Secret Intelligence Service

Room No. 15

Bioterrorism - Introduction

(I of 25)

Possible motivations for resort to bioterrorism and the technical hurdles that face anyone attempting to use biological agents

Note Format (C-I)

During the past five years, the threat of BIOTERRORISM has become a subject of widespread concern. Journalists, academics, and policy analysts have considered the subject, and in most cases found much to alarm them.

Many who are concerned present apocalyptic visions of the threat, contending that it is only a matter of time before some terrorist uses biological agents to cause mass casualties. In contrast, others argue that the empirical record provides no basis for concern, and thus largely dismiss the potential threat. Neither approach is helpful. Imagining catastrophic threats inevitably leads to a requirement for impossibly large response capabilities. In contrast, denying the potential danger altogether leads to the kind of tunnel vision that led intelligence officials to totally ignore the emergence of Aum Shinrikyo, in Japan.

Let’s look at what supports (or otherwise) the views of those who argue that >> biological agents are difficult to use.

Indeed there is abundant evidence that some people have desired to inflict mass casualties on innocent populations through employment of biological agents. Fortunately, these accounts also suggest that such people lacked the capability to follow through with their plans. In addition considerable doubt is cast on the ability to predict which biological agents a perpetrator might employ. While some assume that

terrorists will use those agents that proved of most interest to state weapons programs, bioterrorists and BIOCROMINALS have acquired and used agents of little or no value as weapons of war. Ultimately bioterrorism is a low probability, though potentially a high consequence event.

What is Bioterrorism? Bioterrorism is assumed to involve the threat or use of biological agents by individuals or groups motivated by political, religious, ecological, or other ideological objectives. This definition differs in several significant ways from many of the widely accepted definitions of terrorism. Official definitions of terrorism generally emphasize that terrorism is intended to intimidate governments or societies. Essentially terrorism is the ability to terrorize. A definition of bioterrorism does not require such a motivation, although it also does not exclude it. A definition that focuses on political intimidation fails to capture two significant motivations for bioterrorism. First, some terrorists are attracted to biological weapons because they understand that pathogens could well cause mass casualties on an unprecedented scale. Official definitions appear to exclude groups with apocalyptic visions who are uninterested in influencing governments and seek instead to inflict mass casualties. Traditional terrorists use violence as a means to an end. In contrast, proponents of catastrophic terrorism view mass killing as the desired end. Groups of this type are not common, yet they do exist. Second, other terrorists are attracted to unique features of bioterrorism that have nothing to do with the intended psychological impact of biological weapons use. They see biological agents as a tool for achieving specialized objectives not necessarily intended to directly influence government actions. Virtually all bioterrorists seek to keep their use of biological agents a secret, because in many instances success depended on the lack of appreciation that a disease outbreak was intentional. A bioterrorist can include any non-state actor who uses or threatens to use biological agents on behalf of a political, religious, ecological, or other ideological cause without reference to its moral or political justice.

There are multiple definitions of terrorism; “the calculated use of violence or threat of violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religious, or ideological.” “the unlawful use of force or

violence against persons or property to intimidate or coerce a Government, the civilian population, or any segment thereof, in furtherance of political or social objectives."

This includes non-state actors who operate in organised military units (as with guerrillas) if biological agent use was undertaken with covert, improvised delivery means.

Despite all the attention devoted to bioterrorism, it remains surprisingly misunderstood. In part, this reflects a lack of information about bioterrorism. Relatively little effort was devoted to its study, and the focus of the small literature on the subject was largely theoretical.

Virtually nothing was written about past examples of bioterrorism. Indeed, the first unclassified effort to systematically identify all bioterrorism incidents was not conducted until 1995.

Given this apparent lack of interest, it is perhaps not surprising that the first official account of the 1984 use of biological agents by the Rajneeshees was published only in 1997.

During the late 1990s, the gaps in our understanding of past terrorist interest in biological agents have been reduced by several initiatives to explore the history of bioterrorism. Scholarly research has played a significant role in this process, creating comprehensive databases of chemical and biological terrorism incidents and detailed case studies analysing terrorist resort to chemical and biological weapons. Researchers have also examined specific instances of bioterrorism.

The unique characteristics of biological agents make bioterrorism fundamentally different from other forms of terrorism. Not only do biological agents differ radically from other weapons available to the terrorist, but biological weapons also are substantially different from other weapons of mass destruction, such as chemical and nuclear weapons. Assessing the prospects for bioterrorism requires an appreciation of how biological agents can be acquired and how they are disseminated. Because terrorists are likely to be confronted with many of the same obstacles faced by criminals

in the acquisition and use of biological agents, both types of actors are included.

A starting point for evaluating the challenge posed by bioterrorism is an examination of the evidence regarding the extent to which terrorists have used or thought about using biological agents. Some caution must be exercised in evaluating the empirical data, because it is possible that future patterns will differ significantly from past patterns of behaviour.

Bioterrorism and /or Biocrimes

Interest in biological agents is not confined to groups with known political agendas. Most individuals and groups who have used biological agents had traditional criminal motives. Hence, it is essential to separate the clearly criminal perpetrators from those with political agendas, whether the motive is sectarian, religious, or ecological. Available evidence, in fact, suggests that the vast majority of cases involve criminal motives.

