CHAPTER 5

Pointing the Finger: Unclassified Methods to Identify Covert Biological Warfare Programs

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Introduction

> *"The current expectation that U.S. [United States] Intelligence will be able to thwart future BCW [biological and chemical weapons] attacks is exceedingly high. Our fear is not that someday, somewhere, an attack will succeed and the IC [Intelligence Community] will be accused of failure. Our fear is that people will die – a lot of people."* [1]
>
> \- John C. Gannon

Biological weapons have been called "the poor man's nuclear bomb" due to their comparatively cheap production costs. While Richard Preston's *The Cobra Event* gave one U.S. President nightmares, Russian defector Ken Alibek told the world that at its height, the Soviet biological warfare (BW) program employed more than 60,000 people.[2] And in the frequently quoted warning of Robert Blitzer, in 1997 head of the FBI's Domestic Terrorism/Counterterrorism Planning Section, "it's not a matter of *if* it's going to happen, it's *when*."[3] Other experts maintain that the threat of a successful mass casualty attack using a biological agent has been over exaggerated in the media, that the number of states possessing an offensive BW program has remained relatively steady over the last fifteen years and, with the rollback of the South African and Russian/Soviet programs, has even decreased. Some also suggest that states suspected of having an offensive BW program and also sponsors of terrorism would be reluctant to cede control over a mass casualty weapon to terrorist organizations.[4]

How can the intelligence community (IC) assist policymakers to assess the potential case against states and terrorist groups that perpetrate BW while still protecting sources and methods of gathering intelligence? The intelligence community can work closely with the scientific community to identify existing BW programs and possibly use rational models predictive of a state or group's likelihood of developing an offensive BW program. This chapter will show how *models* for predicting development of a BW program and unclassified *indicators* can be used to "point the finger" by applying them to four case studies of actual or alleged programs. It will conclude with a discussion of the current state of cooperation between the intelligence and scientific communities and offer several suggestions for their enhanced cooperation.

What factors must be present for a state or terrorist group to develop or acquire biological or other mass casualty weapons? Three unclassified *models* will be examined to elucidate these factors – an "assimilation model" that examines a state or group's proclivity for a BW program based on its material base and threat perceptions, a model developed by the Russian Foreign Intelligence Service (FIS), and a model described by the United States (U.S.) Office of Technical Assessment (OTA).

What are the *indicators* that a state or terrorist group has a covert, offensive biological warfare program? This chapter will consider 26 indicators that mark an outbreak of disease as a suspicious BW agent and will discuss them in relation to natural outbreaks of infectious disease.

The chapter will then examine four case studies, two incidents of suspicious outbreaks of disease indicative of a covert BW program and two incidents of alleged state use of biological weapons. The *models* for acquisition or development of a covert BW program will be applied to the cases, and the cases will be evaluated for common factors from the *models* that may be applied to future, similar instances. Being able to make a credible and logical assessment of future adversaries' likelihood of developing a BW program or the existence of a BW program is vital to the protection of U.S. national security.

The final portion of the chapter will consider the state of cooperation between the intelligence and scientific communities with regard to identification of BW threats, particularly since the terrorist attacks of 11 September 2001, and will propose ways in which this cooperation might be enhanced. The intelligence and scientific communities have improved their important cooperation but many improvements may still be made.

Models for Acquisition or Development of an Offensive BW Program

In this section, three models or sets of indicators of the development or acquisition of a biological warfare capability will be considered. Models can be used by intelligence and other analysts to focus their analysis and to compare various state and non-state actors. For instance, the usefulness of a particular model can be evaluated by using it to study an admitted past possessor of BW capability, such as the former Soviet Union (FSU) or South Africa. Once a model is validated as useful it can be applied to other cases of suspected proliferants to evaluate the likelihood of possessing a covert BW program. Models can also be even more effective when combined with analysis of suspicious outbreaks of infectious disease. Models are thus another open-source tool available to postulate possession of a BW capability.

The first model is an "assimilation model" based on a goal-instrument relationship developed by Jean Pascal Zanders of SIPRI (Stockholm International Peace Research Institute). It is applicable to state and non-state actors and is useful for assessing a group's predisposition to develop a BW program in the absence of a great deal of information in the form of official or public pronouncements. The second model is based on a 1993 report by the Russian Foreign Intelligence Service. Given that the former Soviet Union developed the largest BW program in history, it is useful to consider their perspective on the subject. The third model, developed by the U.S. Office of Technology Assessment, is a set of observable indicators of research and development signatures, weaponization and testing signatures, production signatures, and stockpile and delivery signatures.

Assimilation Model

The "assimilation model" examines the relationship between an actor's goals and the instruments available to it or of interest to it to achieve those goals. As defined by Zanders, "Assimilation is the process by which political and military imperatives, as constrained by a political entity's material base, become reconciled with each other so that a new weapon, weapon system, or arms category becomes an integral part of the political entity's mainstream military doctrine."[5] The model considers a dual decision-making track existing in a state of creative tension – a political track consisting of security and budgetary decisions, and a military track using threat information and political inputs to determine military doctrine and strategy. The model has *thresholds* that must be crossed for adoption of a weapon or weapon system along with applicable military *considerations*. The *thresholds* are classified as intrinsic or extrinsic, and military *considerations* relate to the attributes of a weapon and the operational "balance between potency and logistical considerations."[6]

Intrinsic Thresholds

Intrinsic thresholds are related to an entity's material base. This consists of the entity's physical base: "geographic location, territorial size, population, presence of natural resources, access to resources abroad, etc. – as well as the level of education, of scientific, technological, and industrial development, of economic strength, and so on."[7] Intrinsic thresholds will be higher for non-state actors than for states, as they will be higher for developing countries than for developed countries.[8] For example, non-state actors will not have the territory, population, national resources, or economic strength of states. Similarly, the physical base of a developing country will be less than that of a developed country. That said, with the continuing global expansion of the biotechnology industry, the increased number of biotechnologists being trained in developed countries, and the industry's attendant characteristic of being information rather than capital-intensive,[9] these intrinsic thresholds relating to the potential capabilities of actors may be lowered, particularly to the extent that extrinsic thresholds such as budgetary restrictions apply.[10]

Extrinsic Factors

Extrinsic factors relate to an entity's domestic or international environment. One important factor relating to BW acquisition or development is the tension between political or social constraints regarding weapons of mass destruction or casualty and threat perceptions.

Another is the nature of the group's structure. Norms against weapons of mass casualty were strengthened even as the weapons themselves were developed – witness the 1925 Geneva Protocol and the 1972 Biological and Toxin Weapons Convention (BWC). Norms, both domestic and international, against biological weapons must be overcome to develop a WMD program and the perception of a high level of internal or external threat may help accomplish this.[11] If a credible threat is perceived, BW may be sought as a means of assassination for political opponents, as a strategic weapon and deterrent to other WMD possessor states in the region, or as a counterinsurgency weapon.[12] Historically, states with possession of a WMD capability did not develop norms against these weapons until the state's monopoly had disappeared or was balanced asymmetrically. Despite proliferation of WMD, this sense of power may still exist for a state within a confined region, leading to the non-development of norms against WMD. The group's structure is also of importance to the acquisition or development of WMD. A vertically integrated and ideologically consistent group will be more capable to develop a high volume program in secrecy than a group organized in small cells. While an organization with a small cell structure might offer the security of decentralization, it would lack the material base of a larger entity required for a high volume BW program.

Military Considerations

Military considerations also play a large role in the adoption of BW by a state or non-state actor. Both state and non-state actors will look to balance weapon effectiveness with logistical considerations in achievement of their goals.[13] States typically have considered the following factors when selecting a BW agent for use as a weapon: reliability, virulence, incubation period, contagiousness, no widespread immunity, low or no susceptibility to common medical treatments, suitability for production in necessary quantities, ease of transport, stability, ability to survive environmental stresses, and availability of protective measures for friendly troops.[14] Military uses such as "denying terrain, degrading combat effectiveness by forcing the enemy to don protective clothing, degrading the operability of facilities and equipment together with imposing the need for elaborate decontamination procedures, causing terror and psychological exhaustion, flushing out enemy troops from strongholds, incapacitation, and crop destruction,"[15] in addition to casualty production, are all factors states will consider when seeking or adopting a BW capability and integrating its use into their military doctrine. Non-state actors may use a similar effectiveness-logistical consideration calculus when seeking a BW weapon. Terrorists, in particular, may consider BW agents and substances that, while not useful for large-scale military applications outlined above, may meet their own needs.[16]

In summary, the assimilation model provides a means of considering intrinsic and extrinsic thresholds and military applications in evaluating an actor's potential for acquiring or developing a BW capability. This model would be useful for establishing a theoretical likelihood for an actor to acquire biological weapons. Examples of the use of this model will be discussed in the analysis of the case studies.

Russia's Foreign Intelligence Service Model

The Russian FIS report entitled "A New Challenge after the Cold War: Proliferation of Weapons of Mass Destruction," described indicators of a WMD program in four areas: political, economic, scientific-technical, and military-technical. It stated that indicators in all four areas must be analyzed to determine a country's involvement in or capability for a WMD program. The model was developed to consider all WMD programs and may be applied to BW programs as well as CW (chemical warfare) and nuclear weapons programs. Indicators that may be observed are highlighted below.

Political Indicators

The model starts with the assumptions that a political decision to embark on a WMD program has been made and that it has been kept secret. It may be noted that these political indicators are very applicable to the past WMD programs of the FSU and South Africa. Political indicators of covert BW programs are:

- Not becoming a party to treaties or instruments renouncing WMD. Not participating in international fora or negotiations on such treaties or instruments.

- Refusal or obstruction of international monitoring of facilities.
- Creation of an administrative structure with extraordinary powers directly subordinate to the highest political leadership or army command.
- Creation of foreign economic agencies or intelligence service units with large financial resources to buy materials, equipment, and technology abroad. Creation of ostensibly private companies for the same purpose.
- Active promotion of WMD by groups closest to the highest levels of power.
- Psychological manipulation of the public to accept WMD as a part of military doctrine.
- No governmental reaction to accusations of a state's proliferation.
- Overt or covert support to proliferating countries.

Economic Indicators

The Russian FIS model considers the strongest BW indicator to be the share of the government's budget devoted to the military, and it notes that this information is often absent, concealed, or contradictory in nature. General indicators include the development of defense and civilian industry sectors and types of imports. Specific direct and indirect indicators are:

- A large military budget.
- Presence of nuclear, biological, or chemical programs.
- Presence of required specific production capabilities.
- Importation of "WMD components, raw materials for their production, specialized equipment, and 'dual-use' technologies."

