failed to include anthrax as a possible cause of their illness. Nor was the extent of contamination in scores of buildings, offices, and postal

facilities quickly recognized. As succeeding days and weeks brought information about more victims and contaminated locations, the public became increasingly anxious. The actual presence of spores, along with several false alarms prompted not only federal buildings in Washington DC to shut down but several offices along the eastern seaboard and a postal facility as far west as Kansas City, Missouri.[49] People everywhere were afraid to open mail.

Despite generating massive disruption the anthrax attacks resulted in relatively few casualties. But they demonstrated the potential for more devastating consequences. More than 30,000 people who were considered at risk from exposure to the bacterium were treated with prophylactic antibiotics.[50] Without this intervention, many of them might well have become infected and died. Moreover, if the strain of bacterium had been drug resistant, or if hundreds of anthrax letters had been mailed, the number of deaths and illnesses would surely have been greater.

While much is known about the 2001 anthrax attacks, many issues remain unresolved. Some have less bearing than others on blocking pathways to proliferation and use. For example, issues related to the recovery of the infected victims, decontamination of infected locations, or the enormous financial consequences of the attacks, while important, have little bearing on understanding how the anthrax was acquired and used. But other facts, challenges, and lessons are more directly related to the pathways toward this bioattack. Four of these issues in particular bear on preparedness and protection.

First, launching a bioattack can be as simple as dropping a letter into a mailbox, which is how the anthrax assault began. Although acquiring and processing the organism could pose challenges, releasing it as an instrument of terror could not be easier. However, only certain agents can effectively be conveyed by mail—those that are durable and potent in powder form. These characteristics apply especially to spore forming bacteria like anthrax, and toxins such as botulinum toxin or ricin. Viral agents, such as those that cause hemorrhagic fever, are transmitted largely through person-to-person contact. The smallpox virus cannot even survive outside a human host unless maintained under certain laboratory conditions, and therefore would pose no threat by mail.

Second, the anthrax attack demonstrates how difficult finding the perpetrator can be. Efforts to pinpoint the source of the anthrax and whoever mailed it have been elusive. Despite an intensive effort by the FBI to identify the culprit, five years after the attack no one has been charged. The case is all the more frustrating because so much information is available about the mailings. The fact that the powdered bacteria were sent with threat messages that identified the contents as anthrax, made finding several letters easier. Another informative feature included the markings on the recovered envelopes that revealed the dates and times they were processed and at which postal centers they were sorted. Finally, bacteria were isolated not only from victims but from the recovered letters, which enabled DNA matching and analysis from both sources. Yet even with all this information, the identity of the perpetrator(s) is still uncertain. His/their motivation and base of operation remain speculative.

Third, the anthrax attack provided information about a method of delivery not previously appreciated. The dissemination of a tiny volume of powdered spores was surprisingly widespread. A Canadian experiment in early 2001 demonstrated that spores in letters could readily disperse after an envelope was slit open. The experiment was conducted in a confined chamber with simulated anthrax powder.[51] But that study hardly foretold the extensive leakage that could occur even from unopened letters and the resulting large-scale contamination of buildings and pieces of other mail. The total volume of powder in all the anthrax letters was less than a handful (an estimated 7-14 grams). Yet the powder became broadly dispersed and prompted widespread anxiety.

Fourth, the attack highlighted the challenge of diagnosing illness caused by a select agent. As the outbreak in 2001 showed, healthcare workers often failed to consider anthrax in their differential diagnoses. Most physicians who examined patients with cutaneous anthrax presumed their lesions were attributable either to a spider bite or to an unknown cause. Similarly, many doctors who saw patients with the inhalation form of the disease ascribed their illness to a viral infection devoid of sinister implications. Few healthcare professionals considered anthrax at the outset.[52] This failure was compounded by a general lack of skill and equipment to test accurately for anthrax.

The CDC began to create a laboratory response network in 1999 that would broadly enhance the nation's ability to identify anthrax and other agents. By 2001 only a limited number of local and state facilities were capable of testing for select agents. That capacity has expanded and now numbers more than 140 laboratories throughout the country including those at federal agencies and military installations.[53] Presumably these laboratories can now confirm the presence or absence of select agents more quickly and accurately than was possible five years ago. Still, a large infusion of samples requiring quick testing would still strain the system. Moreover, while awareness of the threat of bioterrorism has doubtless grown in the medical community since 2001, whether doctors are now more likely to consider anthrax or other select agent illnesses in their differential diagnoses remains uncertain.

Conclusion

In reviewing the nature of biological weapons, their potential sources, and how they might be used, it becomes clear that blocking their acquisition is a formidable challenge. No policies can ensure that a determined state or group will be deprived of a biological arms capability. But this fact does not negate the need to minimize the chances of that eventuality. In this regard, traditional methods of oversight, such as surveillance and intelligence, are essential. Domestic regulation and export controls, as discussed previously, are also vital. These efforts can be buttressed by underscoring the universal understanding that the use of biological agents as weapons should be rejected on moral grounds. This moral understanding is at the core of the 1925 Geneva Protocol and the 1972 Biological Weapons Convention. In both these international agreements, the use of biological weapons is posed as an effrontery to the civilized world.

Still, some states and sub-state groups have defied this universal precept, and the threat of bioweapons must continue to be addressed. A helpful step would be to strengthen the BWC by adding provisions for verification of compliance. This would include visits by international inspectors to a country's laboratories and other relevant facilities. Violators of the treaty would be subject to punishment including sanctions and force. Although sub-state groups are not directly affected by the terms of the BWC, strengthening the norm against biological weapons could influence behavior even among terrorist groups. In a society that vigorously condemns the possession of such weapons, pressure on all groups not to violate the norm would be greater. Still, the threat, even if lessened, will not be eliminated. The need for preparedness and the ability to respond to a bioattack will persist as long as the threat persists.

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