To date, few terrorists have demonstrated an interest in bioterrorism, and fewer still tried to acquire biological agents. Open source accounts mention at least 54 cases in which a terrorist group allegedly had an interest in biological agents, but there is little evidence to confirm most of the cases. Thus, there are only 27 cases in which there is more than minimal evidence that a terrorist group possessed, attempted to acquire, threatened to use, or expressed interest in biological agents. Even in some of confirmed cases, there is no way to determine the seriousness of the interest in biological agents. Terrorist groups apparently acquired biological agents in only eight cases. Terrorists have used biological agents, but rarely and with relatively little effect. A review does confirm only five groups that used or tried to use biological agents. Although there may be other examples that have never been publicly identified, only one of these cases is known to have resulted in harm to people.

USA. According to the FBI, there is only one instance in which a terrorist group operating in the United States actually employed a chemical or biological agent. This incident took

place in September 1984. The perpetrators were members of the Rajneeshee, a religious cult that established a large commune in Wasco County, a rural area east of Portland, Oregon. The Rajneeshees used Salmonella typhimurium, which causes salmonellosis or food poisoning, to contaminate restaurant salad bars. An estimated 751 people became ill because of that attack, including about 45 who were hospitalized. There were no fatalities. This is the only bioterrorism incident in which human illness has been verified.

In addition to using sarin nerve gas in the Tokyo subway system, Aum Shinrikyo produced biological agents and tried to use them. According to press reports, the Japanese police discovered and alarmingly that the Aum's membership included skilled scientists and technicians, including some with training in microbiology. The Aum expressed an interest in several biological agents, allegedly including anthracis, botulinum toxin, burnetii (Q-fever), and even Ebola. The Aum tried to disseminate biological agents, including anthracis and botulinum toxin, but there is no evidence that they actually managed to produce any pathogens or toxins. The group allegedly targeted the U.S. Navy base at Yokosuka in one of its attempted attacks.

United Kingdom. Dark Harvest - a little known group protested the continued anthrax contamination of Gruinard Island, which is where the British military tested an anthrax bomb during World War Two. The group took anthrax-contaminated soil, apparently from the island, and dumped it on the grounds of Porton Down, the site of the Biological and Chemical Weapons Research Establishment. The anthrax was in a form that was highly unlikely to cause harm.

Mau Mau / Kenya: UK authorities believe that during late 1952, individuals associated with the Mau Mau African independence movement were responsible for using a plant toxin to poison livestock in what is now Kenya. The full extent of these activities is not known.

Poland. Polish Resistance: Multiple reports suggest that Polish resistance organizations used biological agents against German forces during the early part of the World War II. One Polish official claimed that 200 Germans were killed in this manner, but the claim was never confirmed.

Motivations

The review of cases identifies a number of reasons that led terrorists and criminals to become interested in biological agents:

Sheryl WuDunn, Judith Miller, and William J. Broad, "How Japan Germ Terror Alerted World," New York Times, May 26, 1998, pp. A1, A10, provides the most thorough reporting of Aum's biological warfare activities. See page 47 for additional details.

Mass murder: At least two terrorist groups, motivated by apocalyptic, millenarian visions of somehow creating a better society, clearly wanted to kill large numbers of people. In principle, such groups also could be motivated by desires for revenge against a specific political or ethnic group. Steven Pera and Allan Schwander formed a group, which they called R.I.S.E., with the intention of killing most of the human race so that mankind could start over again. Aum Shinrikyo also wanted to murder vast swathes of the population as part of their efforts to seize control of Japan.

Murder: Several terrorist groups are known to have considered biological agents as weapons to kill specific individuals. In general, the perceived attractiveness of biological agents results from the belief that the victim will appear to have died a natural death. The perpetrators hoped that it would prove impossible either to detect the biological agent (especially if it was a toxin) or to determine that the victim was deliberately infected (especially if it was a pathogen).

Incapacitation: In at least two instances, the perpetrators wanted to incapacitate large numbers of people without necessarily killing anyone. According to press accounts, the Weathermen attempted to obtain biological agents to infect water supplies. They hoped the repressive reaction of the government to such an incident would radicalize the general population and create additional supporters for their cause.

Rajneeshees also wanted to incapacitate the citizens of The Dalles. Oregon. USA - so that the people of the community could not vote in an upcoming election. While the

circumstances of that attack are unlikely to reappear, the case demonstrated that biological agents have utility as inducing mass incapacity.

Political statement: In one case, the perpetrators used biological agents to make a political statement. This was the objective of Dark Harvest, a group that apparently was uninterested in causing harm to people or property, but was willing to 'use' biological agents to send a political message.

Anti-agriculture: Either targeting livestock or crops.

As previously mentioned, the Mau Mau apparently used a plant toxin to kill cattle as part of a concerted campaign that involved known use of other poisons, including arsenic.

Agriculture: Numerous biological agents can be used to target crops and livestock. The viability of the threat is demonstrated by the efforts by several countries to develop biological agents for use against crops

The Soviet Union had a substantial program to develop agents for use against crops and animals.

Iraq admits that during the 1980s it was developing at least one biological agent for use against crops, wheat cover smut, which kills the affected plants.

Criminal motives: An examination of criminal use of biological agents reveals additional motives. Many of the criminal uses of biological agents involved extortion. Generally, the target is / was a food or grocery company. In only one of these cases is the perpetrator known to have had the capability to undertake the threatened contamination. There is no documented case of a terrorist group using biological agents to extort money. However, several unidentified individuals tied political agendas to extortion plots involving threats of biological weapons use. Many of the cases appear to involve deliberate efforts to terrorize the victims. In most of these cases, the perpetrator appeared to want to accomplish nothing more than to make the victims worry about their health. At least one case, involving the Japanese physician Dr. Mitsuru Suzuki, appears to have been motivated by the desire for revenge. Suzuki was angry about the treatment he was receiving as a resident in his medical training, and allegedly retaliated by infecting other health care providers and

patients. Suzuki's motivations are complicated by suggestions that he may have been creating clinical cases to further his academic research into S. typhi.