- Scientific or technological advancement beyond apparent civilian need of specific production capabilities.
- Unexpectedly high budgetary allocations for ostensibly civilian sectors such as biotechnology.

Scientific-Technical Indicators

This set of indicators focuses on technical capabilities, human resources, and means of expanding scientific potential.

- Presence of raw materials.
- Importation of non-indigenous raw materials or components.
- Presence of required technologies.
- Presence of required production capacity.
- Required scientific or technical specialists are present and a system for training others exists.
- Ability or programs to attract needed specialists from abroad is present.
- Scientific centers are created.
- Scientific and production firms with required specialties are present.
- A supercomputer or powerful computer network for running simulations is present.

Military-Technical Indicators

Military-technical indicators revolve around a doctrine that incorporates the use of WMD and the presumption that WMD will be used against itself. Direct and indirect indicators include:

- Technical units in the military relating to the use of WMD.
- Reinforced or hardened facilities for the government and military.

- Training of personnel to deploy WMD in warfare and to operate in a WMD environment.
- Storage facilities with high security measures.
- Possession of appropriate delivery systems.
- Intensified intelligence activities against specific enemy targets.
- A highly developed program for civil defense.

The Russian FIS model presents an organized way to look at indicators for a possible covert WMD program. Taken together, these indicators, many of them openly observable, form a useful checklist for evaluating a country's likelihood with regard to proliferation of weapons of mass destruction.[17]

U.S. Office of Technology Assessment (OTA) Model

As is acknowledged by many authors and experts in the field, detection of a covert BW program is very difficult to do, and even under the best of circumstances is likely to produce only circumstantial evidence and not the "smoking gun" so sought after in international fora. Several factors contribute to this, and perhaps most important among them is the dual-use nature of equipment and feedstock materials. Also, as technology develops, production can take place in much smaller and less visible locations than in the past. The dual-use nature of equipment makes it possible to convert legitimate facilities to BW agent production in a very short time, thus possibly obviating the need for dedicated facilities. The speed with which BW agents may be grown and the potency of small quantities mean that large stockpiles may not be necessary. And finally, as will be discussed in more depth below, when BW agents that are endemic to the affected area are used, they can be very difficult to distinguish from natural outbreaks of disease. That said, this model, taken from the Office of Technology Assessment's (OTA) *Technologies Underlying Weapons of Mass Destruction*, focuses on signatures as indicators. Observable indicators for each signature – research and development, weaponization and testing, production, and stockpile and delivery – are outlined below.

Research and Development Signatures

The OTA model evaluates many of the same indicators found in the Russian FIS model, but it is careful to place them within the overall context of a country's behavior and the transparency of its defense program. Indicators could include biological research facilities under military control, production of vaccines in excess of domestic needs, and the purchase of dual-use materials and equipment. Analysis of a state's open source scientific and technical information can allow the monitoring of research trends, identification of institutions and individuals associated with biotechnical research, and the identification of sudden halts in certain types of research that might be indicative of military censorship. The assessment acknowledges that monitoring publications can only provide a very broad measure of a country's activities, as many of the articles from countries of interest are not published or available in English. Also, because much of the basic science is already understood and available, very little preliminary research would be necessary.

Weaponization and Testing Signatures

Any weaponization development would have no obvious civilian application and would be an indicator in and of itself. Indicators observable via overhead imagery could include field tests of aerosols, tests of weapons' effectiveness against large animals, and the burial of animals used at weapons testing sites. Observation of indicators in this category is made difficult because much testing could be done inside production facilities. The sensitivity of many BW agents to sunlight would necessitate testing at night, and legitimate activities such as crop dusting or the use of conventional smoke bombs could be used as a clandestine way of testing BW delivery. Weaponization and testing signatures may be more susceptible to detection through on-site inspections.

Production Signatures

Advances in production technology, particularly in developed countries, have made detection of production signatures more difficult. Small, continuous-flow fermenters capable of producing large quantities of agent quickly have replaced the large, batch fermenters and refrigerated storage vaults of the past, thus greatly reducing the size of production facilities. Smaller facilities may be buried underground or hidden within larger, legitimate, commercial plants. That said, several indicators could be detected via overhead imagery. Tight security and secrecy around an ostensibly civilian facility, including “double or triple fencing, watch towers, and air-defense missile batteries,” could be an indicator, although it would be possible to conceal these measures from overhead satellites. The existence of very extensive microbiological production plants that were much more sophisticated than known civilian facilities could be an indicator. Another could be the existence of facilities unassociated with vaccine production with large numbers of test animals, especially “primates, horses, rats, mice, rabbits, sheep, goats, or chickens (for producing eggs).”[18] Finally, observable changes in ostensibly civilian production facilities could be an indicator. Production signatures are more observable via on-site inspections than overhead imaging. On-site inspections can determine plant layout and physical containment measures, plus they can also reveal the types of equipment and materials in use.

Stockpile and Delivery System Signatures

A few indicators could be observable via overhead imagery, but more could be detected only through on-site inspections. Observable indicators could include refrigerated bunkers or igloos for storage of large amounts of BW agents, storage depots for BW munitions near suspected production facilities, and heavy trucks for the transportation of munitions or for decontamination use.

In summary, for this model, the signatures discussed are indicators that could be observed via open sources and overhead imagery. There are other indicators that could be observed via on-site inspection, but until an inspection protocol is put into place for inspections to be carried out under the BWC, non-coercive or coercive on-site inspections are likely to remain a rarity. Also, human intelligence is noted as a valuable source of information.[19] These indicators and sources of information are not considered as they are beyond the scope of this study.

Summary of Models

Models present an organized process for examining the open source information available regarding a state's predisposition or actions taken towards developing a BW capability. The assimilation model approaches the problem from resource base and a normative political-military decision-making process. The Russian FIS model is based on experience, and points to indicators that would be particularly valid for a highly centralized state with an industrial base and significant monetary resources available to devote to the problem. Finally, the US-based model is indicative of the approach taken by a country with a robust microbiological technical base, a relatively transparent defense structure, and an open society. Models provide a starting point for considering the issue and can be used in conjunction with examinations of possible use of BW or accidental releases to better draw conclusions about an entity's BW capabilities.

Unnatural versus Natural Outbreaks of Disease: Indicators

While most experts agree that detection of a covert biological weapons program is difficult at best, many also agree that the careful and thorough examination of outbreaks of disease can yield significant clues.[20] Even though there are significant ways in which unnatural outbreaks of disease differ from natural outbreaks, distinguishing between the two remains difficult. It is in this arena, perhaps more than any other, that the close cooperation between the public health community and the intelligence community could be most beneficial.

This section will discuss the general parameters for investigation of outbreaks of disease and sources of information on outbreaks. It will then consider some characteristics of natural outbreaks of disease and characteristics of unnatural or suspicious outbreaks.

Investigation of Outbreaks of Disease

The initial steps taken in an analysis of a disease outbreak are the same whether the outbreak is suspicious or initially thought to be a natural outbreak. Two principal types of information are collected: personal interviews, particularly of those involved, and biological samples. The first step in an investigation is definition of the disease, including a case definition. The case definition is broad enough to include all likely cases and is refined as the investigation proceeds. As the definition becomes more precise, previously analyzed cases are reanalyzed and discarded if they do not fall within the revised parameters.

The next steps are to locate the earliest cases of exposure and determine the victims' physical location and the time when symptoms began to manifest. Determination of locations and case histories may lead to environmental sampling and possible identification of the causative agent. Finally, laboratory analysis and attempts to isolate and cultivate the putative agent will occur. At the end of this process, the identity of the disease should result.[21]

An outbreak of disease could result from one of several causes. Natural outbreaks are by far the most common versus the accidental release of a BW agent being developed as part of a covert BW program, the field testing of an agent, the small scale use of an agent against a target, a larger scale attack, a criminal attack, or a terrorist attack.[22]

The free flow of information regarding outbreaks of disease is facilitated by databases such as ProMED Mail, which makes it possible for medical, veterinary, and agricultural professionals to exchange and monitor disease outbreak information real time. This also makes it more difficult for states or non-state actors to conceal information on outbreaks of disease. Information in this forum is free of governmental influence.[23] Other media for the dissemination of disease outbreak information include the *Weekly Epidemiological Record* published by the World Health Organization, the *Morbidity Mortality Weekly Report* published by the Centers for Disease Control, the *Communicable Disease Intelligence* from Australia, and the *Monthly EPI Comment* from South Africa.[24]

Indicators of Natural Outbreaks of Disease

This section will outline some of the characteristics of natural outbreaks of disease. Some of the characteristics of unnatural or suspicious outbreaks of disease outlined in the following section may also apply to natural outbreaks. This possibility of overlap between the two categories is indicative of the difficulty of distinguishing between the two.

Natural outbreaks are usually characterized by a gradual increase in cases until the majority of the population has been exposed to the disease, after which there is a gradual decline in the number of cases.[25] In a natural outbreak, cases may continue to occur throughout the outbreak and will be widely spread in location.[26] There will be a gradual increase in the incidence of disease as it is spread from person to person in the case of a communicable disease.[27] Natural outbreaks may also originate from a point source with many victims making contact with the agent at the same time. This could be common with exposure to food-borne pathogens. In this case the outbreak would exhibit a compressed epidemic curve (a temporal plotting of the incidences of the disease) which may peak in days or hours. A second peak could occur after the first if the agent is contagious and is passed on.[28]

Indicators of Unnatural or Suspicious Outbreaks of Disease

While most experts on the subject agree that a definitive model for distinguishing between natural and unnatural outbreaks of disease does not exist, many authors list several common indices to differentiate the two. Since determination that an outbreak of disease is of unnatural origin is one of the more effective ways of detecting the existence of a covert BW program or a BW attack, a thorough listing of possible indicators drawn from multiple sources is presented below. As will be seen, several of the indicators are common to natural outbreaks of disease as well.

- Origination from a point source with many victims coming into contact with the agent at the same time.
- Origination from a line source with many victims coming into contact with the agent at the same time.
- A compressed epidemic curve which may peak in days or hours. If the disease is contagious and passed from person to person, there may be a second peak after the first.
- A large epidemic, especially if it occurs in a discrete population.
- More severe disease than is normally expected for the pathogen.