Trends in Bioterror

It is suggested that there is an explosion of interest by criminals in biological agents

USA. The most extensive official comment on terrorist and criminal interest in biological weapons comes from as far back as 1997 in a testimony given by Director Louis Freeh. At that time, he made the following observations: The FBI has also investigated and responded to a number of threats which involved biological agents and are attributed to various types of groups or individuals. For example, there have been apocalyptic-type threats which actually advocate destruction of the world through the use of WMD. We have also been made aware of interest in biological agents by individuals espousing white-supremacist beliefs to achieve social change; individuals engaging in criminal activity, frequently arising from jealousy or interpersonal conflict; individuals and small anti-tax groups, and some cult interest. In most cases, threats have been limited in scope and have targeted individuals rather than groups, facilities, or critical infrastructure. Threats have surfaced which advocate dissemination of a chemical agent through air ventilation systems. Most have made little mention of the type of device or delivery system to be employed, and for this reason have been deemed technically not feasible. Some threats have been validated.

According to 1997 testimony by DCI George Tenet, the US Intelligence Community also has found evidence that foreign terrorist groups are showing greater interest in biological weapons. >>"We are increasingly seeing terrorist groups looking into the feasibility and effectiveness of chemical, biological, and radiological weapons."

The CIA concluded at the time, "The current WMD terrorist threat is considered low.

There are documented instances of chemical contamination of food to prevent sale of agricultural produce. For example, mercury was injected into oranges exported from Israel in

1978, causing a dramatic reduction in demand for its citrus crop.

Specifically, the United States weaponized and stockpiled rice blast, rye stem rust and wheat stem rust.

However, during April 1998, Clinton Administration officials reportedly testified during a classified hearing before the Senate Intelligence Committee that there was a >> “high degree of likelihood that such an attack would occur in 10 years.”

There is reason for concern that future bioterrorism attacks may be more deadly than past incidents. Three factors account for the change.

An increasing number of terrorist groups, foreign and domestic, are adopting the tactic of inflicting mass casualties to achieve ideological, revenge, or “religious” goals, often hard to understand. If such groups acquired an effective aerosol dissemination capability for anthrax, for example, they could potentially kill tens or hundreds of thousands of people. The World Trade Centre and Oklahoma City bombings both were conducted by people who had no compunction about mass killing and, in fact, sought to kill large numbers of civilians.

>>The technological sophistication of the terrorist groups is growing. We now know that some terrorists have tried to master the intricacies of aerosol dissemination of biological agents. Perhaps more disturbing for the future, some terrorists might gain access to the expertise generated by a state-directed biological warfare program.

Aum Shinrikyo demonstrated that terrorist groups now exist with resources comparable to some governments. Therefore, it is seems increasingly likely that some group will become capable of using biological agents to cause massive casualties.

Biological agents are organisms or toxins produced by organisms that can be used against people, animals, or crops. In contrast, chemical agents, poisonous substances that can kill or incapacitate, are man-made materials.

Pathogens are naturally occurring micro-organisms that cause disease. There are hundreds of pathogens, including bacteria,

viruses, fungi, and parasites. Among the pathogens often mentioned as potential biological agents are Bacillus anthracis, the organism that causes anthrax, and Yersinia pestis, the organism that causes plague.

Because pathogens are living organisms, they are self-replicating. Exposure to even a small number of organisms can produce severe symptoms or even death.

A definition of a biological agent

Biological agents are either replicating agents (bacteria or viruses) or non-replicating materials (toxins or physiologically active proteins or peptides) that can be produced by living organisms. Some of the non-replicating biological agents can also be produced through either chemical synthesis, solid-phase protein synthesis, or recombinant expression methods.

A microorganism is that which causes disease in personnel, plants, or animals or causes the deterioration of materiel."

A toxin agent can be defined as "a poison formed as a specific secretion product in the metabolism of a vegetable or animal organism as distinguished from inorganic poisons. Such poisons can also be manufactured by synthetic processes."

Toxins can be defined as any toxic substance of natural origin produced by an animal, plant, or microbe. They are different from chemical agents such as VX, cyanide, or mustard in that they are not man-made."

Note, there are many different strains of B. anthracis, but there is no uniquely military type. Rather, biological agents used in biological weapons have been strains of naturally occurring organisms. Similarly, there is considerable confusion about plague. Y. pestis, the plague bacillus, causes several different diseases, including bubonic plague and pneumonic plague, but there is no bubonic plague or pneumonic plague organism.

According to one estimate, the accidental release of B. anthracis spores from the Soviet biological weapons facility at Sverdlovsk killed at least 66 people and involved somewhere between a few milligrams and a gram of agent. It appears that 1-3 per cent of those in the area covered by the B. anthracis cloud died. Thus, if only 6 milligrams were disseminated, the

agent cloud would have contained at least 6 million lethal doses, which is nearly 100,000 times the number of people who actually died

A review** of the published anthrax research reached the following conclusion on the susceptibility of humans to infection from anthrax. The data available on human exposure to B. anthracis spores do not allow us to establish the minimum critical dose required to establish any of the forms of the disease. From the information available, it can be said that man appears to be moderately resistant to anthrax. It is crucial to note that any critical dose will depend very heavily on the strain of B. anthracis, particularly the presence of the virulence factors, and on the health of the individual host. ** See A. Watson and D. Keir, "Information on which to base assessments of risk from environments contaminated with anthrax spores," Epidemiology and Infection, 113(1994), pp. 479-490.