- Unusual routes for exposure for the pathogen, such as inhalational anthrax instead of dermatological anthrax.
- A disease that is unusual for the affected area or for the season in which it appears.
- An endemic disease found outside its established range.
- A disease that is impossible to transmit naturally without the presence of its usual vector, when that vector is not present.
- Multiple epidemics of different diseases.
- Different diseases in the same patient.
- A disease that attacks animals as well as humans.
- Unusual strains of disease or antibiotic resistant strains different from expected disease strains. If an agent is isolated in a laboratory culture for some time before its use, it may stand out against the background strains of the disease, as they continue to evolve in nature.
- A strain of disease last seen some years before the outbreak.
- Higher attack rates in different areas. For instance, if an agent were released indoors, those inside the location would have higher exposure rates and, therefore, higher attack rates. Likewise, if an agent were released outdoors, lower exposure rates would be expected for those who were inside at the time of release.
- Intelligence information that a group has access to an agent.
- Claims by a group that it has perpetrated an attack.
- Direct evidence of an attack such as equipment or munitions.
- Pulmonary disease in the absence of a natural high-concentration aerosol.
- High military and civilian casualties when both are collocated.
- High morbidity and mortality.

- High morbidity and mortality in relation to the number of individuals potentially exposed.
- Lower disease rates for those with filtered air supplies or closed ventilation systems.
- Failure of a group or state to cooperate with an investigation of an outbreak or refusal of offers of assistance.
- The sudden demand for large quantities of a specific vaccine greatly in excess of previously known requirements.
- A specific disease in a population with high immunity to that disease as a result of vaccination. This could suggest a modified agent.
- An outbreak of disease in a target population for which a suspected or potential adversary is known to have been vaccinated.[29]

While there are many overlapping indicators for classification of natural and unnatural outbreaks of disease, a thorough and patient investigation over time will usually reach a valid determination in the end. This section outlined some of the standard steps to be taken in an investigation of an outbreak. Disease investigation is, however, much more complicated than simply taking the steps outlined here, as it involves computer databases for analysis and requires specially trained health professionals. As described in this section, there are several sources, both governmental and non-governmental, of information on outbreaks. Finally, a likely determination of whether an outbreak is natural or unnatural can be made by a skilled epidemiologist in many cases by performing an epidemiologic investigation and applying a set of indicators to the outbreak.

Presentation of Case Studies

Four disease outbreaks are presented below. The first two outbreaks are a limited smallpox epidemic in Aralsk, Kazakhstan, USSR in 1971 and the anthrax outbreak in Sverdlovsk, Russia, USSR, 1979. Both outbreaks are alleged to have been caused by release of BW agents – as a result of field-testing in the Aralsk case and accidentally in the Sverdlovsk case.

The second two outbreaks of disease are the 1978-1980 outbreak of anthrax in Zimbabwe and two outbreaks of cholera in Burma in 1993 and 1994. Both outbreaks are alleged to have been the result of BW attacks by the governments of the two states against sectors of the people, and both were alleged to have occurred during counterinsurgency campaigns.

Aralsk, Kazakhstan, USSR – 1971

A limited smallpox epidemic occurred in Aralsk, Kazakhstan, from July through October 1971. There were 10 infections, and 3 resulted in death. The index case for this epidemic likely was exposed to smallpox on 30 July 1971. She was an ichthyologist aboard the research ship *Lev Berg*. The *Lev Berg* left Aralsk on 15 July, traveled east and south of Vozrozhdeniye Island, and then made a port call on 29 July at Uyaly. The ship made another port call at Komsomolsk-on-Ustyurt on 31 July and at Muynak on 4 August. It returned to Aralsk on 11 August.[30]

The index case had been vaccinated against smallpox and probably for this reason contracted a relatively mild form of the disease. She began to manifest symptoms on 11 August.[31] The index case transmitted the virus to her younger brother, who was also vaccinated, who also contracted a less severe form of the disease and fully recovered. He began to show symptoms on 27 August. The boy returned to school before medical authorities had diagnosed smallpox but was later quarantined after the diagnosis had been made. Six adults and 2 children from 4 households contracted smallpox over the period from 10 September through 2 October. The adults ranged in age from 24 to 60, with a median age of 34.5, and the two children were 4 years old and 9 months old. Both children and one adult were unvaccinated, and all of them died from a rare, highly lethal, hemorrhagic form of the disease. The remaining adults were vaccinated and contracted either a discrete or a varioloid form of the illness and survived.[32]

The public health response began on 22 September when a diagnosis of smallpox was clinically confirmed. The two known cases at that time were transferred to an isolation unit, their contacts were identified, and their residences disinfected. On 23 September, a 150-bed isolation unit for contacts of the patients was established, and house-to-house interviews were started. A vaccination program began with vaccination centers being set up at the train station and airport. Quarantine of the city was established, and individuals without vaccination certificates were prohibited from traveling out of Aralsk. A virologist arrived from Moscow on 23 September, and the city was placed under quarantine on 24 September. On 25 September, the smallpox diagnosis was confirmed via laboratory tests. Additional medical personnel arrived from Moscow, Alma-Ata, Aktyubinsk, and Leningrad; a medical headquarters with a director for the outbreak was established. On 26 September, the military took over enforcement of the quarantine from the civil authorities. Autopsies were performed on the victims by civil authorities during the period 24 September through 7 October.[33]

During the outbreak 274 people were isolated, and 270 visits were made to homes and schools, with 20,000 to 25,000 people clinically examined daily. Hospital personnel worked in anti-plague protective gear and were quarantined, and the smallpox hospital and isolation units were guarded by police on a 24-hour basis. Nine hundred sixty-four buildings and 10,400 kg of household goods were disinfected. A total of 36,276 residents of Aralsk were vaccinated, resulting in a 100 per cent vaccination rate for the population by 5 October. The quarantine of Aralsk was lifted on 11 October. Post-outbreak measures included continued epidemiological surveillance, disinfection of the hospital and isolation units, and additional house-to-house calls.[34]

The official report posited that the index case most likely had contracted the disease during the port calls at either Uyaly or Komsomolsk-on-Ustyurt. It offered Afghanistan as a second, but less likely, hypothetical source via transmission through Tajikistan or Uzbekistan, due to extensive economic and shipping links between those republics and Aralsk. Under this second hypothesis, the index case would have contracted the disease in Aralsk, not during port calls. The official report on the outbreak remained secret until early 2002.[35]

The ichthyologist stated during an interview in May 2002 that she did not leave the ship at any point during the voyage. Since none of the male crew members, who were allowed to go ashore during port calls, became ill with smallpox, it is unlikely that she contracted the illness from one of them. Smallpox was considered eradicated from the USSR in 1936, and the last reported, imported case was in 1961. Yet the smallpox outbreak was not reported to the World Health Organization (WHO).[36]

Vozrozhdeniye Island was a primary open air, field-testing site for the Soviet BW program from 1936 to at least 1990, with a 17-year hiatus from 1937 through 1954.[37] A military facility housed several hundred people, who lived and worked on the island beginning in 1954. Personnel received regular immunizations and hardship benefits. The northern part of the island included a residential area and an airport, and the southern portion of the island housed the BW testing complex. Agents tested included anthrax, botulinum toxin, brucellosis, plague, Q fever, smallpox, tularemia, typhus, and Venezuelan equine encephalitis. Special strains developed for high virulence or survivability were tested on the island. Vozrozhdeniye Island was declared as a testing site for outdoor aerosol tests in the Russian BWC declaration of July 1992. The site was officially closed on 18 January 1992, and this was confirmed by a United States Department of Defense (DOD) inspection in August 1995.[38]

The *Lev Berg* was probably south of Vozrozhdeniye Island on 30 July, and the prevailing winds in the area blew from north to south over the island during that time of the year. The primary testing season for BW agents was April through August, and the index case spent most of her time working on the deck of the ship casting fishing nets. In a 2001 interview, Dr. Pyotr Burgasov stated that 400 grams of a smallpox weapon was exploded on the island, and the *Lev Berg* came within 15 km of the island, within the contamination radius of the smallpox. He confirmed that the index case contracted smallpox as a result of the test. Burgasov stated that he informed KGB chief Yuri Andropov of the event, and Andropov directed that it not be reported further.[39]

In conclusion, an epidemiological analysis of the outbreak assesses that the index case contracted smallpox as a result of exposure to an open-air smallpox test conducted on Vozrozhdeniye Island while her ship sailed near it on or about 30 July, and that this was the origin of the smallpox outbreak in Aralsk.[40] Former first deputy director of Biopreparat Ken Alibek stated that the description of the case was factual, and stated that it was "talked about" when he worked at Biopreparat.[41]

Sverdlovsk, Russia, USSR - 1979

On 2 April 1979, between the hours of 1330 and 1600[42], an accidental release of anthrax spores occurred at the military compound known as Compound 19 in Sverdlovsk. Two Soviet sources have stated that a problem with the plant's filtration system caused the release.[43] An aerosolized plume was released, possibly from a rooftop ventilator at height of approximately three to four meters.[44] It traveled in a southeasterly direction about 15km per hour over the Chkalovskiy section of the city and into the surrounding countryside.[45] The pattern of animal deaths indicated a plume of 50km in length.[46]

Livestock, including sheep and cows, in six villages lying along the extended axis of the plume south of the city were infected at the same time as humans. The livestock deaths began on 5 April.[47] While livestock and human deaths occurred almost concurrently, anthrax was recognized as the cause of the animal deaths first due to veterinarians' greater familiarity with the symptoms of anthrax in animals. Roadblocks were established 12km south of Sverdlovsk to check for suspected contaminated meat. Carcasses of infected animals were burned. Public health measures similar to those taken in response to human cases (see below) were taken for confirmed animal cases and included the vaccination of humans associated with the animals.[48]

In response to the crisis, an emergency meeting of local officials took place on 9 April, at which it was decided to conduct a house-to-house survey in the Chaklovskiy *rayon*. At the beginning of the outbreak, before anthrax had been identified as the cause, hospital quarantine measures were taken, and victims were isolated and restricted to only two area hospitals. Morgues and burials were also isolated. The Ministry of Health was contacted on or about 9 April, and authority for dealing with the crisis was ceded to the central government. The central government dispatched experts from Moscow to take charge of the situation, undertook a vigorous public health campaign, and posited tainted meat as the cause of the outbreak. On 12 April, Dr. Vladimir Nikiforov, an infectious disease expert, was sent with several assistants from Moscow to supervise the medical treatment of the victims. Deputy Minister of Health, Dr. Pyotr Burgasov, was dispatched from Moscow on or about 13 April as the senior official in charge of handling the outbreak. Dr. Nikolay Babich headed the local public health efforts.[49] Intelligence community documents report that Defense Minister Ustinov and Health Minister Petrovski visited Sverdlovsk in early May.[50] Reportedly, work on virulent anthrax ended by 15 April.[51]

On 18 April, leaflets describing anthrax symptoms and warning against consumption of meat bought in unofficial markets were distributed in the southern part of Sverdlovsk. Leaflets were distributed on 19 April describing four methods of anthrax transmission: cutaneous, inhalational, gastrointestinal, and via insect bites. It also described two forms of the disease: cutaneous and systemic. The leaflets described symptoms and public health measures to be taken in case of infection.[52] During the epidemic, buildings were washed with a chlorine solution and roads were paved, which Burgasov attributed to preparations for the upcoming May Day celebrations rather than to public health measures. In the Chalovskiy *rayon*, where the majority of the victims worked, the interior and exterior of the ceramics factory buildings were washed.[53] According to eyewitnesses, hundreds of stray dogs in the affected area were killed.[54]

The public health response to individual fatalities followed a set pattern. An autopsy of the victim was conducted, and the victim was encased in a coffin treated with lime. Interment then proceeded in a specific part of the Vostochniy cemetery. Police prevented family members from entering the cemetery for the burials, and burial charges and cemetery plots were funded by the government. Antibiotics were given to victims' surviving family members. The victims' houses were disinfected, and their bed linens and suspect clothing removed. The outsides of the houses were washed in a chlorine solution.[55] Residents of the affected area received a series of three inoculations, reportedly with vaccine from Georgia, while residents at Compound 19 were inoculated with vaccine reputed to have been produced there.[56] A reported 80 per cent of 59,000 persons in the area were vaccinated at least once. Two vaccination campaigns occurred, one beginning in mid-April and a second beginning on or about 11 May.[57]

The earliest human victims began to display symptoms on 4 April, with the first deaths occurring 7-8 April, and an official diagnosis of anthrax was made on 10-11 April. Laboratory tests confirmed the diagnosis on 12 April and the last death occurred 16 May. The total number of deaths is not known with absolute certainty, but it is likely 64 to 68. Based on primate experiments showing that anthrax spores can remain dormant in the lungs for up to 100 days after exposure, it seems reasonable that all of the deaths in the 2 April – 16 May period resulted from one release. Biologist Matthew Messelson estimates that the release was a minimum of 2-4 mg to a maximum of 300-600 mg,[58] while the U.S. intelligence community's early estimate was 22 pounds.[59]

Victims were primarily older men. Seventy-five percent were male, and half were older than 45. All of the women except one were 32 or older. No one under the age of 24 was a victim.[60] Guillemin reports that "only one person per household was affected."[61] Causes of death were not always listed as anthrax; other causes included pneumonia and sepsis. The deaths were three times the average yearly number of anthrax deaths in the USSR.[62] A 1998 report of polymerase chain reaction analysis of tissue samples determined that up to four strains of anthrax were present in victims, which was judged to be indicative of an unnatural cause for the outbreak.[63] If it had been a natural outbreak, only one strain of anthrax would have been expected. A Russian military officer who worked at Compound 19 in 1979 confirmed in 1993 that the facility had many strains of anthrax.[64]

Local governmental records on victims were absent, confiscated by Dr. Burgasov, and there were allegations that autopsy and other case records were confiscated by the KGB. The KGB also reportedly confiscated records from the ceramics factory. All birth, marriage, and death records were unavailable.[65] While records documenting human cases disappeared, veterinary records did not.[66] Soviet officials attributed the lack of available documentation to the negligence of local officials.[67]At the time of the event and for years afterwards, rumors abounded amongst the local population that the cause was a biowarfare plant, Compound 19, in Sverdlovsk.[68]

When initially confronted with the event by U.S. State Department officials during the first Biological Weapons Convention (BWC) review in 1980, Soviet officials denied that there had been an anthrax outbreak. This initial denial was subsequently changed to an acknowledgement with an attribution to tainted meat products resulting from improper meat processing procedures. The USSR on 21 March 1980 admitted that there had been cases of intestinal anthrax but denied that the anthrax outbreak had any bearing on a possible violation of the BWC.[69] Soviet authorities maintained that tainted meat was sold to workers at the ceramics factory.

Many of the victims' surviving family members reported that they had not eaten any meat bought from private sources immediately before the outbreak.[70] Despite the official explanation for the outbreak, a formerly secret Soviet document dated 5 June 1979 states that anthrax was "isolated from samples of soil, air, washings from a woolen wall hanging, the outside part of a door," indicating airborne anthrax.[71] The Soviet government resisted the 1983 and 1988 attempts of American teams to investigate the incident, and the Russian government obstructed the later investigation by an American team in 1992.[72] Russian President Boris Yeltsin acknowledged in an interview in 1992 that the outbreak was caused by the military BW development and production facility in Sverdlovsk. In July 1992, a Russian BWC declaration admitted that research and development of biological weapons occurred after Soviet accession to the BWC; however, it denied that BW agents were produced or stored in Sverdlovsk.[73] The Russian delegation to the BWC Ad Hoc Group negotiations still promulgated the tainted meat explanation as recently as March 1997.[74]

Additional governmental actions and communications about the incident took place. As has been well reported, in 1986 a team of American experts received a presentation in Moscow on the attribution to tainted meat, followed by a reciprocal visit in 1988 of a team of Soviet scientists to institutions in Washington, D.C., Baltimore, and Cambridge. The tainted meat explanation was judged plausible by some U.S. scientists even though unsupported by epidemiological or clinical evidence.[75] Burgasov asserted that infected meat had been sold by mistake, specifically at the ceramics factory, where up to a third of the victims had worked. Burgasov further claimed that male heads of households performed more physically strenuous labor and therefore ate more meat than other family members. He explained that this was why more men than women were victims and why almost no children were casualties.[76] Burgasov claimed that there were no deaths of workers at Compound 19, but this was later refuted.[77] During 1992 and 1993 investigations, there were instances in which governmental participants contradicted one another on the facts of the incident and their beliefs about its likely cause.[78] Compound 19 commander in 1992, General A.T. Kharechko, is quoted in Guillemin's *Anthrax* as having said "The rumors … that an explosion took place on the territory of our institution and that anthrax pathogen was discharged into the external environment do not have any real basis, primarily because we have never had any explosion of that sort."[79] It can be noted that this is actually a true denial of an explosion, not a denial of an anthrax release or of a biological weapons program.

Zimbabwe, 1978-1980

The world's largest recorded outbreak of anthrax among humans occurred in Zimbabwe, with 10,738 cases reported by the government from January 1979 through December 1980. There were 182 human deaths, mostly from cutaneous anthrax.[80] The outbreak manifested in three provinces covers the period November, 1978 through October, 1980, during which 9,711 cases were recorded.[81] A human epidemic followed a severe epizootic in cattle, in which, for example in the Lupane district of Matabeleland, at least 5% of the cattle population died and in which some owners lost up to 50% of their herds.[82]

The first reported human case was on 24 November 1978 in the Nkai district of the Matabeleland province. It was a case of cutaneous anthrax, and the victim reported that he had skinned and butchered infected cattle. The outbreak remained localized in the Nkai district from November 1978 through June 1979, until it spread to the contiguous Que Que district. In October 1979 it spread westward into the contiguous Lupane district, and in November 1979, the outbreak spread to the non-contiguous districts of Insiza, Umzingwane, and Bubi to the south and east. Anthrax continued to spread among humans and cattle, and by October 1980, all districts of Matabeleland except the Binga district had been affected. A total of 2,065 human cases were reported in the Matabeleland province for the period January 1979 through October 1980, with 36 deaths, representing a mortality rate of 1.74%.

Anthrax spread to the Que Que district of the Midlands province in June 1979, spreading to additional districts in November and December 1979, and January and March 1980. Ninety-eight percent of the cases and 99% of the deaths in the Midlands were localized in the Que Que district, where it affected two communal farming areas while leaving the commercial farming areas almost completely untouched. A large shoe factory in the province, processing over 130,000 hides yearly, had no recorded cases, and urban areas also had no reported cases. There were a total of 6,609 cases and 101 deaths for the period June 1979 through October 1980, representing a mortality rate of 1.53%.

Anthrax entered the Mashonaland province in the Sanyati communal farming area on 29 September 1979, with cases appearing in new districts month by month through January 1980. The first case was cutaneous anthrax, and the victim reported that he had cut up and eaten an infected cow. There were some cases recorded from commercial farming areas, but most cases originated in the communal farming areas. There were 1,037 cases in Mashonaland during the period September 1979 through October 1980 and 14 deaths, resulting in a mortality rate of 1.35%.[83]

All forms of anthrax – cutaneous, medistinal and gastrointestinal – occurred, along with the two major complications, septicemia and meningitis. Uncomplicated cutaneous anthrax accounted for approximately 95% of all cases, and the mortality rate was 1.55%.[84] The prevalence of the cutaneous form was consistent with most scientific literature, which cites the prevalence as 95% for cutaneous, 5% for inhalational, and 0-5% for gastrointestinal. The aggregate mortality rate was slightly higher than what would be expected for cutaneous anthrax alone, which is less than 1% in treated cases.[85] This could be because the aggregate mortality rate of 1.55% includes non-cutaneous cases. Of the cutaneous cases, 74% of the lesions were on the head, neck, face, and upper limbs, 13% were on the lower limbs, and 13% were on the trunk.[86]

Various authors writing about the outbreak describe efforts to control the outbreak among livestock as being largely unsuccessful due to the disruption caused by the ongoing armed conflict between the state and guerrillas. A veterinary team sent to begin a vaccination campaign in the Matabeleland was ambushed, but despite this disruption they managed to vaccinate some 8,000 cattle in areas including commercial farms.[87] The breakdown of civil administration also appears to have contributed to the extent of the oubreak, and attempts to persuade the rural people to have their cattle vaccinated were mostly unsuccessful. Efforts to control the outbreak in remote areas were eventually abandoned.[88] Numerous authors attributed the outbreak to the breakdown of veterinary services in the tribal areas.[89] Dr. Meryl Nass, however, stated that "routine anthrax vaccination of livestock was not practiced to a large extent in Zimbabwe before 1979, according to local veterinary experts." She maintained that this meant that the breakdown of veterinary services was not a contributing factor to the early development of the outbreak.[90]