Anthrax is not contagious, and only those exposed to the released B. anthracis spores are likely to become infected.

Pathogens require an incubation period before symptoms of infection appear. For some diseases, the incubation period is only a few days, while for others it might be several weeks. Typically, 3-5 days pass before the acute symptoms of inhalation anthrax appear, while for Q fever (caused by the Coxiella burnetii organism) the incubation period is two to three weeks, depending on the size of the dose.

Toxins are poisonous chemicals produced by living organisms. Among the best known are botulinum toxin, which is produced by the bacteria Clostridium botulinum, and ricin, which is extracted from the seed of the castor bean plant. Unlike pathogens, toxins are not self-replicating, so their physical effects are solely a result of the agent released. While toxins share many characteristics with chemical agents, they also have some significant differences.

Many toxins are more toxic than the most lethal of chemical agents. Thus, the LD50 for botulinum toxin when injected is 0.001 micrograms per kilogram of body weight. In contrast, VX, perhaps the most lethal of the chemical agents, has an LD50 of 15 micrograms per kilogram of bodyweight.

Toxins are not volatile, unlike many chemical agents, and thus do not naturally generate a persistent threat. Generally, toxins are not dermally active, meaning that contact with the skin is insufficient to produce disease. Rather, the agent must be brought into the body, either by ingestion, inhalation, or through an opening in the skin.

The quantity of toxin required to achieve a desired effect is dependent on the lethality of the agent. According to one estimate, eight tons of ricin would be needed to blanket an area to achieve the same effect accomplished using only eight kilograms of botulinum toxin. For many toxins, the quantities of agent required to produce a given effect are similar in size to that for the more lethal chemical agents.

USA. Only 33 of non-state cases involved actual acquisition of agent. Four different methods were used: purchase from legitimate suppliers, theft, self-production, and use of material of natural origin contaminated with biological agents.

Acquiring biological agents has usually proven to be relatively easy. In a few cases, pathogens were acquired from culture collections, usually legitimately but sometimes not, while the perpetrators usually produced toxins. Culture collections were a preferred source for pathogens even when the terrorists or criminals possessed the skills to culture organisms acquired in nature. Reliance on such collections may be a result of the relative ease with which the cultures can be obtained. Alternatively, perpetrators may prefer to obtain cultures from standardized sources to ensure purity and avoid cross-contamination of cultures with unwanted organisms. In addition, the effectiveness of biological agents depends heavily on the specific strain of the organism, and it may be difficult to acquire the more dangerous strains relying on natural sources.

At least one authority argues that the LD50 is significantly greater than commonly reported. According to William Patrick, who developed biological weapons for the U.S. Army during the 1950s and 1960s, the LD50 for botulinum toxin through the inhalation route is 4.88 micrograms (a microgram is one millionth of a gram) for a 70 kilogram man (assuming 50% pure toxin). This translates to about 0.035 micrograms of pure toxin per kilogram of body weight, not 0.001 micrograms as usually reported.

Despite efforts to restrict the illicit acquisition of biological agents, it is likely that terrorists and criminals will be able to obtain the agent that they want when they want it. If unable to acquire from a legitimate culture collection or a medical supply company, they can steal it from a laboratory. If unable to steal it, a group with the right expertise could culture the agent from samples obtained in nature. Many biological agents are endemic, and a skilled microbiologist would have little difficulty culturing an agent from material taken from nature.

The American Type Culture Collection (ATCC) was the source of the agent in at least two cases. Larry Wayne Harris obtained Y. pestis, while Kevin Birch and James Cahoon acquired Clostridium botulinum and Clostridium tetani from this source. Benoyendra Chandra Pandey obtained the Y. pestis from the stocks of a medical research institute that he used to murder his brother, but only after several failed attempts to obtain it illicitly from the same source. The Rajneeshees purchased their seed stock of Salmonella typhimurium from a medical supply company.

The Rajneeshees had a state certified clinical laboratory, which gave them a legitimate reason to acquire agents like the one that they used.

In four cases of the 33 cases involving acquisition, the perpetrators acquired their biological agents by stealing them from research or medical laboratories. Almost all of the thefts involved people who had legitimate access to the facilities where the biological agents were kept. J.A. Kranz, a graduate student in parasitology, took the Ascaris suum eggs that he used against his roommates from the collections in the university laboratory where he studied. Law enforcement officials believe that a laboratory technician removed the Shigella dysenteriae Type 2 used to infect hospital laboratory technicians from the culture collection of the hospital where she worked. Similarly, Dr. Suzuki stole S. typhi cultures from the Japanese National Institute of Health, and reportedly used those cultures in preference to the ones he cultured himself from specimens taken from typhoid patients. In only one of the reported incidents was an attempt made to infiltrate a laboratory to steal a biological agent. It is alleged that the Weathermen group attempted to suborn an employee at the U.S.

military research facility at Ft. Detrick. USA., in order to obtain pathogens.

In cases involving acquisition, the perpetrators manufactured the agent themselves. In every reported case, the perpetrators produced ricin toxin by extracting it from castor beans. The Minnesota Patriots Council, which produced a small quantity of ricin toxin, made it from a recipe found in a book. In contrast, there were no successful attempts to grow C. botulinum to produce botulinum toxin. Several readily available 'how-to' manuals purport to describe techniques for producing botulinum toxin or extracting ricin from castor beans. A considerable number of perpetrators used 'The Poisoner's Handbook' and 'Silent Death'. Maynard Campbell's 'Catalogue of Silent Tools of Justice'.

Long before the Internet, perpetrators found it easy to obtain information about biological agents.

In certain cases involving acquisition the biological agent was obtained from a natural reservoir and transmitted without any processing. Some perpetrators apparently used castor beans, the seed containing ricin, to poison people without attempting to extract the ricin from the bean. Similarly, in several cases the perpetrators injected the victims with HIV-contaminated blood.

Terrorists and criminals have shown an interest in both pathogens and toxins. In 129 of the 150 non-state cases, the perpetrators threatened to use or considered pathogens. Note that few of these cases involved actual possession. Some perpetrators considered multiple pathogens. In one instance, at least seven different pathogens were involved. Terrorists and criminals may not use the same agents as those selected by military biological weapons programs. The objectives of the terrorists will influence the selection of an agent, as will agent availability and the resources at the disposal of the group for producing and disseminating the agent. This may lead to selection of unusual agents not associated with state-sponsored biological weapons programs. Fortunately, many of the alternative agents are unlikely to result in mass fatalities, even if they affect large numbers of people.

Bacterial agents: B. anthracis appears most often, and is associated with at least 113 cases, largely due to the growing popularity of anthrax threats. Note that only three of cases

involved possession of anthrax. Aum Shinrikyo may have had a stolen vaccine anthrax strain incapable of causing harm to humans. Dark Harvest had anthrax-contaminated soil, but never possessed the agent in a form likely to cause harm to people. Finally, the Polish Resistance apparently used cultures stolen from laboratories with legitimate uses for the organism. Yersinia pestis, S. typhi, and Shigella dysenteriae strains appear several times, while seven other pathogens appear no more than once.

Few perpetrators have considered viral agents, except when they can use it in a natural state. HIV appears in 15 cases, including at least four murder cases. Six of the HIV cases involved extortion threats in which in which there is no evidence of actual possession. In one case, the perpetrators employed a viral agent, rabbit haemorrhagic disease. Other pathogens: In only one case involved use of a parasite. In that case, the perpetrator contaminated food with Ascaris suum, a worm that infects pigs and does not normally infect humans.

In 27 of the 180 non-state cases, the perpetrators considered toxins. Ricin was considered in 14 cases. The next most common choice was botulinum toxin, which was an agent of choice in 9 cases. Significantly, there is no reported example of successful production of botulinum toxin, despite claims that it is easy to produce.

Other toxins include tetrodotoxin, an unknown mushroom poison, and an unspecified snake toxin. In most cases, only a single toxin was involved. In one case, a group of murderers acquired the toxins produced by Corynebacterium diphtheria and Vibrio cholerae.

Combinations: In six cases, the perpetrators considered use of both pathogens and toxins. In three of the cases, the perpetrator was interested in both B. anthracis and botulinum toxin. In another case, the perpetrators thought about HIV and tetanus in addition to both B. anthracis and botulinum toxin. The last two cases involved combinations that are more unusual: tetanus and botulinum toxin in one case, and S. typhi and an unknown mushroom poison in another instance. In only two of these cases did the perpetrator acquire a viable biological agent.

Employing Biological Agents

A biological agent is not necessarily a biological weapon. Only if there is a mechanism for spreading the agent is it transformed into a weapon. Thus, a pathogen growing on a petri dish is not a weapon, or even a threat, because it is unlikely to infect anyone. In some cases, the release method need not be very sophisticated. If the agent is highly contagious, infecting a single person or animal may be sufficient to start an epidemic.

When the agent is not contagious, as with many pathogens and all toxins, it is necessary to have a dissemination mechanism that spreads the agent to the intended target. While it is possible to infect people by injecting them one by one with biological agents, such a method is unlikely to prove attractive to most

More likely, a terrorist will seek a technique to infect the entire target, whether people, livestock, or crops, at one time.

Aerosol dissemination: Of greatest concern is the possibility that a terrorist might disseminate biological agents as an aerosol cloud. In the context of biological warfare, the aerosol cloud should consist of particles of 1-5 microns (one-millionth of a meter) in size. Particles much larger than 5 microns do not penetrate into the lungs, since they are filtered out by the upper respiratory tract. In addition, they tend to settle out of the air relatively quickly. In contrast, smaller particles do not remain in the lungs, but tend to be breathed out.

Several considerations account for the concern about aerosol delivery. Many diseases are most dangerous when contracted in this fashion. Thus, cutaneous anthrax, which is contracted through the skin, has a case fatality rate of 5 to 20 per cent, though antibiotic treatment is highly effective. In contrast, inhalation anthrax is usually fatal, and if not detected early there is no effective treatment. Similarly, Y. pestis is responsible for substantially different diseases, including both bubonic and pneumonic plague. Bubonic plague, generally acquired from the bite of an infected flea, has a case fatality rate of 50 to 60 per cent if untreated, but generally responds to medical treatment. Pneumonic plague is also generally fatal if untreated. Early treatment is

essential to save those infected. Pneumonic plague is considered highly contagious, while bubonic plague is not.34 Aerosol transmission also makes it possible to spread biological agents over a large area and thus affect a large number of people in one attack.