In sheer number of cases the 1979-1980 anthrax outbreak was a catastrophic departure from Zimbabwe's experience with anthrax both after but especially before the outbreak. There were no reported cases of human or bovine anthrax during the period October 1976 to September 1977,[91] and only two human cases had been reported in 1978.[92] For the period from 1926 through 1977, 311 cases of human anthrax and 20 deaths were reported, a mortality rate of 6.43%. The highest recorded number of cases was in 1967 with 86, which also saw the most deaths at 6.[93] For the period 1981 through 1985 the number of anthrax cases continued to be much higher than the historical rate before the 1979-1980 outbreak. This period saw a total of 4,124 cases reported. Two hundred ninety-five cases was the lowest total reported during the period and was the total number of cases reported in both 1983 and 1984.[94] For the period 1988 through 1995 the number of reported cases dropped dramatically to a total of 169 cases, with the largest numbers being 89 and 30 in 1991 and 1992, respectively.[95] Recent outbreaks have included the following:

- September 2000 in the Mt. Darwin district – 70 animal deaths, seven human cases, and no human fatalities.
- November 2000 in the Makoni district – 25 animal deaths, 15 human cases, and 2 human fatalities.
- November 2000 in the Mhondoro communal farming area – 44 animal deaths, possibly 630 human cases, and 9 human fatalities.[96]
- October 2001 near the town of Kwekwe – 5 animal deaths, 15 human cases, and 1 human fatality.[97]
- November 2002 in Bindura – unknown animal cases, 20 human cases, and 2 human fatalities.[98]

In the outbreaks reported for 2000-2002, the government was described as having quickly deployed veterinary services to conduct vaccination campaigns in the affected areas. Various accounts blamed either the movement of cattle related to squatting on commercial farms and the poor state of disease control. Conversely, various members of the government have attributed recent outbreaks to deliberate sabotage by white farmers.[99]

The 1979-1980 outbreak began and was localized for six months in the district of its original focus. It then spread outward largely to contiguous districts through communal farming areas, while mostly bypassing the commercial farming areas. It spread in areas where vaccination of cattle was still possible, although vaccination was not likely to be absolutely complete or effective. Some authors did not attribute the outbreak to a single point source and concluded that cattle acquired the disease locally, presumably from spores already present in the soil.[100]

Initial studies of the outbreak attributed the spread among cattle to direct contamination of pastures and posited that vultures feeding on dead carcasses could account for some of the spread across areas with no previously known bovine cases. Watering holes were also implicated in the "hopping" nature of the spread, both because vultures wash themselves after feeding and because cattle in the terminal stages of the disease could discharge anthrax bacilli from the nose, mouth, and intestinal tract into water. Cattle in communal farming areas mingled at watering holes, while water was usually piped directly to restricted paddock areas in commercial farms. The implication was that in communal farming areas the disease could be spread via contaminated water, and the water in commercial farms would not be contaminated. Evidence for these theories was not judged to be conclusive by the studies. Authors noted that human lesions of the lips, tongue, and mouth were rare, leading to the conclusion that eating infected meat was probably not an important cause. This was supported when most patients stated that they had not handled infected meat.[101] Cutaneous lesions resulting from the handling of hides during slaughter were thought to be a primary cause until the advent of later theories about the role of biting and non-biting flies.[102]

Although the evidence was not conclusive, several authors cited the possible role of biting and non-biting flies in spreading the disease. It was noted that the peak months of the spread of the disease and the highest numbers of human cases coincided with the rainy season and the highest prevalence of horse flies (*Tabanidae*). A study of the location of lesions in children revealed that the majority were located on the head, neck, or face – areas that were more exposed when they were carried about on a parent's back. Likewise, nearly 85% for all cases had cutaneous lesions on exposed areas. It was postulated that in addition to biting, flies could be attracted to existing cuts and abrasions. The flies could contaminate the cuts with spores adhering to their legs/bodies or by vomiting spores/bacilli into the cuts.[103]

Author Meryl Nass, MD took a dim view of the various insect vector explanations. In her 1992 article "Anthrax Epizootic in Zimbabwe 1978-1980: Due to Deliberate Spread?" she noted that many authors dispute insect transmission of anthrax in cattle. Dr. Nass pointed out that several investigators encountered great difficulty when attempting to infect cattle by parenteral injection because of a relatively large volume of blood needed to be transferred to achieve an infection. She cited successful attempts to use stable flies to infect mice and guinea pigs with anthrax, but she maintained that these results could not be extrapolated to cattle and humans due to the differences in susceptibility to infection and the required dose sizes. Dr. Nass also ruled out horse flies as vectors for the same reasons, judging that even the horse fly's increased infective capacity over stable flies would not be sufficient to infect cattle or humans.

Dr. Nass noted the explosive nature of the outbreak when compared with the number of anthrax cases in Zimbabwe both before and after 1978 - 1980. She noted that most anthrax outbreaks are localized, while this outbreak spread to encompass 17% of the land area of the country. Many cases occurred in areas where there were no previous recorded anthrax cases, and cases were confined almost exclusively to communal farming areas. There were 4 outbreaks with only 11 cattle deaths in the commercial farming areas and no anthrax deaths among white Zimbabweans, which seemed suspicious in the context of the ongoing civil war in Zimbabwe. Finally, Dr. Nass noted that the outbreak coincided with the final months of the civil war in Zimbabwe, which saw an escalation of tactics by the Rhodesian military. Dr. Nass judged that cattle were likely the primary object of attack due to their economic importance. The economic importance of cattle was highlighted by several other authors.[104]

Since the outbreak there have been several claims that it was a deliberate counterinsurgency attack by Rhodesian forces. In March 1997, Dr. Tim Stamps, then Minister of Health for Zimbabwe, stated his belief that the anthrax outbreak was the result to a BW attack by Rhodesian security forces.[105] An alleged former Rhodesian intelligence officer confirmed the attack in a confidential communication to David Martin in 1993.[106] A search of open source literature did not reveal documentary or conclusive proof of these allegations.

While theories on insect vector transmission are judged by many authors to be inconclusive, the reality of 10,738 human cases of anthrax from January 1979 through December 1980 remains. This period also coincided with an escalation and the conclusion of the civil war in Zimbabwe, during which there are credible reports of the use of other BW agents by government forces against the insurgents.[107]

Burma, 1993-1994

During the night of 12 August 1993, aircraft, presumed to be Burmese Air Force (BAF), dropped an unknown number of devices consisting of a radiosonde in a white box with a 2 meter parachute and one or two balloons attached in the Karen districts of Thaton and Mudraw. The balloons were said by the villagers to have contained a "foul-smelling 'black-yellow-green' liquid." Villagers found the devices, but Burmese officials did not attempt to recover them. After a period ranging from three days to two weeks, villagers in the drop area and some areas downriver began to be ill with a disease resembling cholera or shigella. The disease was highly contagious and most lethal for adults over 15 years of age, resulting in over 300 deaths. This area had previously reported a few deaths per month from dysentery; in September 1993, 185 deaths due to dysentery were reported.

Several Karen villages in the area were quarantined by the Burmese military. Villagers said that the troops stopped entering the villages after the epidemic began, and that the soldiers remained healthy. Villagers believed that the soldiers had been vaccinated against the disease. In a location where there were soldiers encamped in a village, the soldiers required the villagers to engage in basic sanitation measures and to stay out of their encampment. The epidemic had abated by December 1993.

A similar incident was reported in January 1994 in the Karen Dta Greh township. Similar devices were reported to have been dropped at night, and a disease resembling cholera spread in the area of the drops, causing more deaths among adults than children. In both cases, it was reported that the disease was curable with basic medicines which were unavailable to the villagers. An additional similar incident was reported in 1985 before the 1993-94 incidents, when at least one balloon with an attached packet of "powder" was dropped by a BAF aircraft, followed by a cholera epidemic with 10-20 fatalities. Another incident was reported in which a device identical to those dropped in August 1993 was recovered near another location, Manerplaw, although it was not known when the device was dropped.[108]

Members of the organization Christian Solidarity International (CSI) investigated the incidents in late 1994 and concurred with an assessment by the Karen Human Rights Group (KHRG) that the radiosondes were originally manufactured to be used with weather balloons, not to be dropped with parachutes from low-flying aircraft. The KHRG also stated that the low-powered, very high frequency transmissions could only be received along a straight line of sight, which they speculated would only be receivable by the aircraft, if at all. Finally, the KHRG noted that Germany acknowledged in 1991 that 15 Burmese Army officers had received biological warfare defense training from the German Army. Both the KHRG and the CSI group believed that the white boxes contained bacteria which were released over the Karen villages.[109]

Tests were conducted on the boxes at the Porton Down Defense Research Establishment, which were inconclusive. Although the devices were described as "consistent with the covert use of germ warfare," an actual BW attack was not confirmed. Other examinations were made by Thai and Canadian scientists, who concluded that the boxes were innocuous pressure-measuring devices.

An alternative explanation for the outbreaks of disease was that they were caused by a particularly virulent, new strain of cholera, *vibrio cholerae* 0139. The strain was almost unknown before 1992, when it caused a major epidemic in India, spread to Bangladesh, and then to Thailand in early 1993. Due to its virulence and resistance to many anti-cholera drugs, *v. cholerae* 0139 has become the main cause of diarrheal disease in South Asia. This explanation has been accepted by Canadian officials, and it is difficult to make a conclusive assessment of the likelihood that these were BW attacks based on the available open source information.[110]

Analysis of Case Studies

The analysis of the case studies will focus on the three models for analyzing acquisition or development of a covert BW program and the 26 indicators of unnatural or suspicious outbreaks of disease presented in this chapter. A final summary of the cases and the applicability of the models and indicators will conclude the analysis.

Assimilation Model

As the Aralsk and Sverdlovsk cases occurred in the same country, under the same form of government, and in relatively close temporal proximity, they are analyzed together. The "assimilation" model would predict a high likelihood of the Soviet Union developing a BW program (Table 1). The USSR had a material base that was very capable of supporting the development of such a program, and its high threat perception would have led to norms against BW being overcome. The Russian government has admitted that the Soviet regime did develop chemical and nuclear weapons in addition to biological weapons as strategic weapons.[111] The BW program was developed in secrecy within the Soviet security structure, a vertically integrated and ideologically consistent entity. The Soviets very clearly balanced logistical considerations in weapons and delivery system design, choosing and enhancing agents for maximum efficacy, and designing ballistic missiles to effectively deliver them. The Soviet cases exhibited six of the seven factors considered in the model.