Table 7: Biological Agent Attack on City of 1,000,000 people Disease Caused by Agent Number of People at Risk Deaths Incapacitated Only Anthrax 180,000 95,000 30,000 Brucellosis 100,000 400 79,600 Epidemic typhus 100,000 15,000 50,000 Plague 100,000 44,000 36,000 Q fever 180,000 150 124,850 Tularemia 180,000 30,000 95,000 Venezuelan equine encephalitis 60,000 200 19,800 Source: World Health Organization, Health Aspects of Chemical and Biological Weapons (Geneva: World Health Organization, 1970), pp. 95-99. The WHO model assumes a city of 1,000,000 people in a developed country, and makes assumptions regarding the population distribution around a high density urban core that may no longer be appropriate. The model also makes certain assumptions about the agent (50 kilograms of dried powder containing 6 × 1015 organisms disseminated in a line 2 kilometres long at a right angle to the wind direction. The model nominally illustrates dissemination from an aircraft, but none of the calculations appears to depend on the type of the delivery vehicle involved. As an example, the model assumes that the Venezuelan equine encephalitis will survive for only about 5-7 minutes, during which time it will travel about 1 kilometre. About 60,000 people will be exposed to the agent. About 20,000 people will become incapacitated, including 200 who will die. In contrast, anthrax will survive for more than two hours and will travel for more than 20 kilometres. At least 180,000 people will be exposed to the agent, including 30,000 who will become incapacitated and 95,000 who will die.

An alternative set of calculations was prepared for a study by the World Health Organization. According to estimates prepared by WHO’s expert panel, 50 kilograms of dry anthrax used against a city of one million people would kill 36,000 people and incapacitate another 54,000.36

Water contamination: Many pathogens that have had a significant impact on human life, such as Vibrio cholerae (which is the organism responsible for cholera) and Salmonella typhi (which causes typhoid fever), are water-borne. It is also possible to inject toxic substances into water systems,

including toxins. Thus, it is not surprising that some terrorist groups interested in biological agents have targeted municipal water systems.

Fortunately, water systems are less vulnerable than often thought. Municipal water systems are designed to eliminate impurities, especially pathogens. As part of this process, communities use filters to remove particles from the water and add chlorine to kill any organisms that remain. In addition, the ID50 for diseases spread through water is often extremely high. One test indicated that only half of persons who ingested 107 (10 million) S. typhi organisms became ill.

According to a US Department of Defense biological warfare analyst, it would require “trainloads” of botulinum toxin to contaminate the New York City water supply to cause problems, simply because of the extent to which the toxin is diluted.

For all these reasons, infecting a large population through deliberate contamination of water supplies is difficult to accomplish.

Food contamination: Terrorists also have spread biological agents by contaminating food. In general, only uncooked or improperly stored food is vulnerable, because the heat generated during cooking readily destroys most pathogens and toxins. This implies that a terrorist would need to target foods that are commonly eaten uncooked, or that can be contaminated after being cooked. Alternatively, the terrorists would need to rely on a toxin that survives cooking. The dangers from deliberate contamination of food have probably grown due to fundamental changes in food distribution systems. The food processing industry has become increasingly centralized, so that contamination introduced at a single facility can affect large numbers of people. In addition, an increasing amount of food is imported, raising the prospect that perpetrators operating in a foreign country might be able to contaminate food consumed in the UK.

Direct application: The most reliable way to infect someone is to inject the victim with the organisms responsible for causing a disease. This technique avoids most of the technical problems associated with the dissemination of biological agents. Similar techniques can be used with toxins. In addition, some toxins can cause harm even if applied on the skin.

Insect vectors: Many diseases are naturally transmitted by insects. For example, plague is transmitted by certain flea species, yellow fever is carried by one specific mosquito species, Aedes aegypti, and typhus is spread by the body louse, Pediculus humanus corporis. It is thus not surprising that biological warfare experts have considered insects as potential vectors for biological agents. The Japanese biological warfare program devoted considerable effort to this dissemination route. On at least a few occasions, the Japanese to have used infected fleas to spread plague.

The United States considered use of mosquitoes to disseminate certain agents, and established a facility to breed the needed mosquitoes.

Insect vectors posed problems: they were difficult to control, and their use was likely to create disease reservoirs in the area where the insects were released.

Difference between the theory and practice of bioterrorism

There is a substantial difference between the theory and practice of bioterrorism. The technical obstacles associated with the use and dissemination of biological agents are considerable, and should not be underestimated. Even individuals with considerable technical expertise often find that it is difficult to work with biological agents, even when using relatively simple dissemination techniques.

Aerosolisation: Only two groups are known to have considered aerosolisation of biological agents: Aum Shinrikyo and R.I.S.E. Neither group mastered the requisite technology. According to published accounts, the Aum Shinrikyo attempted to disseminate both B. anthracis and botulinum toxin on multiple occasions. They are not known to have caused any casualties. Water contamination: In six instances, the perpetrators threatened or planned to contaminate water supplies. The quasi-Green group R.I.S.E. wanted to put S. typhi into the Chicago water supply with the objective of killing hundreds of thousands of people. In contrast, it is alleged that the Weatherman organization conceived of biological agents as something that could be used to contaminate water supplies to make a great many people sick.

Rajneeshee spread S. typhimurium at salad bars and other places to affect a large number of people. Several of the

criminal cases also involved contamination of food to make multiple people ill, including one case of contamination of donuts and muffins with shigella organisms.