The "assimilation" model would predict a high likelihood of Rhodesia developing a BW program. Rhodesia had a material base that was capable of supporting the development of a limited program and its high threat perception from the civil war would have led to norms against BW being overcome. Anthrax was endemic in Zimbabwe and thus would have been available for development as a biological weapon. The program was developed in secrecy within the security structure, an ideologically consistent entity. In addition to the possible use of anthrax, other alleged weapons included toxins, poisons, bacteriological cultures, and cholera. Agents such as poisons were used tactically for assassinations of insurgency leaders. Alleged agents such as cholera, which was alleged to have been used to contaminate rivers,[112] and anthrax would have been used as strategic weapons. By choosing agents endemic to the area such as cholera and anthrax, the Rhodesians were able to conceal their source. These agents were also used to target specific insurgent areas and groups. In this way the Rhodesians balanced weapon effectiveness with the ability to conceal their source and considerations of the weapons' utility in counterinsurgency tactics when selecting agents for employment. The Zimbabwe case exhibited all of the factors considered in the model.

The "assimilation" model would predict a low likelihood of Burma developing a BW program. Burma's material base would have had a limited capability of supporting the development of a BW program. Its GDP per capita was $650 compared to Zimbabwe's $2,160.[113] In 1993 Burma ranked 130th out of 173 countries according to the UN's Human Development Index ranking. Zanders' "assimilation" model places strong emphasis on the necessity for a physical base to support the development of a BW program, and it seems unlikely that Burma possessed enough of a material base to support anything other than a very rudimentary program. Burma's government had largely prevailed over insurgent groups, and the Karen group had been substantially weakened. Thus the government would not be likely to perceive the villagers as a high threat level.[114] Thus norms, if there were any, against BW would be less likely to be overcome. The Burma case exhibited one of the seven factors considered in the model. The following table summarizes the case studies when analyzed using the "assimilation" model.

Table 1. Assimilation Model Analysis of Cases

Indicators	Aralsk & Sverdlovsk	Zimbabwe	Burma
Material base	Yes	Yes	No
Credible threat	Yes	Yes	No
Insurgency	No	Yes	Yes
Vertically integrated structure	Yes	Yes	Not evaluated
Ideological consistency	Yes	Yes	Not evaluated
Program developed in secrecy	Yes	Yes	Unknown
Military considerations a factor	Yes	Yes	Unknown
Overall Likelihood	**High**	**High**	**Low**

Russian FIS Model

The Soviet Union outbreaks exhibited most of the indicators listed in the Russian FIS model. The indicators are evaluated based on accounts of the Soviet BW program in Ken Alibek's *Biohazard* and Tom Mangold and Jeff Goldberg's *Plague Wars*. The Soviet cases were consistent with 25 out of 30 indicators.

While less information is available on the Rhodesian BW program than for the FSU program, numerous elements of the Russian FIS model are applicable. The indicators are evaluated based on accounts of the Rhodesian BW program in Tom Mangold and Jeff Goldberg's *Plague Wars*, and *The Rollback of South Africa's Chemical and Biological Warfare Program* by Dr. Stephen Burgess and Dr. Helen Purkitt.[115] The Zimbabwe case exhibited 13 of the 30 indicators.

Less open source information was available on an alleged Burmese BW capability than for any of the other cases studied; nevertheless a few elements of the Russian FIS model are applicable. The indicators are evaluated based on Andrew Selth's account.[116] The Burma case exhibited 6 of the 30 indicators.

The evaluation below reflects the state of indicators in the various countries at the time of the incidents, as described in the sources used for the assessments.

Table 2. Russian FIS Model Analysis of Cases

Indicators	Aralsk & Sverdlovsk	Zimbabwe	Burma
Political			
Not a party to treaties or instruments renouncing WMD; not participating in fora or negotiations on such.	No	Yes	No
Refusal or obstruction of international monitoring of facilities.	Yes	Unknown	Unknown
Creation of an admin structure w/ extraordinary powers subordinate to highest pol leadership or army command.	Yes	Yes	Unknown

Creation of foreign econ agencies, intel units or ostensibly private cos. with large financial resources.	Yes	Yes	Unknown
Active promotion of WMD close to highest levels.	Yes	Yes	Unknown
Psychological manipulation of public to accept WMD.	Yes	Unknown	Unknown
No reaction to accusations of a state's proliferation.	No	Unknown	No
Overt or covert support to proliferating countries.	Yes	Yes	Unknown
Economic			
Large military budget.	Yes	Unknown	Unknown
Presence of nuclear, biological, or chemical programs	Yes	Yes	Yes
Required specific production capabilities	Yes	Unknown	Yes
Importation of WMD components, etc.	Yes	Unknown	Unknown
Advancement beyond civilian needs for prod capabilities	Yes	Unknown	Unknown
High budget allocations for ostensibly civilian sectors such as biotechnology.	Yes	Unknown	Unknown
Scientific-Technical Indicators			
Presence of raw materials.	Yes	Yes	Unknown
Importation of non-indig raw materials or components.	Yes	Unknown	Yes
Presence of required technologies.	Yes	Yes	Yes
Presence of required production capacity.	Yes	Yes	Yes
Required scientific/tech specialists present and system for training others exists.	Yes	Yes	Unknown
Ability or programs to attract needed specialists from abroad.	No	Unknown	Unknown
Scientific centers are created.	Yes	Unknown	Unknown
Presence of scientific and production firms w/ required specialties.	Yes	Unknown	Unknown
Supercomputer or powerful computer network for running simulations is present.	Unknown	Unknown	Unknown

Military-Technical Indicators

Tech units in military relating to WMD.	Yes	Unknown	Unknown
Reinforced/hardened facilities for government & military.	Yes	Unknown	Unknown
Training to deploy WMD in warfare and to operate in a WMD environment.	Yes	Yes	Yes
Storage facilities with high security measures	Yes	Unknown	Unknown
Possession of appropriate delivery systems.	Yes	Yes	Unknown
Intensified intelligence activities against specific enemy targets.	Unknown	Yes	Unknown
Highly developed program for civil defense.	Yes	Unknown	Unknown
Overall Likelihood	**High**	**Medium**	**Low**

U.S. Office of Technology (OTA) Model

The Soviet outbreaks exhibited all 14 of the signatures of a BW program as described in the U.S. OTA model. This reflects the model's usefulness in evaluating a very large scale program in a developed country.

The limited material available combined with the scale of the Rhodesian and Burmese programs made this model less useful in these cases than it was for the Soviet cases. The Rhodesian program exhibited none of those signatures per se, however it did have two similar signatures. Under research and development signatures, while not stated in the OTA model, a similar factor is the allegation in *Plague Wars* that "doctors and chemists from the University of Rhodesia were recruited by the CIO and asked to identify and test a range of chemical and biological agents which could be used in the war against the nationalist guerrillas."[117] For weaponization and testing signatures, allegations of experimentation and testing of poisons, toxins, bacteriological cultures, and cholera may be found in *Rollback*.[118]

Finally, the alleged Burmese program exhibited a few of the signatures of a BW program as described in the OTA model. [119] As with the Rhodesian program, the limited material available combined with the small scale of the possible Burmese program made this model less useful. The Burmese case exhibited 2 of the 14 signatures. The indicators are considered for the cases below:

Table 3. OTA Model Analysis of Cases

Indicators	Aralsk & Sverdlovsk	Zimbabwe	Burma
Research and Development Signatures			
Research facilities under military control.	Yes	Unknown	Unknown
Production of vaccines in excess of domestic needs.	Yes	Unknown	Unknown
Purchase of dual-use materials and equipment.	Yes	Unknown	Yes
Sudden halts in research indicative of military censorship or other indicators of military censorship.	Yes	Unknown	Unknown
Weaponization and Testing Signatures			
Field tests of aerosols.	Yes	Unknown	Unknown
Tests of weapons' effectiveness against large animals.	Yes	Unknown	Unknown
Burial of animals used at weapons testing sites.	Yes	Unknown	Unknown
Production Signatures			
Tight security and secrecy around an ostensibly civilian facility.	Yes	Unknown	Yes
Very extensive microbiological production plants much more sophisticated than known civilian facilites.	Yes	Unknown	Unknown
Facilities unassociated with vaccine production with large numbers of test animals.	Yes	Unknown	Unknown
Observable changes in ostensibly civilian production facilities.	Yes	Unknown	Unknown

Stockpile and Delivery System Signatures

Refrigerated bunkers or igloos for storage of large amounts of BW agents.	Yes	Unknown	Unknown
Storage depots for BW munitions near suspected production facilities.	Yes	Unknown	Unknown
Heavy trucks for the transportation of munitions or for decontamination use.	Yes	Unknown	Unknown
Overall Likelihood	**High**	**Low**	**Low**

Indicators of Unnatural or Suspicious Outbreaks of Disease

The Aralsk and Sverdlovsk cases had 13 and 14, respectively, of the 26 indicators and exhibited the highest number of indicators of the 4 cases studied. The events held 11 of the indicators in common. These common indicators were a point source origination, a compressed epidemic curve, severe disease, unusual exposure routes, unusual diseases for the area, unusual strains of the diseases, a higher attack rate depending on location of the victim, pulmonary disease, high morbidity and mortality, the failure of the government to cooperate with an investigation, and sudden demand for vaccines. A credible Russian official who was in a position of authority at the time (Yeltsin), later acknowledged that a BW facility was responsible for the outbreak in Sverdlovsk. Although the Russian government continues to deny that Sverdlovsk was a BW facility, it has admitted that the USSR had a BW program. This admission, coupled with the relatively large amount of information known about the cases, makes these cases good tests of the predictive ability of the indicators for other cases about which less is known.

Less is known about the Zimbabwe case, but the correlation with the indicators was still relatively strong. When the outbreak is compared to the list of generic indicators, it exhibited 10 of the indicators. The exhibited indicators were a point source origination, a large epidemic curve, unusual extent of the disease for the area, a disease that attacks both animals and humans, a higher attack rate depending on location of the victim, claims of attack by the perpetrator, pulmonary disease, the failure of the government to cooperate with an investigation, sudden demand for vaccine, and outbreak of disease for which a potential adversary was vaccinated.

As has been noted, the amount of substantiated, open source information available on a possible Burmese program is substantially less than that available for the former Soviet program or the Rhodesian program. When the outbreak is compared to the list of generic indicators, it exhibited six of the indicators. Exhibited indicators are shown below in italics. The exhibited indicators were a point source origination, a compressed epidemic curve, a large epidemic, severe disease, a higher attack rate depending on location, and high mortality.

Table 4. Indicators of Unnatural or Suspicious Outbreaks of Disease Analysis of Cases

Indicators	Aralsk	Sverdlovsk	Zimbabwe	Burma
Point source origination	Yes	Yes	Yes	Yes
Line source origination	No	No	No	No
Compressed epidemic curve	Yes	Yes	No	Yes
Large epidemic	No	Yes	Yes	Yes
Severe disease	Yes	Yes	No	Yes
Unusual exposure routes	Yes	Yes	Undetermined	Undetermined
Unusual for the area or season	Yes	Yes	Yes	No
Endemic disease outside established range	Yes	No	No	No
Impossible to transmit naturally without vector	No	No	No	No
Multiple epidemics of different diseases	No	No	No	No
Different disease in the same patient	No	No	No	No
Disease that attacks animals and humans	No	Yes	Yes	No

Unusual strains of disease	Yes	Yes	Unknown	Probable
Strain of disease seen some years before outbreak	Unknown	Unknown	Unknown	No
Higher attack rate depending on location	Yes	Yes	Yes	Yes
Intelligence information about agent	Unknown	Unknown	Unknown	Unknown
Claims of attack by perpetrator	No	No	Yes	No
Direct evidence of attack – equipment, munitions	No	No	No	Undetermined
Pulmonary disease	Yes	Yes	Yes	No
High military and civilian casualties when collocated	No	Unknown	No	No
High morbidity and mortality	Yes	Yes	No	Yes
Low disease rates for those with controlled air supplies	Unknown	Unknown	Unknown	Unknown
Failure to cooperate with investigation	Yes	Yes	Yes	No
Sudden demand for vaccine	Yes	Yes	Yes	No
Disease in population with high immunity	Yes	No	No	No
Outbreak of disease for which adversary was vaccinated	N/A	N/A	Yes	Unknown
Overall Likelihood	**High**	**High**	**Medium**	**Low**

Conclusions about the Cases and the Models

The following chart summarizes the assessment of the likelihood that a case was indicative of a covert BW program for each case using each of the models.

Table 5. Summary of Analytic Models and Cases

Case	Assimilation Model	Russian FIS Model	U.S. OTA Model	Indicators of Unnatural or Suspicious Outbreaks
Aralsk	High	High	High	High
Sverdlovsk	High	High	High	High
Zimbabwe	High	Medium	Low	Medium
Burma	Low	Low	Low	Low

The Soviet cases illustrate the utility of the models in indicating the existence of a covert BW program. The Soviet program was officially acknowledged by the Russian government, and despite later denials by the government, a credible Russian official admitted that the Sverdlovsk plant was a BW installation. In the Sverdlovsk case, the disease was localized in a distinctive area indicative of a plume; a rare form of the infection was prevalent; animals as well as humans were affected; and multiple strains of anthrax were isolated in victims.[120] Although the Russian government has not officially acknowledged the Aralsk case, it has admitted that Vozrozhdeniye Island was used for open air testing of BW agents. Thus the case is strong that these incidents were what they appeared to be – accidental releases of BW agents. Given that they strongly correlated with the models and indicators used, this serves to validate the models and indicators.

The Zimbabwe case is more difficult. As has been shown, the amount of substantiated, open source information available on the Rhodesian program is substantially less than that available for the former Soviet program. Given the inadequacy of open source information, the use of the models considered likely would not lead an analyst to conclusively suspect that Rhodesia had a covert BW program. While the "assimilation" model indicated a high likelihood of a covert BW program, the Russian FIS model and the U.S. OTA model, both most applicable to large programs in developed countries, had medium and low correlations, respectively. This outbreak is an example of the difficulty in positively identifying outbreaks of disease as indicators of a BW attack or capability. In this case, additional, reliable human intelligence would enable a more definitive conclusion. As has been described in *Plague Wars* and *The Rollback of South Africa's Chemical and Biological Warfare Program*, Rhodesia did employ poisons, toxins, and bacteriological cultures. The government is alleged to have used cholera and other chemical and biological agents to foul water supplies.[121] All of these measures were undertaken as part of the government's counterinsurgency efforts, which heightened during the period of the 1978-1980 anthrax outbreak. Given the magnitude of the outbreak, its anomalous nature, and its timing, the event is assessed as likely to have been a BW attack. This case highlights the need for close cooperation between the intelligence community and the scientific community.

An analysis of the 1993-1994 outbreaks of cholera in Burma based on models and indicators for the acquisition or development of BW capability points to a low likelihood that the outbreak was a BW attack. As with the Zimbabwe case, the inadequacy of open source information likely would not lead an analyst to suspect that Burma had a covert BW program when using the models as determinants. The suspicion of a covert BW program is only slightly strengthened by comparing the information known about the events to indicators of an unnatural outbreak of disease. In this case as in the Zimbabwe case, additional, reliable human intelligence and additional epidemiological information could lead to a more definitive conclusion.

The preceding case studies and analyses show that when more information is available, a more definitive conclusion may be made about the likelihood of a state's possession of a covert BW program. In the Soviet cases, defectors and declassified reports provided a great deal of critical information, as did analysis of overhead imagery. In both Soviet cases, extensive epidemiological work produced a definitive portrait of the outbreak, which made analysis of it much more conclusive. These cases demonstrate the results that may be achieved from the synergy of epidemiological and intelligence analysis.

In the Rhodesian case, epidemiological information was more extensive than open source intelligence information. Open source intelligence information was largely unsubstantiated, and scientific information regarding the possible spread of the disease was judged by some to be inconclusive. In this case, the models were of some use when combined with an analysis of the indicators of a suspicious outbreak of disease. Still, additional, credible intelligence combined with definitive scientific information on the role of biting flies as vectors could enable a more conclusive determination.

Finally, as was seen with the Burmese case, sketchy information, both intelligence and epidemiological, make it very difficult to reach a judgment on a possible covert BW program. Additional information in both realms is necessary before a conclusion can be reached and could be obtained through a close partnership between the intelligence and scientific communities.

Cooperation between the Intelligence and Scientific Communities

Cooperation between the intelligence community and public health experts is vital to achieving a full understanding of outbreaks of infectious disease as indicators of covert biological weapons programs. Dr. Jonathan Tucker and Col Robert Kadlec commented on this in a Spring 2001 article in *Strategic Review*, noting that problems in making accurate assessments of outbreaks arise due to lack of coordination between the public health and intelligence communities. Dr. Tucker and Col Kadlec suggested various means of enhancing coordination between the two communities. This section will review their comments and will contribute assessments and suggestions made by analysts from the intelligence community (IC).

Dr. Tucker and Col Kadlec cited the response to the West Nile virus outbreak of 1999 as indicative of the coordination problems plaguing the various local, state, and federal agencies involved. They maintained that the outbreak highlighted major coordination problems between the veterinary and public health communities, and likewise between the intelligence and public health communities. The authors noted that timely dissemination of information available as a result of the veterinary investigation of the outbreak would have been of great use to the public health investigators dealing with the outbreak. Dr. Tucker and Col Kadlec found that the intelligence communities "connection of the dots" in this case lead to an unwarranted suspicion of Iraqi involvement. They asserted that full and open coordination with trained epidemiologists would have ruled this out. The authors attributed the lack of such coordination to the greatly differing organizational cultures, logistical and security barriers, and an extant sense of mutual distrust.

Dr. Tucker and Col Kadlec had several recommendations to “bridge the gap” between the public health and intelligence communities. They recommended institutionalization of exchanges of personnel and training between the two communities, with “temporary details” of six months to one year. They also recommended the creation of an “intra-governmental coordinating body of experts from public health and intelligence agencies that would meet periodically to review unusual outbreaks of infectious disease when some suspicion of covert biowarfare or bioterrorism exists.”[122]

A discussion with various intelligence community analysts in February 2003 yielded a more rosy picture of the current state of interaction in the post-9/11 world, but a near mirror image of the difficulties and frustrations encountered when working with partners in the public health community. Analysts acknowledged a residual cultural distrust between the two communities, but stated that this fell away as individuals got to know each other on a personal basis. The IC analysts also cited logistical and administrative restrictions necessary to maintain security as barriers to interaction. IC analysts lauded the very significant interaction with partners in the Department of Homeland Security (DHS) and the National Institutes of Health (NIH) since 11 September 2001. They agreed with some of the suggestions made by Dr. Tucker and Col Kadlec for enhanced cooperation between the two communities and put forth several of their own.[123]

IC analysts believed that as interaction between the public health community and the IC increased, their partners in the public health community gained a greater understanding of IC analysts’ motives. They noted an evolving understanding of the need for closer cooperation between the two communities among the senior levels of public health agencies. The analysts noted that when they reached below the senior levels of those agencies, they sensed residual misperceptions about the intelligence community among lower ranking officers. They saw mistrust as stemming from a perception that the two communities have different agendas. The analysts saw the fact that the United States does not have an offensive BW program as a positive for the relationship – it allowed scientists and IC analysts to realize that they are on the same side. They noted that when they made visits to laboratories, and scientists did not focus on where they worked, all participants, whether IC or scientific, clearly realized that they were eager to find the same information to get at the truth. The analysts perceived that before the 2001 anthrax attacks the scientific and health community tended to think that the BW threat was overblown. This has now changed, and public health officers look to the IC for more threat information. IC analysts now felt that they and the scientific community were more "on the same sheet of music." This was especially so with officials in Homeland Security. The IC analysts felt that the public health community was becoming more aware of the insidious nature of some interlocutors who want information from them.

The IC analysts also noted obstacles to interaction dictated by the security measures necessary for an intelligence organization. They said that collegial interactions were somewhat restricted, as they were unable to talk readily to individuals openly and freely, due to both security considerations and lingering cultural differences. They noted that very few of their interlocutors have security clearances, and that this restricts the flow of information. They further lamented the impracticality of clearing scientific partners for isolated projects and were unsure that the public health agencies would be willing to make the commitment to engage fully in the classified world. This kind of commitment would involve outlays for secure communications, clearances, and SCIFs (Sensitive Compartmented Information Facilities).