Direct application: In 16 cases the perpetrators planned to directly apply a biological agent, either by parenteral delivery (injection) or topical application. Injection has been used to deliver both toxins and pathogens. Dr. Suzuki injected S. typhi, as did the French murderer Henri Girard. Several perpetrators have injected their victims with HIV-contaminated blood. Topical application generally involves use of toxins, although the Rajneeshees attempted to spread S. typhimurium by contaminating objects that people handle in the hope that the intended victims would transfer the organisms to their mouth. The Minnesota Patriots Council planned to use a mixture of ricin and DMSO, apparently hoping that the DMSO would transport the ricin. More plausibly, Thomas Leahy mixed DMSO with pure nicotine to achieve the same result. Insect vectors: In at least two cases, the threatened dissemination technique involved insects. In one case, an individual sent letters containing ticks, threatening to spread infection in that way. There is no evidence, however, that the ticks carried any pathogens. In any event, the insects were dead on delivery.

Consequences of use Bioterrorism differs significantly from other forms of terrorism. In the typical terrorist attack, there is immediate evidence that something has happened. In contrast, a biological agent attack is unlikely to generate any visible signatures, and the first evidence of a biological attack is likely to be the onset of disease.

Thus, it might be days or even weeks before the consequences of a biological attack become evident. It might be impossible to determine that an outbreak resulted from an intentional act. Numerous efforts have been made to calculate the potential impact that biological weapons might have on population centres. In general, such estimates should be used with considerable caution. Models used to calculate agent effects rely on numerous assumptions regarding the movement and infectiveness of the agent, and the results may be extremely sensitive to changes in those variables. At best, the models provide an illustration of the potential consequences of bioterrorism. The World Health Organization

has prepared the most authoritative estimates of the casualties likely to result from the biological weapon use.

Although these estimates are highly dependent on the assumptions built into the calculations, they provide a basis for understanding the potential consequences of biological agent use. The impact depends heavily on the nature of the attack, including the method of dissemination, the particular agents involved, the concentration of agent, and (in the case of aerosol dissemination) atmospheric conditions. If the agent causes a disease resulting in few fatalities, such as Q-fever, only a few hundred people might be killed, although tens of thousands of people might be incapacitated. In contrast, a high lethality agent, such as anthrax, could kill 95,000 people and incapacitate another 30,000.

Even in cases where no agent was present, the perpetrators can achieve a disproportionate impact. The costs of the required medical and public health response to an attack also could be disproportionate to the actual effects of the dissemination. A single case of smallpox in Yugoslavia in 1972 eventually required the quarantine of 10,000 people for periods of at least two weeks, and the government was forced to immunize 20,000,000 people. The neighbouring countries closed their borders with Yugoslavia, disrupting normal commerce. It was nine weeks before the outbreak was over. This illustrates how even a small outbreak can have huge economic and social consequences.

The psychological impact of even a small agent release should not be underestimated. The concern that developed over the relatively small plague outbreak in India in 1996 is indicative of the fear that certain infectious diseases can generate. Experience with Aum use of chemical agents suggests that there will be lasting psychological consequences for many of the victims and initial responders.

Technical constraints on use

There is considerable disagreement among experts concerning the extent of the technical impediments that may constrain use of biological agents.

Some argue that terrorists face few if any technical hurdles in employing bioagents. For example, DCI George Tenet told Congress, “Terrorist interest in chemical and biological

weapons is not surprising, given the relative ease with which some of these weapons can be produced in simple laboratories…."

In contrast, Dr. David Franz, formerly Commander of the U.S. Army Medical Institute for Infectious Diseases (USAMRIID), argued that "an effective, mass-casualty producing attack on our citizens would require either a fairly large, very technically competent, well-funded terrorist program or state sponsorship."

Empirical evidence suggests that effective dissemination of some agents, and especially aerosolisation of agents such as anthrax, can pose significant technical hurdles. In general the level of expertise required appears to depend on two factors: the quantity of agent involved and the dissemination technique. As previously noted, access to bioagents has rarely posed a problem for terrorists or criminals. More skill was necessary if the perpetrators sought to grow larger quantities of an agent, depending on the agent involved. Some pathogens are easy to culture, while others are extremely difficult. For this reason, perpetrators who adopted objectives that required significant quantities of agent usually selected biological agents easy to culture. None of the perpetrators examined in this study successfully cultured any agent that required technical skill to grow. Thus, there is no evidence that any managed to culture a virus, although several had success with bacteria. Nor is there any evidence to suggest that any individual or group ever successfully cultured a virulent strain of C. botulinum, although several have tried. In fact, one recent criminal perpetrator, Thomas Leahy, may have inadvertently grown a non-virulent strain of the organism. If a simple dissemination technique is employed, relatively little technical expertise is needed. For example, limited skill is required if the perpetrators can inject agent directly into their victims or if they seek to contaminate food. Moreover, dissemination of a highly communicable disease like smallpox would require limited expertise. The use of highly contagious diseases may be the easiest way to cause mass casualties from a technical perspective. However, such agents pose risks for the group using them and could have an impact on people that the perpetrators do not want to affect. In contrast, spreading an agent through the air poses formidable difficulties. There is no known example of a terrorist or criminal successfully spreading a disease through

the aerosol route, at least one group—the Aum Shinrikyo—reportedly tried, and R.I.S.E. intended to do so. The central technical problems for bioterrorism arise when the objective is to cause mass casualties through the aerosolisation of an agent. The apparent failure of the Aum Shinrikyo to develop a biological warfare capability is suggestive. The Aum drew on the skills of a relatively large cadre of trained people, and apparently devoted considerable resources to their biological warfare efforts. It appears that the Aum failed to produce an effective biological weapon. Unfortunately, too little is known about the Aum's activities to determine why they failed.