The analysts believed that enhanced interaction on an issue dependent basis was logical and reasonable. Certain issues, such as biodefense, lend themselves to interaction with NIH, Centers for Disease Control, DHS, and Health and Human Services Officials. For other issues, enhanced interaction is not logical, as the IC analysts would tend to rely upon their own sources of information. While interaction with federal officials has increased, the analysts saw more interaction likely in the future with officials at the state level. They believed that while contacts in the academic community were developing at a slower pace, they would be likely to accelerate as universities started to institute academic departments for the study of homeland security or biological warfare. The incentive for increased publication would increase contacts. Finally, the IC analysts noted that they made and maintained contacts outside the IC during interagency working groups that bring together professionals under a policy umbrella. They found it beneficial to maintain contacts in these groups for the future, and they noted that they leveraged cleared contacts at State, DoD, and the NSC as conduits to the scientific community.

The IC analysts concurred with Dr. Tucker and Col Kadlec's suggestion for rotational assignments for scientists from CDC and USAMRIID into the IC. They noted that it would be easier to clear these individuals for such assignments, and they would start with more knowledge of the IC than would individuals without a federal government affiliation. They would welcome rotations by members of the public health community as specialists in certain IC branches for assignments of six months to one year, as these would be good opportunities for exchanges of knowledge and cross-cultural pollenization between the communities. The analysts would also welcome rotational assignments or conferences with experts in cultural and historical issues for various regions of concern. They believed that this type of interaction would be more practical than purely scientific exchanges. The analysts thought that periodic review of unusual outbreaks of infectious diseases should be accomplished virtually due to the fast pace of outbreaks. Finally, the IC analysts also advocated issue-based conferences to be held on an ad hoc basis. They noted that a "neutral" sponsor such as the National Defense University would be welcomed by both communities, and they envisioned attendance at such conferences of experts from the public health, intelligence, academia, and policy communities.

The analysts noted that technical depth in the IC had been enhanced in the last five years; as expectations have increased, so has the need to have analysis backstopped by the scientific credentials of the analysts. The number of PhDs working in the IC has greatly increased over the last ten years, and they described it as being "in good shape," both technically and substantively. That said, they noted that they do not stay current in most subspecialties of basic research. They said that as there are so many scientific fields that contribute to any given subject, it is not possible for the analysts to have knowledge as in-depth as the scientist working in the lab. This level of detail is neither needed nor desired for the majority of the work the analysts do.

The IC analysts summarized by saying that the IC and public health communities are making very good progress on increasing interactions, IC analysts are staying abreast of developments and increasing technical depth when warranted, and communication with other agencies and communities is coming along very well.[124]

Conclusion

> *"BW programs have become more technically sophisticated as a result of rapid growth in the field of biotechnology research and the wide dissemination of this knowledge. Almost anyone with limited skills can create BW agents. The rise of such capabilities also means we now have to be concerned about a myriad of new agents."*[125]
>
> \- George Tenet, 11 February 2003

As the threats to our nation increase and become more complex, so too must the integration of all elements of national power grow and become more profound. The difficulty of effectively "pointing the finger" using unclassified information was made apparent when the world watched in early 2003 as Secretary of State Colin Powell made the case for Iraq's continuing possession of weapons of mass destruction. These realities make it imperative that the intelligence community and the public health community work together to protect our nation.

Models of behavior and indicators for disease outbreaks provide a framework for assessing suspicious outbreaks of disease as indicators of covert BW programs. Using these tools to assess events can help to determine if further investigation is warranted and the directions such investigations might take. Using the framework they provide, preliminary and tentative conclusions about incidents may be drawn.

As shown by the amount of publicly available and declassified information on the 1971 smallpox epidemic in Aralsk, the 1979 outbreak of anthrax in Sverdlovsk, and the 1978-1980 anthrax outbreak in Zimbabwe, it is clear that international scrutiny of suspicious outbreaks of diseases will occur. Given the advent of the Internet and websites such as

ProMED, it is likely that international suspicion will be aroused sooner than was the case before the maturation of the Information Age. Open source reporting of observable traits common to suspicious outbreaks can speed initial evaluation of events and spur international demand for investigations or explanations. Evaluation based on open source reporting can be readily shared with interested parties without risking the compromise of intelligence sources or methods. Finally, open source information may be more readily received by international parties, as it would be independently verifiable by them.

The open source arena is one in which the intelligence community and the scientific community can easily collaborate. While both communities describe a culture of distrust, the events of 11 September 2001 have served to bring them closer together in achieving the common goal of defending our nation and people. Interaction between the communities continues to increase, as members of both have shown a strong willingness to reach out to the other. The stakes are high, and a strong partnership between the intelligence community and the public health community will further strengthen our defenses against weapons of mass destruction.

Notes

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30. Jonathan B. Tucker and Raymond A. Zilinskas, eds., *The 1971 Smallpox Epidemic in Aralsk, Kazakhstan, and the Soviet Biological Warfare Program*, Occasional Paper No. 9 (Monterey, CA: Center for Nonproliferation Studies, July 2002), 12.

31. Ibid., 17-9. The official report states that the index case began to sicken on 6 August, while she recalled in a May 2002 interview that she began to have symptoms on 11 or 12 August.

32. Ibid., 13-5.

33. Ibid., 23-7, 31-46.

34. Ibid., 31-59, 1.

35. Ibid., 30.

36. Ibid., 17-20.

37. Ibid., 20.

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39. Tucker and Zilinskas, eds., 9, 20-1.

40. Ibid., 21. Ronald M. Atlas, Ph.D. and Richard Clover, M.D., "Implications of the 1971 Smallpox Outbreak in Aralsk, Kasakhstan, for U.S. Smallpox Vaccination Policy,"*CNS Occasional Papers: #9 Commentaries*, n.p., on-line, Internet, 9 September 2002, available from http://cns.miis.edu/iiop/cnsdata?Action=1&Concept=0&Mime=1& collection=CNS+Web+S. The authors of this commentary agree with Tucker and Zilinskas' conclusion.

41. Ken Alibek, Lecture Question and Answer Session, SAIC, Tyson's Corner, VA, 12 September 2002.

42. Guillemin, 234. Guillemin places the date and time of the release based on extensive interviews with victims' surviving family members and survivors of the incident. Ken Alibek, in his book *Biohazard*, identifies the date of the accident and the release as being during the night of 30 March. As Guillemin's date and time are based upon epidemiological research conducted with survivors and surviving family members, and as it is consistent with established dates of death and the expected course of anthrax in humans, it is used instead of Alibek's date and time, which are based on information that is second-hand at best.

43. One source is retired counterintelligence officer General Andrey Mironyuk in 1993, quoted in Guillemin, 187. The second is Ken Alibek, *Biohazard*, (New York, NY: Random House, 1999), 73-4.

44. Guillemin, 196, 224. Guillemin cites General Valentin Yevstigneyev as the source for the rooftop ventilator release information. Also in Alibek, 73-4, Alibek cites exhaust pipes as the source of the release, but does not specify a height.

45. Guillemin, 234.

46. Raymond A. Zilinskas, ed., *Biological Warfare: Modern Offense and Defense*, (Boulder, CO: Lynne Rienner Publishers, Inc., 2000), 79.

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50. Defense Intelligence Agency, *Trends and Developments: Foreign Technology Weapons and Systems* (Washington, D.C.: Defense Intelligence Agency, 1980), 13. Document is now declassified.

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52. Guillemin, 14.

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67. Ibid., 93.

68. Ibid., 83, 103, 129, 135, 143-4, 150, 155.

69. Ibid., 8.

70. Ibid., 85, 88.

71. Ibid., 226.

72. Ibid., 93, 119, 137, 147-148.

73. Ibid., 163, 185, 256.

74. Zilinskas, ed., 78.

75. Guillemin, 10.

76. Ibid., 25-6. Guillemin reports that one six-year-old girl contracted cutaneous anthrax.

77. Ibid., 29, 230.

78. Ibid., 16-22, 44-7. Guillemin relates that Dr. Babich maintained that there were no intestinal lesions or symptoms, while Dr. Nikiforov's report judged the cases to be gastrointestinal anthrax based on the amount of damage to intestinal organs. Photographic slides presented by the two primary pathologists involved in the case, who performed the majority of the autopsies, showed intestinal lesions. These pathologists believed the cause to be inhalational anthrax. The assistant chief sanitary inspector of the Sverdlovsk Oblast Sanitary Epidemiological Station (SES) asserted an animal outbreak before the human cases, while Dr. Babich maintained that animal deaths occurred after the human deaths began. Dr. Vladimir Nikiforov's son stated that his father had been coerced into supporting the tainted meat explanation, and he shared his father's information, which he believed supported inhalational anthrax, with investigators. The two primary pathologists involved in the case, who performed the majority of the autopsies, believed the cause to be inhalational anthrax.

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105. Mangold, *Plague Wars*, 219-21.

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111. Tom Mangold and Jeff Goldberg, *Plague Wars* (New York, NY: St. Martin's Press, 1999), 83-5.

112. Burgess, *Rollback*, 6-9.

113. United Nations Development Programme, *Human Development Report 1994*, (New York, NY: Oxford University Press, 1994), 129-31.

114. Selth, "Working Paper," 12-3.

115. According to David Martin in *The Use of Poison and Biological Weapons in the Rhodesian War*, as of 1993 Zimbabwe was not a signatory to the BWTC. According to Dr. Burgess and Dr. Purkitt in *Rollback*, 8-9, "SADF Special Fores and SAP officers stationed in Rhodesia had studied … the use of chemical and biological agents."

116. Selth, "Working Paper," 7-11. Several analyses have concluded that Burma may have had a chemical warfare program, possibly targeted at the country's insurgents. It has also been alleged that Burma may have dual-use facilities built with the assistance of German firms. Burmese military officers received BW defense training in Germany.

117. Mangold, *Plague Wars*, 222.

118. Burgess, *Rollback*, 9.

119. Ibid., 6. Possible dual-use facilities are described as being highly secure locations.

120. Joshua Lederberg, ed., *Biological Weapons: Limiting the Threat* (Cambridge, MA: MIT Press, 2000), 77-9, and Jackson, et al.

121. Burgess, *Rollback*, 6-9.

122. Jonathan B. Tucker and Robert P. Kadlec, "Infectious Disease and National Security," *Strategic Review* 29, no. 2 (Spring 1999), 12-20.

123. Intelligence Community Analysts, Personal Interview, Central Intelligence Agency, Langley, VA, 13 February 2003

124. Ibid.

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