Aerosolisation is a complicated process, and is subject to factors that are difficult to assess. Agents that can be spread through the air can be in either liquid or dry form. The liquid form is relatively easy to produce, but must be processed into a form suitable for dissemination. The processing must address both physical issues (to ensure that the sprayer nozzles do not become clogged) and biological issues (to ensure that the organisms survive once aerosolized). An agent in liquid form can be aerosolized using a modified commercially available sprayer, but problems remain. Most of the agent dies during the spraying process (estimates range as high as 99 per cent). In contrast, a dry agent is relatively simple to disseminate, but most experts agree producing it is a dangerous process almost certainly beyond the capabilities of non-state actors.

As previously noted, biological agents disseminated through the air must be released in particles 1-5 microns in size. Smaller particles are not retained in the lungs. Particles larger than 10 microns fall out of the air relatively quickly. In addition, the body filters large particles so that they do not reach the lungs. Moreover, the size of the dose required to induce illness climbs substantially as the size of the particles grows. Producing aerosol particles of the wrong size might reduce an attack to complete ineffectiveness.

In addition, the particles must be released in the correct location to have the desired effect. Particles 1-5 microns in size act like a gas. They settle from the air very slowly. If the agent is not released in an enclosed space, like a building or subway, then considerable operational skill is needed to ensure that the agent infects the intended victims.

Technical skills are required to overcome environmental conditions hostile to agent survival.

Biological agents die or lose virulence once released into the atmosphere. Thus, some disease-causing bacteria lose virulence at a rate of 10 per cent per minute, while some viruses would decay at a rate of 30 per cent per minute. A few organisms, such as the spores of B. anthracis, decay extremely slowly when not exposed to ultraviolet radiation. The implications of these variables will differ from one organism to the next. Perpetrators need to be familiar with the factors that affect the agents they are using.

The rate of biological decay depends on a host of factors, including ultraviolet radiation, temperature, humidity, and a phenomenon known as the Open Air Factor (believed to be the presence of certain air pollutants).

According to a press report, Japanese authorities believe that Aum may have used a "relatively harmless vaccine strain" of B. anthracis. Similarly, it appears that Aum may have used a C. botulinum strain that was not prolific in the production of toxin.

Aerosols consisting of particles of 1-5 microns have certain characteristics of significance for biological weapons use. Such aerosol clouds tend to act as a gas, meaning that the particles will enter buildings. The particles also remain airborne for extended periods. According to one calculation, a 1-micron particle settles out of the air at a rate of 0.21 centimetres per minute. This means that the particle will take about 500 minutes, or more than 8 hours, to drop just 1 meter. In contrast, a 5-micron particle has a settling rate of 4.7 centimetres per minute, so would take only 20 minutes to drop 1 meter.

The WHO experts estimated that an aerosol cloud containing the organisms that cause Q fever would decay at a rate of 10 percent per minute. They estimated the decay rate for the organism responsible for yellow fever at 30 percent per minute, the rate decay for the agents causing plague and tularemia at only 2 percent per minute, and the decay rate for anthrax is a mere 0.1 percent per minute. All these figures assume that the agents were produced using special stabilizers to protect against adverse environmental conditions. World Health Organization, Health Aspects of Chemical and Biological

Weapons, p. 94. B. anthracis survives only in the spore form; the vegetative organisms are not very hardy and die quickly in the outdoors.

Dissemination

Weather is particularly important. Poor atmospheric conditions can make it virtually impossible to release an agent cloud likely to cause casualties. These comments suggest that aerosolisation of pathogens can be extremely difficult. Thus, while aerosolisation is the most dangerous way to disseminate agent, it is significantly more difficult to accomplish than by the alternative methods. This is an important factor in assessing the sources of potential threats from biological agents.

Yet, this threat is not theoretical. The potential was demonstrated during studies conducted by the United States Army's Chemical Corps in the 1950s and 1960s, before the United States abandoned its offensive biological warfare programme. These tests demonstrated - to the extent possible with the technology then available - that biological agents could be disseminated as an aerosol cloud and cover a large area with potentially lethal doses.

Particularly disturbing are the results of tests in the New York City subway conducted during the 1960s. The U.S. Army released a simulant for B. anthracis, Bacillus globigii, into the subway system. Based on the distribution patterns of the agent, Army experts estimated that 10,000 people would have died if B. anthracis had been released.

Open Air Factor, which remains a poorly understood phenomenon, was first identified by UK researchers during the late 1960s. They found that when E. coli organisms were exposed to air from outdoors the decay rate went from 0.2 per cent per minute to between 1.5 and 20 per cent per minute, but normally between 3-10 per cent per minute. This effect was noted with many organisms, including some with biological warfare potential, such as the organisms responsible for tularemia and brucellosis. Significantly, spore-forming organisms such as B. anthracis were unaffected. Some researchers believe that the Open Air Factor is related to the presence of ozone and certain kinds of hydrocarbons.

Potential use of drones – to be discussed

Some of the perpetrators of anthrax hoaxes have included powders in the packages sent to their victims. As this discussion indicates, if the particles are larger than 10 microns they are unlikely to pose a risk to large numbers of people. In most cases, the descriptions suggest the particles were considerably larger than 10 microns. Such large particles will fall out of the air relatively quickly, so even if it turned out that the powder was composed of Bacillus anthracis spores few people would become exposed.

Secret Intelligence Service

Room No. 15

Bioterrorism - Introduction

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Possible motivations for resort to bioterrorism and the technical hurdles that face anyone attempting to use biological agents